KCG

COLLEGE OF TECHNOLOGY

QUESTION BANK

SEVENTH SEMESTER

B.E-Mechanical Engineering

(Anna University Regulation 2013)

DEPARTMENT OF MECHANICAL ENGINEERING

KCG COLLEGE OF TECHNOLOGY

CHENNAI – 600097

VISION OF THE COLLEGE

KCG College of Technology aspires to become a globally recognized centre of excellence for science, technology & engineering education, committed to quality teaching, learning, and research while ensuring for every student a unique educational experience which will promote leadership, job creation, social commitment and service to nation building

MISSION OF THE COLLEGE

- Disseminate knowledge in a rigorous and intellectually stimulating environment
- Facilitate socially responsive research, innovation and entrepreneurship
- Foster holistic development and professional competency
- Nurture the virtue of service and an ethical value system in the young minds

VISION OF THE DEPARTMENT

The Department of Civil Engineering envisions becoming a global centre of excellence founded on effective teaching and innovative research, producing competent engineering graduates to serve the nation

MISSION OF THE DEPARTMENT

- To effectively teach engineering fundamentals and modern technology.
- To identify, analyze and find sustainable solutions to infrastructural challenges facing the nation.
- To contribute to the holistic development of the students.

PROGRAM OUTCOMES (POs)

Engineering graduates will be able to:

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solution for complex engineering problems and design systems components or process that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research- based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environmental and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-Long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates of the programme, will continuously update their domain knowledge for continuous professional development with focus on research & development and industry interaction.

PEO2: Graduates of the programme will create innovations in providing solution for sustainable built environment.

PEO3: Graduates will be familiar with modern engineering software tools and equipment to analyze complex civil engineering problems.

PEO4: Graduates of the programme will involve in the research world to meet the practical challenges.

PEO5: Graduates of the programme will be professional civil engineers with ethical and societal responsibility.

PROGRAMME SPECIFIC OUTCOMES(PSOS)

PSO 1 :Model, analyze, design and realize physical systems, components or process by applying principles of three core streams of Mechanical Engineering, i.e.Design, Manufacturing, Thermal and Fluid Engineering.

PSO 2 :Apply the knowledge of Auto CAD, SolidWorks, ANSYS,CNC, Simulation softwares, MATLAB, Machine tool practices, Material & Machine testing, Fluid & Thermal machinery to solve real time Mechanical Engineering problems

PSO 3 :Engage in lifelong learning and follow professional ethics, codes and standards of Professional practices.

ME6701 POWER PLANT ENGINEERING

SYLLABUS

UNIT I COAL BASED THERMAL POWER PLANTS

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems..

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada DeuteriumUranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 8

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

Text Book(s)

T1: Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

Reference Book(s)

R1: El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd.,2010.

R2: Black & Veatch, Springer, "Power Plant Engineering", 1996.

R3: Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

R4: Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

Course Outcomes:

CO Nos.	Description of the COs
CO 1	Know working of modern boilers & subsystems of thermal power plants and solve problems based on ranking cycle and binary cycle
CO 2	Analyse & optimize Diesel, Dual , Brayton & Combined cycle and know the working of diesel, gas turbine and combined gasifier power plant
CO 3	Know working and types of nuclear reactors and safety measures.
CO 4	Know the working principle ,construction ,types, layout of renewable energy power plants including solar, hydro, wind, geothermal, SPV, Tidal, Biogas and Fuel cell.
CO 5	Know and calculate different tariff types, draw load curves, compare various power plant and do cost calculation of power plants.

CO-PO Mapping

CO Nos.	Level of correlation* of the COs with the relevant POs/PSOs					
	PO 1	**PO 2**	**PO 3**	**PO 6**	**PO 7**	**PO 8**
CO 1	2	2	2	2	1	1
CO 2	2	2	2	2	1	1
CO 3	2	2	2	3	3	1
CO 4	2	2	2	3	3	1
CO 5	2	2	2	3	2	1

Note(*): 1- Low level, 2- Medium level and 3- High level

UNIT 1 COAL BASED THERMAL POWER PLANTS

PART A

1. What are the different types of power plants?

1. Thermal Power Plant
2. Diesel Power Plant
3. Nuclear Power Plant
4. Hydel Power Plant
5. Steam Power Plant
6. Gas Power Plant
7. Wind Power Plant
8. Geo Thermal
9. Bio – Gas
10. M.H.D. Power Plant

2. What are the flow circuits of a thermal Power Plant?

1. Coal and ash circuits.
2. Air and Gas
3. Feed water and steam
4. Cooling and water circuits

3. List the different types of components (or) systems used in steam (or) thermal power plant?

1. Coal handling system.
2. Ash handling system.
3. Boiler
4. Prime mover
5. Draught system.

a. Induced Draught
b. Forced Draught

4. What are the merits of thermal power plants? Merits (Advantages) of Thermal Power Plant:

1. The unit capacity of thermal power plant is more. The cost of the unit decreases with the increase in unit capacity
2. Life of the plant is more (25-30 years) as compared to diesel plant (2-5 years)
3. Repair and maintenance cost is low when compared with diesel plant
4. Initial cost of the plant is less than nuclear plants
5. Suitable for varying load conditions.

5. What are the Demerits of thermal power plants?

Demerits of thermal Power Plants:

1. Thermal plant is less efficient than diesel plants
2. Starting up the plant and brining into service takes more time
3. Cooling water required is more
4. Space required is more.

6. What are the various steps involved in the coal handling system?

1. Coal delivery
2. Unloading,
3. Preparation
4. Transfer
5. Outdoor storage
6. Covered storage
7. In-Plant handling
8. Weighing and measuring
9. Feeding the coal into furnace

7. After coal preparation, How the coal transfer?

1. Belt conveyors
2. Screw conveyors
3. Bucket elevation
4. Grab bucket elevators
5. Skip hoists
6. Flight conveyor.

8. Write the advantages of belt conveyor?

1. Its operation is smooth and clean,
2. It requires less power as compared to other types of systems.
3. Large quantities of coal can be discharged quickly and continuously,
4. Material can be transported on moderate inclines.

9. What are the systems used in pulverized coal firing?

1. Unit system or Direct system
2. Bin or Central system

10. Write the classification of Mechanical Stokers?

1. Travelling grate stoker
2. Chain grate stoker
3. Spreader stoker
4. Vibrating grate Stoker
5. Underfeed stoker.

11. What are the three major factor, consider for ash disposal system?

1. Plant site
2. Fuel source
3. Environmental regulation

12. Write the classification of Ash handling system?

1. Hydraulic system,
2. Pneumatic system
3. Mechanical system

13. What are the Ash discharge equipments?

1. Rail road cars
2. Motors truck
3. Barge

14. Define Draught.

Draught is defined as the difference between absolute gas pressure at any point in a gas flow passage and the ambient (same elevation) atmospheric pressure.

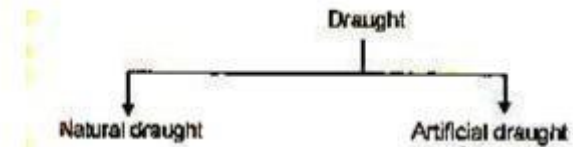
15. What are the purpose of Draught.

(i) To supply the required amount of air to the furnace for the combustion of fuel. The amount of fuel can be burnt per square foot of grate depends upon the quantity of air circulated through fuel bed.

(ii) To remove the gaseous products of combustion.

16. Write the classification of Draught?

The following flowchart gives the classification of draughts



17. Define artificial draught?

If the draught is produced by steam jet or fan it is known as artificial draught.

18. Define Induced draught?

The flue is drawn (sucked) through the system with a fan or steam jet.

19. Define Forced draught?

The air is forced into the system by a blower or steam jet.

20. Write the merits of Natural Draught?

1. No external power is required for creating the draught
2. Air pollution is prevented since the flue gases are discharged at a higher level
3. Maintenance cost is practically nil since there are no mechanical parts
4. Its has longer life,
5. Capital cost is less than that of an artificial draught.

21. Write the De-merits of Natural Draught?

1. Maximum pressure available for producing draught by the chimney is less,

2. Flue gases have to be discharged at higher temperature since draught increases with the increase in temperature of flue gases.

3. Heat cannot be extracted from the fluid gases for economizer, superheater, air pre-heater, etc. Since the effective draught will be reduced if the temperature of the flue gases is decreased.

22. Write the surface condenser?

1. Down flow condenser
2. Central flow condenser
3. Evaporative condenser

23. Write the advantages of surface condenser?

1. The condensate can be used as boiler feed water

2. Cooling water of even poor quality can be used because the cooling water does not come in direct contact with steam

3. High vacuum (about 73.5 cm of Hg) can be obtained in the surface condenser. This increases the thermal efficiency of the plant.

24. Write the disadvantages of surface condenser?

1. The capital cost is more,
2. The maintenance cost and running cost of this condenser is high,
3. It is bulky and requires more space.

25. Name any two heat saving devices used in a thermal power plant?

I. Air pre heater
II. Economizer.

PART B

1. Explain briefly the basic Rankine cycle of a thermal power plant. List out the major components and explain their functions.

2. A) Why reheating is used in some power plants. Explain the modified Rankine cycle.
   B) Draw the complete layout of steampower plant and explain its major components

3. (i) Explain the working principle of FBC with a neat sketch.
(ii)Briefly discuss types of FBC?

4. (i) Sketch and explain a pressurized FBC system.
(ii)Steam enters the high pressure turbine at 12 Mpa and 600°C and is condensed in the condenser at a pressure of 10 kPa. If the moisture content of steam at the exit of low pressure turbine is not to exceed 12 %. Determine pressure at which the steam should be reheated and thermal efficiency of the cycle.

5. (i)Explain the unique features of high pressure boilers.
(ii)What is the ash handling system? Draw a line diagram of the hydraulic ash handling system for modern high capacity plants.Explain its working.(10)

6. (i)Explain the principle involved in preparation of coal and what are the methods of preparation.
(ii)Distinguish between high pressureboiler and supercritical boiler.

7. Explain the various draught system with a neat sketch.
8. (i)Explain cogeneration plant efficiency
(ii)What do you understand by cogeneration of power and process heat? Explain its thermodynamic advantage.

9. (i)Define binary cycle? Explain the layout and operation of the mercury steam binary cycle power plant?
(ii)Define power coefficient? How does it affect the performance of a cogeneration plant?

10. (i)How does an industrial steam generator differ from a utility boiler?
(ii)Why boiler water is to be treated? Explain briefly feedwater treatment.

UNIT 2 DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS
PART A

1. **List the various types of diesel plants.**
   Based on number of strokes: (a) Two stroke diesel engine (b) Four stroke diesel engine
   Based on orientation: (a) Horizontal diesel engine (b) Vertical diesel engine
   Based on number of cylinders: (a) single cylinder (b) Multi cylinder
   Based on aspiration (a) naturally aspirated (b) supercharging or turbocharging.

2. **List the components of diesel power plant.**
   1.Diesel engine 2. Air intake system 3. Exhaust system 4. Fuel system 5.Cooling system 6. Lubricating system

3. **List the reason why the cooling system is necessary for a diesel engine.**
   I. To avoid damage and overheating of piston

   II. To avoid uneven expansion which results in cracking in the piston and cylinder

   III. To avoid pre-ignition and detonation or knocking

   IV. To avoid reduction in volumetric efficiency and power output of the engine.

4. **List the various functions of fuel injection system.**
   I. It filters the fuel

   II. Monitor the correct quantity of fuel to be injected

   III. Timing of the injection process

   IV. Regulates the fuel supply

   V. Fine atomization of fuel oil

   VI. Distributes the fuel evenly to all cylinders in case of multi cylinder engine

5. **List the classification of the oil injection system.**

(a) Common rail injection system (b) Individual pump injection system (c) Distributor system

6. **What are the methods of cooling system used?**
   I. Air cooling
   II. Liquid cooling (water is commonly used liquid)

7. **List the methods adopted for circulating the water in a cooling system.**
   1. Thermo-siphon cooling 2. Forced cooling by pump 3. Thermostat cooling 4. Pressurised water cooling 5. Evaporative cooling

8. What are the important functions of a lubricating system?
1. Lubricating 2. Cooling 3. Cleaning 4. Sealing 5. Noise absorption

9. List the various types of lubricating system used in diesel engines.
1. Mist lubricating system 2. Wet sump lubrication system 3. Dry sump lubrication system

10. What are the starting methods of diesel engines?
1. By an auxiliary engine 2. By an electric motor 3. By compressed air

11. List any four advantages of diesel power plant.
1. It is easy to design andinstall 2. It is easily available in standard capacities 3. They can respond to load changes 4. They have less stand by losses

12. List any four disadvantages of diesel power plant.
1. High operating cost 2. High maintenance and lubrication cost 3. Capacity is restricted 4. Noise pollution

13. List any four applications of diesel power plant.
1. Used as peak load plants 2. Suitable for mobile plants 3. Used as standby units 4. Used as emergency plant.

14. List the advantages of gas turbine power plant.
1. Low capital cost 2. High reliability 3. Flexibility in operation 4. Capability to quick start 5. High efficiency

15. List the major components of gas turbine.
1. Compressor 2. Combustion chamber 3. Turbine

16. List the types of gas turbine power plants.

1. Open cycle gas turbine power plant 2. Closed cycle gas turbine power plant

17. List the disadvantages of gas turbine power plant.

1. No load and Partial load efficiency is low 2. High sensitive to component efficiency 3. The efficiency depends on ambient pressure and ambient temperature 4. High air rate is required to limit the maximum inlet air temperature. Hence exhaust losses are high 5. Air and gas filter is required to prevent dust into the combustion chambers.

18. Define regenerator efficiency.

The regenerator efficiency is defined as the ratio between the actual temperature rise of air to maximum temperature rise possible.

19. List the factors which affect the performance of gas turbine power plants.

1. Part load efficiency 2. Fuel consumption 3. Air mass flow rate 4. Thermal efficiency 5. Regeneration

20. What are the working fluids in gas turbine?

1. Air 2. Helium 3. Argon 4. Carbon dioxide

21. What is the function of draft tube?

The draft tube is a conduit which connects the runner exit to the tail race where the water is being finally discharged from the turbine. The primary function of the draft tube is to reduce the velocity of the discharged water to minimize the loss of kinetic energy at the outlet. This permits the turbine to be set above the tail water without any appreciable drop of available head.

22. How solid injection is classified?

Solid Injection Classification:

- Common Rail System
- Unit Injection System
- Individual Pump and Nozzle System
- Distributor System

23. What do you mean by regeneration in gas turbine power plant?

The hot exhaust gases from the turbine are passed through a heat exchanger, or regenerator, to increase the temperature of the air leaving the compressor prior to combustion. This reduces the amount of fuel

needed to reach the desired turbine-inlet temperature. The increase in efficiency is, however, tied to a large increase in initial cost and will be economical only for units that are run almost continuously.

24. Write about types of turbines.

Major classifications are, (1)Impulse turbine (2)Reaction turbine Subdivided into, (a)Kaplan Turbine (b)Propeller Turbine (c)Francis Turbine (d)Pelton Turbine

25. What type of cycle is used in gas turbine?

In an ideal gas turbine, gases undergo three thermodynamic processes: an isentropic compression, an isobaric (constant pressure) combustion and an isentropic expansion. Together, these make up the Brayton cycle.

PART B

1. List and explain the function of the essential components of a diesel power plant.

2. (i)With an aid of a block diagram, explain the working principle of a closed cycle gas turbine plant.
   (ii)Explain how do you select engine for a diesel power plant?

3. (i)What are the factors to be considered for selecting the site of a diesel engine power plant?
   (iii) Describe the different fuels which can be burnt in a turbine plant..

4. (i)Explain in detail about Otto cycle and processes with PV and T S diagrams.
(ii)Draw a neat sketch of a diesel power plant showing all the systems.

5. (i)Write a note on the fuel system of diesel power plant.
(ii)Explain how reheating improves the efficiency of a simple open cycle gas turbine plant.

6.(i)Discuss the effect of pressure ratio on the Brayton cycle output and efficiency.
(ii)Explain in detail about Dual cycle.

7. (i)Discuss the performance characteristics of a gas turbine power plant.

(ii)What are the essential features of gas turbine blades? How are blades cooled?

8. (i)Discuss the materials which are used for gas turbines and compressors. What propertiesshould the blade material possess?
(ii)Explain the effect of regeneration in a gas turbine plant.

9. (i)Explain the use of coal in a combined cycle plant.
(ii)What is the environmental impact of a combined cycle plant.

10. (i)How can a combined cycle plant be used for cogeneration? What is its thermodynamic advantage?
(ii)Discuss the advantages of combined cycle power generation. Why is it so important in the present day energy scenario?

UNIT III NUCLEAR POWER PLANTS

PART – A

1. Define Isotopes?

Those pairs of atoms which have the same atomic number and hence similar chemical properties, but different atomic mass numbers are called isotopes.

2. Define Isobars?

Those atoms which have the same mass number, but different atomic numbers are called isobars. Obviously, these atoms belong to different chemical elements.

3. Define Isomers?

Those pairs of atoms (nuclides) which have the same atomic number and atomic mass number but have different radioactive properties are called isomers and their existence is referred to as nuclear isomerism.

4. Define isotones?

Those atoms whose nuclei have the same number of neutrons are called isotones**.**

5. Define Radioactivity?

The phenomenon of spontaneous emission of powerful radiations exhibited by heavy element is called radioactivity. The radioactivity may be natural or artificial.

6. Write the types of Nuclear radiations?

The five types of nuclear radiations are :

(i) Gamma rays (or photons) : electromagnetic radiation.

(ii) Neutrons : uncharged particles, mass approximately 1.

(iii) Protons : + 1 charged particles, mass approximately 1.

(iv) Alpha particles : helium nuclei, charge + 2, mass 4.

(v) Beta particles : electrons (charge – 1), positrons (charge + 1), mass very small**.**

7. Define Fertile Materials?

It has been found that some materials are not fissionable by themselves, but they can be converted to the fissionable materials, these are known as fertile materials.

8. Define Fission?

Fission is the process that occurs when a neutron collides with the nucleus of certain of heavy atoms, causing the original nucleus to split into two or more unequal fragments which carry-off most of the energy of fission as kinetic energy. This process is accompanied by the emission of neutrons and gamma rays.

9. Define chain reaction?

A chain reaction is that process in which the number of neutrons keeps on multiplying rapidly (in geometrical progression) during fission till whole the fissionable material is disintegrated. The multiplication or reproduction factor (K) is given by:

$$K = \frac{No.\ of\ neutrons\ in\ any\ particular\ generation}{No.\ of\ neutrons\ in\ the\ preceding\ generation}$$

If K > 1, chain reaction will continue and if K < 1, chain reaction cannot be maintained.

10. Define Nuclear fusion?

Nuclear fusion is the process of combining or fusing two lighter nuclei into a stable and heavier nuclide. In this case a large amount of energy is released because the mass of the product nucleus is less than the masses of the two nuclei which are fused.

11. Define Nuclear Reactor?

A nuclear reactor is an apparatus in which nuclear fission is produced is the form of a controlled self-sustaining chain reaction.

12. Write the Essential components of a nuclear reactor?

Essential components of a nuclear reactor are:

(i) Reactor core
(ii) Reflector
(iii) Control mechanism
(iv) Moderator
(v) Coolants
(vi) Measuring instruments
(vii) Shielding.

13. What are the main components of a nuclear power plant?

The main components of a nuclear power plant are:

(i) Nuclear reactor
(ii) Heat exchanger (steam generator)
(iii) Steam turbine
(iv) Condenser
(v) Electric generator

14. Mention some important reactors?

Some important reactors are :

(i) Pressurized water reactor (PWR)
(ii) Boiling water reactor (BWR)
(iii) Gas-cooled reactor
(iv) Liquid metal-cooled reactor
(v) Breeder reactor.

15. What are the factors considered to be selected the site for Nuclear power plant?

Following factors should be considered while selecting the site for a nuclear power plant:

(i) Proximity to load centre
(ii) Population distribution
(iii) Land use
(iv) Meteorology
(v) Geology
(vi) Seismology
(vii) Hydrology

16. Write the types of Reactors?

1. On the basis of neutron energy.
2. On the basis of fuel used.
3. On the basis of Moderate used.
4. On the basis of coolant used.

17. What are the advantages of nuclear power plant?

1. It can be easily adopted where water and coal resources are not available.
2. The Nuclear power plant requires very small quantity of fuel. Hence fuel transport cost is less.
3. Space requirement is very less compared to other power plant of equal capacity.
4. It is not affected by adverse weather condition.

18. Mention any 3 fast breeder reactors?

1. Liquid Metal
2. Helium
3. Carbon dioxide

19. What are the ways the liquid wastes are disposed?

1. Dilution
2. Concentration to smaller volumes and storages.

20. Write the effects of Nuclear radiation?

Biological damage

1. Ionization
2. Absorption

PART B

1. i) Explain the following terms. a. Mass number, b. Atomic number, c. Mass defect, d. Binding energy.

   (ii) Explain fission and fusion reactions with an example.

2. (i)How are nuclear reactors classified? Describe some common types of reactors used for electric power plants.

   (ii) Explain the construction and working of Nuclear power plant with a layout.

3. (i) Discuss about a breeder reactor.

   (ii)Explain the working of a typical fast breeder nuclear reactor power plant with neat diagram.

4. (i) What are the difference between a pressurized water reactor nuclear power plant and boiling water reactor nuclear power plant?

   (ii)Explain the following terms: (a) Fission of nuclear fuel (b) Distribution of fission energy (c) The chain reaction.

5. (i)List out the advantages and disadvantages of breeder reactor?

   (ii) Explain briefly about radiation hazards and shielding?

6. (i)With the help of a sketch show all the important parts of nuclear reactor. Describe briefly the functions of each part.

(ii)Distinguish between controlled and uncontrolled nuclear chain reaction.

7. (i)Explain the working principle of a BWR with a neat sketch.

(ii) Write short note on a pressurized water reactor.

8. (i) Generalize the Safety measures for Nuclear Power plants?

(ii) Write notes on the hazardous effects of nuclear materials.

9. (i) Explain the Gas Cooled Reactor with a neat sketch.

(ii) Explain Liquid Metal Cooled Reactors.

10. (i) Explain the CANada Deuterium- Uranium reactor (CANDU).

(ii) Give the advantages and disadvantages of CANDU Reactor.

11. (i) Explain radioactive decay and halflife of nuclear fuels.

(ii)Write short note on moderating power and moderating ratio.

12. (i) Explain the types of liquid metal fast breeder reactors.
(ii)Explain with a neat sketch the vapour type pressurizer system.

13. (i) Define a chain reaction? Explain how it is maintained?

(ii)What is the difference between controlled and uncontrolled chain reaction?

Explain with neat sketches and with examples.

14. (i) List out the advantages and disadvantages of nuclear power plant?

Explain with a neat sketch the indirect gas cooled reactor.

UNIT IV POWER FROM RENEWABLE ENERGY

PART – A

1. Define heat engine?

Any type of engine or machine which derives heat energy from the combustion of fuel or any other source and converts this energy into mechanical work is termed as a heat engine.

2. What are the essential components of diesel power plants?

Essential components of a diesel power plant are:

a. Engine
b. Air intake system
c. Exhaust system
d. Fuel system
e. Cooling system
f. Lubrication system
g. Engine starting system
h. Governing system.

3. What are the injection systems are used in diesel power plants?

Commonly used fuel injection system in a diesel power station:
(I) Common-rail injection system (ii)Individual pump injection system
(iii) Distribution system.

4. List the various Liquid Cooling System?

In liquid cooling following methods are used for circulating the water around the cylinder and cylinder head:

I. Thermo-system cooling
II. Forced or pump cooling
III. Cooling with thermostatic regulator
IV. Pressurized cooling
V. Evaporative cooling.

5. What are the various Lubricating systems used in I.C Engines?

Various Lubrications systems used in I.C. engines are:

a. Wet sump lubrication system
b. Dry sump lubrication system
c. Mist lubrication system.

6. Mention three starting systems for Large and Medium size engines?

The following three are the commonly used starting systems in large and medium size engines:

I. Starting by an auxiliary engine
II. Use of electric motors of self starters
III. compressed air system.

7. **What is the purpose of supercharging?**

The purpose of supercharging is to raise the volumetric efficiency above that value which can be obtained by normal aspiration.

8. What are the classifications of Heat Engine?

Heat engines are classified into two types:

1) External combustion engines,
2) Internal combustion engines.

9. Define connecting rod?

It connects the piston and the crankshaft, thereby transmitting the force exerted on the piston to the crankshaft.

10. Define crankshaft?

It converts the reciprocating motion of the piston into the rotary motion of the output shaft.

It is enclosed in the crankcase.

11. Define Flywheel?

It is a heavy wheel mounted on the crankshaft. It stores the excess energy delivered by the engine during the power stroke and supplies the energy needed during other strokes. Thus it keepsthe fluctuations in the crankshaft speed within desired limits.

12. What are the 2 – cooling Medium in the cooling system?

The cooling medium used in the cooling system can be air or water. There are two types of cooling systems:

1) Liquid or indirect cooling system,
2) Air or direct cooling system.

13. Write the three types of liquid cooling systems?

This system can be classified under three types:

i) Natural circulation type or thermo syphon system,
ii) forced circulation system,
iii) Thermostatic cooling system.

14. Write the Disadvantages of over cooling of the Engine?

1) Engine starting is difficult,
2) Over-cooling reduces the overall efficiency of the system,
3) At low temperatures, corrosion assumes considerable magnitude that it may reduce the life of various components.

15. Write the advantages of Air cooling?

1. It occupies less space,
2. Air cooled engine is lighter than water-cooled engines. Hence used in two wheelers, agricultural sprayers, etc.
3. Engine warms up faster than water cooled engines,
4. Practically, there is no need for maintenance.

16. Write the advantages of Water cooling?

1) Cooling is more efficient,
2) Uniformity in cooling,
3) Engines cooled by water can be placed anywhere in the vehicle.

17. Write the function of Lubrication?

a. To reduce the wear and tear between the moving parts and thereby increasing the life of the engine.
b. The lubricating oil acts as a seal, i.e., it prevents the high pressure gases in the combustion chamber from entering the crankcase
c. To cool the surfaces.

18. What are the classifications of Lubrication system?

Classification of Lubrication System: Some of the lubricating systems used for IC engines are:

i) Wet sump lubricating system,
ii) Mist lubricating system.

Wet sump lubricating system can be further classified as,

i) Splash type lubricating system,
ii) Pressure feed lubricating system.

19. What are the components of fuel injector?

The fuel injector or atomizer consists of:

1) Needle valve,
2) Compression spring,
3) Nozzle,
4) Injector body.

20. What are the duties of Air intake systems?

The duties of the air intake systems are as follows:

i) To clean the air intake supply,
ii) To silence the intake air,
iii) To supply air for super charging.

21. Define – open cycle gas turbine?

In the open cycle gas turbine, air is drawn into the compressor from the atmosphere and is compressed. The compressed air is heated by direct burning the fuel in the air at constant pressure in the combustion chamber. Then the high pressure hot gases expand in the turbine and mechanical power is developed.

22. Define – closed cycle gas turbine?

In this, the compressed air from the compressor is heated in a heat exchange (air heater) by some external source of heat (coal or oil) at constant pressure. Then the high pressure hot gases expand passing through the turbine and mechanical power is developed. The exhaust gas is then cooled to its original temperature in a cooler before passing into the compressor again.

23. Write the few fuels for Gas turbine and why these fuels are use of gas turbines?

Natural gas, last furnace gas, produce gas, coal gas and solid fuels distillate oils and residual oils paraffins used in gas turbine and methane, ethane, propane, octane. Important properties to be considered while selecting the fuel for gas turbine are as follows: 1) Volatility 2) Combustion products, 3) Energy contents, 4) Lubricating properties, 5) Availability.

24. Write the major field of application of gas turbines?

The major fields of application of gas turbines are:
i) Aviation
ii) Power generation
iii) Oil and gas industry
iv) Marine propulsion.

25. Define Gas turbine plant and write the working medium of this gas turbine?

A gas turbine plant may be defined as one ,in which the principal prime-mover is of the turbine type and the working medium is a permanent gas'.

26. What are the components of a gas turbine plant?

A simple gas turbine plant consists of the following:
i) Turbine

ii) Compressor
iii) Combustor
iv) Auxiliaries.

A modified plant may have in addition and intercooler, a regenerator, a reheater etc.

27. What are the methods to improving the thermal efficiency in open cycle gas turbine plant?

Methods for improvement of thermal efficiency of open cycle gas turbine plant are :

i) Inter cooling
ii) Reheating
iii) Regeneration

28. What is the main difference between free piston engine plants and conventional gas turbine plant?

Free-piston engine plants are the conventional gas turbine plants with the difference that the air compressor and combustion chamber are replaced by a free piston engine.

PART- B

1. (i)Draw the general layout of thermal power plant and explain the working of different circuits. (ii)Sketch the layout of hydroelectric power plant and explain the functions of each component in it. List out the advantages and limitations of this plant.

2. (i)Explain in detail about surge tank used in a hydroelectric power plant. Also explain about the classification and selection of dams.

   (ii)What are the factors to be considered while selecting a site for hydroelectric power plant?

3. (i)Explain the selection factors of a hydraulic turbine .What are the function of a hydraulic turbine?

   (ii)How are the turbines classified? Explain anyone with a suitable sketch.

4. (i)Sketch and explain the two pool tidal power plant.

   (ii) What are the different types of Tidal power plants?

5. (i)Explain with a neat diagram of wind electric generating power plant.

(ii)Explain in detail about the various types of Wind energy system.

6. (i) Write notes on solar thermal power plants.

(ii)Explain the Solar thermal central receiver system.

7. (i) Write short notes on the types of collectors in a solar power plant.

(ii)Enumerate the advantages and disadvantages of concentrating collectors over flat plate collectors.

8. (i) Explain the construction and working of Geo thermal power plant.

(ii)Discuss the different system used for generating power using geothermal energy.

9. Enumerate and explain the various types of prime movers used in geothermal energy conversion systems.

10. (i)What is a (Solar Photovoltaic)SPV power plant and Explain in detail how power is produced in a SPV power plant?

(ii)Listout the advantages and advantages of SPV power plant.

11. (i)Explain the method of power generation using Biogas.

(ii) Write short notes on the types of generators to generate electricity from biogas.

12. (i) What is a fuel cell? Explain its working using a block diagram.

(ii) Explain the generalised concept of a fuel cell as a power plant.

13. (i) Explain the principle, construction and working of a tidal power plant.

(ii)Listout the advantages and disadvantages of a tidal power plant.

14. (i) Explain the principle, construction and working of a wind power plant.

(ii)Listout the advantages and disadvantages of a wind power plant.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS

PART – A

1. Define Tide?

The periodic rise and fall of the water level of sea, which are carried by the action of sun and moon on the water of the earth is called the tide.

2. **In which system thepower is Intermittently generated?**

In a single basin arrangement power can be generated only intermittently.

3. What are the consistencies 'Solar farm' and 'Solar tower'?

The solar farm consists of a whole field covered with parabolic trough concentrators and a 'solar tower' consists of a central receiver on a tower and a whole field of tracking.

4. Define See beck effect?

If two dissimilar materials are joined to form a loop and the two junctions maintained at different temperatures, an e.m.f. will be set up around the loop'. This is called Seeback effect.

5. What is working principle of thermionic?

A thermionic converter works because of the phenomenon of 'thermionic emission'.

6. What is Photo voltaic effect?

'Photovoltaic effect' is defined as the generation of an electromotive force as a result of absorption of ionizing radiation.

7. Write a short notes on MHD – generator?

'MHD generator' is a device which converts the heat energy of a fuel directly into electrical energy without a conventional electric generator.

8. Write a short notes on Fuel cell?

A 'fuel cell' is an electrochemical device in which the chemical energy of a conventional fuel is converted directly and efficiently into low voltage, direct current electrical energy.

9. List the non – conventional energy sources?

The various non-conventional energy sources are as follows:

I. Solar energy

II. Wind energy
III. Energy from biomass and biogas
IV. Ocean thermal energy conversion
V. Tidal energy
VI. Geothermal energy
VII. Hydrogen energy
VIII. Fuel cells
IX. Magneto-hydrodynamics generator
X. Thermionic converter

10. Write the advantages of non – conventional Energy sources?
Advantages of non-conventional energy sources:

The leading advantages of non-conventional energy sources are:
1. They do not pollute the atmosphere
2. They are available in large quantities.
3. They are well suited for decentralized use.

11. Write the characteristic's of wind energy?
1. Wind-power systems do not pollute the atmosphere.
2. Fuel provision and transport are not required in wind-power systems.
3. Wind energy is a renewable source of energy.
4. Wind energy when produced in small scale is cheaper, but competitive with conventional power generating systems when produced on a large scale.

Wind energy entails following shortcomings/problems:
1. It is fluctuating in nature.
2. Due to its irregularity it needs storage devices.
3. Wind power generating systems produce ample noise.

12. What are the types of wind mills?
1. Multiple blade type
2. Savonius type
3. Darrieus type

13. Write the types of wind machines?
1. Horizontal axis wind machines
2. Vertical axis wind machines

14. Write the classification of Tidal power plants?
1. Single Basin arrangement.
2. Double Basin arrangement.

15. What are the advantages and limitation of Tidal power generation?

Advantages:

1. Tidal power is completely independent of the precipitation (rain) and its uncertainty besides being inexhaustible.
2. Large area of valuable land is not required
3. When a tidal power plant works in combination with thermal or hydro-electric system peak power demand can be effectively met with.
4. Tidal power generation is free from pollution.

Limitations:

1. Due to variation in tidal range the output is not uniform.
2. Since the turbines have to work on a wide range of head variation (due to variable tidal range) the plant efficiency is affected.
3. There is a fear of machinery being corroded due to corrosive sea water.
4. It is difficult to carry out construction in sea.
5. As compared to other sources of energy, the tidal power plant is costly.
6. Sedimentation and silteration of basins are the problems associated with tidal power plants.
7. The power transmission cost is high because the tidal power plants are located away from load centres.

The first commercial tidal power station in the World was constructed in France in 1965 across the mouth of La Rance Estuary. It has a high capacity of 240 MW. The average tidal range at La Rance is 8.4 m and the dam built across the estuary encloses an area of 22 km^2.

16. Write the advantages of MHD systems?

1. More reliable since there are no moving parts.
2. In MHD system the efficiency can be about 50% (still higher expected) as compared to less than 40% for most efficient steam plants.
3. Power produced is free of pollution.
4. As soon as it is started it can reach the full power level.
5. The size of plant is considerably smaller than conventional fossil fuel plants.
6. Less overall operational cost.
7. The capital cost of MHD plants is comparable to those of conventional steam plants.
8. Better utilization of fuel.

9. Suitable for peak power generation and emergency service.

17. Write the advantages and disadvantages of fuel cell?

Advantages

1. Conversion efficiencies are very high.
2. Require little attention and less maintenance.
3. Can be installed near the use point, thus reducing electrical transmission requirements and accompanying losses.
4. Fuel cell does not make any noise.
5. A little time is needed to go into operation.
6. Space requirement considerably less in comparison to conventional power plants.

Disadvantages

1. High initial cost
2. Low service life.

18. Write the application of fuel cell?

The application of fuel cell relate to:

1. Domestic use.
2. Automotive vehicles
3. Central power stations.
4. Special applications.

19. Write the advantages of OTEC?

1. Ocean is an infinite heat reservoir which receives solar incidence throughout the year.
2. Energy is freely available

20. Write the disadvantages of OTEC?

1. Efficiency is very low, about 2.5%, as compared to 30 - 40% efficiency for conventional power plants.
2. Capital cost is very high

21. Define – Tidal power plant?

The tidal power plants are generally classified on the basis of the number of basins used for power generations. They are further subdivided as one-way or two-way system as per the cycle of operation for power generation.

22. Define – Renewable sources of energy?

Renewable sources of energy are continuously produced in nature, and they will not get exhausted eventually in future.

23. Define – Non-renewable source of energy?

Non-renewable sources of energy will get exhausted eventually in future. Example: Energy from fossil fuels.

24. Mention some conventional sources?

Fossil fuels, hydel energy and nuclear energy.

25. Mention some Non-conventional sources?

Solar energy, wind energy, tidal energy, ocean thermal energy, geothermal energy and biomass.

26. What are the 3 – mayor energy sources?

The energy sources available can also be classified into three major types based on the yield of net energy. They are:

i) Primary energy sources,
ii) Secondary energy sources,
iii) Supplementary energy sources.

27. What are the five general categories of geothermal sources?

The following five general categories of geothermal sources have been identified.

a) Hydrothermal convective systems
   i) Vapour – dominated or dry steam fields.
   ii) Liquid – dominated system or wet steam fields.
   iii) Hot – water fields.
b) Geopressure resources.
c) Petro-thermal or hot dry rocks (HDR)
d) Magma resources
e) Valcanoes.

28. Write the application of geothermal energy?

The following are the three main applications of the steam and hot water from the wet geothermal reservoirs:

1. Generation of electric power.
2. Space heating for buildings.
3. Industrial process heat.

The major benefit of geothermal energy is its varied application and versatility.

29. What are the Advantages and disadvantages of Geothermal Energy over other Energy forms?

Advantages of geothermal process:

1. Geothermal energy is cheaper.
2. It is versatile in its use.
3. It is the least polluting as compared to other conventional energy sources.
4. It is amenable for multiple uses from a single resource
5. Geothermal power plants have the highest annual load factors of 85 percent to 90 per cent compared to 45 per cent to 50 per cent for fossil fuel plants.
6. It delivers greater amount of net energy from its system as compared to other alternative or conventional systems.
7. Geothermal energy from the earth's interior is almost as inexhaustible as solar or wind energy, so long as its sources are actively sought and economically tapped.

Disadvantages:

1. Low overall power production efficiency (about 15% as compared to 35% to 40% for fossil fuel plants).

2. Drilling operation is noisy.
3. Large areas are needed for exploitation of geo-thermal energy.

PART B

1. (i)What do you understand by power plant economics? Discuss.
   (ii)Explain the fixed costs and operating costs of a power station.

2. (i)Show the elements which contribute to the cost of the electricity?
   (ii)Describe how the cost of power generation be reduced?

3. (i)What do you understand by cost of electrical generation?
   (ii)Explain the various types of cost associated with power generation?

4. (i)Write the explanatory noteson the economics of power generation.
   (ii) A residential consumer has 10 lamps of 40 W each. His demand is

   Midnight to 5 am – 40 W
   5am to 6 pm – no load
   pm to 7 pm – 329 W
   pm to 9 pm – 360 W
   9 pm to midnight – 160 W

Plot the load curve. Calculate the average load, max load and demand factor.

5. (i) What is a tariff?
(ii)Discuss and compare various tariff used in practice.

6. (i)Explain the various methods used to calculate the depreciation cost.
(ii)Elucidate the objectives and requirements to tariff and general for of tariff.

7. (i) Explain the terms peak load, demand factor, load factor and plant use factor.
(ii)What are load curves and load duration curves? Discuss their utility in the economics of generation.

8. A generating stations as a maximum demand (MD) of 15 MW and the daily load curve on the station is as follows,

10pm to 05 am 2500 KW
01pm to 04pm 10000KW
05am to 07 am 3000KW
04pm to 06pm 12000KW
07pm to 11am 9000KW
06 pm to 8pm 15000KW
11am to 01pm 6000KW
08pm to 10pm 5000KW

Determine the size and the number of generator units, plant load factor, plant capacity factor, use factor and reserve capacity of plant.

9. A power plant has to supply load as follows:

Time(hrs)	0-6	6-12	12-14	14-18	18-24
Load(MW)	45	135	90	150	75

Draw the load curve, load duration curve and Choose suitable generation units and its operation schedule to supply the load.

10. (i)Explain about economics of load sharing between generators.

(ii)Explain about economics of load sharing between Power Plants.

11. (i)What are the fixed and operating costs of steam power plants?
(ii) Describe how are they accounted for fixing cost of electricity?

12. (i) Explain the pollution control technologies including waste disposal options for coal power plant.

(ii) Explain in detail Capital & Operating Cost of different power plants.

13. Explain the pollution control technologies including waste disposal options for nuclear power plant.

14. (i)Give short notes on site selection criteria.

(ii)Explain the merits and demerits of site selection criteria.

ME6702
MECHATRONICS

SYLLABUS

UNIT I INTRODUCTION

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors

UNIT II 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram,.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE

Introduction – Architecture of 8255, Keyboard interfacing, LED display – interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

Text Book(s)

T 1: Bolton, “Mechatronics”, Printice Hall, 2008.

T 2: Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice Hall, 2008.

Reference Book(s)

R 1: Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement
systems”, McGraw Hill International edition, 2007.

R 2: Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.

R 3: Smaili.A and Mrad.F , “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007.

R 4: Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.

R 5: Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2007.
R 6: Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013.

COURSE OUTCOMES

CO Nos.	**Description of the COs**
CO 1	Explain the mechatronics system and its component sensors
CO 2	Explain the concept and architecture of 8085 microprocessor and 8051 microcontroller
CO 3	Utilize 8255 for peripheral interfacing
CO 4	Analyzing the sequence of programming and solution using PLC
CO 5	Select actuators based on requirement

CO- PO Mapping

CO nos.	**Level of correlation* of the COs with the relevant POs/PSOs**					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 12
CO 1	2	1	-	-	-	2
CO 2	2	1	-	-	-	2
CO 3	3	2	1	1	-	3
CO 4	3	3	2	2	1	3
CO 5	3	2	1	1	-	3

Note(*): 1- Low level, 2- Medium level and 3- High level

UNIT I INTRODUCTION
PART A

1.Write an example for a transducer and state its transduction principle

Transducer is a device which converts an input of one form of energy (pressure, temperature, displacement, force, etc.) into an output of another form of energy (mechanical, electrical, magnetic, etc.). For example, thermocouple is a transducer which converts change in temperature into a voltage.

2.State the advantages of capacitive type proximity sensor

The advantages of capacitive type proximity sensor are

- The system responds to average displacement of a large area in a moving electrode
- Excellent linearity over entire dynamic range when area is changed
- Capacitors are noiseless
- High accuracy, sensitivity and resolution

3.What is meant by RTD? State its applications.

Resistance Temperature Detector (RTD) is a resistance thermometer which is used to measure temperature by correlating the resistance of the RTD element with temperature.

- Precision process temperature control (Textile, chemical, food, brewing)
- Automatic temperature control (Test chambers, oven temperature, plasticextruders)
-

4.Distinguish between measurement system and control system.

Measurement system	Control system
A measurement system involves the precise measurement and display /recording of physical,chemical ,mechanical and electrical or optical parameters	a group of physical component connected or related in such a manner as to command direct or regulate itself or another system
Various elements of a measurement system are sensor or transducer, signal processor display of recording device	Several elements of a control system are reference variable, output, feedback, comparison element, correction element

5. What are the key elements of a mechatronics system?

The key elements of a mechatronics system are
Actuators and sensors
Signals and conditioning
Digital logic systems
Software and data acquisition system
Computers and display devices

6.State the application of position and proximity sensor.

The applications of position sensor are
IC engine ignition system timing
Brushless DC motors to detect the position of permanent magnet
Detection of moving parts
Indexing of rotational or translational motion
The applications of proximity sensor are
Computer mouse buttons and arcade game joysticks
Door and window closure sensors in security applications

7.How is precision machine achieved in mechatronics system?

The use of nano-materials in manufacturing machine components by using mechatronics systems leads to more accuracy and high precision.

8. Define – Hysteresis

It is defined as the maximum differences in output for a given input when his value approached from the opposite direction. It is phenomenon which shows different outputs when loading and unloading

9.**What is the working principle of an eddy current proximity sensor?**

It detects the presence of a target by sensing the magnetic fields generated by a reference coil. An eddy current is a local electric current induced in a conductive material by the magnetic field produced by the sensor or active coil. This is sensed by a reference coil to create an output signal. When the distance between the target and the probe changes, the impedance of the coil changes. This change in impedance can be detected by a bridge circuit.

10.Write the different mechatronics systems used in automobiles.

Automobile applications mechatronics include electronic engine management system, collision detection system, antilock braking system, keyless entry system, cruise control system and parking assistance system.

11.**Write two factors that need to be considered in selecting a sensor for a particular application.**

i. Accuracy required: It is difference between the measured value and the true value. Accuracy of the sensor should be as high as possible.

ii. Precision: It is the ability to reproduce repeatedly with a given accuracy. It should be very high. Error between sensed and actual value should approach zero.

iii. Sensitivity: It is the ratio of change in output to a unit change of the input. It should be chosen to allow sufficient output.

12.**Distinguish between open-loop and closed loop system.**

Open loop	**Closed loop**
It does not use a feedback to control the operation of the system	Closed loop operation uses a negative feedback
The effects of known disturbances alone can be countered	The effects of disturbances are countered by virtue of negative feedback
conditioning means manipulating an analog signal in such a way that it meets the requirements of the next stage for further processing. It performs filtering and amplification functions.Less accurate	More accurate
Simple in construction	Complicated in construction
Slow response because of manual control	Closed loop can perform a task faster than open-loop

13.What is meant by signal conditioning?

A signal

14.Define – Gauge factor

Gauge factor is the ratio of changes of the resistance per unit resistance to the strain

15.Why are three concentric tracks used in an optical incremental encoder?

The incremental encoder consists of two tracks and two sensors whose outputs are called channels A and B. As the shaft rotates, pulse train occur on these channels at a frequency proportional to the shaft speed and the phase relationship between the signals yields the direction of the rotation. Incremental encoders often have third channel called index channel with a

single segment slot or reference yields one pulse per revolution which is useful in counting full revolutions. It is also useful as a reference to define a home base or zero position.

16.Define Mechatronics

The term Mechatronics is used for the integration of microprocessor control system, electrical systems and mechanical systems. Mechatronics is defined as the integration of precision mechanical & electronic control or the development of smart products & process

.

17. What are the various elements of a closed loop system for a person controlling the temperature?

The various elements of a closed loop system are,

- Controlled variable
- Comparison element
- Error signal
- Control unit

Measuring device For example Controlled variable - The room temperature Reference value (The required room temperature)
Comparison element - The measured value compared with the required value of temperature Error signal - The difference between the measured and required temperatures Control unit - The person Correction unit - The switch on the fire Process - The heating by the fire Measuring device - A thermometer

18. What is the larger scale application of Mechatronics?

A larger scale application of Mechatronics is a Flexible Manufacturing engineering System (FMS) involving computer – controlled machines, robots, automatic material conveying and overall supervisory control.

19.**List some of the applications of Mechatronics?**

- Home Appliances: Washing machine, Bread machines etc
- Automobile: Electrical fuel injection, Antilock brake system
- Aircraft: Flight control, Navigation system
- Automated Manufacturing

20.What are the two types of feedback loop?

The two types of feedback loop are,

- Positive feedback loop
- Negative feedback loop.

The feedback is said to be negative/positive feedback when the signal; which is feedback, subtracts/adds from the input value. It is required to

control a system. The control elements decide what action to take when it receives an error signal"

PART B

1.With an example explain the various functional units of a measurement system. (NOV/ DEC 2012)

2. Explain open loop and closed loop control system with neat sketches. (APR/ MAY 2005)

3. Explain the basic elements of a closed loop system. (NOV/ DEC 2007)

4. Explain the functioning of a closed loop system with a neat sketch for controlling the speed of a shaft. (NOV/ DEC 2010), (APR/ MAY 2006)

5. Explain the functioning of a closed loop system with a neat sketch for temperature control system. (NOV/ DEC 2011)

6. Explain the functioning of a closed loop system with a neat sketch for automatic water level controller. (NOV/ DEC 2007), (NOV/ DEC 2009)

7. Explain the static performance characteristics of a sensor. (NOV/ DEC 2008), (APR/ MAY 2006) (NOV/ DEC 2010), (APR/ MAY 2010)

8. Explain the dynamic characteristics of a sensor. (NOV/ DEC 2010), (APR/ MAY 2005), (NOV/ DEC 2012), (APR/ MAY 2008)

9. Describe neatly potentiometer sensor. (NOV/ DEC 2013)

10. Explain the functions of a capacitive sensor with neat sketch. (APR/ MAY 2008)

11. Explain the function of a LVDT with neat sketch. (APR/ MAY 2013), (APR/ MAY 2006)

12. Explain the Hall Effect sensor with neat sketch. (NOV/ DEC 2010)

13. Explain the functions of a bimetallic strip with neat sketch. (NOV/ DEC 2014), (APR/ MAY 2013)

14. Explain the functions of a thermocouple with neat sketch. (NOV/ DEC 2013), (APR/ MAY 2006) 15. Explain the functions of a RTD with neat sketch. (NOV/ DEC 2014), (NOV/ DEC 2009)

16. Explain any two types of light sensors with neat sketch. (APR/ MAY 2005)

17. Explain the working and construction of Hall Effect Sensor, Thermocouples and RTD. (NOV/ DEC 2015)

18. Explain the dynamic characteristics of Sensors. (NOV/ DEC 2015)

19. Explain about the model of a measurement system. (MAY/ JUNE 2016)

20. Discuss the control systems with example. (MAY/ JUNE 2016)

21. Discuss on the Static and Dynamic characteristics of Sensors in detail.

UNIT-2 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER

PART-A

1.What is meant by microprocessor?

A microprocessor is a multipurpose, programmable, clock driven, registers –based electronic device that reads binary instructions from a storage device called memory, accepts binary data as input and processes data according to those instructions, and provides results as output.

What are the four components of a programmable machine?

A typical programmable machine can be represented with four components.

- Microprocessor
- Memory
- Input
- Output

2. Define - Bus

A group of lines used to transfer bits between the microprocessor and other components of the computer system.

3.What are the types of languages?

The types of languages used are,

- Machine language
- Assembly language
- Low – level language
- High – level language

4. What are the two parts of an instruction?

An instruction has two parts.

 Opcode – Operation to be performed. Operand – The operand can be data (8 – or 16 – bit), address, or register, or it can be implicit. The method of specifying and operand (directly, indirectly, etc.,) is called the addressing mode.

6. What are the types of bus?

The types of bus are,

- Address bus
- Data bus
- Control bus.

7. Define - Address Bus

A group of lines that are used to send a memory address or a device address from the MPU to the memory location or the peripheral and is unidirectional. The 8085 microprocessor has 16 address lines.

8. Define - Data Bus

A group of bi-directional lines used to transfer data between the MPU and peripherals and is bi-directional. The 8085 microprocessor has eight data lines.

9.What is meant by 16 – bit register of 8085 microprocessor?

The 8085 has two 16 – bit register.

The program counter - The program counter is used to sequence the execution of a program.

Stack pointer - The stack pointer is used as a memory pointer for the stack memory.

10.**What are the two types of memories?**

The two types of memories are,

- Static memory (SRAM)
- Dynamic memory (DRAM)

11.Write is meant by SRAM?

This memory is made up of flip – flops, and it sores the bit as a voltage.

Each memory cell requires six transistors.

The memory chip has low density, but high speed.

More expensive, and consumes more power

Also known as cache memory

12.What are the advantages of DRAM?

The advantages of DRAM are

This memory is made up of MOS transistor gates and it stores the bit as a charge.

It has high density

Low power consumption

Cheaper than static memory

Economic to use when the system memory size is at least 8K for small systems

13.What are the disadvantages of DRAM?

The disadvantages of DRAM are,

The charge (bit information) leaks

Stored information needs to be read and written again every few milliseconds this is called refreshing the memory

Requires extra circuitry, adding to the cost of the system

14.What is meant by flash memory?

The flash memory must be erased either in its entirely or at the sector level. The memory chips can be erased and programmed at least a million times. The power supply requirement for programming these chips 2 was around 12V, but now chips are available that can be programmed using a power supply as low as 1.8 V. Hence, this memory is ideally suited for low – power systems.

15.What are the instructions of an 8085 instruction set for data transfer from memory to the microprocessor?

The 8085 instruction set includes three memory transfer instructions
They are,
MOV R,M : Move from Memory to Register
LDAX B/D : Load Accumulator Indirect
LDA 16 – bit : Load Accumulator Direct

16.What are the instructions of an 8085 instruction set for data transfer from microprocessor to the memory?

The 8085 instruction set includes three memory transfer instruction
They are,
MOV. R,M : Move from Memory to Register
STAX B / D : Store Accumulator Indirect
STA 16 – bit : Store Accumulator Direct
MVI M, 8 – bit: Load 8 – bit data in memory

17.What are the opcodes related to rotating the accumulator bits?

The opcodes related to rotating the accumulator bits are,
RLC – Rotate Accumulator Left through Carry
RAL – Rotate Accumulator Left
RRC – Rotate Accumulator Right through Carry
RAR – Rotate Accumulator Right

18. Define - RAM & ROM

RAM – Random Access Memory. Data is stored in a read / write memory.

ROM – Read only Memory. A memory that stores binary information permanently. The information can be read from this memory but cannot be altered

19.**What are the advantages of the microprocessor controlled system?**

The microprocessor controlled system can cope easily with giving precision and programmed control. The system is much

more flexible. This improvement in flexibility is a common characteristic of mechatronics systems when compared with traditional systems.

20.What is meant by ALU? State its function.

The ALU is responsible for data manipulation and performs arithmetic and logical operations such as addition and subtraction. In addition, the ALU contains a number of control inputs, which specify the data manipulation function to be performed. ALU is combinational logic circuit, whose output is an instantaneous function of its data and control inputs.

PART B

1. Explain with a neat block diagram the architecture of 8085 Microprocessor.

2. Explain the addressing modes of 8085 Microprocessor with suitable instructions.

3. Explain the pin diagram of 8085 Microprocessor.

4. Explain about instruction format of Intel 8085.

5. Explain about 8051 architecture with neat diagram.

6. Mention the difference between the Microprocessor and Microcontrollers.

UNIT-3 PROGRAMMABLE PERIPHERAL INTERFACE

PART-A

1. What are the interfacing devices?

The bus drivers increase the current driving capacity of the buses, the decoder decodes the address to identify the output port, and the latch holds data output for display. These devices are called interfacing devices. The interfacing devices are semiconductor chips that are needed to connect peripherals to the bus system.

2.How will you interface the I/O devices?

I/O devices can be interfaced using two techniques. They are,
Peripheral – mapped I/O
Memory – mapped I/O

3. What is meant by peripheral mapped I/O?

In peripheral – mapped I/O, a device is identified with an 8 – bit address and enabled by I/O related control signals

4.What is meant by memory – mapped I/O?

In memory mapped I/O, a device is identified with a 16-bit address and enabled by memory – related control signals.

5.What is meant by A/D and D/A converter?

The electronic signal that translates the analog signal into digital signal is called analog to digital (A/D) converter. The electronic signal that translates the digital signal into analog signal is called digital to analog (D/A) converter.

6.What are the types of D/A converters?

Digital to analog converters can be broadly classified in three categories. They are, Current output, Voltage output, Multiplying type

7.**What are the three types of D/A converters?**

- Current output – It provides current as the output signal.
- Voltage output – Internally converts the current signal into the voltage signal. It is slower than the current output DAC because the delays in converting the current signal in to the voltage signal.

Multiplying type – Its output represents the product of the input signal and the reference source and the product is linear over a broad range.

8. **What are the elements required for D/A converter?**

- A D/A converter circuit require three elements. They are, Resistor network with appropriate weighting
- Switches
- Reference source
-

9.What are the two techniques involved in A/D conversion?

The techniques involved in A/D conversion are, comparing a given analog signal with the internally generated equivalent signal. This group includes successive approximation, counter, and flash – type converters. Changing an analog signal into time or frequency and comparing these new parameters to known values. This group includes integrator converters and voltage to frequency converters

10.What are the applications of A/D converters?

The A/D converters are used in applications such as data loggers and instrumentation, where conversion speed is important. The integrating type converters are used in applications such as digital meters, panel meters and monitoring systems, where the conversion accuracy is critical.

11. **What are the functions of a microprocessor to be interfaced with an A/D converter?**

To interface an A/D converter with the microprocessor, the microprocessor should, Send a pulse to the 'START' pin. This can be derived from a control signal such as write (WR)

- Wait until the end of the conversion. This period can be verified either by status checking (polling) or by using the interrupt.
- Read the digital signal at an input port.

12. What is meant by break point?

In a single – board computer, the break point facility is a software routine that allows executing a program in sections. The break point can be set in a program by using RST instructions. When the execute key is pushed, the program will be executed until the breakpoint, where the monitor takes over again. If the segment of the program is found satisfactory, a second breakpoint can be set at a subsequent memory address to debug the next segment of the program

13. What are the advantages of the break point?

- Isolate the segment of the program with errors.
- Isolated segment can be debugged with the single – step facility.
- Check out the timing loop.

- Check the I/O section
- Check the interrupts.

14. What is meant by key debouncing?

When a key press is found, the microprocessor waits for at least 10 ms before it accepts the key as input. It is called key debouncing

15. Define – PPI

8255 is a widely used, programmable, parallel I/O device. It can be programmed to transfer data under various conditions from simple I/O to interrupt I/O.

16.Distinguish between parallel data transfer and serial data transfer.

S.No	Parallel data transfer	Serial data transfer
1	Data is transferred as byte	Data is transferred as bit
2	More number of channels arerequired for data transfer	Only one channel is enough
3	No need of parallel to serial dataconversion for transmission andreception	Needs parallel to serial data conversion for transmission and reception

17. What are the methods used for communication in 8085.

- Serial communication
- Simplex, half duplex and full duplex communication
- Synchronous and asynchronous communication
    - Parallel communication

18.What are the applications of D/A converter interfacing with 8255?

Temperature control
Air conditioning control
Washing machine control
Traffic light control

19.What is the bit set reset mode of 8255 PPI?

The individual bits of port C can be set or reset by sending out a single OUT instruction to the control register. When port C is used for control/ status operation, this feature can be used to set or reset individual bits.

20.What are the interface methods available in stepper motor?

- Universal
- Unipolar
- Bipolar

PART B

1. Explain the operating modes of 8255 PPI.

2. Explain the interface 8085 microprocessor with A/D and D/A converters.

3. Explain the Mode 1 input mode operation of 8255 in detail.

4. Explain the seven segment LED interface with microprocessor.

5. Describe with a neat diagram the stepper motor control using Microprocessor 8085.

6. Describe with a neat diagram the traffic light control using Microprocessor 8085.

7. Describe with a neat diagram the temperature control using Microprocessor

UNIT 4 PROGRAMMABLE LOGIC CONTROLLERS

PART-A

1.What is meant by PLC?

A programmable logic controller is a microprocessor based controller that uses a programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic in order to control machines and process

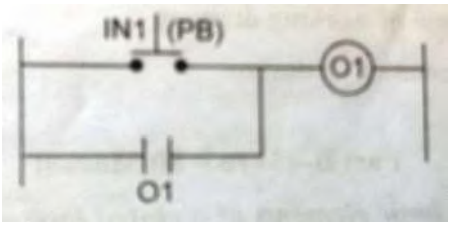
2.What is an internal relay in a PLC?

Most PLCs have an area of memory allocated for internal storage that are used to hold data which behave like relays. It is able to switch ON and OFF. But this is only for internal purpose. This will not exist in the real world

3. What is shift register? What is the data required for a shift register?

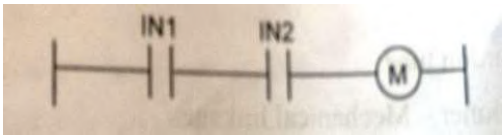
Shift registers can be used where sequence of operations is required for movement or track the flow of parts and information The data required for the shift register are address of the bit array, address of the control structure, address of the source bit, number of bits in bit array

4. Draw the general ladder rungs to represent a latch circuit.



O1 – Output IN1 – Push button

5. Draw the ladder logic diagram to represent two switches that are normally open and both have to be closed for a motor to operate.



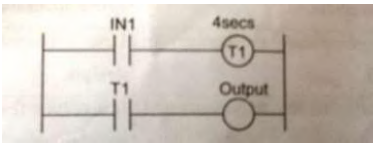
M – Motor

IN1 and IN2 – Input switches

6. Draw the ladder diagram of ON delay and OFF delay timer

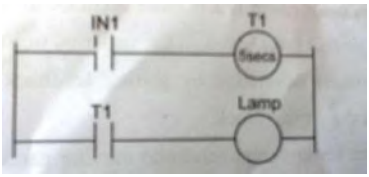
ON delay timer:

The timer is energized when the input IN1 becomes energized. The timer starts running after some present time

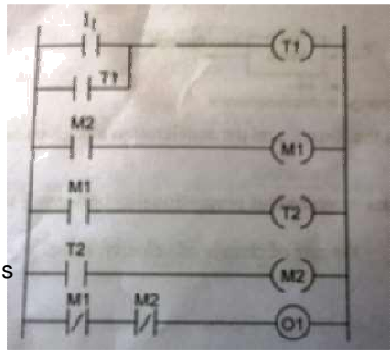


OFF delay timer:

When the contact IN1 is closed, the contact will energize the timer T1 and holds the output lamp ON for specified set value of 10 seconds. The action of an OFF delay timer is to delay setting the lamp OFF.



7.Draw a PLC timing circuit that will switch an output on for 10 seconds and then switch it off.



I1 – Input
T1 – Timer 1 for 1 second
T2 – Timer 2 for 10 seconds
M1, M2 – Memory coil
O1 – Output (light)

8.How does PLC differ from relay logic?

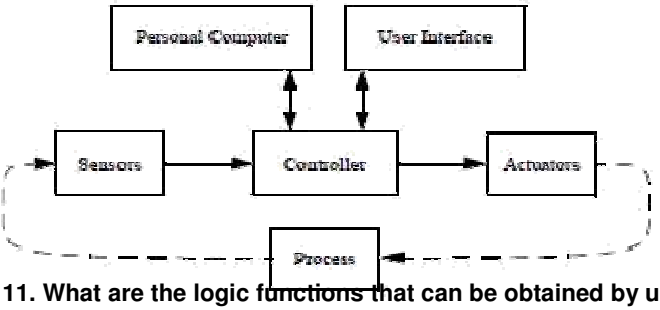
- Rewiring should be easily done in PLC.

No vertical connections are allowed. In PLC, there must always be one output on each line

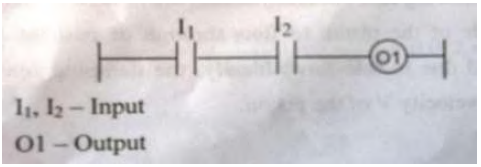
9.What is the use of JUMP control in PLC

The JUMP instruction is an output instruction, enabling part of a ladder diagram to be jumped over. With JUMP instruction the processor scan time can be reduced by jumping over instruction not patinent to the machine operation there by missing intermediate program and can skip instructions when a production fault occurs.

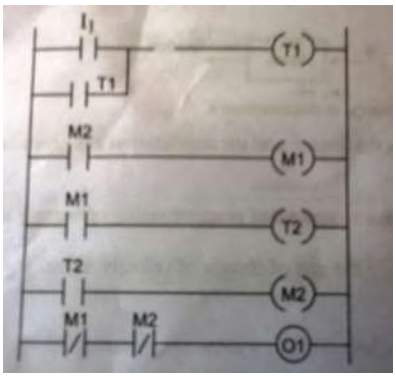
10.Draw the block diagram of PLC.



11. What are the logic functions that can be obtained by using switches in series?

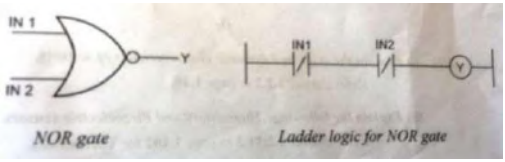


12. Draw a timing circuit that will switch an output for ON for 1 sec then OFF for 20 seconds, then ON for 1 second, then OFF for 20 seconds and so on



I1 – Input
T1 – Timer 1 for 1 second
T2 – Timer 2 for 20 seconds
M1, M2 – Memory coil
O1 – Output (light)

13. Draw NOR logic function using ladder diagram.



14.What is the main advantage of PLC?

PLC's have great advantage that it is possible to modify a control system without having to rewire the connections to the input and output devices

15.What are the features of PLC as a controller?

The features of PLC as a controller are,

- They are rugged and designed to withstand vibrations, temperature, humidity and noise
- The interfacing for inputs and outputs is inside the controller

They are easily programmed and have an easily understood programming language.

15. What is meant by ladder programming?

The ladder programming involves each program task being specified as though a rung of a ladder. Thus such a rung could specify that the state of switches A and B, the inputs, be examined and if A and B are both closed then a solenoid, the output is energized

16.What is meant by up counter?

An up counter would count up to the preset value. Events are added until the number reaches the set value. When the set value is reached the counters contact changes the state.

17. What is the criteria need for the selection of a PLC?

- Input / output capacity
- Types of inputs/outputs
- Size of memory
- Speed and power of the CPU
-

18.**What is meant by internal relay in PLC?**

Most PLCs have an area of memory allocated for internal storage that is used to hold the data, which behave like relays. It can able to switch ON and OFF. But this is for internal purpose. This will not exist in the real world.

19.What is meant by down counter?

Down counter counts down from the preset value to zero. Events are subtracted from the preset value. When zero is reached the counters contact changes state

PART B

1. Explain the architecture of a PLC. (NOV/ DEC 2007)

2. Explain the basics of ladder programming used in PLC. (APR/ MAY 2008)

3. Write a short notes on Jump control used in PLC using a ladder diagram. (NOV/ DEC 2009), (NOV/ DEC 2014)

4. Explain the factors to be considered while selecting a PLC. (NOV/ DEC 2007), (NOV/ DEC 2009), (NOV/ DEC 2014), (APR/ MAY 2014)

5. Explain the timers, counters, internal relays. (NOV/ DEC 2013), (APR/ MAY 2014)

6. Using simple programs, explain the data handling operation in a PLC. (NOV/ DEC 2012)

7. Explain how the shift register can be used to sequence the event with a neat diagram. (NOV/ DEC 2010)

8. Explain latching with ladder diagram. (NOV/ DEC 2014)

9. With a neat sketch, discuss about the internal structure of a PLC.

10. (NOV/ DEC 2015) . Discuss on selection of PLC.(NOV/ DEC 2015) (MAY/ JUNE 2016)

11. Discuss in detail about data handling. (NOV/ DEC 2015)

12. Explain about Mnemonics with examples. (NOV/ DEC 2015)

13. Explain the architecture of a PLC. (MAY/ JUNE 2016)

14. Discuss on input/output Processing. (MAY/ JUNE 2016)

15. Discuss in detail about cylinder sequencing with PLC and its programming. (MAY/ JUNE

UNIT-5 ACTUATORS AND MECHATRONIC SYSTEM DESIGN

PART-A

1. List out the drawbacks of traditional design approach

The drawbacks of traditional design approach are:

- Less flexible
- Less accurate
- More complicate mechanism in design
- It involves more components and moving parts

2. What is the role of an opto-isolator in robot control?

TRIAC opto-isolator consists of LED and TRIAC. If the input of the LED is 1, it glows and activates the TRIAC to conduct the current to the solenoid valve. Otherwise, TRIAC will not conduct the current to the solenoid.

3.**What are the sensors used in engine management system?**

- Airflow sensor
- Ford-type MAP sensors
- Hall effect and AC excited sensors

4. How is a traditional design of flow control in a large pipe improved by mechatronics design?

A traditional design of flow control system in large pipe line can be improved by using fluid flow sensors such as venture meter, turbine flow meter, etc., along with servo motor controlled valves.

5.Automatic camera is a mechatronics system – Justify

A typical mechatronics system should have some of the basic elements such as actuators, sensors, signal conditioning elements, digital logic systems, software, display devices, etc., As the automatic camera has all those elements, it is considered as mechatronics system

6.Compare traditional design with mechatronics design

S.No	Traditional design	Mechatronics design
1.	It is based on traditional systems such as hydraulic, mechanical and pneumatic systems	It is based on mechanical, electronics, computer technology and control engineering
2	Less flexible	More flexible
3	Less accurate	More accurate

4	More complicate mechanism in design	Less complicate mechanism in design
5.	It involves more components and moving parts	It involves fewer components and moving parts

7.What are the mechatronics elements used in an automatic camera?

The various mechatronics elements in an automatic camera are:

- Auto-focussing mechanism control
- Aperture drive
- Shutter drive
- Mirror drive
- Lens position encoder
- Lens drive
- Film advance mechanism control

8.What are the advantages of using a microprocessor in the place of a mechanical controller for a carburettor of an automobile?

The advantages of using a microprocessor in the place of a mechanical controller for a carburettor of an automobile are:

- Micro processor controller is more accurate in terms of supplying proper mixture air fuel ratio based on the variation of load.
- It also avoids detonation by getting feedback from the knock sensor placed in the engine block.

It involves fewer components and moving parts and hence less wear and long life.

9. Identify the sensor, signal conditioner and display elements in the Bourdon pressure gauge.

Sensor – Bourdon tube

Signal conditioner – Mechanical linkages

Display elements – Pointer and scale

10.**List out the seven modules of mechatronics design approach.**

- Need for design
- Analysis of problem
- Preparation of specification
- Generation of possible solution
- Selection of suitable solution or evaluation
- Production of detailed design
- Production of working drawing
- Implementation of design

11.What is meant by timed switch?

The device which is used to start the pulse applied, check the timer whether it is ON or OFF condition and timer should be in OFF condition before triggering is called timed switch.

12. How is a traditional design of temperature control of domestic central heating system improved by mechatronics design?

The traditional design of the temperature control for a central AC system involves a bimetallic thermostat in a closed loop control system. The basic principle behind this system is that the bending of the bimetallic strip changes as the temperature change and is used to operate an ON/OFF switch for the temperature control of the AC system. The same system is modified by mechatronics approach. This system uses a micro processor controlled thermocouple as the sensor. Such a system advantages over traditional system. The bimetallic thermostat is less sensitive compared to the thermodiode.

13. List out the advantages of mechatronics design over traditional design.

- The advantages of mechatronics design over traditional design are Mechatronics system serves the purpose effectively with high dimensional accuracy requirements
- It provides increased productivity in the industry
- It provides higher flexibility by pre-supplied programs which facilitate small volume production cycles

14.What are the factors to be considered while selecting a motor?

The factors to be considered while selecting a motor are Speed of a motor Starting torque and rotational torque of a motor Size and style of a motor.

15.What is meant by servomotor?

A servomotor is a rotary actuator that allows for precise control of angular position. It consists of a motor coupled to a sensor for position feedback, through a reduction gearbox.

16.What are the applications of a servomotor in mechatronics systems?

Servomotor are used in mechatronics systems for position control, velocity control and torque control in various applications such as CNC machine tools, robots etc.,

17.What are the applications of stepper motor in mechatronics system.

The applications of stepper motor in mechatronics system are

- High accuracy positioning applications in robotics

- Computer hard disc drives

18.What could be a suitable actuator for robot arm joint? Justify.

The actuator of a robot arm may be servomotor or pneumatic rotary actuator and hydraulic rotary actuator. The selection of actuator depends on the purpose of use of the robot. However, most of the robots uses servomotor as an actuator because of precise and easy control mechanism

19. What are the performance specifications of servo motor?

- Shaft speed
- Terminal voltage

Torque

20. What is meant by synthesis?

It is a process of taking elements of the concept and arranging them in the proper order, sized and dimensioned in the proper way.

PART B

1. Explain construction and working principle of AC and DC motor. (NOV/ DEC 2012), (APR/ MAY 2010), (NOV/ DEC 2013), (APR/ MAY 2014)

2. Explain the working principle of stepper motor. (NOV/ DEC 2010), (APR/ MAY 2010)

3. What are the various stages in designing a mechatronics system? Explain. (NOV/DEC 2005), (NOV/ DEC 2010)

4. Briefly explain traditional and mechatronics designs. (NOV/ DEC 2010)

5. Design a pick and place robot using mechatronics elements and explain about the robot control. (NOV/ DEC 2005) (NOV/ DEC 2007) (NOV/ DEC2009) (APR/ MAY 2010) (NOV/ DEC 2011)(NOV/ DEC 2013)

6. With necessary diagrams, explain the automatic car park system. (APR/ MAY 2006)(APR/ MAY 2008)(APR/ MAY 2014)

7. Explain about the basis of mechatronics system design considering vehicle engine management system as example. (APR/ MAY 2006)(NOV/ DEC 2009)(NOV/ DEC 2014)(NOV/ DEC 2007)(NOV/ DEC 2013) (MAY/ JUNE 2016)

8. With neat sketches explain various types of Stepper motors with the control. (NOV/ DEC 2015)

9. Explain about construction and working principle of DC and AC motors. (MAY/ JUNE 2016)

ME6703

COMPUTER INTEGRATED MANUFACTURING SYSTEMS

SYLLABUS

UNIT I INTRODUCTION 10 Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING 10 Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III CELLULAR MANUFACTURING 9 Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED 73 GUIDED VEHICLE SYSTEM (AGVS) 8 Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V INDUSTRIAL ROBOTICS 8 Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

Text Book(s)

T1: Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.

T2: Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

Reference Book(s)

R 1: Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003

R 2: Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995

R 3: Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

Course Outcomes

CO No.	Description of the COs
CO 1	Apply the concept of manufacturing models and metrics to find the production performance and control
CO 2	Solve problems in various production planning components
CO 3	Identify the different part families using the concept of GT,PFA and ROC
CO 4	Apply quantitative analysis on Flexible manufacturing system
CO 5	Illustrate the vehicle guidance technology and its management

CO-PO Mapping

CO Nos.	Level of correlation* of the COs with the relevant POs/PSOs							
	PO1	PO2	PO3	PO4	PO9	PO10	PO11	PO12
CO 1	3	2	1	1	-	-	3	3
CO 2	3	2	1	1	3	3	3	3
CO 3	3	2	1	1	3	3	-	3
CO 4	3	2	1	1	3	-	-	3
CO 5	2	1	-	-	3	-	-	2
CO 6	3	2	1	1	3	-	-	3

Note(*): 1- Low level, 2- Medium level and 3- High level

UNIT I INTRODUCTION

Part-A

1. Define – CAD and CAM

- CAD may be defined as any design activity that involves the effective use if computer to create, modify or document engineering design.
- CAM may be defined as an effective use of computers and computer technology in the planning, management and control of the manufacturing function.

2. List out the fundamental reason for implementing a CAD system.

Reasons for implementing a CAD system are

- Identify productive activities.
- Develop an implementation plan.
- Establish good practices.
- Plan your system architecture.

3. Define – CIM

Computer Integrated Manufacturing (CIM) denotes the pervasive use of computer system to design the products, plan the production, control the operations, and perform the various information-processing functions needed in a manufacturing firm.

CIM = CAD + CAM + Business function

4. Write the types of production

a. continuous production

The process is carried out on a continuous stream of material, with no interruptions in the output flow.

b. batch production

batch production is discontinuous because there are interruptions in production between batches.

5. What is lean production?

Lean production means operating the factory with the minimum possible resources and yet maximizing the amount of work that is accomplished with these resources.

6. Define – Production Capacity

Production capacity is defined as the maximum rate of output that a production facility is able to produce under a given set of assumed operating conditions.

7. Define – Utilization and Availability

- Utilization refers to the amount of output of a production facility relative to its capacity.
- Availability is defined using two other reliability terms, mean time between failures (MTTF) and mean time to repair (MTTR).

8. Define – Manufacturing Lead Time

The total time required to process a given part of product through the plant, including any lost time due to delays; time spent in storage, reliability problems and so on.

9. Define – Direct Labor, Material and Overhead Cost

- Direct labor cost is the sum of wages and benefits paid to the workers who operate the production equipment and perform the processing and assembly tasks.
- Material cost is the cost of all raw materials used to make the product.
- Overhead costs are all of the other expenses associated with running the manufacturing firm.

10. Define – Fixed Cost and Variable Cost

A fixed cost is one that remains constant for any level of production output. (Example) the cost of the factory building and production equipment, insurance and property taxes.

A variable cost is one that varies in proportion to the level of production output. (Example) direct labor, raw materials and electric power to operate the production equipment.

11. Name five typical factory overhead expenses

1. Insurance
2. Factory and equipment depreciation
3. Applicable taxes
4. Power
5. Maintenance crew

12. Name five typical corporate overhead expenses

1. Corporate executives
2. Sales and marketing
3. Finance department
4. Security personnel
5. Research and development

13. Define – Automation

Automation can be defined as the technology by which a process or procedure is accomplished without human assistance. It is implemented using a program of instructions combined with a control system that executes the instructions.

14. Write the basic elements of an automated system.

An automated system consists of three basic elements:

1. Power
2. Program of instructions
3. Control system

15. Differentiate open loop and closed loop control system in an automation system.

An open loop control system operates without the feedback loop. In this case, the controls operate without measuring the output variable, so no comparison is made between the actual value of the output and the desired input parameter.

A closed loop control system is one in which the output variable is compared with an input parameter, and any difference between the two is used to drive the output into agreement with the input.

16. Identify the five levels of automation in a production plant.

1. Device level
2. Machine level
3. Cell or system level
4. Plant level
5. Enterprise level

17. What is the role of CIM in manufacturing?

CIM is most closely associated with functions in manufacturing engineering such a process planning and numerical control (NC) part programming.

18. What are important applications of CIM in manufacturing planning?

The applications of CIM can be divided into two broad categories.

a.Manufacturing planning b. Manufacturing control

PART-B

1. Describe the basic activities that must be carried out in a factory to convert raw material into finished product

2. (a) Examine what is meant by product data management? Explain why it is important in a. CAD/CAM integration.

b. Identify the main element of automated system.

c. Name various level of automation.

3. Define MUDA and KAIZEN with example.

4. When the conditions are to be fulfilled in order to implement JIT concept effectively

5. Describe the need for CIM and the issues addressed by CIM

6. Summarize are the various activities of a manufacturing plant which can be carried out through computer control?

7. Discuss the main elements of CIM systems.

8. Express how does IT facilitate concurrent engineering?

9. (a) Distinguish the different types of manufacturing.(b) Discuss an assessment of extent of computer control in specific cases of each types of manufacturing

10. (a) Demonstrate the significance of concurrent engineering approach in limiting design changes.

11. (b) Illustrate how CIM can act as an enabling technology for concurrent engineering

12. (a) Examine lean production and mass production

(b) Shown the characteristic of Just-In-Time

13. (a) Analyze various implementation issues on KANBANS and JIT systems. (b) Explain with various applications on flexible work force in JIT.

14. (a) Point out the effect on Pull systems with various examples. (b) Compare Lean and Agile manufacturing systems.

15. Analyze a case study on manufacturing in competitive environment

16. Assess the contemporary implementation automation of manufacturing process, Numerical control & adaptive control

17. Generalize the conditions that need to be fulfilled in order to implement JIT concept effectively.

UNIT II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING

Part-A

1. Define – Process Planning

Process planning involves determining the sequence of processing and assembly steps that must be accomplished to make the product.

2. Define – Route Sheet

The processing sequence is documented on a form called a route sheet or operation sheet.

3. Define – Concurrent Engineering

Concurrent Engineering is an approach used in product development in which the functions of design engineering, manufacturing engineering and other functions are integrated to reduce the elapsed time required to bring a new product to market.

4. Write the benefits of CAPP.

1. Process rationalization and standardization
2. Increased productivity of process planners
3. Reduced lead time for process planning
4. Improved legibility
5. Incorporation of other application programs

5. Write the types of process planning.

1. Manual process planning
2. Computer Aided Process Planning

(a) Retrieval CAPP systems

(b) Generative CAPP systems

6. What is meant by retrieval CAPP systems?

A retrieval CAPP system, also called a variant CAPP system, is based on the principles of GT and parts classification and coding. A standard process plan is stored in computer files for each part family. Developing the database of these process plan requires substantial effort.

7. What is meant by generative CAPP systems?

The process sequence is planned without human assistance and without a set of predefined standard plans.

8. Define – Production Planning and Control

PPC is concerned with the logistics problems that are encountered in manufacturing, that is, managing the details of what and how many products to produce and when, and obtaining the raw materials, parts and resources to produce those products.

9. What are the activities within the scope of production planning?

1. Aggregate production planning
2. Master Production Schedule (MPS)
3. Material Requirement Planning (MRP)
4. Capacity Planning (CP)

10. What is the difference between the aggregate production planning and master production schedule?

Aggregate production planning involves planning the production output levels for major product lines produced by the firm. Aggregate planning involves planning six months or more into the future.

MPS which is a specific plan of the quantities to be produced of individual models within each product line. MPS is concerned with shorter term.

11. What is meant by MRP?

MRP is a planning technique that converts the master schedule for end products into a detailed schedule for the raw materials and components used in the end products.

12. What are the main inputs to the MRP processor?

1. Master production schedule
2. Bill of materials
3. Inventory record file

13. What are the outputs to the MRP system?

1. Planned order release
2. Reports of planned order release in future periods
3. Rescheduling notices, indicating changes in due dates for open orders
4. Reports on inventory status
5. Exception reports
6. Performance reports

14. Write the benefits of MRP system.

1. reduction in inventory
2. quicker response to changes in demand
3. reduced setup and product changeover costs
4. better machine utilization
5. improved capacity to respond to changes in the master schedule

15. What is meant by capacity planning? And write the two stages of capacity planning.

Capacity planning consists of determining what labor and equipment resources are required to meet the current MPS as well as long-term future production needs of the firm.

Stages of Capacity planning:

(a) rough cut capacity planning (RCCP)

(b) Capacity requirements planning (CRP)

16. Define – Shop Floor Control

SFC is the set of activities in production control that is concerned with releasing production orders to the factory, monitoring and controlling the progress of the orders through the various work centers, and acquiring current information on the status of the orders.

17. Write the three phases of shop floor control.

1. Order release
2. Order scheduling
3. Order progress

18. Define – Shop Packet

The collection of documents through the factory called shop packet. It consists of

1. The route sheet
2. Material requisitions to draw the raw materials from inventory
3. Job cards means to report direct labor time devoted to the order
4. ove tickets to authorize the material handling personnel to transport parts between work centers
5. the part list

19. Define –Factory Data Collection System

The FDC system consists of the various paper documents, terminals and automated devices located throughout the plant for collecting data on shop floor operations

20. Define – MRP II

Management Resource Planning (MRP II) can be defined as a computer based system for planning, scheduling and controlling the materials, resources and supporting activities needed to meet the master production schedule.

21. Define – ERP

Enterprise Resource Planning (ERP) is a computer software system that organizes and integrates all of the data and business functions of an organization through a single, central data base.

PART-B

1. List the two approaches commonly used in CAPP systems bringing out their advantages and limitations.

2. (a) Define process planning? What are the activities associated with it?

3. Describe the information required for process planning. What are the factors that influence process planning?

4. (a) Examine details logical steps in computer aided process planning
(b) Identify the features of variant and generative CAPP systems.

5. (a) Name the criteria for selection of CAPP systems.
(b) Define what is meant by CAPP? List various advantages of CAPP systems.

6. (a) Summarize briefly on CMPP. In what ways, CMPP is considered vary significant.
(b) Describe the factors should be consider while selecting the best CAPP system.

7. Discuss in details in phase of shop floor control system.

8. Express about production planning process in discrete part manufacturing

9. Demonstrate production planning and control. Describe the various activities of PPC

10. Illustrate notes on the following.
    a. Aggregate production planning
    b. Master production planning
    c. Material requirements planning
    d. Capacity planning

11. Analyze shop floor control? What are the functions of SFC?

12. Explain the various priority sequencing rules used for job sequencing.

13. Point out what is computer process monitoring? Also explain the use of data acquisition systems, and multilevel scanning.

14. Explain the four classes of users and four steps of evolution in MRP.

15. Compare briefly cost planning and control and capacity planning and control

16. Assess an engineering brief about (i) MRP-II and (ii) ERP

17. Develop an engineering brief about the various types of automatic identification technologies.

UNIT-III CELLULAR MANUFACTURING

Part-A

1. Define – Group Technology

Group Technology [GT] is a manufacturing methodology in which identical or similar components grouped processed together during design, process planning and manufacturing so that a wide variety of components can be manufactured, at the least expense of time, inventory, man hours and material handling.

2. List out the stages in Group Technology.

The stages in Group Technology are

a] Production planners to setup the GT database.

b] Grouping the parts or components into part-families with some similar characteristics.

c] Re-design the shop-floor arrangement according to common shape, function or manufacturing process and tooling.

3. Define – Part Family

Part family is defined as collection of parts which are similar either in geometric shape and size or in the processing steps required in their manufacture.

4. What are the three methods for solving the problem of grouping parts into part families?

1. Visual inspection
2. Parts classification and coding system
3. Production flow analysis

5. What is the difference between a hierarchical structure and a chain type structure in a classification and coding scheme?

Hierarchical structure, also known as monocode, in which the interpretation of each successive symbol depends on the value of the preceding symbols.

Chain type structure, also known as polycode, in which the interpretation of each symbol in the sequence is always the same; it does not depend on the value of preceding symbols.

6. Write the benefits of GT.

1. GT promotes standardization of tooling, fixturing and setups
2. Material handling is reduced
3. Process planning and production scheduling are simplified
4. Setup times are reduced, resulting in lower manufacturing lead times

5. Work-in-progress is reduced

7. Define – Production Flow Analysis (PFA)

Production flow analysis is a technique for pre-planning the division of the whole factory into groups or departmental groups. When the knowledge of division is available, then it is possible to plan the layout.

8. What is the weakness of PFA?

The weakness of production flow analysis (PFA) are derived from existing production route-sheets. But the process-sequences have been prepared by different process planners and the difference is reflected on to these route-sheets.

10. Write the steps involved in production flow analysis.

1. Data collection
2. Sortation of process routings
3. PFA chart
4. Cluster analysis

11. Define Cellular manufacturing

Cellular manufacturing is an application of GT in which dissimilar machines or processes have been aggregated into cells, each of which is dedicated to the production of a part.

12. Explain the two categories of attributes of parts.

1. Design attributes, which are concerned with part characteristics such as geometry, size, length-to-diameter ratio, surface finish and tolerances.
2. Manufacturing attributes, which consider the sequence of processing steps required to make a part, machine tool, batch size, annual production and cutting tools.

13. Write the applications of GT.

1. Manufacturing applications

(a) Informed scheduling and routing of similar parts through selected machines

(b) Virtual machine cells

(c) Formal machine cells

2. Product design applications

14. What is meant by composite part concept?

The composite part concept takes this part family definition to its logical conclusion. The composite part for a given part family is a hypothetical part that includes all of the design and manufacturing attributes of the family.

15. Write the types of machine cells and layouts in GT.

1. Single machine cell
2. Group machine cell with manual handling
3. Group machine cell with semi-integrated handling
4. Flexible manufacturing cell

16. Write the various types of coding system.

1. OPITZ
2. MICLASS
3. DCLASS

PART-B

1. (a) List the various benefits of implementing a GT in a firm. Also bring out the advantages and limitation of using GT.
(b) Define the Production Flow Analysis in detail.

2. Describe what is Group Technology? Also explain why GT is important in achieving CAD and CAM integration.

3. (a) Identify what do you understand by cell design? What are the criteria used for cell design?
(b) Examine what is MICLASS system? Compare it with DCLASS system.

4. Name and briefly explain the various machine cells and layouts in used industries.

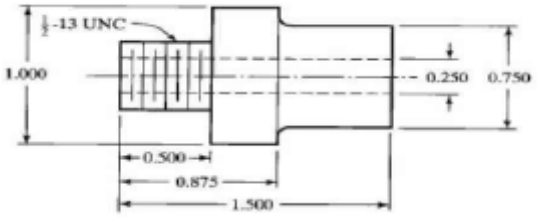
5. Summarize how group technology is used in designing manufacturing cells.

6. Describe an engineering brief about (i) DCLASS, and (ii) Opitz Classification system

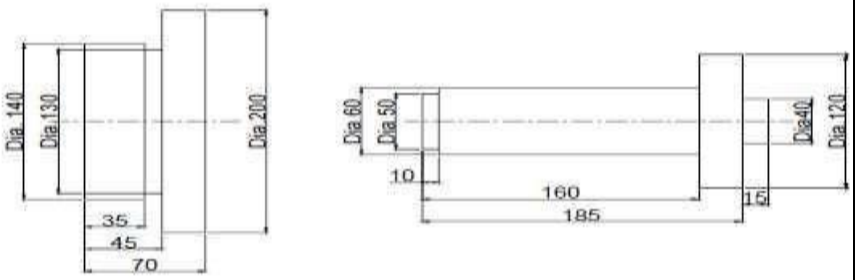
7. Discuss about (i) Composite part concept (ii) Key machine concept

8. Demonstrate in brief of following
    a. Opitz coding system
    b. MICLASS
    c. DCLASS
    d. PFA

9. Illustrate the form code (first five digits) in the Opitz system for a given part



10. Two components are shown in Fig. do they belong to the same part family? Compare.



Rotational Components

11. Analyze the rank order clustering technique to the part-machine incidence matrix in the following table to identify logical part families and machine groups. Parts are identified by letters, and machines are identified numerically.

	Parts				
Machine	A	B	C	D	E
1	1				
2		1			1
3	1			1	
4		1	1		
5				1	

12. Explain that four machines 1, 2, 3, and 4 have been identified as belonging in a GT machine cell. An analysis of 50 parts processed on these machine has been summarized in the From-To chart of table below. Additional information is that 50 parts enter the machine grouping at machine 3, 20 parts leaved after processing at machine1, and 30 parts leave

after machine 4. Determine the a logical machine arrangement using Hollier method-1

	To	1	2	3	4
From:	1	0	5	0	25
	2	30	0	0	15
	3	10	40	0	0
	4	10	0	0	0

UNIT-IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)

Part-A

1. Define – FMS

A Flexible Manufacturing System [FMS] is a highly automated GT machine cell, consisting of a group of processing workstations, interconnected by an automated material handling and storage system, and controlled by a distributed computer system

2. What are the components of FMS?

Flexible Manufacturing Systems [FMS] consists of the following four components.

1. Processing stations or workstations
2. Material handling and storage
3. Computer control system
4. Human labor

3. What are the objectives of FMS?

The Objectives of FMS are

1. To provide flexible manufacturing facility for pan family components.
2. To provide the benefits of grouping the operation in single location.
3. To provide the flexibility in producing small and medium parts.
4. To maximize the utilization of facilities.
5. To have a good management control.

4. What are the types of layout configuration in FMS?

FMS can be divided into five categories

1. In-line layout
2. Loop layout
3. Ladder layout
4. Open field layout
5. Robot-centered cell.

5. What is the difference between a dedicated FMS and a random-order FMS?

A dedicated FMS is designed to produce a limited variety of part styles, and the complete universe of parts to be made on the system is known in advance.

A random-order FMS is more appropriate when the part family is large, there are substantial variations in part configurations, new part designs will be

introduced into the system and engineering changes will occur in parts currently produced, and the production schedule is subject to change from day to day.

6. List out any two advantages and disadvantages of FMS implementation.

Advantages of FMS implementation.

1. Faster
2. Lower-cost changes from one part to another which will improve capital utilization

Disadvantages of FMS implementation.

1. 1ower direct labor cost
2. Due to the reduction in number of workers

7. How the FMS is classified based on level of flexibility?

FMS classified based on level of flexibility are

1. Production flexibility
2. Machine flexibility
3. Mix flexibility
4. Product flexibility

8. How the FMS is classified based on number of machines?

The FMS is classified based on number of machines are

1. Single Machine Cell (SMC)
2. Flexible Manufacturing Cell (FMC)
3. Flexible Manufacturing System (FMS)

9. What are the types of FMS?

The types of FMS are

1. Dedicated FMS
2. Engineered FMS
3. Random order FMS

10. What is FMS?

FMS is a manufacturing system based on multi-operation machine tools, incorporating (automatic part handling and storage).

11. Write the FMS benefits.

1. Increased machine utilization
2. Fewer machines required
3. Reduction in the amount of factory floor space required
4. Reduced inventory requirements
5. Lower manufacturing lead times

6. Greater responsiveness to change

12. Define – AGVS

An Automated Guided Vehicle system is a material handling system that uses independently operated, self-propelled vehicles guided along defined pathways.

13. What are the components of AGVS?

1. The vehicle
2. Guide path
3. Control unit
4. Computer interface

14. Write the types of AGVS.

1. Driverless trains

A driveless train consists of a towing vehicle pulling one or more trailers to forma train. A common application is moving heavy payloads over long distances in warehouses or factories with or without intermediate pickup and drop-off points along the route.

2. Unit load carriers

AGV unit load carriers are used to move unit loads from one station to another. They are often equipped for automatic loading and unloading of pallets by means of powered rollers, moving belt, mechanized lift platforms built into the vehicle deck.

3. Pallet trucks

AG pallet trucks, are used to move palletized loads along predetermined routes.

15. Write the AGVS applications.

1. driveless train operations
2. storage and distribution
3. assembly line applications
4. flexible manufacturing systems

16. What is meant by vehicle guidance technology?

The guidance system is the method by which AGVS pathways are defined and vehicles are controlled to follow the pathways.

17. Name the different AGVS guidance system.

1. imbedded guide wires

a. frequency select method

b. path switch select method

2. paint strips

3. Self-guided vehicles

18. What is the purpose of traffic control in AGV system?

The purpose of traffic control in an automated guided vehicle system is to minimize interference between vehicles and to prevent collisions.

19. Write the types of methods of traffic control in AGV system.

1. On-board vehicle sensing

On-board vehicle sensing, also called *forward sensing*, uses one or more sensors on each vehicle to detect the presence of other vehicles and obstacles ahead on the guide path. When the on-board sensor detects an obstacle in front of it, the vehicle stops.

2. Zone control

In zone control, the AGVS layout is divided into separate zones, and the operating rule is that no vehicle is permitted to enter a zone that is already occupied by another vehicle.

PART-B

1. (a) List what are the major components of an FMS? Explain them in brief.
(b) Describe the various workstations of FMS.

2. (a) Define the various aspects of FMS layout configurations
(b) Identify the various functions that are performed by the FMS computer control system.

3. Examine what is flexible manufacturing system? In what ways, FMS differs from other manufacturing systems.

4. (a) List and explain the functions of the material handling system in a FMS
(b) Name the applications, advantages and disadvantages of a FMS.

5. Summarize with suitable sketches, explain the various FMS layout configurations prevalent today.

6. (a) Discuss the important of In-process monitoring of workpiece quality in FMS. (b) Express how is tool life monitored in FMS

7. (a) Give principle of an automated storage and retrieval system.
(b) Discuss how is an FMS optimized?

8. (a) Show distinguishing facts between FMS and FM
(b) Distinguishing facts between Dedicated FMS and Random-order FMS

9. Illustrate short notes various material handling equipment that are commonly found in a FMS.

10. (a) Analyze a case study of an AGVS (b) Explain what is AGV? How do they operate?

11. (a) Explain various types of software in FMS (b) Point out various systems issues in FMS

12. Contras extrinsic and intrinsic functions. What are factor should be consider implement in FMS?

13. Assess following types of AGVs along with their application a. AGVs towing vehicles (4)
AGVs pallet trucks (4)
AGVs fork lift trucks (4)
AGVs unit load transporters (4)

14. (a) Develop the two main types of AGVs steering control
(b) Prepare what are the advantages of AGVs over other material handling systems

UNIT-V INDUSTRIAL ROBOTICS

Part-A

1. Define – Robot

Robot is a programmable, multifunction manipulator designed to move materials, parts, tools or special devices through variable programmed motions for the performance of the variety of tasks.

2. Write the types of joint notations.

1. Linear joint (type L joint), the relative movement between the input link and the output link is a translational sliding motion, with the axes of the two links parallel.
2. Orthogonal joint (type O joint), this is also a translational sliding motion, but the input and output links are perpendicular to each other during the move.
3. Rotational joint (type R joint), it provides rotational relative motion, with the axis of rotation perpendicular to the axes of the input and output links.
4. Twisting joint (type T joint), involves rotary motion, but the axis of rotation is parallel to the axes of the two links.
5. Revolving joint (type R joint) the axis of the input link is parallel to the axis of rotation of the joint, and the axis of the output link is perpendicular to the axis of rotation.

3. What are the four basic robot configurations available commercially?

1. Cartesian coordinate robot
2. Cylindrical configuration
3. Polar configuration
4. Jointed arm robot
5. SCARA

4. What is meant by Work space?

The space in which the end point of the robot arm is capable of operating is called as workspace in other words reach ability of robot arm is known as workspace.

5. Define – Work Volume

The work volume of the manipulator is defined as the envelope or 3D space within which the robot can manipulate the end of its wrist.

6. What is an end effector?

The end effector enables the robot to accomplish a specific task. The two categories of end effectors are (a) grippers and (b) tools

7. Define – Grippers

Grippers are end effectors used to grasp and manipulate objects during the work cycle. Types of grippers:

1. Mechanical grippers
2. Vacuum grippers
3. Magnetic devices
4. Adhesive devices

8. Classify the sensors in robotics

Sensors used in industrial robotics can be classified into two categories:

1. *Internal sensors* are components of the robot and are used to control the position and velocities of the various joints of the robot. These sensors form a feedback control loop with the robot controller.
2. *External sensors* are used to coordinate the operation of the robot with the other equipment in the cell.

9. Name the various sensors used in industrial robotics

1. Tactile sensors
2. Proximity sensors
3. Optical sensors
4. Machine vision

10. Define – Control Resolution, Accuracy and Repeatability of Robot

Control resolution refers to the capability of the robot's positioning system to divide the range
of the joint into closely spaced points, called addressable points, to which the joint can be moved by the controller.

Accuracy is the robot's ability to position the end of its wrist at a desired location in the work volume.

Repeatability is a measure of the robot's ability to position its end-of-wrist at a previously taught point in the work volume.

11. What is meant by pitch, yaw and roll?

Pitch is rotation around the X-axis, Yaw is around the Y-axis, and roll is around the Z-axis.

12. Write the applications of an industrial robot.

1. Repetitive work cycle
2. Material handling

a. Material transfer
b. Machine loading and unloading

3. Processing operations

a. Spot welding b. Arc welding

c. Spray coating
4. Assembly and inspection

13. Define – Robot Programming

A robot programming can be defined as a path in space to be followed by the manipulator, combined with peripheral actions that support the work cycle.

14. Write the types of robot programming methods.

1. Leadthrough programming
2. Computer-like robot programming languages
3. Off-line programming

PART-B

1. (a) List the different types of robotic movements.
(b) Define the types of joints used in robots and explain its application

2. (a) List our four common robot configuration and explain its applications
(b) Name the relative merits and demerits of different types of robot configuration

3. (a) Describe the various types of industrial robot.
(b) Describe the basic structure of a robotic system with neat sketch.

4. Identify and Draw the neat sketch of components of teach pendant and explain briefly

5. (a) Describe the various types of robot control.
(b) Discuss briefly explain the need for robots in industries.

6. (a) Express briefly explain selection of robots.
(b) Differentiate the advantages, disadvantages and applications of robots

7. (a) Summarize what are robot end effectors? How do you classify them
(b) Discuss various drive system used for robot gripper.

8. Demonstrate short notes on robot part programming

9. Classify the various types of gripper mechanism with neat sketch.

10. (a) Explain briefly the lead through programming method in detail

(b) Point out the capabilities and limitations of lead-through programming methods

11. Explain in detail robot language structure and motion commands used.

12. Analyze a Program for pick and place robot.

13. Explain at least four languages meant for robot programming and briefly discuss the features of any two of them.

14. (a) Formulate principle of operation of teach pendent.
(b) Prepare What are the limitations of teach pendent control?

GE6757
TOTAL QUALITY MANAGEMENT

SYLLABUS

OBJECTIVES:

To facilitate the understanding of Quality Management principles and process

UNIT I INTRODUCTION

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors..

Text Book

Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2006.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.

2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006. 3. Janakiraman. B and Go

Outcomes:

CO No.	Description of the Cos
CO 1	Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.
CO 2	Identify the key aspects of the quality improvement cycle and to select and use appropriate tools and techniques for controlling, improving and measuring quality.
CO 3	Critically appraise the organisational, communication and teamwork requirements for effective quality management
CO 4	Critically analyse the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans
CO 5	to apply the tools and techniques of quality management to manufacturing and services processes

CO-PO Mapping

CO Nos.	Level of correlation* of the COs with the relevant POs/PSOs									
	PO1	PO3	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	1	3	3	3	3	3	3	3
CO 2	3	2	1	3	3	3	3	3	3	3
CO 3	3	2	1	3	3	3	3	3	3	3
CO 4	3	2	1	3	3	3	3	3	3	3
CO 5	3	2	1	3	3	3	3	3	3	3

Note(*): 1- Low level, 2- Medium level and 3- High level

UNIT I INTRODUCTION

Part A

1. Define TQM.

Total Quality Management is a technique to guarantee survival in a world class competition,TQM is the art of managing the whole to achieve excellence.It is the application of quantitative methods and human resources to improve all the processes within an organization and exceed customer needs.

2. Define quality.

Quality = Performance x expectations.

Quality is the totality of features and characteristics of a product or service that bear on its availability to satisfy stated and implied needs of the customers.

3.What are thedimensions of quality?

Performance, features, conformance,reliability, durability, service ,response, aesthetics, reputation.

4.What is leadership?

Leadership is the process of influencing the activities of an individual or a group towards the achievement of a goal in a given situation.

5. Define quality council.

A quality council is a team to provide overall direction for achieving the total quality culture.

6.What are quality statements?

Quality statements include the vision statement, mission statement and quality policy statement.

7. Define vision statement

Vision statement is a declaration of what an organization aspires to be tomorrow.

8. Define mission statement.

The mission statement answers the following questions: who we are , who are the customers , what we do , and how we do it.

9. What is a quality policy statement?

Quality policy statement is a guide for everyone in the organization as to how they should provide products and services to the customers.

10. What are the steps in strategic planning?

Seven steps to strategic planning:

1. Customer needs
2. Customer positioning.
3. Predict the future
4. Gap analysis
5. Closing the gap.
6. Alignment and
7. Implementation.

11. What do you mean by performance measures?

Performance measures indicates the measurement of success in an organization.

12. What are quality costs?

Quality costsalso known as costs of quality or poor quality costs, are those costs associated with the non-achievement of product/service quality as defined by the customer's requirements.

13. What are the types of quality costs?

Prevention costs, appraisal costs, internal failure costs and external failure costs.

14.What are prevention costs?

Costs that occur when a company is performing activities designed to prevent quality problems from arising in products For ex: Training , planning, fixtures.

15. What are appraisal costs?

Appraisal costs are associated with measuring, evaluating or auditing products to ensure that they conform to specifications. For ex: Inspection.

16 What are internal failure costs?

Costs arise due to internal failures and are linked to correcting mistakes before delivery of the product. For example: re-work, wrong purchase order and correction inside.

17. What are the techniques for analyzing the quality costs?

The techniques are:

i)Trend analysis

ii) Pareto analysis

18. What are external failure costs?

Costs that occur when a non-conforming product/service reaches the customer(ie after delivery). For ex: wrong purchase order going to customer and wrong product going to customer.

19.Define customer retention.

Customer retention is more powerful and effective than customer satisfaction. Customer retention produces customer satisfaction that creates customer loyalty, which improves the bottom line. Market share is the level of customer retention.

20. Name two major quality awards?

i) The Deming Prize

ii) The Rajiv Gandhi National Quality Award.

21.What is the important role of Senior Management?

i) Listening to internal and external customers and suppliers through visits, focus groups and surveys.

ii) Communication.

Iii) To dive out fear out of the organization, break down barriers, remove system road blocks and minimize resistance to change and change the culture.

Part B

1. Describe Deming's fourteen points for the improvement of quality management. (Nov/Dec'14)(16)

2. List out and explain the various stumbling blocks while implementing TQM Programme, Nov/Dec '10.(16)

3. I)Select a product or service and describe how the dimensions of quality influence its acceptance. Nov/Dec'10

ii) Write down the seven step procedure of strategic planning cycle. Nov/Dec'10 (8)

4. I) Describe he six basic concepts of TQM. Nov/Dec'11 (8)

ii) Explain the various dimensions of Quality. Nov/Dec'11 (8)

5. State and explain the principles of TQM. Nov/Dec'11 (16)

6. Briefly explain the history of evolution of TQM. Nov/Dec2008

7. a) Briefly discuss the elements of TQM
b) Explain the pillars of TQM

8. What should a leader know and understand to be effective?Nov/Dec2006

9. What are the duties of quality council? Explain in detail Nov/Dec2007

10 Describe the various quality statements. Give examples. May/June2009

11. Write briefly about the following; May/June2009
a) Quality statements b) Vision statement c) Mission statement
d) Quality policy statement

12. Write down the seven step procedure of strategic planning cycle. Nov/Dec'10

13, Explain the basic techniques used for measuring performance May/June2006

14 Explain Quality Costs. Nov/Dec2006

15. How are quality costs categorized? Explain in detail. Nov/Dec 2006

II – TQM PRINCIPLES

Part A

1. What is customer perception of quality?

Customer perceptions of quality are : 1.Performance, 2. Features, 3. Service, 4. Warranty, 5. Price and 6. Reputation.

2. What is a customer complaint?

A Customer complaint may be defined as an expression of dissatisfaction with a product /service , either orally or in writing , from an internal or external customer.

3. What are the tools used for customer complaints?

1. Comment cards, 2. Customer questionare (surveys), 3. Report (or feedback) cards , 4. Employee feedback, 5. Customer visits.

4. What is customer service?

Customer service is the set of activities an organization uses to win and retain customers' satisfaction.

5. Define customer retention.

Customer retention is the process of retaining the existing customers.

6. Define motivation.

Motivation is the process of inducing people inner drives and action towards certain goals and committing his energies to achieve these goals.

7. What are Maslow's five basic needs?

Maslow's five basic needs are 1) Survival 2) Security 3) Social 4) Esteem and 5) Self-Actualization.

8. What is Empowerment?

Empowerment means to invest people with authority. Its purpose is to tap the enormous amount of potential contribution that lies within every worker.

9. What is a team?

A team can be defined as a group of people working together to achieve common objectives or goals.

10. What are the types of teams?

Types of teams are : 1) Process improvement team, 2) Cross – functional team, 3) Natural work team, 4) Self managed work team.

11. Define performance appraisal.

Performance appraisal isa systematic and objective assessment or evaluation of performance and contribution of an individual.

12. What are the different continuous process improvement approach?

1) Juran's trilogy
2) 2) PDCA Cycle
3) 3) 5S Concept
and 4) Kaizen

13. What is Juran's quality Trilogy?

1) Quality Planning 2) Quality Control and 3) Quality Improvement.

14. What do you mean by PDSA Cycle?

PDSA stands for Plan,Do , Study , and Act. PDSA Cycle also known as Deming Wheel is an effective continuous process improvement technique.

15. What is 5S ?

5S is a house-keeping technique used to establish and maintain a productive and quality environment in an organization. 5S stands for SEIRI, SEITON, SEISO, SEIKETSU, and SHITSUKE.

16.**What is Kaizen?**

Kaizen is the process of continuous improvements in small increments that make theprocess more efficient , effective, controllable and adequate.

17 **Define partnering.**

Partnering is a long term commitment between two or more organizations for the purpose of achieving specific business goals and objectives by maximizing the effectiveness of each partner's resources. The relationship is based on trust , dedication, to common goal and objectives.

18. **What are the important elements in partnering?**

1) Long term commitment , 2) Trust and 3) Shared vision.

19. **What are the types of supplier sourcing?**

1) Sole sourcing 2) Multiple sourcing and 3) Single sourcing.

20 .**What do you mean by Supplier Rating System?**

A supplier rating system also referred to as an ascore cardsystem, is used to obtain an overall rating of supplier performance. It is based on quality, delivery and service. Grades are provided for each supplier.

Part B

1. I)Write about the system of recognition and reward followed in an organization. Nov/Dec'11 (12)
   ii) What are the suggestions to improve the appraisal system? Nov/Dec'11 (4)

2. Explain the different approaches towards Continuous Process Improvement. Nov/Dec'11 (16)

3. What is 5S? Explain all the elements of 5S principle in detail.Nov/Dec'10 (16)

4. Briefly explain employee motivation and empowerment. Nov/Dec'09 (16)

5. Explain JuranTriology. Nov/Dec'09 (16)

6. What do you mean by customer satisfaction? Briefly discuss. May/June2009

7. What are customers perception on quality? Explain. May/June02006.

8. Explain the service quality with its characteristics and expectations. May/June2006.

9. Write a brief about customer retention.

10. What is motivation? Explain Maslow's hierarchy of needs .Nov/Dec2008.

11. Explain PDCA cycle with suitable illustrations. Nov/Dec2005.

12. What is Kaizen? Explain the various aspects of Kaizen. Nov/Dec2008.

13. What is supplier rating? Explain how will you select/rate a supplier.Nov/Dec2008.

14. What are the objectives in performance measures? And explain the various measures used in performance measurement.

15. Explain the basic techniques used for measuring performance.

UNIT-III TQM TOOLS & TECHNIQUES

PART A

1. DefineStatistics?

Statistics is defined as the science that deals with the collection, tabulation, analysis, interpretation, and presentation of quantitative data.

2. What is a measure of centraltendency?

A measure of central tendency of a distribution is a numerical value that describes the central position of the data or how the data tend to build up in the center. There are three measures in common in use in quality viz, the average, the median and the mode.

3. What is Measures ofdispersion?

Measures of dispersion describe how the data are spread out or scattered on each side of the central value. The measures of dispersion used are range and standard deviation.

4. Define Six Sigma Problem SolvingMethod?

Define - improvement opportunity with an emphasis on increasing customer satisfaction.

Measure - determine process capability (Cp/ Cpk) & dpmo (defects per million opportunities).

Analyze - identify the vital few process input variables that affect key product output variables ("Finding the knobs").

Improve - Make changes to process settings, redesign processes, etc. to reduce the number of defects of key output variables.

Control - Implement process control plans, install real-time process monitoring tools and standardize processes to maintain levels.

5. What are the new seven managementtools?

i. AffinityDiagram
ii. Interrelationship Digraph
iii. Tree Diagram
iv. MatrixDiagram
v. PrioritizationMatrices
vi. Process Decision Program Chart

vii. Activity Networkdiagram

6. Give the seven tools ofquality?

- ParetoDiagram
- Process FlowDiagram
- Cause-and-EffectDiagram
- CheckSheets
- Histogram
- ControlCharts
- ScatterDiagrams

7. Give the usage of C&Ediagrams?

- Analyze actual conditions for the purpose of product or service quality improvement, more efficient use of resources, and reduced costs.
- Eliminate conditions causing nonconformities and customercomplaints.
- Standardize existing and proposedoperations.
- Educate and train personnel in decision-making and corrective-actionactivities.

8. Define SixSigma?

Six-Sigma is a business process that allows organizations to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction. It is achieved through continuousprocess measurement, analysis & improvement.

9. Define Benchmarking?

Benchmarking is a systematic method by which organizations can measure themselves against the best industry practices. The essence of benchmarking is the process of borrowing ideas and adapting them to gain competitive advantage. It is a tool for continuous improvement.

10. Enumerate the steps to benchmark?

a) Decide what to benchmark

b) Understand current performance

c) Plan

d) Study others

e) Learn from the data

f) Use the findings

11. What are the types of benchmarking?

i. Internalii. Competitive iii. Process

12. What are the various histogramshapes?

Symmetrical Skewed right Skewed left Peaked

Flat Bimodal Plateau distribution Comb distribution

Double peaked distribution

13. Differentiate Population &Sample?

Population represents the mathematical world and Sample represents the real world. A population frequency distribution is represented by a smooth curve whereas a sample frequency distribution is represented by a histogram.Give the sources ofvariation?Equipment Material Environment Operator

14. What is FMEA?

Failure Mode Effect Analysis is an analytical technique that combines the technology and experience of people in identifying foreseeable failure modes of a product or process and planning for its elimination.

15. Define Six Sigma Problem Solving Method?

Define - improvement opportunity with an emphasis on increasing customer satisfaction.

Measure - determine process capability (Cp/ Cpk) &dpmo (defects per millionopportunities).

Analyze - identify the vital few process input variables that affect key product outputvariables (—Finding the knobsll).

Improve - Make changes to process settings, redesign processes, etc. to reduce thenumber of defects of key output variables.

Control - Implement process control plans, install real-time process monitoring tools,standardize processes to maintain levels.

16. Explain the stages ofFMEA?

Stages of FMEA

1. Specifying possibilities
2. Quantifyingrisk

3. Correcting high riskcauses
4. Revaluation ofrisk

18.**What are the several types of FMEA?**

Design FMEA
Process FMEA
Equipment FMEA
Maintenance FMEA
Concept FMEA
Service FMEA
System FMEA
Environment FMEA etc.

19. Give a hint about the implementation of Six Sigma in various sectors.

Six-Sigma is a business process that allows organizations to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction. It is achieved through continuous process measurement, analysis & improvement.

20. What are the four basic steps included in SPC?

The four basic steps included in SPC are
a. Measuring the process
b. Eliminating variances in the process to make it consistent.
c. Monitoring the process.
d. Improving the process to its best target value

Part B

1. Explain the seven tools of quality

2. How the Pareto analysis done? explain with example

3. How is cause and effect diagram constructed? Discuss in detail with a case study.

4. Discuss the properties of normal curve. And what are the measures of central Tendency and dispersion?

5. Describe the control charts for variable and attributes.

6. Describe the process capability analysis concept of six – sigma.

7. Explain the various methods of six sigma with example.

8. Draw the general structure of house of quality and indicate the constituents.

9. Explain Benchmarking with example.

10. Explain FMEA in detail with suitable example.

11. Discuss different scatter diagram patterns.

12. Describe the seven traditional tools of TQM.

13. Discuss the various types of diagrams that are used to improve the quality.

14. Explain how the management tools are used in manufacturing industry.

15. What is FMEA? What are the types and stages of FMEA?

UNIT-IV TQM TOOLS & TECHNIQUES II

PART A

1. What are the benefits of QFD?

i. Customer driven

ii. Reduces implementation time iii.

Promotes teamwork

iv. Provides documentation

2. What are the steps required to construct an affinity diagram?

i. Phrase the objective

ii. Record all responses iii.

Group the responses

iv. Organize groups in an affinity diagram

3. What are the parts of house of quality?

i. Customer requirements

ii. Prioritized customer requirements iii.

Technical descriptors

iv. Prioritized technical descriptors

v. Relationship between requirements and descriptors vi. Interrelationship between technical descriptors

4. How will you build a house of quality?

a) List customer requirements

b) List technical descriptors

c) Develop a relationship matrix between WHATs and HOWs\

d) Develop an interrelationship matrix between HOWs

e) Competitive assessments

f) Develop prioritized customer requirements

g) Develop prioritized technical descriptors

5. What are the goals of TPM?

The overall goals of Total Productive Maintenance, which is an extension of TQM are

i. Maintaining and improving equipment capacity

ii.Maintaining equipment for life

iii. Using support from all areas of the operation

iv. Encouraging input from all employees

v. Using teams for continuous improvement

6. Give the seven basic steps to get an organization started toward TPM?

a) Management learns the new philosophy

b) Management promotes the new philosophy

c) Training is funded and developed for everyone in the organization

d) Areas of needed improvement are identified

e) Performance goals are formulated

f) An implementation plan is developed

g) Autonomous work groups are established

7. What are the major loss areas?

i. Planned downtime

ii. Unplanned downtime

iii. Idling and minor stoppages

ivSlow-downs

v. Process nonconformities

vi. Scrap

8. What are the generic steps for the development and execution of action plans in benchmarking?

Specify tasks. Sequence tasks.

Determine resource needs. Establish task schedule.

Assign responsibility for each task. Describe expected results.

Specify methods for monitoring results.

9. What are the phases of QFD process?

i. Product planning

ii. Part development

iii. Process planning

iv. Production planning

10. Define TPM?

T : Total = All encompassing by maintenance and production individuals working together.

P : Productive = Production of goods and services that meet or exceed customer's expectations.

M : Maintenance = Keeping equipment and plant in as good as or better than te original condition at all times

11. What is a normalcurve?

The normal curve is a symmetrical, unimodal, bell-shaped distribution with the mean, median and mode having the same value.

12. What is the use of the controlchart?

The control chart is used to keep a continuing record of a particular quality characteristic. It is a picture of process overtime.

13. Give the objectives of the attributecharts?

- Determine the average qualitylevel.
- Bring to the attention of management any changes in theaverage.
- Improve the productquality.
- Evaluate the quality performance of operating and managementpersonnel.
- Determine acceptance criteria of a product before shipment to thecustomer.

14. Define Runchart?

A run chart is a very simple technique for analyzing the process in the development stage or, for that matter, when other charting techniques are not applicable.

15.W hat are the various patterns of scatterdiagrams?

Positive correlation Negative correlation No correlationNegative correlation may exist Correlation by stratificationCurvilinear relationship

15. What is the procedure for constructing the treediagram?

Choose an action –oriented objective statement from the interrelationship diagram, affinity diagram, brainstorming, team mission statement, and so forth.

Using brainstorming, choose the major headings. Generate the next level by analyzing the major headings.

Give atleast five standard formats of matrixdiagram?L-shaped

T-shaped Y-shaped C-shaped X-shaped

16. What are the benefits of an activity networkdiagram?

A realistic timetable determined by the users.

Team members understand the role in the overall plan. Bottlenecks can be discovered and corrective action taken. Members focus on the critical tasks.

17. List some applications of scatter diagram.

The applications of scatter diagram

a. Validating „hunches" about a cause-and-effect relationship between types of variables
b. Displaying the direction of the relationship (positive negative, etc).
c. defective parts produced? How strong is the relationship between typing faster and the
number of typing errors made.

18. What are the problems that can be interpreted by the histogram?

The problems that can be interpreted
by the histogram are,

a. Skew problems

b. Clustering problems.

Part B

1. Explain Quality Loss Function for Various Quality Characteristics with example.

2. Describe the concepts of QFD.

3. Explain the concepts of TPM.

4. How to measure the cost of quality? Explain with neat diagram.

5. Write short notes on a. traditional tools b. improvement needs

6. Explain the seven step plan to establish the TPM in an organization in detail

7. Explain the concept of Taguchi"s Quality loss function in detail. Give an example.

8. Explain the different types of cost contributing to the cost of quality.

9. Discuss in detail how the voice of customer is transformed into technical and functional requirements by QFD

10. How is house of quality constructed?

11. Write a note on performance measures of TQM.

12. What are the ways to improve the performance measures in any sector?

13. Define the QFD process with control chart and diagrams.

14. Differentiate scatter diagram and matrix diagram with suitable pictures.

15. Explain HOQ with suitable example.

UNIT-V QUALITY SYSTEMS

Part A

1. Give the ISO 9000 Series of Standards?

- ISO 9000, "Quality Management and Quality Assurance Standards Guidelines for Selection and Use".
- ISO 9001, "Quality Systems – Model for Quality Assurance in Design, Development, Production, Installation & Servicing".
- ISO 9002, "Quality Systems – "Model for Quality Assurance in Production, Installation & Servicing".
- ISO 9003, "Quality Systems – "Model for Quality Assurance in Final Inspection and Test".
- ISO 9004-1, "Quality Management and Quality System Elements – Guidelines".

2. What is the need for ISO 9000?

ISO 9000 is needed to unify the quality terms and definitions used by industrialized nations and use terms to demonstrate a supplier's capability of controlling its processes.

3. Give some other quality systems?

i. QS-9000
ii. TE-9000
iii. AS9000

4. Give the objectives of the internal audit?

a) Determine the actual performance conforms to the documented quality systems.
b) Initiate corrective action activities in response to deficiencies.
c) Follow up on noncompliance items of previous audits.
d) Provide continued improvement in the system through feedback to management.
e) Cause the auditee to think about the process, thereby creating possible improvements.

5. What are the requirements of ISO 14001?

i. General requirements
ii. Environmental policy
iii. Planning
iv. Implementation and operation
v. Checking and corrective action
vi. Management review

6. What are the benefits of ISO 14000?

i. Global Facilitate trade and remove trade barriers

ii. Improve environmental performance of planet earth

iii. Build consensus that there is a need for environment management and a common terminology for EMS.

iv. Organizational

- Assuring customers of a commitment to environmental management
- Meeting customer requirements
- Maintaining a good public / community relations image
- Satisfying investor criteria and improving access to capital
- Obtaining insurance at reasonable cost
- Increasing market share that results from a competitive advantage
- Reducing incidents that result in liability
- Improving defense posture in litigation
- Conserving input materials and energy
- Facilitating the attainment of permits and authorization
- Improving industry/government relations

7. What are the four elements for the checking & corrective action of ISO 14001?

a) Monitoring and measuring
b) Non-conformance and corrective and preventative action
c) Records
d) EMS audit

8. What are the seven elements for the implementation & operations of ISO 14001?

a) Structure and responsibility
b) Training, awareness and competency
c) Communication
d) EMS documentation
e) Documentation control
f) Operational control
g) Emergency preparedness and response

9. What are the four elements for the planning of ISO 14001?

a) Environmental aspects
b) Legal and other requirements
c) Objectives and targets
d) Environmental Management Programs

10. Give the types of Organizational Evaluation Standards?

- Environmental Management System
- Environmental Auditing
- Environmental Performance Evaluation

11. Give the types of Product Evaluation Standards?

- Environmental Aspects in Product Standards
- Environmental Labelling
- Life-Cycle Assessment

12. Define Quality Audits ?

Quality Audits examine the elements of a quality management system in order to evaluate how well these elements comply with quality system requirements.

13. Analyze TQM?

Total Made up of the whole.
Quality Degree of excellence a product or service provides.
Management Act, art or manner of handling, controlling, directing etc.

14. What are the benefits of ISO?

a) Fewer on-site audit by customers.
b) Increased market share.
c) Improved quality, both internally and externally.
d) Improve product and service quality levels from suppliers.
e) Greater awareness of quality by employees.
f) A documented formal systems.
g) Reduced operating costs.

15. Give the ISO 9001 requirements?

a) Scope
b) Normative Reference Terms and Definitions
c) Quality Management System Management Responsibility Resource Management Product Realization
d) Measurement, Analysis & Improvement

16. What are the methods of actual audit?

i. Examination of documents
ii. Observation of activities
iii. Interviews

17. What is the concept of environmental management system?

The overall aim of the Environmental Management systems is to provide protection to the environment and to prevent pollution

18. What are the types of audit based on area taken into account?

a) System audit
b) Process Audit
c) Product Audit
d) Adequacy Audit
e) Compliance Audit

19. What is the purpose of the audit?

The main purpose of the audit is to verify whether all the processes are going as per the QMS, if not how to make the processes work based on QMS.

20. What is the difference in ISO 9000 & ISO 14000?

Both the regulations of ISO are towards the QMS only. Yet ISO 9000 focuses the quality of the product or outcome in every step of the whole process where as ISO 14000 focuses mainly the environmental safety related to the process.

Part B

1. Discuss the requirements and benefits of ISO-14000

2. List the different types of quality audits available in practice and explain when each has to be carried out

3. (i) Discuss in detail the elements of ISO-9000. (ii) what are the objectives of ISO-9000

4. Explain the steps to be followed in implementing quality system ISO-9001:2000

5. Why is ISO 9000 important?

6. Discuss about ISO 9000:2000 QualitySystems.

7. Explain the implementation and documentation of Quality System? Implementation steps

8. Explain the elements of ISO 9000:2000

9. Explain the major clauses of QS9000 standard
10. Explain QMS auditing
11. Why auditing is required to improve the quality? Explain
12. Explain the concept of Malcome Bridge criteria.
13. Explain the industrial application of ISO 14000.
14. Explain the benefits of EMS. And discuss quality auditing in detail.
15. Discuss TQM implementation in manufacturing and service sectors including IT

ME6005
PROCESS PLANNING AND COST ESTIMATION

SYLLABUS

UNIT I INTRODUCTION TO PROCESS PLANNING

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION

Estimation of Machining Time - Importance of Machine Time Calculation-Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning - Machining Time Calculation for Grinding

OUTCOMES:

CO no.	Description of COs
CO 1	Apply the collaborative and social aspects of research and writing processes
CO2	Comprehend that research and writing is a series of tasks, including accessing, retrieving, evaluating, analyzing, and synthesizing appropriate data and information from sources that vary in content, format, structure, and scope
CO3	Use appropriate technologies to organize, present, and communicate information to address a range of audiences, purposes, and genres
CO4	Explain the relationships among language, knowledge, and power including social, cultural, historical, and economic issues related to information, writing, and technology.
CO5	Demonstrate the role of a variety of technologies/media in accessing, retrieving, managing, and communicating information.

UNIT I-INTRODUCTION TO PROCESS PLANNING

PART A

1.What is meant by Process Planning? (BT-II)

It is defined as an act of preparing a detailed processing documentation for the manufacture of a piece part or assembly.

2.Write the importance of process planning. (BT-I)

Process planning establishes the link between engineering design and shop floor manufacturing. Since process planning determines how a part/product will be manufactured, it becomes the important determinant of production costs and profitability.

3.List out the responsibilities of process planning Engineer. (BT-I) (May/June 2012)

- Interpreting part print analysis, and symbols
- Gathering the fundamental details of product design
- Setting the machining processSequencing the operations. etc.

4.What are all the factors affecting process planning? (BT-I) (May/June 2012)

a.Volume of production
b.The skill and expertise of manpower
c.Delivery dates for parts or products
d.Material specifications
e.Accuracy and process capability of machines
f.Accuracy requirements of parts or products

5.List out any two important specific activities involved in process planning.(BT-I)

1.Analyse finished part requirements
2.Determine operating sequence

6.What are all the primary parameters affecting the choice of a material selection(BT-I)

Function, Appearance, Service life, Reliability, Environment, Compatibility, Produce ability.

7.What is meant by out-planning? (BT-II)

The calculation of part processing time requires the determination of the sequence of processing steps on each machine. This activity is often called out-planning.

8.What is route sheet? (BT-I)

The resulting process plan is generally documented as a job routing or operation sheet. The operation sheet is also called “route sheet” , “instruction sheet” , “traveller” , or “planner”.

9.What are all the information’s available in the route sheet? (BT-I)

Part identification (numbers and names)
Description of the processing steps in each operation
Operation sequence and machines
Standard setup and cycle times
Tooling requirements for each operation.
Production control information showing the planning lead time at each operation.

10.Write the reasons for documenting the process details. (BT-I)

To have a record on how a part is processed in order to plan future parts with similar design requirements in a consistent manner
To provide a record for future job quoting, cost estimating, and standard costing systems.
To act as a vehicle for communication.

11.What are all the approaches to process planning? (BT-I) (May/June 2012, Nov/Dec 2013)

a.Manual process planning
b.Computer aided process planning (CAPP)
Retrieval CAPP system, Generative CAPP system

12.Wite the advantage of process planning(BT-I)

It is very much suitable for small scale companies with few process plans to generate.
This method is highly flexible
This requires low investment cost.

13.Write about the advantages of manual process planning. (BT-I)

It is very much suitable for small scale companies with few process plans to generate.
This method is highly flexible.
This requires low investment costs.

14.Write about the disadvantages of manual process planning(BT-I)

Manual process planning is a very complex and time consuming job requiring a large amount of data.
This method requires the skilled process planner.
More possibilities for human error because this method depends on the planner's skill, judgement and experience. It increases the paper work.

15.What is CAPP? (BT-I)
Computer aided process planning.With the use of computers in the process planning, one can reduce the routine clerical work of manufacturing engineers. Also it provides the opportunity to generate rational, consistent and optimal plans. In addition, CAPP provides the interface between CAD and CAM.

16.Write the benefits of CAPP? (BT-I)
Process rationalization and standardization
Productivity improvement
Product cost reduction
Elimination of human error
Reduction in time.

17.What is retrieval type CAPP system? (BT-I)
A retrieval CAPP system is based on the principles of group technology(GT) and parts classification and coding. In this system ,for each part family a standard process plan(i.e route sheet) is prepared and stored in computer files. Through classification and coding, a code number is generated .These codes are often used to identify the part family and the associated standard plan. The standard plan is retrieved and edited for the new part.

18.What is Generative CAPP system? (BT-I)
In this generative approach, the computer is used to synthesize or generate each individual process plan automatically and without reference to any prior plan.

19.What are all the components of a generative CAPP system? (BT-I)
A part description
A subsystem to define the machining parameters
A subsystem to select and sequence individual operations.

20.Write the advantage of generative CAPP(BT-I)
It can generate consistent process plan rapidly.
New components can be planned as easily as existing components.
It has potential for integrating with an automated manufacturing facility to providedetailed control information.

21.Mention the three commonly used tools for acquiring and documenting knowledge. (BT-I)

1.Flow chart
2.Decision tables, and
3.Expert system shells.

22.Write about the disadvantages of flow chart. (BT-I)

Flow charts focus on process rather than on the structure of decision logic.
Flow charts provide no check against incompleteness, contradiction, and redundancy.
Flow charts often employ abbreviations and hence they are defective for effective communication of knowledge.

23.What is expert system shells? (BT-I)

Expert system is one of the latest system tools for the development and display of manufacturing knowledge.
Using an expert system shell, the knowledge engineers can collect the information to develop a knowledge base within the predefined decision structure of the shell.

24.What is decision table? (BT-I)

Decision tables are a system/logic tool to bring together, analyze, and display complex decision logic in such a way that its meaning can be readily grasped.

25.What way decision tables assist the production engineers? (BT-I)

Decision tables assist the production engineers in thinking through a problem thoroughly and presenting its resolution in a systematic and rationally structured format.
Decision tables ensure accuracy, eliminate redundancy, and avoid contradiction.

26.List any 4 information required for process planning. (BT-I)(Nov/Dec2012, May/June 2013)

Interpreting part print analysis, and symbols.
Gathering the fundamental details of product design, such as
Type of rough stock, Dimensional tolerance, Type of finish, Production rate, Production volume, Downtime, Scrap losses, Design changes. Etc.,
Selecting the machining processes
Selecting proper machining with allied tooling based onrequired machine capability, Practical lot size, cost of tooling, set up time, quality of parts, type of tooling.

27.What are the advantages of manual process planning? (BT-I) (Nov/Dec2012)

Manual process planning is very much suitable for small scale companies with few process plans to generate.This method is highly flexible.This requires low investment costs.

PART-B

1. Explain with neat sketch various methods of process planning (16)(BT-II) (Nov/Dec 2016)

2.Describe various approaches to process planning (16) (BT-II) (Nov/Dec 2015)

3.What are the constraints in tool selection (6)(Nov / Dec 2016)Write down the procedure to be followed during material selection ?Discuss the factors that's are taken into account in process selection and equipment selection (10) (BT-V)(Nov / Dec 2016)

4.Explain the technological framework of process planning by using a block diagram. (BT-II) (May/June 2013)

a.Product Design

5.What is process planning? What are the activities associated with it? . (BT-II) (May/June2012, Nov/Dec 2013)

6.Explain in detail about the responsibilities of process planning engineer. (BT-II)

7.List and explain the information required for process planning (BT-IV)

8.Explain the manual approach to process planning. What are its advantages and limitations?. (BT-II)

9.What is meant by CAPP? List out the benefits of CAPP systems. (BT-II)

10.Explain the two approaches commonly used in CAPP systems bringing out their advantages and limitations. (BT-II)11.What factor should be considered while selecting the best process planning system? Explain in detail. (BT-II)(Nov/Dec2012)

12.Compare and contrast the features of a variant and generative CAPP systems(BT-II)

13. (i) What are the factors to be considered in machine selection(BT-IV) (May/June 2013)

(ii) Explain the basic factors affecting process design. (BT-II)(Nov/Dec 2013)

UNIT II- PROCESS PLANNING

PART A

1. Whatisprocessplanning? (BT-I)

It is defined as the systematic determination of methods by which a product is to be manufacturedeconomicallyandcompetitively.

2. Whataretheactivitiesassociatedwithprocessplanning? (BT-IV)

Listofoperationstobeperformedandtheirsequence. Specificationsofthe machinesandequipmentrequired Necessarytoolingsjigsand fixtures. Givesthemanufacturingdetailswithrespecttofeed,speed,anddeptho fcutforeach operationtobeperformed.Itgivesthe estimatedorprocessingtimesof operations.

3. Whatistheinformationrequiredforprocessplanning? (BT-I)

i)Assemblyandcomponentdrawingsandbillofmaterials.
ii)Machineorequipmentdetails.
iii)Thestandardtimesforoperationanddetailsofset-uptimeforeachjob.
iv)Availabilityoftooling.

4. Whatarethefactorsaffectingprocessplanning? (BT-IV)

i)Volumeofproduction
ii)Deliverydates forcomponents
iii)Accuracyandprocesscapabilityofmachines.
iv)Theskillandexpertiseofmanpower.
v)Materialspecifications
vi)Accuracyrequirementsofcomponentsorparts.

5. Whatarethestepsinprocessplanning? (BT-IV)

i)Detailedstudyofthecomponentdrawings,processandmachineselection,inspection stages and toolings required.
ii)Listthesurfacestobe machined.
iii)Determinethe workcentre,tools,cuttingtools,jigsand fixturesand inspectionstages and equipmentrequired.
iv)Determinethespeed,feed anddepthof cutforeachoperation.
v)Estimatetheoperationtime.
vi)Findthetotaltimeto completethejob.
vii)Representthedetailsontheprocesssheet.

6.Whatismachinecapacity? (BT-I)

MC-Machinecapacity

MP-Maxproduction
UC-Utilizationcapacity
N–Numberofmachines
ST-Standardtime
MC=STXMP/NXUC.

7.Whatismeantbybalancing? (BT-I)
Itreferstotheprocedureof adjustingthetimesat work centresto conformasmuchas possibletotherequirecycletime.

8.Definemachineloading(BT-I)
Itistheprocessof assigningspecificjobstomachines,men(or)work centresbasedon relativeprioritiesand capacityutilization.

9.Defineprocess(BT-I)
Itisdefinedas
anygroupofactionsinstrumentaltotheachievementoftheoutputofan operationssystemin accordancewithaspecifiedmeasureof effectiveness.

10.Givethepurposesof processplanning(BT-I)
a.Specificrequirementsareestablishedforwhichmachines,toolsandotherequi pmentcanbe designedorselected.
b.Theeffortsofall engagedinmanufacturingtheproductis coordinated.
c.A
guideisfurnishedtoshowthebestwaytousetheexistingortheprovidingfacilities.

11.Whatarethefactorsusedforselectionofmachineandequipment? (BT-IV)
a.Accuracy b.Rateofoutput c.CostofProduction

12.Whatisthemainfunctionofprocessplanning? (BT-I)
'Makeorbuy'decisionisthemainfunctionofprocessplanning.Heredecisionis made aboutwhichpartsaretobemadeinthefactoryandwhichpartsaretobe boughtfromoutside.
Decisiononwhethertomakeorbuyistakenbybreakevenanalysis.

13.Howtheprocessselectionisdetermined? (BT-I)
Processselectiondeterminehowtheproduct(Orservice)willbeproduced,Itdeter minesthe mosteconomicalmethodofperformingan activity.

14.Mentionthetypesof process planning (BT-I)
a)Generativeprocessplanning

b)Retrievalprocessplanning

15.WhatisthefunctionofCAPP? (BT-I)

Acomputeraidedprocessplanning(CAPP)systemoffersthepotentialforreducing the routineworkofmanufacturingengines.Atthesametime, Itprovidesthe opportunitytogenerate productionroutingswhicharerational,consistentandoptimal.

Part-B

1. Explain the process planning procedure (8) (BT-II) (Nov / Dec 2016)

2.List the information required for process planning. (8) (BT-I) (Nov / Dec 2016)

3.What are the procedures to be followed for selection Jigs and fitures ? Discuss in detail (8) (BT-IV) (Nov / Dec 2016)

4.What are the different types of inspection methods ? write briefly about them(8) (BT-IV)(Nov / Dec 2016)

5.Explain the use of computers in process planning and cost estimation and list out the advantages of CAPP (16) (BT-II) (Nov / Dec 2014)

6.. (i) What are the set of documents required for process planning. (BT-II)

(ii) The fixed costs for a factory for the year 2009 – 10 are Rs. 1,50,000 and the variable cost is Rs. 10 per unit produced. The selling price per unit is Rs. 25. Calculate the break-even quantity. (BT-V)(Nov/Dec 2013)

7.Following are the information on two machines

Sl No	Item	Capstan lathe	Automatic (single spindle)
1	Tooling cost	Rs.300	Rs. 300
2	Cost of cams	-	Rs .1,500
3	Material cost per piece	Rs.2.50	Rs. 2.50
4	Operating labour cost	Rs.20 per hour	Rs 80 per hour
5	Cycle time per piece	5 min	1 min
6	Setting up labour cost	Rs.20/hour	Rs.20 /hour
7	Setting up time	1 hrs	8 hrs
8	Machine overheads(Seeting and operation)	300 % of (4)	`1000 % of (4)

UNIT III- INTRODUCTION TO COST ESTIMATION

PART A

1.Define Cost estimation. (BT-I)(Nov/Dec2012)

Cost estimating may be defined as the process of determining the probable cost of the product before the start of its manufacture.

2. How to achieve the estimated design cost? (BT-I)

Estimated design cost = (Estimated design time) x (Salary of designer per unit time)

3. Brief the importance of the cost estimating. (BT-I)

Only accurate cost estimating can enable the factory owner to make vital decisions such as manufacturing and selling policies. Both over estimating and under-estimating are dangerous for a concern.

4. List a few objectives of the cost estimation? (BT-I) (May/June 2012)

i) To establish the selling price of a product for a quotation or contract, so as to ensure reasonable profit to the company.

ii) To verify the quotations submitted by the vendors.

iii) To take make or buy decision

To ascertain whether the proposed product can be manufactured and marketed profitably

5.Write the formulae to find out area and perimeter for ellipse. (BT-I)

Area = πab , Perimeter = π(a+b)

6.What are the methods of estimation? (BT-I)

i) Conference method

ii) Comparison method andDetailed analysis method

7. What is departmental costing? (BT-I)

This method is adopted in determining the cost of the output of each department separately for the manufacture of the standardized products. This method is applied in industries like steel industry, automobile industry, etc. where each department is producing independently one or more components.

8.Define job costing? (BT-I)

Concerned with finding the cost of each individual job or contract. The total cost for each order is obtained from the daily cost sheet. E.g.: Ship building, Building contract

9.Define Batch costing? (BT-I)

Batch costing is a form of job costing. A batch of components is taken as a job

10.What is multiple cost method? (BT-I)(Nov/Dec2012, Nov/Dec 2013)

This method is used in firms which manufacture variety of standardized products, having no relation to one another in cost, quality and type of process, etc.

11.Differentiate Estimating and job costing on the basis of nature of cost. (BT-IV)

Estimating: It gives the probable cost of product before the start of its manufacture.

Costing: It gives the actual cost of the product after adding different expenses incurred in various dept.

12. What is Labour Cost? (BT-I)

Labour cost = Estimated labour time needed to produce the product x Cost of labour per hour

13. Differentiate Estimating and job costing on the basis of Quality of personal required. (BT-IV)

Estimating: Estimation requires a highly technical knowledge hence an estimator is basically an engineer.

Costing: Costing requires the knowledge of accounts and therefore it is done by accountants.

14. Differentiate Estimating and job costing on the basis of duration of process. (BT-IV)

Estimating: Estimation is carried out before the actual production of a product.

Costing: Costing usually starts with the issue of order for production of product and ends after the product is dispatched on sale.

15. Differentiate Estimating and job costing on the basis of organizing dept. (BT-IV)

Estimating: Estimating work is done under the planning dept. Costing: Costing work is done under the accounting dept.

16.What are fatigue allowances? (BT-I)

They are indicated to provide a workman an opportunity to recover from physiological and psychological effects of fatigue caused by carrying out a specified task under specified conditions. Fatigue may be due to excessive work, repeated work, poor lighting, poor ventilation, machine noises, visual and mental strain

17.Write some examples for operating cost method. (BT-I)

In transport services, water works, electricity boards, railways, etc. Cost is determined on the basis of operating expenses. That is, charges are made as passenger per km,per kw- hr, tonne-km, etc.

18.What is meant by direct material cost? (BT-II) (May/June 2012, May/June 2013)

Direct material cost is one which becomes the part of the product. It is the material which is consumed in the manufacturing of a product. It can be measured and charged directly to the cost of the product.

19.What is meant by indirect material cost? (BT-II)

Indirect material is one which cannot be traced as a part of the product. It's the material required for maintaining and operating the plant but cannot be a part of the product. Examples: Grease, lubricating oil, coolants used.

20.Who are called direct labour? (BT-I)

Direct labour are the workers who actually work or process different materials either manually or with the help of machines. They are also called as productive labour, process labour, operating labour.

21.Who are called Indirect labour? (BT-I)

Indirect labour is the non-productive staffs that help the productive labour in performing their duties. Examples: Supervisors, inspectors, foreman, store keepers, time keepers.

22.Give examples for direct expenses. (BT-III)

Cost of preparing designs, drawings, for the manufacture, of a particular product.

Cost of experimental work done specifically for a particular product.

Cost of hiring special type of patterns, moulding flasks, dies.

Cost of consultancy charges for design and manufacture of a specific product.

23.What are indirect expenses? (BT-I)

All expenses other than direct labour cost, direct material cost and direct expenses are called indirect expenses.

24.List the classification of overhead expenses. (BT-I) (May/June 2012)

Factory expenses, administrative expenses, selling expenses, distribution expenses.

25.What are all factory on-cost? (BT-I)

Factory on cost are also known as factory expenses, works on cost, factory overhead, works overheads, production overheads, etc. Expenses incurred on indirect materials like lubricating oils, grease, coolants, etc. Rent, taxes, insurance expenses of the plant, machinery, etc.

26.What do you mean by multiple cost method? (BT-II)(Nov/Dec 2012)

Multiple costing is used when many different finished products are made. Many components are made which are subsequently assembled into the completed article, which may be bicycles, cars etc. Costs have to be ascertained for operations, processes, units and jobs, buildings together until total cost is found.

27.Define Costing. (BT-I) (Nov/Dec 2012, May/June 2013)

Costing may be defined as a system of accounts which systematically and accurately records every expenditure in order to determine the cost of a product after knowing the different expenses incurred in various department.

PART-B

1. Explain in detail about the types of estimates and how it is done? (BT-II)

2.Explain in detail about all the methods of estimation? (BT-II)

3.List and explain in detail about the components of a job estimate? (BT-I) (Nov/Dec 2012, Nov/Dec 2013)

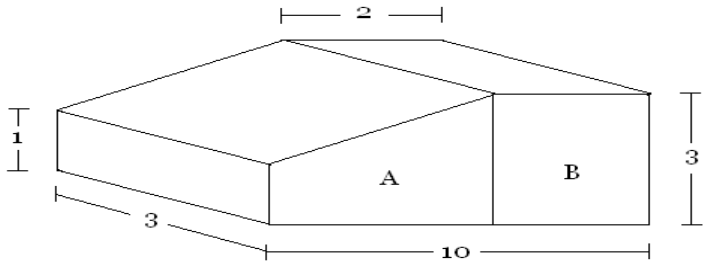
4.Explain the step by step cost estimation procedure in detail.(BT-II)(Nov/Dec 2012)

5.List and explain in detail about the objectives of cost accounting? (BT-I)

6. What are the methods of costing? Explain in detail. (BT-IV)(May /June 2012, May/Jun 2013)

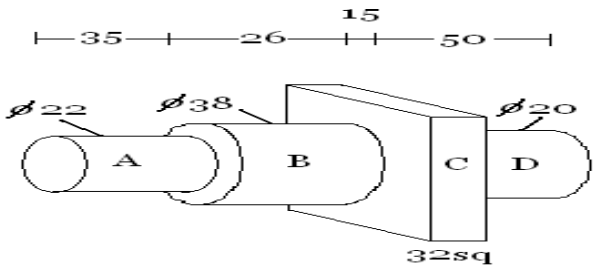
7. Figure shows a wedge is forged from M.S bar of 4cm diameter. Estimate what length of bar shall be needed, if the volume of material remains unchanged (BT-V)

8.Find the break even quantity for a job which can be produced on either of the machines.Also comment about the choice of machine based on break even quantity (BT –V)(Nov /Dec 2015)



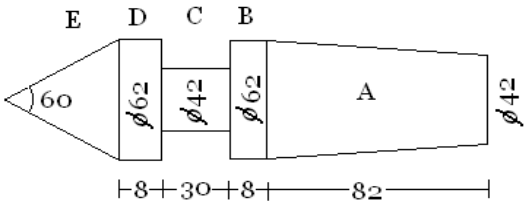
All dimensions in cm

9 An isometric view of the work piece is shown in figure. What will be the weight of the material required to produce it. The density of material is 2.681gm/cc. Find also the material cost, if its rate is 13.60 per kg. (BT-V)

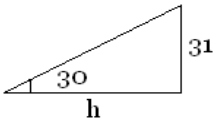


All dimensions in mm

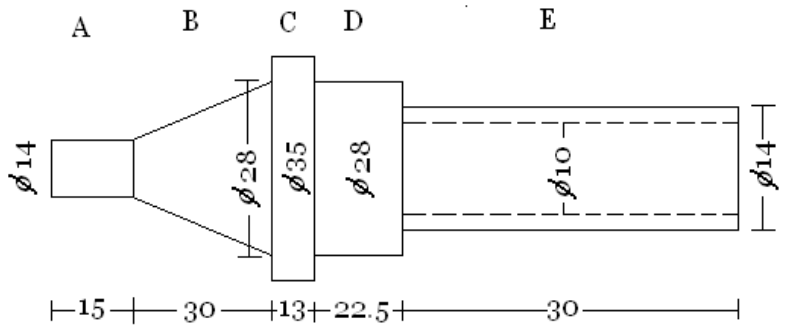
10.The dimensioned figure shows a lathe centre. Estimate the weight and cost of material for the same, if the material weighs 7.868 gm/cc density and the material cost is Rs11.45 per kg. (BT-V)



All dimensions are in mm



11. Estimate the weight of material required for manufacturing 220 pieces of shaft as shown in figure. The shafts are made of mild steel which weighs 7.87gm/cm^3 and costs Rs.4.25 per kg. Also calculate the material cost for 220 such shafts.



All dimensions in mm

13. What is meant by analytical estimating? Write its procedure, advantages, limitations and applications. (BT-II) (Nov/Dec 2013)

14.Discuss various method of costing in detail (8) (Nov/Dec 2016)

15.Explain the procedure followed for estimating the cost of an individual product (8) (Nov/Dec 2016)

16.Explain any one method of calculating depreciation cost with an example(8) (Nov/Dec 2016)

17.Discuss the various methods used for allocation of overheads(8) (Nov/Dec 2016)

18.Discuss the objectives of cost estimating. (8) (Nov/Dec 2015)

19.Explain the advantages cost accounting (8) (Nov/Dec 2015)

20.Describe the classification and elements of cost(16) (Nov/Dec 2015)
Write the difference between cost accounting and cost estimation(Nov/Dec 2015)
21.Write basic steps in cost estimation (8) (Nov/Dec 2015)

22.Write the difference between cost accounting and cost estimating (8) (Nov/Dec 2014)

23.Write basic steps in cost estimation (8) (Nov/Dec 2014)

24.Calculate prime cost ,factory cost,production cost,total cost and selling price per item from the data given below for the year 2012-

25.Cost of raw material in stock as on 01.04.2012-Rs 25,000
Raw material purchased –Rs 40,000
Direct labour cost –Rs 14,000
Direct expenses-Rs 1,000
Factory /work over heads –Rs 9,750
Administrative expenditure-Rs 6,500
Selling and distribustion expenses –Rs 3,250
Numbers of items produced-650
Cost of raw material in stock as on 31.03.2013-Rs 15,000
Net profit of the items is 10 % of the total cost of the product (16) (Nov/Dec 2014)

UNIT IV-PRODUCTION COST ESTIMATION

PART A

1. What is preliminary estimate? (BT-I)

This is based on incomplete data. These estimates are based on assumptions and general information supplied by either the sales or engineering groups, especially in areas of incomplete data.

2. How are preliminary estimates done? (BT-I)

Drawings/layouts are made use of by an estimator. This is done by *comparing* with a production already completed, using his discretion to determine the percentage of deviation

If drawings are not available, survey men who have made survey of the product brief the estimators on the available data. From this *briefing*, the survey men estimate the costs of making this product.

3. What is final estimate? (BT-I)

This is based on complete data for a product and hence it is the most accurate estimate. Here a detailed estimate is made for every component, assembly, sub-assembly. However, this type of estimate is not justified as it involves huge costs, which is not justified.

4. What are Establishment on-cost expenses? (BT-IV)

It includes the expenses are incurred for general administration and management for efficient and proper functioning of the enterprise. Administrative expenses are also called as Office expenses and Establishment on-cost.

5. What is the information required for estimating the cost of a product? (BT-I)

Design time
Amount and cost of materials required
Labour charges
Cost of machinery, overheads and other expenses
Effect of volume of production on costing rates

6. What are the probable errors in cost estimation? (BT-IV)

Over-estimation
Under-estimation

Realistic estimation

7. What are the functions of cost estimation? (BT-IV) (May/June 2013)

Cost estimates are required to submit accurate *tenders* for getting the contracts

Cost estimates are required for the manufacturer to *choose* from various *methods ofproduction*, the one which is likely to be most economical.

Cost estimates are required for fixing the *selling price* of a product.

Cost estimates give the *detailed* information of all the operation and their costs, thus setting a standard to be achieved in actual practice

Cost estimates enable the management to plan for *procurement* of raw materials, tools, etc, and to arrange the necessary capital, as it gives detailed requirement.

8. What is the process of conference method? (BT-I)

Here a coordinator from either accounting, or estimating collects these costs and applies overhead factors to develop a total manufacturing cost for the product.

This is *not* often supported by detailed paper work, standard data or mathematical calculations.

The degree of accuracy of this method depends upon the availability of specifications, samples and drawings.

9. What is meant by the comparison method? (BT-II)

The costs of *similar* parts are applied to the product and are adjusted to suit variations in the work piece, materials and labour cost. This method of estimating is based on accumulation of past experience and data.

10. What method is used for estimation when time is a constraint? (BT-IV)

Conference method and Comparison method are used when time is a constraint.

11. What is detailed analysis method in cost estimation? (BT-IV)

The detailed analysis involves:

Calculation of all raw material usage including scrap, allowances and salvage material.

Processing each individual component, determining the production time for each operation, the equipment required

Tools, gauges and special fixtures or dies

Inspection and testing equipment
Packing and shipping requirements
This method consumes a lot of time; however it is the most reliable one

12. List out the name of any four data sources for cost estimating. (BT-I)

Product engineering and sales department
Estimate requests
Customer or his contact man
Manufacturing engineering
Quality control
Vendors of materials
Shipping department
Methods engineering
Special charts, tables, time studies, technical books and magazines
Plant layout engineer/plant layout engineer

13. What is allowance with reference to cost estimation? (BT-I)

The amount of time added to the normal time to provide for personal delays, unavoidable delays and fatigue of the operator

14. Mention the types of allowances in cost estimation? (BT-I)

Relaxation allowance
Contingency allowances
Process allowances
Interference allowances and Special allowances

15. What is a special allowance in cost estimation? (BT-I)

These allowances are provide for activities that are not part of the normal cycle of operations, but they are essential for the satisfactory performance of a given task
These include, for example:
Start-up allowance
Shut-down allowance
Cleaning allowance
Time for adjustment and maintenance of tools
Changeover allowance

16. How is standard time calculated? (BT-I)

It is the time allowed to an operator to carry out the specified task under specified normal conditions and defined level of performance

Standard time = Normal time + allowances

17. What is relaxation allowance in cost estimation? (BT-I)

This is the time provide to the worker to recover from the physiological effects of carrying out a specified task under specified conditions and to allow attention to personal needs.These are of two types:Personal allowances,Fatigue allowances

18. What are contingency allowances in cost estimation? (BT-IV)

These allowances are provide for small unavoidable delays as well as for occasional and minor extra work, like tool breakage, sharpening, replacing, filling coolant reservoirs, consulting with foreman, power failures of small duration, daily oiling and cleaning

They are less than 5% of the time

19. What are interference allowances in cost estimation? (BT-IV)

This is provided when two or more elements occur simultaneously.

This occurs when an operator is attending on more than one machine at a time, resulting in idle time occurring in more than one machine.

20.What are selling expenses? (BT-IV)

These are expenses which are incurred for creating and enhancing the demand for the product. It includes the expenditure spent securing orders, creating and retaining markets for the products manufactured.

Examples:

Cost of advertisement and publicity

Expenses incurred for the preparation of tenders and estimates.

21..What are Distribution expenses? (BT-IV)

These are the expenses which are spent for the distribution of the product. It includes the expenditure made on holding finished stock, packing cost and dispatching items to the customer.

Examples:

Packaging and forwarding expenses

Salaries of workers employed in packaging section.

22. List out the components of ladder cost. (BT-I)

The various components of ladder cost are:Prime cost,Factory or workers cost,Manufacturing or production cost,Total or ultimate cost,Selling price

23.What is prime cost or direct cost? (BT-I)

Prime cost = Direct labor cost + Direct material cost + Direct expenses

24.What is Factory cost? (BT-I)

Factory cost = Prime cost + Factory expenses

25.What do you mean by a realistic estimate. (BT-IV) (Nov/Dec 2012) (May/June 2012)

If the estimated cost of the product proves later on, to be almost sane as the actual cost of that product it is a realistic estimate.

26.Define parametric estimating. (BT-I) (Nov/Dec 2012)

Parametric estimating is the act of estimating cost or time by the application of mathematical
formulas. These formulas can be as simple as multiplices or as complex as regression models.

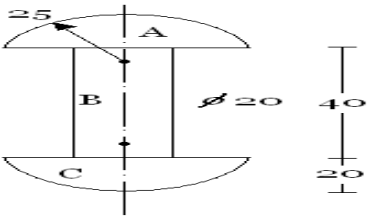
PART-B

1.What are all the data required for cost estimating and explain. (BT-IV)

2. (i) Write the fixed cost and the variable cost of running a motor car for one year. (ii) Discuss the data requirements and sources of information for cost estimation. (BT-V)(Nov/Dec 2013)

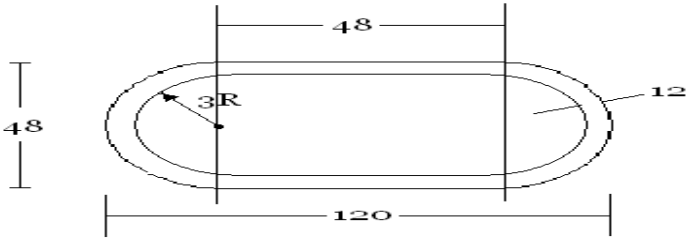
3. Explain about allowances in cost estimation. (BT-II) (May /June 2012)

4. Calculate the number of rivets of dimensions shown in figure, which can be manufactured from 6 kg of M.S. Assume no material wastage. Take density of M.S as 7.87 g/cc. (BT-V)



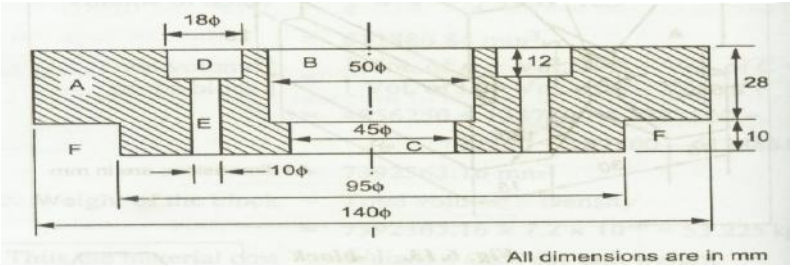
All dimensions are in mm

5. Calculate the weight of 60m of steel chain, one link of which is shown. Assume weight of steel rod of 12mm dia as 0.75 g/mm length. (BT-V)



All dimensions are in mm

6. Find the cost of material for the machine part shown in figure. Density of material may be taken as 8.2gm/cc. The cost of material is Rs2 per kg. Assume 20% of wastage of material of the finished component and 6 holes for the bolt. (BT-V)



7. The direct material used is Rs.1000 and direct wages of Rs.443 for the manufacture of certain items.Calculate factory cost(i) when the on-cost is to be 60% of prime cost, and
(ii)When the on-cost is to be 90% of direct productive labour cost.

8. A certain piece of work is produced by a firm in batches of 100. The direct material cost for that 100 workpiece is Rs. 160 and the direct labor cost is Rs. 200. Factory on cost is 35% of the total material and labour cost. Overhead charges are 20% of the factory cost. Calculate the prime cost and factory cost. If the management wants to make a profit of 10% on gross cost, determine the selling price of each article.

9. The catalogue price of a certain machine is Rs 1050, the discount allowed to the distributors being 20%. Data collected at a certain period show that the selling cost and factory cost are equal and that the relations among material costs, labor cost, and on-cost in the factory are 1:3:2. If the labor cost is Rs.200, what profit is being made on the machine?

10.A factory is producing 1000 bolts and nuts per hour on a machine. Its material coat is Rs.400, labour cost Rs.350 and direct expenses is Rs.75. The factory cost is 150% of the labor cost and office on-cost is 25% of the total factory cost. If the selling price of each bolt and nut is Rs.1.75, calculate whether the factory is going in loss or gain and by what amount.

11.Find the sales price of a component made from solid steel bar 6cm long and 2 cm in diameter. The machining operation requires 5/4 hrs. Assume the following data

Cost of mild steel id Rs.20 per kg.
Density of mild steel 8 g/cc.
Labor charges Rs.4 per hour.
Overhead charges are 100% of the direct labor cost.
Profit as 20% of the total cost.

Weight of the material = Volume x Density= $(\pi /4\ 2^2 \times 6) \times 8 = 150.796$ g
Material cost = 20 x 0.150796 = Rs. 3.016
Labor cost = Labor rate x time = 4 x 1.25= Rs. 5
Overhead charges = 100% of labor cost =Rs. 5
Total cost = Material cost + labor cost + overhead charges
= Rs.13.016
Profit = 20% of the total cost = Rs. 2.603
Selling price = 13.016 + 2.603= Rs. 15.62

12. The total on-cost of a firm for a period of 8 months is Rs. 75,000. The firm employs 35 workers and an average working day per month is 23 days. 10% of total time is allowed for various allowances. Calculate the share of overheads to be allocated to a product requiring 9/2 man hours. Take 8 hrs of work per day.

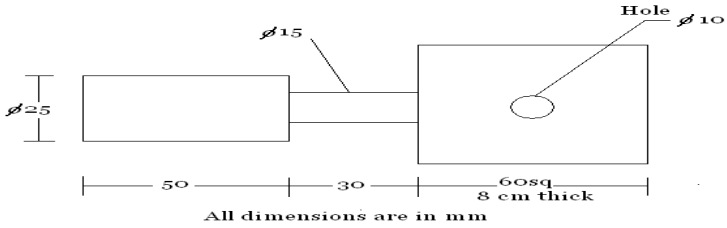
13. A factory has 15 lathes of same make and capacity and 5 shapers of same make and capacity. Lathes occupy $30m^2$ area while shapers occupy $15m^2$ area. During the calendar year, factory expenses for this section are as follows.(Nov/Dec 2012)

Building rent and depreciation = Rs. 5000
Indirect labor and material = Rs. 15000
Insurance = Rs. 2000
Depreciation charges of lathe = Rs. 5000
Depreciation charges of shaper = Rs. 3000
Power consumptions for lathes = Rs. 2000
Power consumptions for shapers = Rs. 1000

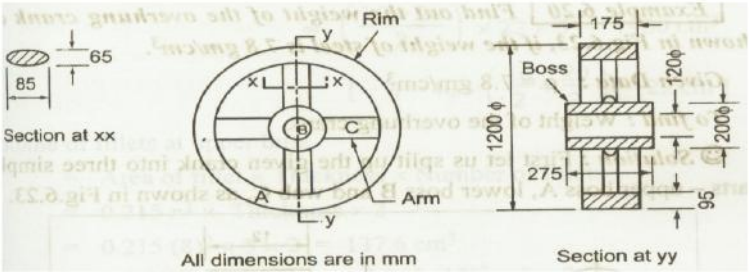
Find out the machine hour rate for lathe and shapers, if all the lathes and shapers work for 25,000 and 8000 hours respectively.(Nov/Dec 2012)

14. A C.I factory employs 25 persons. It consumes material worth Rs.35,000 pays workers at the rate of Rs.5 per hour and incurs total overheads of Rs. 20,000. In a particular month (25 days) workers had an overtime of 150 hrs and were paid
double than the normal rate. Find (i)the total cost and (ii)the man hour rate of overheads. Assume an 8 hrs working days.

15. Calculate the net weight and gross weight for the manufacture of 500 levers shown in figure. The material weighs 7.8 g/cc and the total losses account for 25% of net weight of the lever. Also calculate (i) length of 3 cm diameter required per component (ii) the cost of forging 500 pieces if material cost Rs. 8 per kg, labor costs Rs. 1.20 per piece and overheads are 25% of material cost.



16. A gas engine flywheel is shown in figure. Determine the weight of the flywheel if the material weighs 7.2 g/cc.

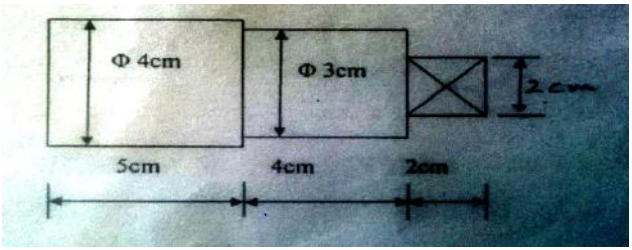


17. What are the components of a job estimate? Explain. (May/Jun 2013)

18. (i) What are the types of estimates. (ii) Differentiate between estimating and costing.(May/Jun 2013)

Generalize the meaning of tonghold loss in forging (6) (Nov / Dec 2016)

200 pieces of a component as shown in figure 1 are to be drop forged a bar stock of diameter 4 cm.Calculate the cost of manufacturing if (1) Material cost is Rs.1000 /meter,(2) Forging charges are Rs 10per cm^2 of surfaces area to be forged (3) On cost is 10% of material cost.consider all possible losses (10) (Nov/Dec 2016)



18.State and expain various losses which are to be considered in a foundary

shop (8) (Nov/Dec 2016)
List the various elements which are to be considerd while calculating the cost of a welded joint (8) (Nov/Dec 2016)

19. Discuss various types of estimates (8) (Nov/Dec 2015)
Explain the data requirements for cost estimation and their sources (8) (Nov/Dec 2015)

20.Describe different methods of estimates(8) (Nov/Dec 2015)
Explain the allowances in estimation (8) (Nov/Dec 2015)

21.What are the three methods used in conceptual cost estimation? Explain any two methods briefly(8) (Nov/Dec 2014)
Write the data requirements and sources of information for cost estimation(8)

22.Name the various elements of cost. (8) (Nov/Dec 2014)
In Manual operation ,observed time for a cycle of operation is 0.5 minute and the rating factors as observed by the time study engineering is 125 % .All Estimate the standard time(8) (Nov/Dec 2014)
23. In a manufacturing process the observed time for one cycle of operation is 110 %.The following are the various allowances as the percentage of normal time.
Personal allowances= 3 %
Relaxation allowances=10 %
Delay allowances=2 %
Estimate the standard time (8) (Nov/Dec 2014)

UNIT V-MACHINING TIME CALCULATION

PART A

1.What is manufacturing cost of a product? (BT-I)
Manufacturing cost = Factory cost + Administrative expenses

2.Write the formula for selling price and market price. (BT-I)
Selling Price = Total Cost + Profit
Market price =Selling price + Discount

3.Write the formula to find out material cost. (BT-V)
Material cost = Weight of the material x Cost per unit weight
Weight of the material = volume x density of the material

4.The lengths of one edge of C.I. cube is 25cm.Calculate its weight, if the density of the material is 7.2 g/cc. (BT-VI)
Given: a=25cm; density =7.2 g/cc
Therefore, volume =Area of base X Height $= a^3 = 25^3 = 15625\ cm^3$
Weight of the cube= Volume x Density = 15625 x 7.2= 112.5 kg

5.What are the factors to be considered by the estimator while calculating the time required for a particular job? (BT-IV)
Set up time,Operation time:Handling time,Machining time,Tear down time, Miscellaneous allowances: Personal allowances, Fatigue allowances, Contingency allowances, Process allowances, Interference allowances, Special allowances

6.What is set up time? (BT-I)
It is the time required for settling and fixing the jobs and tools on the machine. It includes the time to study the drawings, blue prints, etc.

7.What is tear down time? (BT-I)
It is time taken to remove job, tools, and other auxiliary equipment from the machine after the last element of the operation has been completed.

8.What are miscellaneous allowances? (BT-IV)

This is the additional time allowed to perform the work over and above the basic time. To obtain the standard time, proper allowances must be added depending upon the working conditions.

9.Write the formulae to find out time taken for tapping operation. (BT-V)

Time taken for tapping = length traveled by tap/(feed/rev)x(r.p.m)

= (L+ D/2) / Pitch x r.p.m

10.Write the formulae to find out time taken for returning tap. (BT-V)

Time taken for returning the tap is taken as ½ of the time required for pushing it in the work piece.

Total time for tapping = 3/2 (L+ D/2) / Pitch x r.p.m

11.A machinist manufactures 25 jobs in 7 hours. If this time includes the time for setting his machine, calculate the machinist's efficiency. Take the allowed standard setting time and standard production time per piece as 45 min and 10 min respectively. (BT-VI)

Standard time for manufacturing 25 jobs = standard setup time + standard production time for 25 jobs.

= 45 + (25*10) = 295 min

Machinist's efficiency = Standard time / Actual time x 100= (295/420) x 100 = 70.24%

12.What are the methods available for allocation of overhead expenses? (BT-IV)

The different methods of allocation of overhead expenses are:

a.Percentage on prime cost,Percentage on direct labor cost,Percentage on direct material cost,b.By hourly rate,Man hour rate,Machine hour rate,Combination of man-hour and machine hour rate,By unit rate,Unit rate method.

13.Write the formula for allocation by percentage of prime cost for overhead. (BT-V)

% of overhead = (Total overhead cost/Total prime cost) x 100

14.What is forging and give its classification? (BT-I)

Forging is defined as the process in which the desired shape and size of an object is obtained through the plastic deformation of the metal of the object.

It is classified as hot forging and cold forging.

15.What is tong hold loss? (BT-I)

While performing forging operations, some length of the stock (at one end) is required for holding the stock in the tong. This small extra length will be removed after completion of the work piece. This is known as tong hold loss.
Tong hold loss = area of cross section of the bar x length of the hold

16.Write the formula for flash loss. (BT-V) (Nov/Dec 2013)

Flash loss = volume of flash x density of the material

17.Write the formula for volume of flash. (BT-V)

Volume of flash = circumference of component at parting time x cross section area of flash
Cross sectional area of flash = flash thickness x flash width

18.A butt joint between two square metal plates of 250 x 250 cm is made using electric arc welding. If the rate of welding is 5metre/hr, calculate the time required to complete ten such welding operations. (BT-VI)

Time required for making 10 welds = (Length of weld/rate of welding) x 10 = (2.5/5) x 10= 5 hours or 300 min.

19.List out the names of gas welding techniques. (BT-I)

Leftward or forward welding
Rightward or backward welding

20.Write the formula for direct material cost for manufacturing pattern. (BT-V)

Direct material cost =gross weight of the pattern including pattern allowances x cost per unit weight.

21.What are the terms used in study of machining time? (BT-IV)

Length of cut ,Feed,Depth of cut,Cutting speed

22.What is boring? (BT-I)

Boring is the operation of enlarging or finishing an internal hole which has been previously drilled.

23.What is reaming? (BT-I)

It is the process of removing small amount of material from a previously drilled hole or bored hole perfecting the hole.

24.Write the formulae to find time taken per cut in milling. (BT-V)

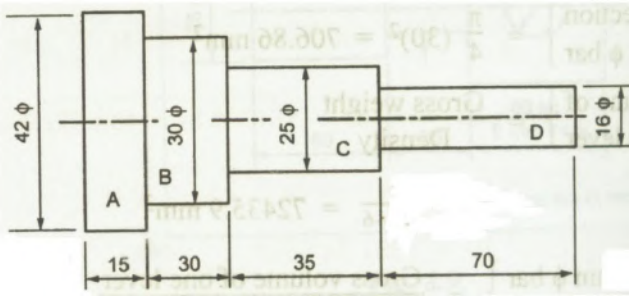
Time taken per cut = (Length of job + Added table travel) / [(Feed/rev) x (r.p.m)]

25.Write the formula for allocation by machine hour rate for overhead. (BT-V)

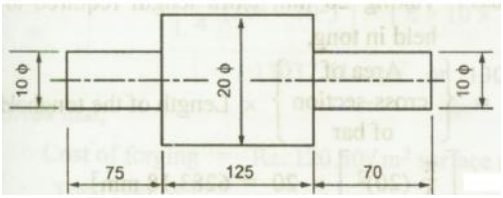
Machine hour rate = (total overhead cost/ total productive machine hours)

PART-B

1. 750 stepped spindles are to be made by machine forging. Estimate the net weight, gross weight and number of bars required if mild steel are available in 4 mm length and 25 mm diameter. Take the density of M.S bar 7.6 gm/cc. consider all the possible forging losses.



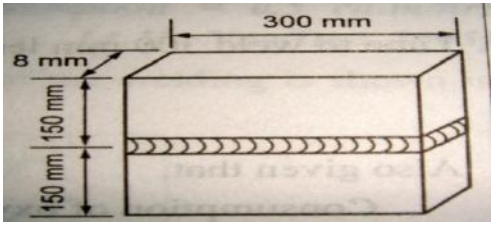
2. 150 pieces of shafts as shown in figure are to be forged from the raw stock of tcm dia .Estimate the cost incurred assuming that material cost =Rs5.20 per metre. Cost of forging = Rs120.50 per sq.m of surface area to be forged. Overhead expenses to be 100% of the cost of forging .Consider all losses.



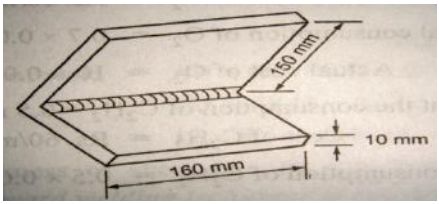
All dimensions are in mm

3. What is the material cost of welding two plates of size 300mm length and 150mm width and 8mm thickness to make a piece 300 x300 mm

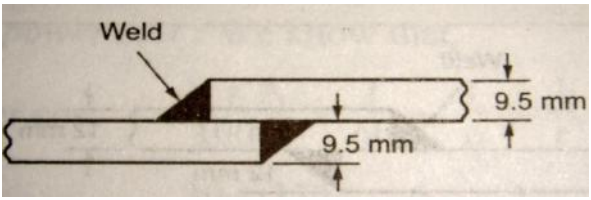
approximately. Use rightward technique with no edge preparation cost .Take overall cost of oxygen as Rs.0.70 per cu m,cost of acetylene at Rs 7 per cum ,Cost of filler metal Rs 2.50 per kg and 1Cu.Cm of filler metal weighs 11.28 gms .Assume dia of filler rod = 4mm . Filler rod used per metre of weld = 3.4 m .Rate of welding = 2.1 m/hr.Consumption of oxygen = Consumption of acetylene = 7.1 Cu.m/hr



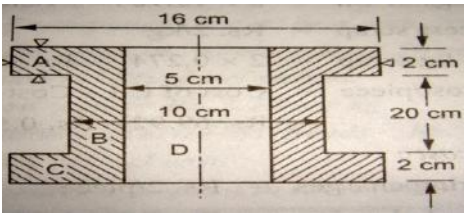
4. Estimate the material cost for welding 2 flat pieces of M.S 15x16x1 cm size at an angle of 90 by gas welding .Neglect edge preparation cost and assume Cost of O_2 = Rs 10/cu.m,cost of C_2H_2= Rs60/cu.m,density of filler metal = 7 gm/cc; Cost of filler metal = Rs12/kg;Filler rod dia = 5 mm , filler rod required 4.5 mm / m of weld, welding time = 30 min /m of welding, consumption of O_2 = 0.7cu.m/hr and consumption of C_2H_2 = 0.5 cu.m/hr.



5. A lap joint is to be prepared in 9.5 mm M.S. sheet using flat welding position and 6 mm electrode .Current used is 250 A and voltage is 30 V.Welding speed is 12 m/Hr and 0.3 Kg of metal is deposited per metre length of joint.Labour cost Rs 1.5 per hour ,power Rs 0.20 per KWhr and electrode Rs 4 per Kg Effeciency of machine is 50% and operating factor is 60 % Calculate the cost of labour , power and electrode per metre of weld.



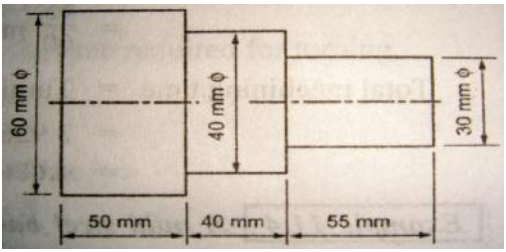
6. Estimate the total cost of 20 CI flanged pipe casting shown in figure, assuming the following data, Cost of CI=Rs.5/kg,cost of process scrap Rs.2/kg,process scrap 2% of net weight of casting , moulding and pouring charges = Rs.2/piece ,casting removal and cleaning = Rs0.5/piece ,administrative overheads = 5% factory cost ,selling overheads = 70%administrarive overheads



7. A small fuse box 300mm long , 20 mm wide and 60 mm deep with a 30 mm deep is to be manufactured in grey iron .The average thickness is 4.5 mm .The pattern supplied by the customer is of loose type, hence bench moulding is to be followed . Estimate the selling price per piece, assume the following data: (i)Cost of iron at the cupola sprout = Rs1.2 per kg (ii)Cost of process scrap return = Rs 55 paise per kg (iii)Administrative on cost = Rs 3.2 per hour (iv) Profit margin = 16% (v) Density = 7.3 gm/cc , (vi) Process scrap = 20% of net weight . Other expenditure details are

Operation	Time per piece	Labour charges per minute	Works on cost per hour
Moulding and pouring	16 min	Rs. 1.50	Rs.4.50
Shot blasting	6 min	Rs. 0.25	Rs. 4.00
Fettling	4 min	Rs. 0.10	Rs. 3.25

8. What is the machining time to turn the dimensions given in figure.The material is brass , the cutting speed with H.S.S tool being 60 m/min and the feed is 7.5mm/rev, depth of cut is 3 mm per pass.

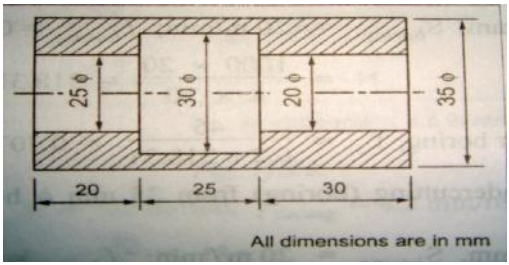


9. A 150 mm thick laminated plate consists of 90 mm thick steel plate and 60 mm thick brass plate .A 20 mm dia hole is to be drilled through this plate .Estimate the total time taken for drilling if , cutting speed for steel = 25 m/min , cutting speed for brass = 50 m/min ,feed of 20 mm drill for steel = 0.2 mm/rev , feed of 20 mm drill for brass = 0.25 mm/rev.

10. Calculate the drilling and tapping time for producing threads in a mild steel of 25 mm thickness. The size of H.S.S drill to be used is 20 mm and the number of threads to be cut is 3 per cm. Taking cutting speed and feed for drill as 20 m/min and 0.25 mm/rev respectively, tapping speed as 5m/min.Neglect the time taken for setting up and approaching and over travelling of tools

11. It is required to produce a hole 15 mm in dia and 10 cm deep through the mild steel piece.Estimate the time taken for completing the hole in the following two cases(i)The hole is drilled by a 15 mm drill .Assume the cutting speed for the mild steel to be 30 m/min and the feed for 15 mm drill to e 0.2 mm/rev.(ii)First, a 10 mm hole is drilled which is then brought to accurate size by boring . Assume the cutting speed for boring and drilling to be 30m/min. The feed for 10mm drill to be 0.15 mm/rev and the feed for the boring operation to be 0.13mm/rev.

12. Estimate the time taken to prepare a job from M.S.stock bar 4 cm in dia and 7.5 cm long.Assume the following data , Cutting speed for turning and boring = 20 m/min . Cutting speed for drilling operation = 30m/min.Feed for turning and boring operation = 0.2 mm/rev .Feed for 20 mm drill = 0.23 mm/rev .Depth of cut not to exceed 3 mm in any operation



13. Find the time required on a shaper to machine a plate 1100*500mm , if the cutting speed is 16 m/min.The ratio of return stroke time to cutting stroke time is 2 : 3 .The clearance at each end is 20 mm along the length and 15 mm on width .Two cuts are required , one roughing cut with cross feed of 2 mm per stroke and one finishing cut with feed of 1.25 mm per stroke

14. A foundry unit produces tractor components as cast. Calculate the selling price of producing a component weighing 50 kgs from the following data(i)Material of the component is cast iron with density = 7.2gm/cc(ii)Cost of molten iron at cupola=Rs2.5 per kg(iii)Process scrap = 17% of net weight(iv) Scrap return value = Rs 1.1per kg
(v) Administrative and sales overheads = Rs 5 per piece(vi)Profit 10%of total cost(vii) other expenditure is given in table below

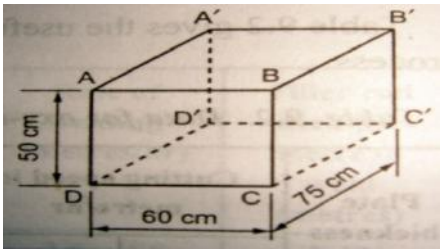
Operation	Time per component (min)	Labour cost per component (Rs)	Shop overheads per hour (Rs)
Moulding and pattern making	6	2.6	4.25
Core making	8	2.4	3.5
Fettling and cleaning	10	2.75	3

15. A small fuse box 25 cm long, 17.5cm wide and 5 cm deep with a lid 2.5cm deep is to be manufactured in grey iron .It has the usual legs and ears with an average thickness of 3.9 mm. The pattern supplied by the customer is of loose type, hence bench moulding is to followed. Estimate the selling

price per piece, given the following data(i)Cost of iron at the cupola spout = 660 paise / kg (ii)Cost of process scrap return = 30 paise /kg (iii) Administrative on cost = Rs 2.00/hr (iv) Profit margin = 15 % Assume: Gate is 18.5mm in diameter and 5cm long. Runner is 1.85cm wide,22.5cm long and 1.25 cm deep. 4 gates and 4 runners.(i.e two on the box and lid each)

Process	Time per piece	Labour charges per piece	Works on cost per hour(Rs)
Moulding and pouring	20 min	Rs. 2.00	Rs. 3
Shot blasting	2 min	Rs. 0.20	Rs. 5
Fettling	1 min	Rs. 0.05	Rs. 3

16. An open water tank of size 75cm x 60cm x 50cm is made by gas welding from a 4 mm thick metallic sheet .Estimate the time require for welding a tank .Neglect other factors. Rate of welding = 5m/hr



17. Find the time required for doing rough grinding of a 15cm long steel shaft to reduce its dia from 4 to 3.8 cm with the grinding wheel of 2cm face width .Assume cutting speed as 15 m/min and the depth of cut as 0.25 min.

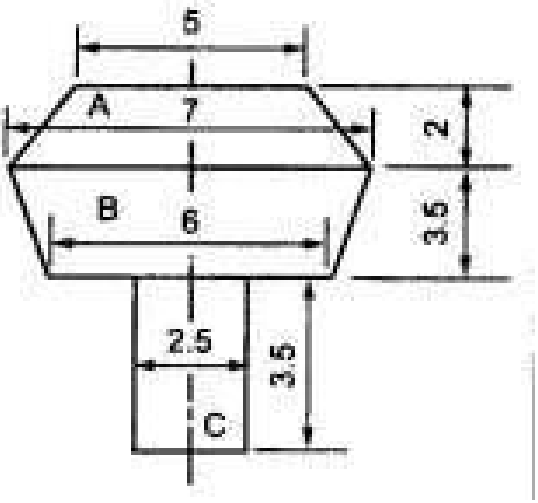
18. Describe the various methods of allocation of overhead expenses?(Nov/Dec 2012)

19. Explain the various time allowances which should be considered for calculating labour cost. (May/Jun 2013)

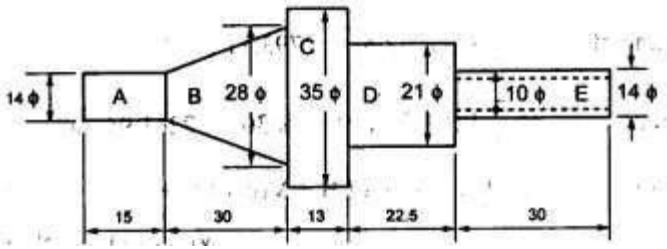
20. Explain the procedure followed for estimating the cost of an industrial product. (May/Jun 2013)

21. An isometric view of a work piece is shown in figure. What will be the weight of the material required to produce it. The density of material is 2.681

gm/cc. Find also the material cost if its rate is Rs.13.60 per kg. All dimensions are in mm. , (16)



22.Estimate the weight of material required for manufacturing 220 pieces of shaft as shown in figure. The shafts are made of mild steel which weighs 7.87 gm/cm3 and costs Rs.4.25 per kg. Also calculate the material cost for 220 such shafts. (16)

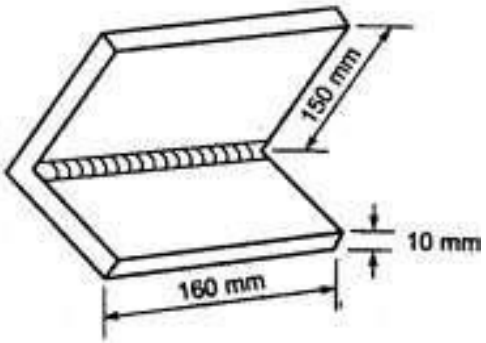


23. For manufacturing a ‘milling machine’, the expenditure is tabulated in table. (16)

S.No.	Particulars	Expenses in Rupees
1.	Material consumed	46,000
2.	Indirect factory wages	7,000
3.	Director's fees	2,500
4.	Advertising	8,000
5.	Net profit	11,750
6.	Depreciation on sales department's car	900
7.	Printing and stationery	350
8.	Depreciation on plant	4,200
9.	Direct wages	59,000
10.	Factory rent	5,750
11.	Telephone and postal charges	250
12.	Gas and electricity	400
13.	Office salaries	2,000
14.	Office rent	600
15.	Showroom rent	1,200
16.	Salesman's commission	1,850
17.	Sales department car expenses	1,200

Find out (a) Prime cost, (b) Factory cost, (c) Total cost of production, (d) Cost of sales, and (e) Selling price.

6.An open water tank of size 75 cm X 60 cm X 50 cm is made by gas welding from a 4 mm thickmetallic sheet. Estimate the time required for welding a tank. Neglect other factors. (16)



7.Estimate the material cost for welding 2 flat pieces of M.S. 15 X 16 1 cm size at an angle of 90° by gas welding Neglect edge preparation cost and assume: Cost O2 = Rs. 10/m3 Cost of C2 H2 = Rs.. 60/m2 Density of filler

metal = 7 gm/cc Cost of filler metal = Rs. 12/kg filler rod dia = 5 mm filler rod required 4.5 m/m of welding assume O2 consumption = 0.7 cu.m/hr. C2H2 consumption = 0.5 cu.m/hr. Welding time = 30 min/m of welding. (16)

8. 20 numbers of gun metal bevel gear blank shown in figure are to be cast in the factory from the planner supplied by the customer Estimate the selling price of each piece from the following data.
Cost of molten gun metal= Rs.9.20 per kg. (3)
Scrap return value = Rs.s 5.00 per kg. (3)
Process scrap = 10 % net weight of casting (3).
Administrative overheads=Rs.3.50 per kg (3).
Profit=15% of manufacturing cost. (2)
Density of gun metal = 8.73 gm/cc .(2)

9. An engine flywheel is required to be cast according to drawing shown in figure (16)

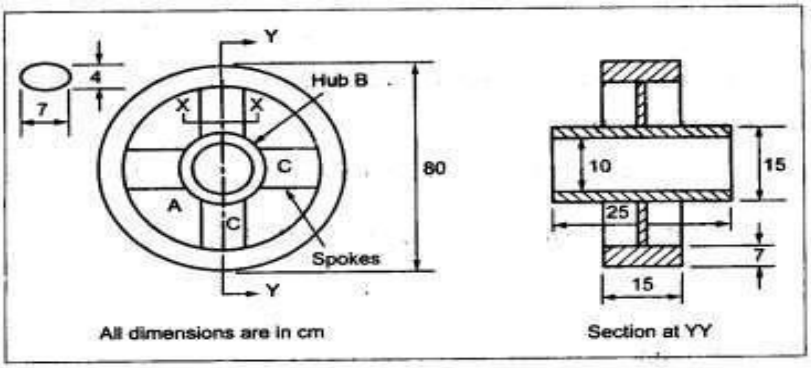
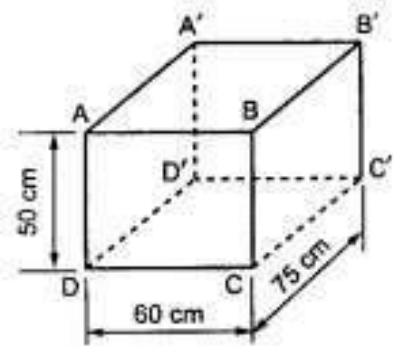


Fig. 10.5.

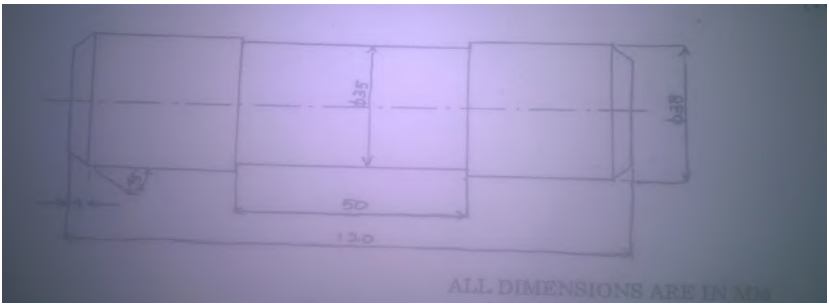
(a) Estimate the net weight of the flywheel casting.

(b) Estimate the selling price of each wheel, given the following data :

- ***(i) Cost of pattern = Rs. 75 per 500 castings;***
- ***(ii) Process scrap = 11% of net weight;***
- ***(iii) Scrap return value = Rs. 0.70 per kg;***
- ***(iv) Cost of molten metal at furnace spout = Rs. 2 per kg;***
- ***(v) Administrative overheads = Rs. 6 per hour;***
- ***(vi) Selling overheads = 25% of production cost;***
- ***(vii) Profit = 15% of total cost;***
- ***(viii) Density = 7.2 gm/cc.***



10 A mild steel bar 120 mm long and 40 mm in diameter is turned to 38 mm diameter and was again turned to a diameter of 35 mm over a length of 50 mm as shown in the figure .The bar as chamfered at both the ends to give a chamfer of 45° ×4 mm after facing .Calculate the machining time .Assume cutting speed of 50 mmin and feed 0.3 mm/rev.The depth of cut is not eceed 3 mm in any operation (16) **(Nov/Dec 2016)**



11.Find the time required to drill to 4 holes in a CI flange each of 2 cm depth ,if the hole diameter is 2 cm .Assume cutting speed as 21.9 mmin and feed as 0.02 cm/rev (8) **(Nov/Dec 2016)**

12. A keyway has to be cut in a spindle whose dimensions are 46 cm length , 5 cm diameter and 1 cm width.The cutter dameter is 13.25 cm .If the cutter revolves at 120 rpm,what is the time required to cut a 1 cm deep key way at a feed of 0.05 cm/rev of cutter? (8) **(Nov/Dec 2016)**

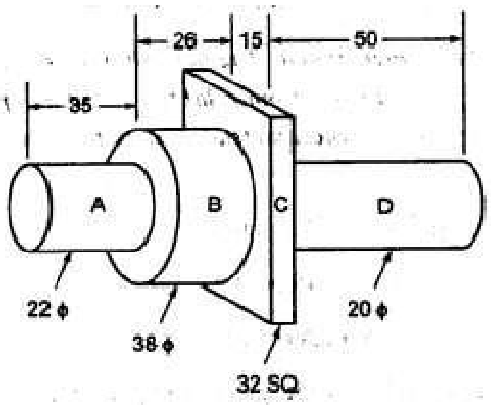
13. A manufacturer is making 100 units of an item per hour and incures the following expenses:

Direct material cost = Rs 35
Direct labour cost = Rs 200
Direct expenses = Rs 75
Factory on cost = 150 % of labour cost
Office on cost = 30 % of factory cost
Find out the selling price for a profit of 15 % on the selling prices (10) **(Nov/Dec 2016)**

14. .A square bar of 3 cm side and 25 cm length is to be hand forged into a hexagonal bar of side of 1.5 cm.Find length of hexagonal bar ignoring metal losses.Density remains same(6) **(Nov/Dec 2016)**

15. .A 25 cm × 10 cm C.L surface is to be faced on a milling machine with a cutter of diameter of 15 cm and 16 teeth.If the cutting speed and feed are 55 m/min and 6 cm /min respectively ,determine the rpm of the cutter ,feed /tooth and the milling time (8) **(Nov/Dec 2016)**

16 .Find the time required for finish grinding a 20 cm long steel shaft to reduce its diameter from 4.5 cm to 4.3 cm with a griding wheel of 2.5 cm face width.Cutting speed is 16 m/min and depth of cut is 0.2 min(6) **(Nov/Dec 2016)**



17. A T Slot is to be cut in a C.I Slab as shown in fig .Estimate the machining time .take cutting speed 25 m/min,feed is 0.25 mm/rev .Dia of cutter for channel milling is 80 mm

ME6012

Maintenance Engineering

SYLLABUS

Unit I

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity– Importance and benefits of sound Maintenance systems – Reliability and machine availability –MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

Unit II

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repairs cycle - Principles and methods of lubrication – TPM.

Unit III

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis

Unit IV

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis –Failures and their development – Logical fault location methods – Sequential fault location.

Unit V

Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance

TEXT BOOKS:

1. Srivastava S.K., “Industrial Maintenance Management”, S. Chand and Co., 1981

2. Venkataraman .K “Maintancence Engineering and Management”, PHI Learning, Pvt. Ltd., 2007

REFERENCES:

1. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., 1995

2. White E.N., “Maintenance Planning”, I Documentation, Gower Press, 1979. 2. Garg M.R., “Industrial Maintenance”, S. Chand & Co., 1986.

3. Higgins L.R., “Maintenance Engineering Hand book”, 5th Edition, McGraw Hill, 1988.

4. Armstrong, “Condition Monitoring”, BSIRSA, 1988.

5. Davies, “Handbook of Condition Monitoring”, Chapman & Hall, 1996.

6. “Advances in Plant Engineering and Management”, Seminar Proceedings - IIPE, 1996.

Course outcomes

CO Nos.	Description of the Cos
CO 1	Explain the principles of maintenance planning
CO 2	Apply reliability concepts in various maintenance systems
CO 3	Summarize maintenance categories and lubrication methods
CO 4	Illustrate the simple instruments used for condition monitoring
CO 5	Examine various repair methods for basic machine elements & material handling equipment
CO 6	Utilize computers in maintenance work

CO-PO Mapping

CO Nos.	Level of correlation* of the COs with the relevant POs/PSOs					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	2	1	-	-	-	2
CO 2	3	2	1	1	-	3
CO 3	2	1	-	-	-	2
CO 4	2	1	-	-	-	2
CO 5	2	1	-	-	-	2

Note(*): 1- Low level, 2- Medium level and 3- High level

UNIT-I

PART-A

1. Define maintenance? (May - 2015)

Maintenance is the routine and recurring process of keeping a particular machine orasset in its normal operating conditionsSo that it can deliver the expected performance or service without any loss or damage.

2. List any two maintenance objectives.

i) To achieve minimum breakdown and to keep the plant in good working condition at the lowest possible cost.

ii) To ensure the availability of the machines and services in an optimum working condition.

3. What is maintenance economics?

Maintenance economics is the application of economic principles in the maintenance of engineering systems. It includes the life cycle cost analysis, evaluation of life of equipment, maintenance cost and budget.

4. What are the basic principles of maintenance planning? (May -2012) (Dec - 2016)

i) Maintenance planning is the task of organizing resources to carry out a job satisfactorily at reasonable cost within a specific period of time.

ii) Maintenance planning involves the assignment of jobs to the maintenance crew.

iii) Job assignment must be done on the basis of proper job scheduling of the maintenance work.

iv) Maintenance planning should be carefully designed in such a manner, it is able to tackle the emergency maintenance as well as to ensure that maintenance work force is fully utilized.

5. Define reliability? (Dec - 2013) (Dec - 2016)

Reliability is defined as the probability that a component /system, when operatingunder given condition, will perform its intended functions adequately for a specifiedperiod of time. It refers to the like hood that equipment will not fail during its operation.

6. State the benefits of reliability analysis in industries?

The main advantages of imposing reliability requirements are increased productivity and reductions in forced outage equipment due to planned maintenanceactivity.

7. Define failure rate?

Failure rate is the ratio of the number of failures during particular unit interval tothe average population during that interval.This failure rate is also known as hazard rate and instantaneous failure rate.

8. What is Mean Failure Rate? (Dec - 2014)

The mean failure rate h is obtained by finding the mean of the failures rates for specified period of time. $h = (Z_1 + Z_2 + Z_3 + \ldots\ldots\ldots + Z_T)/ T$ where, Z_T represents failure rates over the specified period of time T.

9. Define Mean Time to Failure.

Let t_1 is the time to failure for the first specimen, t_2 is the time to failure for the second specimen and t_N is the time to failurefor the Nth specimen. Hence the mean time to failure for N specimens are$MTTF = (t_1+t_2+\ldots\ldots+t_N) /N$

10. What is Mean Time between Failures (MTBF)? (Dec - 2013)

Mean Time between Failures (MTBF) is the mean or average time between successive failures of a product. Mean time between failures refers tom the average timeof breakdown until the device is beyond repair.

11. Define Mean Time to Repair (MTTR)? (May - 2015)

Mean Time to Repair is the arithmetic mean of the time required to performmaintenance action. MTTR is defined as the ratio of total maintenance time and number of maintenance action.

MTTR = Total maintenance time/ Number of maintenance action.

12. Give any four benefits of sound maintenance system.

i) Minimization of downtime.

ii) Extended life of Equipment.

iii) Safety and smooth operation of the process.

iv) Provide proper working environment.

13. Define Maintenance Action Rate? (Dec - 2014)

Maintenance action rate is the number of maintenance action that can be carried out on equipment per hour. M = 1/MTTR

14. Define the term MWT.

MWT refers to Mean Waiting Time. It is defined as the average length of time a customer waits before being served.

15. Define Failure Density?

Failure Density is the ratio of the number of failures during a given unit interval of time to the total number of items at the very beginning of the test.

16. State the types of reliability?

Reliability can be generally of two types:

(i) Inherent Reliability: It is associated with the quality of the material and design of machine parts.

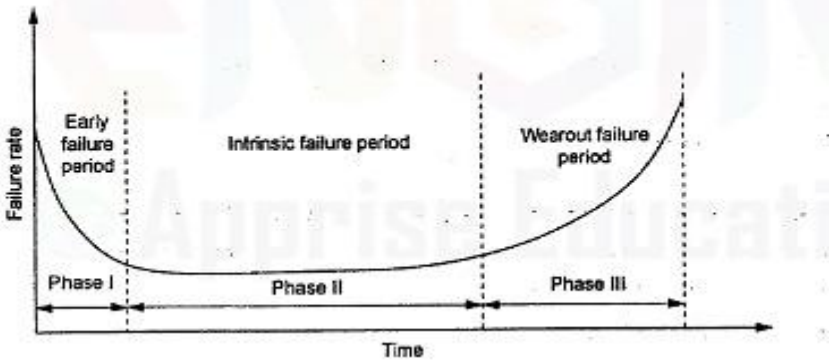
(ii) Achievable Reliability: It depends upon other factors such as maintenance and operation of the equipment.

17. Draw the equipment life cycle and name the various phases In it?

Phase I - Failure pattern inherent in a new product because of manufacturing or design defects.

Phase II - Life period of an equipment

Phase III - Failures due to wear out conditions because to aging of the equipment.



18. Define maintainability?

Maintainability is defined as the probability that a unit or system will be restored to specified working conditions within a given period when maintenance action is taken in accordance with the prescribed procedures and resources.

19. Define availability?

Availability is the ratio of the time at which equipment is available for the designated operation/service to the total time of operation and maintenance of the equipment. It is also defined as the ratio of equipment uptime to the equipment uptime and downtime over a specified period of time.

20. State the advantages of life cycle cost analysis.

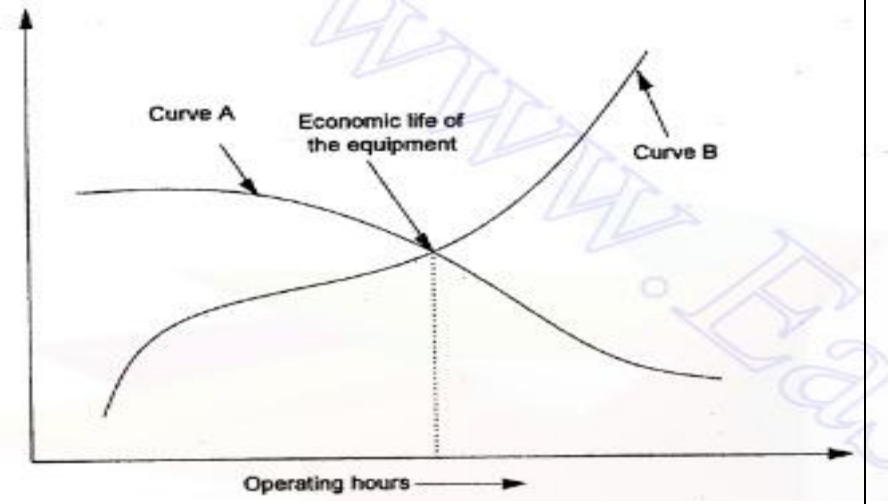
(i) Integration of engineering, economics and financial aspects lead to the wayof robust metric for the selection and purchase equipment required for the industry.

(ii) Reduced operating and maintenance cost of equipment due to cost analysisover span of time.

(iii) It leads to the selection of proper and economically viable equipment.

21. Draw the curve to determine the economic life of equipment?

The economic life of equipment depends on the maintenance and repair costs, availability and operational efficiency. A plot of cumulative efficiency and maintenanceand repair cost per cumulative hours Vs operating hours of the equipment to find the economic life of the equipment is shown in the figure.



22. State the components of maintenance cost? (or) List the main factors of maintenance cost.

The maintenance cost is comprised of two factors:

(i) Fixed cost: This includes the cost of support facilities including the maintenance staff.

(ii) Variable cost: This includes the consumption of spare parts, replacement ofcomponents and cost other facilities requirements of maintenance.

23. State the role of maintenance budget

The maintenance budget is used to set aside certain amount of money to meetthe expenditures incurred in achieving the objectives of maintenance.

24. State the types of maintenance budget?

(i) **Appropriation Budget**: Budget used to allocate money for each activity independently.

(ii) **Fixed Budget**: Fixed used to allocate money for a specified period of time.

(iii) **Variable Budget**: Dynamic allocation of expenditure based on maintenance requirements and activities.

25. Give the types of Maintenance Organization.

i) Line Organization ii) Line and staff Organization iii) Functional Organization iv) Centrally controlled Maintenance Organization v) Area Maintenance Organization.

Part-B

1. Write at least ten maintenance system importance and benefits of availability of reliability information.

2. What do you mean by maintenance job planning? Discuss various steps of maintenance job planning.

3. What are the objectives of maintenance organization and what different types of organizations are in use in Indian industries? (or) Describe the objectives of maintenance organization and what are the different types of organizations? (Dec - 2016)

4. What is equipment availability and what are the three basic approaches to define and quantity availability. (Dec - 2014)

5. Discuss the different areas that can be considered for good maintainability and improvement in maintainability.

6. Discuss the role of R&D in maintenance organization.

7. Briefly explain the reliability centered maintenance and the important elements of MTTR.(May - 2015)

8. Mention the maintenance functions and activities.

9. Drive an expression for determining the mean time to failure. (MTTF) and state the variousobjectives of maintenance planning.

10. Explain in detail maintenance organization and maintenance economics. (May - 2012)

11. Explain MTBS, MTBF, MTTF, MTTR and failure rate? (Dec - 2016) **(**Dec - 2017)

12. State the steps necessary to reduce the maintenance cost in an industry and the benefits of a sound maintenance management system.

13. Explain briefly different types and classes of maintenance cost. (Dec - 2014)

14. What is the difference between Reliability cost and Maintenance cost? (May - 2012)

15. Explain in detail the test plan for determination of MTBF (May - 2012)

16. Explain the objectives and principles of planned maintenance in detail. (May - 2012) (May - 2015) (Dec - 2016)

17. Explain the maintenance Organization structure in detail. (May - 2015)

18. Explain the factors to be considered in maintenance planning. (Dec - 2017)

19. List the important factors to be considered in maintenance economics. (Dec - 2016)

UNIT-II

PART-A

1. What is meant by planned maintenance approach?

The planned maintenance is a proactive approach to maintenance in which the maintenance work is scheduled to take place on a regular basis. This type of organized maintenance is planned, documented and done before the equipment fails. The process of planning the maintenance makes the task more effective and it eliminates the effect of maintenance on the operation of the facility.

2. Define the term Preventive Maintenance?

It is a maintenance program which is committed to the elimination or prevention of corrective and breakdown maintenance. It is designed for day to day maintenance like cleaning, inspection, lubricating, retightening etc. to retain the healthy condition of equipment.

3. Define predictive maintenance?

Predictive maintenance is a management technique that uses regular evaluation ofthe actual operating conditions of plant equipment, production systems and plantmanagement function to optimize total plant operation.

4. What is meant by Breakdown maintenance approach? (Dec - 2014)

It is a type of maintenance approach in which equipment is allowed to function /operate till no failure occurs i.e. no maintenance work is carried out in advance to prevent the failure.

5. Classify various planned maintenance approach. (Dec-2016)

1. Preventive maintenance
2. Corrective maintenance
3. Predictive maintenance
4. Condition based maintenance

6. What are the goals/objectives of preventive maintenance? (May - 2012)

i) To minimize the number of breakdown on critical equipment.

ii) To reduce the loss of production that occurs when the equipment failure takes place.

iii) To increase the productive life of all capital equipment.

iv) To promote better safety and health of the work force.

v) To permit better planning and scheduling of required maintenance work.

7. List down the elements of preventive maintenance.

a. Inspection b. Servicing c. Calibration d. Testing e. Alignment f. Adjustment g. Installation

8. What are the steps involved in preventive maintenance?

Step 1: Analyzing the maintenance system.

Step 2: Reviewing the systems

Step 3: Prioritizing the maintenance

Step 4: Training the maintenance staffs.

Step 5: Implementing the maintenance plan.

9. Mention any four importance of preventive maintenance.

i) Cost incurred towards breakdown maintenance is usually higher than the cost incurred on preventive maintenance.

ii) It keeps equipment in good condition to prevent large problems.

iii) It prolongs the effective life of the equipment.

iv) It detects the problem at earlier stages.

10. What are the disadvantages of preventive maintenance?

i) Catastrophic failures still likely to occur.

ii) Labour intensive.

iii) It includes performance of unneeded maintenance.

iv) Risk of damage when conducting unneeded maintenance.

v) saving not readily visible without a base line.

11. Define Corrective maintenance.

Corrective maintenance can be defined as the maintenance carried out to restore the unserviceable equipment that has stopped working to acceptable standards.

12. Define corrective maintenance approach. (Dec - 2014)

Corrective maintenance is the program focused on regular planed tasks that will maintain all critical machinery and system in optimum operation conditions

13. What is meant by preventive maintenance approach?

A comprehensive preventive maintenance program involves periodical evaluation ofcritical equipment, machinery to detect problem and schedule maintenance task toavoid degradation in operating conditions. It is designed for day to day maintenancelike cleaning inspection, lubricating, retightening etc. to retain the healthy conditionof equipment.

14. List the objectives of corrective maintenance?

1. Elimination break downs
2. Elimination deviations from optimum operating condition.
3. Elimination unnecessary repairs

15. What are the prerequisites of corrective maintenance?

i) Existence of trained full time maintenance planners for accurate identification of root cause of all incipient problems.

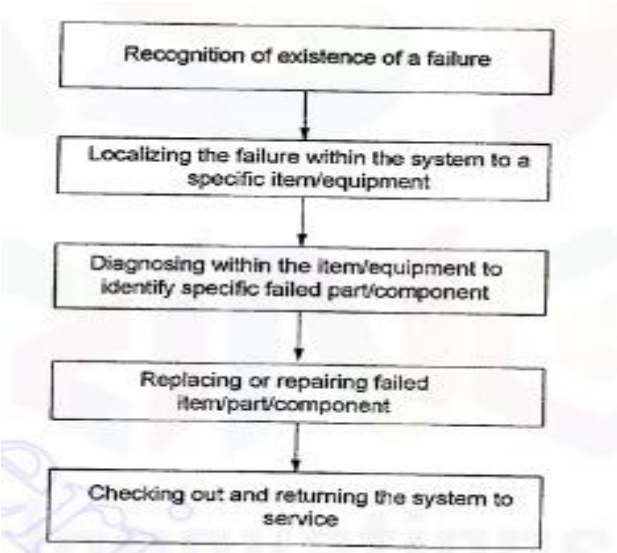
ii) Properly trained craftsmen with necessary skill to complete the repair of each emerging problem.

iii) Standard maintenance procedure for recurring repairs and maintenance task.

iv) Allowing sufficient time to maintenance amidst tight production schedule and management constraints.

v) A thorough verification process to ensure the completion of repair.

16. Draw the flow diagram for the steps of corrective maintenance.



17. Mention the various advantages and disadvantages of Corrective maintenance.

Advantages: i) It lowers the short term costs. ii) It requires less staff, since less work is being done.

Disadvantages: i) It increases long term costs due to unplanned equipment down time. ii) It is prone to neglect of assets. iii) It is possible for secondary equipment or process damage.

18. What is meant by predictive Maintenance?

Predictive maintenance is a management technique that uses regular evaluation ofthe actual operating conditions of plant equipment production systems and plantmanagement functions to optimize total plant operation.

19. List the differences between predictive maintenance and corrective maintenance.

S. No.	*Predictive maintenance*	*Corrective maintenance*
1.	Initially, equipment is assessed to predict when the equipment failure might occur and then maintenance is performed to prevent occurrence of the failure.	Maintenance is carried out to restore the unserviceable equipment that has stopped working to acceptable standards.
2.	Predictive maintenance is done before the problem occurs.	Corrective maintenance is done after the problem occurs.
3.	Highly skilled manpower is required.	Less skilled manpower is sufficient.
4.	It reduces the breakdown losses.	It increases the breakdown losses.
5.	It increases the equipment life.	It reduces the equipment life.
6.	It reduces the maintenance cost.	It increases the maintenance cost.
7.	It increases the cost on condition monitoring equipment.	There is no cost involved on condition monitoring equipment.
8.	There is no possibility of secondary equipment or process damage.	Possibility of secondary equipment or process damage.
9.	Energy cost is low.	Energy cost is high.
10.	Product quality is better.	Product quality is low.

20. List out some condition based monitoring techniques and briefly discuss on them.

1. Vibration monitoring
2. Thermograph
3. Tribology
4. Electrical motor analysis

21. What is meant by reliability centered maintenance (RCM)? (Dec - 2017)

Reliability centered maintenance is one of the well-established systematic and a step by step instructional tool for selecting applicable and appropriate

maintenanceoperation types. It helps in how to analyse all failure modes in a system and define how to prevent or find those failures early.

22. What is total productive maintenance (TPM) and discuss its similarities with TQM? (May - 2015) (Dec - 2013)

Total productive maintenance is a maintenance program which involves a newly defined concept of maintaining plants and equipment. The goal of TPM program is to significantly increase the production, at the same time increasing employee morale and job satisfaction.

23. What does safety, health and environment pillar of TPM aims at?

This pillar aims at achieving Zero accident, Zero health damage and Zero fires.

24. What are the limitations of breakdown maintenance?

1. Most repairs are poorly planned due to time constraint caused by productionand plant management. This will cost three to four times than the same repairwhen it is well planned.
2. This approach focus only on repair or the symptoms of failure and not on theroot cause of failure. This results only in increase in the frequency of repairand correspondingly the maintenance costs.

25. List the benefits of implementing preventive maintenance. (or) Mention the reasons for preventive maintenance to be adopted in the present times. (May - 2015)

1. It maintains the equipment in good condition to prevent them from biggerproblems.
2. Prolongs the effective life of the equipment.
3. Detects the problem at earlier stages.
4. minimizes/eliminates the rework/scrap and helps in reducing the processvariability
5. Significantly reduces unplanned downtime.

26. Name the 5S principles used for implementations of TPM.

1. SEIRI – Sort out
2. SEITON –Organize
3. SEISO – Shine workplace
4. SEIKETSU – Standardization
5. SHITSUKE – Self discipline

27. List the various pillars of TPM? (Dec-2016)

1. 5,S Principle
2. jishu hozen(jh) (autonomous maintenance)
3. Kaizen
4. Planned maintenance (PM)
5. Quality maintenance (QM)
6. Training
7. Office TPM
8. Safety, health and environment

28. What are the objectives of TPM?

The main objectives of TPM are

1. To achieve zero defects
2. To achieve zero accidents and zero break downs in all functional areas of anorganization
3. To create different team of people to have active participation.
4. To aim at minimization of defects and
5. To inculcate autonomous policy.

29. Name the various stakeholders of maintenance scheduling.

1. Operators
2. Planners
3. Schedulers
4. Maintenance supervisors
5. Craftsman
6. Stores incharge

7. Operation superintendent

30. What are the benefits of TPM?

i) Improved productivity and overall plant efficiency

ii) Reduction of manufacturing cost.

iii) customer satisfaction by delivering right quantity at right time with expected quality.

iv) minimization of accidents.

v) High confidence level among employees.

31. Define Maintenance Scheduling.

Maintenance scheduling is a joint maintenance operations activity in which maintenance agrees to make the recourses available at a specific time when the unit can also be made available by operations.

32. What is meant by downtime scheduling? (May - 2012)

Downtime scheduling means to decide when the shutdown time will be done and who will do it without affecting the scheduled activity.

33. Define Repair cycle.

It is a kind of maintenance schedule which involves inspection, repair (minor and major) and overhauling which are repeatedly carried out in sequence.

34. What are the principles of Lubrication?

The primary objective of lubrication is to reduce wear and heat between contacting surfaces in relative motion. By means of lubrication, the coefficient of friction could be reduced and in turn, heat and wear of the surfaces. Lubrication also aids to i) reduce oxidation and rust formation ii) provide insulation in transformer application iii) transmit mechanical power in hydro fluid power systems. iv) seal against dust, dirt and water.

35. Why do you need lubrication? (Dec - 2013)

Lubricants are used to reduce the friction between moving parts due to rubbing of contact surfaces because the friction leads to increase wear and tear of the moving parts increasing the contamination forming rust and corrosion,increasing the power loss due to friction producing heat from the hot moving parts,producing shocks and noise, and damaging the seal against high pressure gases.

PART-B

1. Describe the repair cycle of metallic materials.

2. Describe the purpose and importance of preventive maintenance and List out the sequencing of activities carried out in machine shutdown. (May - 2012)

3. Briefly discuss about the evolution of TPM.

4. Discuss in brief the roles of various stakeholders of maintenance scheduling communication chain? Write down the basic steps in condition monitoring.

5. Illustrate functions of lubrication and explain the different methods of lubrications.(Dec - 2013) (or) what are the functions of lubrication and mention the tips on lubrication.(Dec-2016)

6. Demonstrate the steps involved in preventive maintenance why preventive maintenance is better than reactive maintenance.(May - 2015) (Dec-2016)

7. Explain with sketch various types of maintenance approach?

8. Distinguish between fixed time maintenance and connect based maintenance. Give the merits and demerits.

9. Compare TQM and TPM and their objectives.

10. What do you understand by maintenance categories? Explain common types and explain the basis of their selection. (Dec-2016)

11. Briefly explain the procedure for TPM. (Dec-2016) (Dec - 2017)

12. Explain the different types of automatic lubrication system with a neat sketch. (May - 2012)

13. Discuss the different types of maintenance system and distinguish between planned maintenance and reactive maintenance. (May - 2015)

14. Describe the importance of TPM and documentation. (May - 2015)

15. Explain the methods of analysis of oil and lubricants in detail with a suitable diagram. (May - 2015)

16. Explain briefly about TPM with the help of flow chart?

17. Explain briefly the stages in implementation of TPM.

18. Discuss about the repairable and repair cycle in tools management. (Dec - 2013)

UNIT-III

PART-A

1. What is equipment health monitoring? (or) What is condition monitoring? (Dec - 2013)

Conditions monitoring is one of the maintenance methods which are used toassess the health and condition of equipment machines, systems or process by absorbing checking, measuring and monitoring several parameters. This technique is also called as equipment health monitoring.

2. List down the factors for increasing the demand condition monitoring (or) Explain the role of condition monitoring.

1. Increased quality expectations reflected in produces liability legislation
2. Increased automation to improve profitability and maintaincompetitiveness
3. Increased safety and reliability expectations
4. Increased cost of maintenance due to labour and material cost.

3. List down the key features of condition monitoring. (Dec - 2014)

1. Links between cause and effect
2. Systems with sufficient response
3. Mechanisms for objective data assessment
4. Benefits outweighing cost
5. Data storage and review facilities.

4. Write down the basic steps in condition monitoring.

1. Identifying critical systems
2. Selecting suitable techniques for condition monitoring
3. Setting baselines
4. Data collection
5. Data assessment
6. Fault diagnosis and repair
7. System review

5. What are three types of condition monitoring?

a. Subjective condition monitoring

b. Minimized breakdown costs

c. Improved morality of the operating personnel and safety.

6. List any four condition monitoring techniques.

i) Visual inspection ii) Vibration monitoring iii) Temperature monitoring iv) Lubrication analysis v) crack monitoring vi) corrosion monitoring

7. State the advantages and disadvantages and disadvantages of condition monitoring. (Dec - 2016)

Advantages:

1. Improved availability of equipment
2. Minimized breakdown cost
3. Improved reliability

Disadvantages:

1. Gives only marginal benefits
2. Increased running cost
3. Sometimes difficult to organize

8. Name any four instruments commonly used for condition monitoring methods. (May - 2012) (Dec - 2016)

a. Thermometers and Pyrometers b. Periscopes and Endoscopes c. Accelerometer d. Magnetic Plugs and Filters e. Spectroscopy

9. What are the benefits of condition monitoring?

i) Improved availability of equipment ii) Minimized Break down costs iii) Improved morality of the operating personnel and safety. iv) Improved reliability v) Improved planning

10. Mention the various costs involved in costing of condition monitoring mainly

I. Installation cost

II. Operating cost

11. State the methods of measuring vibration

a. Amplitude

b. Frequency

c. Phase

12. Name the types of pyrometers. (Dec - 2014)

1. Total radiation pyrometers
2. Infra-red pyrometers
3. Optical radiation pyrometers

13. Describe briefly pistol thermometer.

Ideal as a professional diagnostic tool for maintenance professionals, the high-end Fluke 576 non - contact, pistol-grip thermometer enables the capture of a simultaneous time stamped digital photographic image as a temperature reading is taken. The logged results and images from upto 100 locations can be uploaded via a USB connection to a PC using the windows based software that comes with the thermometer.

14. State the advantages of filled system thermometer. (May - 2012)

i) They are self contained. They do not require auxiliary power unless they are combined with an electronic transmission system.

ii) Simplicity of design makes them inexpensive.

iii) Sensitivity, speed of response and accuracy generally satisfy most of the requirements of the process industries.

iv) They are simple and rugged.

15. Mention the applications of bimetallic strip.

1. Bimetallic strips are frequently used in simple ON – OFF switches.
2. The bimetal strips are also used in control switches.

16. List down the features of RTD.

1. High degree of accuracy

2. Resistance thermometer is interchangeable in a process withoutcompensation or recalibration.

17. State the application and limitation of thermistors.

Applications:

1. It is used for varying temperatures
2. It is used in time delay circuits
3. Thermistors are used for temperature compensation.
4. It is used to measure thermal conductivity.
5. It is used to measure pressure and flow of liquids.
6. It is used to measure gas composition.

Limitations:

1. Self heating may occur.
2. It provides highly non linear behaviour over its range of operation.
3. Possible to have an increase of resistance when time lapses.

18. What is meant by Thermography? (May - 2015)

A Thermography technique uses the distribution of surface temperatures to assess the structure or behaviour of what is under the surface called Thermography.

19. What are two main types of infrared thermography?

1. Passive thermography
2. Active thermography

20. Mention few uses of Infrared thermography.

Applications	*Condition detected*
1. bearings	Overheated
2. Boilers	Wall deterioration
3. Cutting tool	Sharpness
4. Die casting/injection moulding equipment	Temperature distribution
5. Distribution panels	Overheating
6. Dust atmospheres (coal, sawdust)	Spontaneous combustion indications
7. Furnace tubes	Heating patterns
8. Heat exchanger	Proper operation
9. Kilns and furnace	Refractory breakdown
10. Electrical motors, generators etc.	Hot bearings
11. Paper processing	Uneven drying
12. Piping	Locating underground leaks
13. Polluted waters	Sources of dumping in rivers
14. Power transmission equipment	Bad connections
15. Electrical panels, breakers, switchgear, splices, insulators, starters, contractors, wiring	Heating, wear and melting of contact points etc.

21. List the advantages of infrared thermography over other inspection methods.

i) Quick problem detection without interrupting service.

ii) Prevents premature failure and extension of equipment life.

iii) temperature profile can be recorded and displayed easily.

iv) It has wide temperature range from -17°C to 900°C.

v) It identifies potentially dangerous or hazardous equipment.

22. List down the types of lubrication analysis.

i) Fluid properties analysis ii) Fluid contamination Analysis iii) Wear debris analysis

23. Mention some of the lubricant monitoring techniques.

1. Spectroscopic Analysis 2. Ferrography 3. Magnetic plug chip 4. Filter debris analysis

24. Write short notes on Wear debris analysis. (Dec - 2013)

Wear Debris Analysis (WDA) is related to oil analysis only in which particles to be studied are collected through drawing a sample of lubricating oil. WDA

provides direct information about the wearing condition of the machine train whereas the lubrication oil analysis determines the actual condition of the oil sample. Particles in the lubricant of a machine can provide significant information about the condition of the machine. This information is obtained from the study of particle shape, composition, size and quantity.

25. What are the types of wear? (May - 2015)

a. Rubbing wear b. Cutting wear particles c. Rolling fatigue d. Combined rolling and sliding wear e. Severe sliding wear.

26. List the flaws which can be identified by liquid penetrant test.

a. Fatigue cracks b.Quench cracks c. Grinding cracks d. Overload and impact fractures e. Porosity f. Pin holes in welds g. Lack of fusion along the edge of bond line.

27.What are the principles very important for the study of eddy current test.

i. Permeability
ii. Conductivity
iii. Material thickness
iv. Edge effect and end effect
v. Lift off
vi. Fill factor

28. Describe the limitation of eddy current test.

The main limitation is the low penetration of parts being examined, using limitedto thin walls or near surface flaws. It is difficult to use on ferromagnetic materialsFalse indications are possible because of mixed variables, edge effects and lift-offeffects. Extensive technical knowledge is required for the development ofinspection procedures, specific probes and to interpret the inspection data.

29. List the applications of Radiography test.

i) Used to inspect most types of solid material, both ferrous and non ferrous alloys, non-metallic materials and composites.

ii) Used to inspect the condition and proper placement of components for proper liquid fill level in sealed components etc.,

iii) Used extensively on castings, weldments, forgings and parts when there is a critical need to ensure freedom from internal flaws.

iv) Well suited to the inspection of semiconductor device for cracks, broken wires, unsoldered connections, foreign materials and misplaced components.

30. Mention the effect of X-rays to human body?

I. Injuries to superficial tissue

II. General effects on the body, particularly the blood forming organs; eg. Producers of anemia and leukaemia

III. Induction of mahgnant tumors.

IV. Genetic effects.

V. Cataracts, imparred fertility,reduction of life span.

31.What are the limitations of ultrasonic test?

a. Unfavourable geometries and coarse anisotropic grain structures aredifficult to inspect.

b. extensive technical knowledge is required for the development ofinspection procedure.

c. Parts that are rough, irregular in shape, very small or thin or nothomogenous are difficult to examine, specific probes and to interpretthe inspection data.

32. Name some of the methods of leakage monitoring.

1. Interstitial monitoring
2. Level monitoring
3. Vapour monitoring
4. Liquid Monitoring

33. Describe the applications of leakage monitoring.

Leak testing can be employed in a variety of components and ways in both pressure and vacuum modes. It can be used for jobs as big as reactor vessels, piping systems, heat exchangers and as small as hermetically sealed components such as transistors. It is widely used to detect leaks in weld, braze and adhesive bonds, glass envelopes, vacuum chambers, elastomer and metal gasket seals, liquid metal containers and components.

35. Define see back effect?

The basic principle of thermocouple is 'when two dissimilar metals are joined together and emf will exist between the two points A and B, which is primarily a function of thejunction temperature. The above said to be principle of see back effect.

36. State the various methods of corrosion monitoring?

a. Weight loss method b. Electrical resistance method c. Linear Polarization method d. Corrosion potential measurement e. Ultrasonic testing f. Sentinel hole method.

PART-B

1. Describe leakage monitoring and explain some of the leakage mediums used for condition monitoring. (Dec - 2014)

2. Examine wear debris analysis what are the three wear debris analysis techniques commonly used and compare their performance and uses? (May - 2012) (Dec - 2016)

3. Discuss the different instruments used for condition monitoring and explain off line condition monitoring system. (Dec - 2016)

4. What is condition monitoring and explain condition monitoring. what type of condition monitoring are normally used in industry.

5. Describe thermal monitoring and what thermal monitoring are used in industries Explain principleand uses of thermograph.

6. Explain on-load and off-load testing used in condition monitoring with its flow chart and Detail the methods and instruments of CM.

7. Describe the six categories of equipment condition monitoring methods and explain with a neat sketch the construction and working of pistol thermometer. (May - 2012)

8. Explain how cost comparison is done in condition monitoring and explain on load and off load testing used in condition monitoring with its flow diagram.

9. Briefly explain various methods and instruments for condition monitoring. (Dec - 2014)

10. How system approach to condition monitoring can be useful? Explain

11. Briefly explain the cost comparison with and without condition monitoring.

12. Explain the principle and working of Pistol Thermometer. (May - 2015) (Dec - 2016)

13. Describe the various types of Non destructive testing techniques for condition monitoring. (May - 2015)

14. Describe briefly the objectives of cost estimating in the condition monitoring. (May - 2012)

UNIT-IV

PART-A

1. Define the term failure.

The term failure may be defined as

1. any loss that interrupts the continuity of production
2. a loss of assets availability
3. the unavailability of equipment
4. a deviation from the status quo
5. not meeting target expectations
6. Any secondary defect.

2. What are the various possible causes for a failure ?

- Unexpected and unintentional damage \
- Workmanship
- Improper design
- Manufacturing defects
- Incorrect usage of equipment

3. Define failure analysis?

Failure analysis is the process by which information/data about failure occurringin equipment/ systems are collected and analysed to find the root cause of failures, andthe causes are addressed to prevent recurrence of failures.

4. Name the three types of failure models?

- Predictable failure model
- Unpredictable failure model
- Running-In-Failure model

5. What are called age-dependent failures?

Time dependent failures are called age dependent failures

6. What are predictable failures?

In spite of all the working conditions maintained at same level, the cause offailure will be random in nature and cannot be assigned to any particular mechanism offailure. This type of failures is called Unpredictable Failures.

7. What are Running In Failures?

Suppose if some components/ equipment are installed with unnoticed defects, mayfail in a short duration after installation than during its useful life. This type offailures is Running In Failures.

8. Define Fault tree diagrams. (Dec- 2017) (Dec - 2014)

Fault tree diagrams are logic block diagrams that display the state of a system interms of the states of its components.

9. Write down the capabilities of Fault Tree Diagram.

1. Fault tree analysis and failure modes and effects analysis,
2. Design for reliability
3. Design for safety

10. Define Event tree Analysis. (Dec - 2014)

An event tree is a visual representation of all the events which can occur in asystem. As the number of events increases, the pictures fans out like the branches ofa tree

11. What is the aim of event tree analysis?

The aim of event tree is to determine the probability of an event based on theoutcomes of each event in the chronological sequence of events leading up to it. Byanalyzing all possible outcomes, we can determine the percentage of outcomeswhich lead to the desired result.

12. What is the drawback of fault tree analysis? (May- 2012)

i) Though fault trees may reveal human error, they do little to determine the underlying cause.

ii) Not suitable for assessing normal operations.

iii) Fault trees may become very large and complex.

13. Define Root cause analysis?

RCA is a step by step method that leads to the discovery of faults first or root cause.Every equipment failure happens for a number of reasons. There is a definiteprogression of actions and consequences that lead to a failure. An RCAinvestigation from the end failure is back to the root cause.

14. Define FMEA?

FMEA is methodology for analyzing potential reliability problems early in thedevelopment cycle where it is easier to take actions to overcome the issues, therebyenhancing reliability through design.

15. Define Risk Priority Number(RPN)

Risk priority numbers is the product of the numerical severity, occurrence anddetection ratings.

RPN = (S) X (O)X(D)

16. Name the factors based on the satisfactory performance of gears/drives.

I. Proper design and manufacture of drive

II. Selection of proper type and size

III. Proper installation

IV. Proper use of service

V. Proper maintenance of unit in it entire life.

17. Name the factors that contribute to tooth breakage.

The common reasons for gear tooth breakage may be due to any of the followingreasons

a. Fatigue

b. Heavy wear

c. Overload

d. Cracking

18. List some of the inspection performed on gears

1. Pitch error
2. Axial and
3. Radial run out
4. Tooth profile etc.

19. Name some of the geometric properties that are checked for guide ways.

1. Straightness
2. Flatness
3. Parallel both on horizontal and vertical surfaces.

20. What are the factors influence the performance of sleeve bearings.

The following are the factors that affect the bearing performance:

1. Dirt
2. Fatigue
3. Hot Shot phenomenon and
4. Crush problem

21. Define Crush

Normally, the bearings are manufactured so that they are slightly longercircumferentially than the mating housing. The bearing will be elastically deformedduring assembly. If the amount of crush is insufficient, relative motion occurs between the bearing and its bore, which causes fretting and makes the bearing back a highly polished or pitted.

22. What are the geometric properties that are checked for slide ways? (Dec - 2017)

a. Non linearity on all guiding surfaces b. Relative parallelism of surfaces with the lead screw axis. c. Parallelism between surface with the longitudinal transverse axis.

23. Give any for repair methods for spindles. (May - 2012)

Repairing spindles includes processing and disassembly, spindle assessment, grinding and other subsequent repairs such as machining and bearing replacement, reassembly and testing for efficiency and additional maintenance procedures such as acoustic and stability control as well as vibration evaluation.

24. Define FCFA. (May - 2015)

Fundamental cage frequency amplitude (FCFA) is the rotational frequency of the cage.

25. What are the benefits of fault Tree diagram. (Dec- 2016)

i) Used to identify possible system reliability or safety problems at design time.

ii) Used to assess system reliability or safety during operation.

iii) helps to improve understanding of the system.

iv) It can identify the root cause of equipment failures.

26. What are called Age dependent failures? (Dec - 2016)

Time dependent failures are called age dependent failures.

PART-B

1. With a neat sketch explain repair method of lathe bed guides and how the repair method of bearing is done. (May - 2015)

2. List a few causes of failures in an electromechanical system like compressor, pumps and elevators. .(May - 2015)

3. Discuss the steps involved in performing FEMA and details about sequential fault location methods. .(May - 2012)

4. Describe the fault tree method with examples.

5. Discuss the repair methods of bearings.(May - 2015)

6. Explain the repair method for lead screws and the logical fault location methods.(Dec - 2014)

7. Briefly discuss on following as regard to bearings: (i) failures (ii) characterization of failures (iii)causes (iv) solutions.

8. Discuss about the types of failure mechanisms and the merits of criticality matrix. (May - 2015)

9. With the aid of suitable sketches, describe the method of repairing cracks in machine bed by (i) riveting (ii) hot clamping.

10. What are the methods followed to repair spindles, gears, lead screw and slide ways? Explain. (May - 2015) .(May - 2012) (Dec - 2016)

11. Describe the following symbols associated with the fault tree analysis method - a. Diamond b. Rectangle c. circle .(May - 2012)

12. Explain the following in detail i) Logical fault location methods ii) Sequential fault location methods.(Dec - 2016)

13. What is failure analysis? Narrate its development. **(**Dec - 2016)

14. Briefly Explain the following: i) Failed part analysis ii) Any four approaches for risk management. (Dec - 2017)

15. Briefly Explain the following: i) Repair methods of machine guideways ii) FMEA and RPN. (Dec - 2017)

UNIT-V

PART-A

1. State few examples of material handling equipment. (May - 2015)

Material handling equipment include carts, hand trucks, fork lifts, conveyors, shelf pickers and other specialized industrial trucks powered by electric motors or internal combustion engines.

2. State the benefits of proper maintenance of material handling equipment.

The benefits of a maintenance program for material handling equipment are tomaintain the high efficiency, keep them in running condition, reduce the cost of repairs,safer operation and enhanced productivity.

3. State the major stages in preventive maintenance of material handling equipment.(Dec - 2017)

There are three stages of preventive maintenance are:

1. Inspection
2. Repair and
3. over haul

4. State the various phases present in a good maintenance management system.

1. Work identification
2. Planning
3. Scheduling
4. Execution
5. Recording and
6. Analysis

5. Define the term computerized maintenance management system (CMMS)

Computerized maintenance management system is the application of computers inplanning, scheduling, monitoring and control of maintenance activities.

6. State the objectives of CMMS.

1. Maintenance of existing equipment
2. Inspection and service of the equipment

3. installation or revamping of the equipment

4. Maintenance storekeeping

5. craft administration

7. State the advantages of CMMS. (or) List the advantages of computers in maintenance.(May - 2012) (May - 2015)

1. Improve maintenance efficiency

2. Reduce maintenance costs

3. Reduce the equipment downtime by proper scheduling preventativemaintenance.

4. provide maintenance reports in specific formats depending on therequirements.

5. Quicker access to plant maintenance statistics

8. Define work order system. (Dec - 2014)

Work order system is the information system used by the industry to keep track ofits maintenance works.

9. Mention the use of work order backlog.

Work order back log is used to find out all active maintenance works orderin an industry.

10. What is work permit?

Work permits are components of work order. Maintenance department issueswork permits to different executing agencies permitting them to start their work.

11. What is job card?

Job cards contain necessary details for performing individual job in maintenanceorganizations. Job card may be in the form of a card, sheet or printout.

12. State the benefits of job card system.

1. Information about maintenance history

2. Knowledge of frequency of frequency of maintenance for equipments

3. Details of equipments which require maximum resources

4. Helps in job auditing

5. Evaluation of cost of maintenance.

13. State the role equipment records in maintenance.

Equipment records are information containing the details of installation, service,repair, maintenance activities, schedules and plans for future implementation.Equipment records are to be used to maintain control on maintenance cost,reliability and availability.

14. State the benefits of keeping equipments records.

1. clear picture about the details of maintenance programmes is obtained.
2. information about completed, pending and regular jobs carried out to theequipment are available
3. Records disseminated to various units of the industry.
4. Helps in standardization of procedures.
5. Evaluation of performance of maintenance tasks.

15. List some of the inspection performed on gears

Pitch error
Axial and
Radial run out
Tooth profile etc

16. Define Root cause analysis?

RCA is a step by step method that leads to the discovery of faults first or root cause.Every equipment failure happens for a number of reasons. There is a definiteprogression of actions and consequences that lead to a failure. An RCAinvestigation from the end failure is back to the root cause.

17.List the main factors of maintenance cost?

The maintenance cost is comprised of two factors:

(i) Fixed cost: This includes the cost of support facilities including the maintenance staff.

(ii) Variable cost: This includes the consumption of spare parts, replacement ofComponents and cost other facilities requirements of maintenance.

18.Name the three types of failure models?

- Predictable failure model
- Unpredictable failure model
- Running-In-Failure model

19.Define Event tree Analysis

An event tree is a visual representation of all the events which can occur in asystem. As the number of events increases, the pictures fans out like the branches ofa tree

20.What are two main types of infrared thermography?

1. Passive thermography
3. Active thermography

21. What are the functions of CMMS? (Dec - 2017)

i) Development of a database to support utilization of periodic maintenance programmes

ii) Analysis of available past records if available to ensure the frequency of maintenance programmes. iii) Development of maintenance schedules. iv) Availability of maintenance materials and manpower.

v) Feedback control system for assessment of programmes carried out.

22. Discuss the degree of maintenance required for cranes. (Dec - 2016)

i) To keep the attachments in overhead cranes loaded within the rated capacity.

ii) To maintain safety factors for replacement parts according to manufacturers specifications.

iii) To keep rail level grounded, properly aligned, properly spaced, and securely attached to the supporting structure free of beading and bends.

iv) To check welded connections for cracks, bends, abrasion and corrosion.

v) To examine over speed sensing/ stopping mechanisms. Brakes, and clutch, sheaves, pins, gears, cables, hooks, rails etc., for wear and maladjustment.

PART-B

1. Discuss in detail any four material handling equipment repair methods.

2. Describe the general structure of six phases of good maintenance management?

3. Discuss the maintenance procedure for various small equipment for material handling purpose like chain block, chain, rope, trolley and R.G.B. **(Dec - 2014)**

4. Explain the work order flow diagram and what is job card system? State its benefits. (Dec - 2017)

5. Describe the general structure of computerized maintenance management system?

6. Explain the preventive maintenance strategies for cranes and detail about maintenance monitoring, execution and control.

7. Explain the need and importance of equipment record with suitable example. (May - 2012)(May - 2015)

8. Explain the job order system and write the role of computer in maintenance. **(**May - 2015)

9. Discuss briefly the structure of a computer-assisted maintenance system and any two methods of job evaluation in detail. (May - 2012)

10. Explain the maintenance strategies for i) Cranes ii) Conveyors (Dec - 2017)

11. Discuss briefly the maintenance requirements for belt conveyors. (May - 2012)

12. Describe the repair methods of material handling equipment of elevator. (May - 2015)

13. Describe the applications of computers in maintenance management system. (May - 2015)

14. Explain various hydraulic and pneumatic equipment used in material handling purpose. How to maintain it. (Dec - 2014)