CBCS SCHEME

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17ME61

Sixth Semester B.E. Degree Examination, June/July 2023
Finite Element Analysis

Time: 3 hrs. Max. Marks: 100

Note : 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Assume the suitable value for the missing data.***

Module-1

1 a. What is FEA? Explain the basic steps involved in FEA for stress analysis of an Elastic body. **(10 Marks)**

b. Use Rayleigh – Ritz method to find stress and displacement at the midpoint of a bar shown in Fig. Q1(b). Take E = 70GPa ; A = 100mm^2. Assume the displacement model to be 2nd order polynomial. **(10 Marks)**

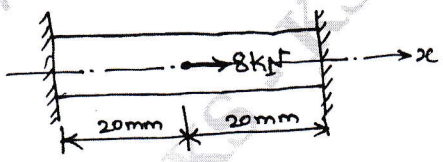

Fig.Q1(b)

OR

2 a. What are Interpolation function? Explain Interpolation model for Simplex Element , Complex and Multiplex Elements in detail. **(10 Marks)**

b. Use the Galerkin's method, to obtain the approximate solution of the differential equation.

$$\frac{d^2y}{dx^2} - 10x^2 = 5 \qquad 0 \le x \le 1$$

With boundary condition y(0) = y(1) = 0. Take the trial function as $N_1(x) = x(x-1)$ and $N_2(x) = x^2(x-1)$. **(10 Marks)**

Module-2

3 a. Derive the shape function for the one dimensional bar element, in natural coordinate system. **(10 Marks)**

b. For the triangular element, shown in Fig. Q3(b), obtain the strain displacement matrix 'B' and determine strain ϵ_x , ϵ_y and γ_{xy}. Nodal displacement {q} = {2 1 1-4 -3 7} × 10^{-2}mm. **(10 Marks)**

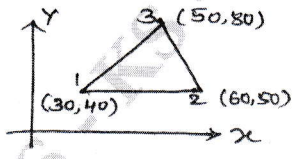

Fig.Q3(b)

OR

4 a. Using Penalty method of Handling boundary condition, determine the nodal displacement , stress in each element in bar shown if Fig. Q4(a) due to applied force P = 100kN. Take E_{steel} = 200GPa ; E_{cu} = 100GPa. **(10 Marks)**

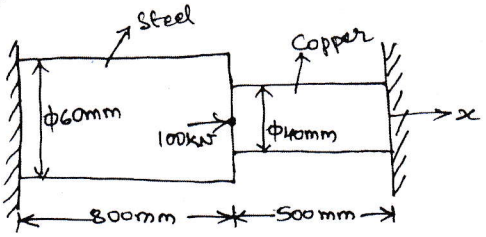

Fig.Q4(a)

b. For the two bar truss shown in Fig. Q4(b) , determine the nodal displacement , stresses in each element. Take $E = 2 \times 10^5$ N/mm^2 , $A = 200$mm^2. **(10 Marks)**

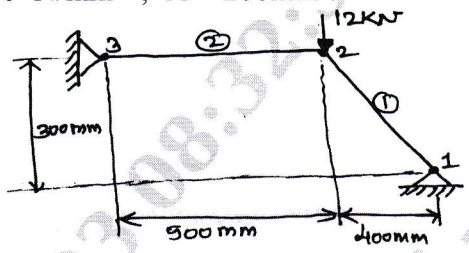

Fig.Q4(b)

Module-3

5 a. Derive Element Stiffness matrix for the Beam Element in Global Coordinate System. **(10 Marks)**

b. Solve for vertical deflection and slopes , at point 2 and 3, using beam elements for the structure shown in Fig. Q5(b). Also determine the deflection at the counter of the portion of the beam carrying UDL. $E = 2 \times 10^8$kN/m^2 , $I = 4 \times 10^6$mm^4. **(10 Marks)**

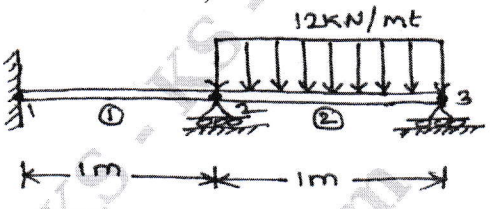

Fig.Q5(b)

OR

6 a. Derive an Potential energy functional for beam element. **(08 Marks)**

b. A solid stepped bar of circular cross – section as shown in Fig. Q6(b), subjected to a torque of 2kN/m at its free end and a torque of 5kN/m at its change in cross – section. Determine the angle of twist and shear stress in the bar.
Take $E = 2 \times 10^5$N/mm^2 and $G = 7 \times 10^4$ N/mm^2. **(12 Marks)**

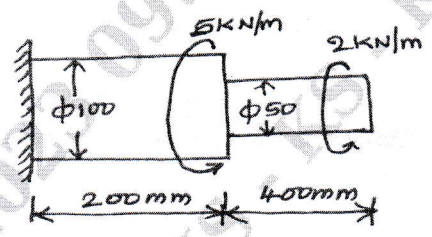

Fig.Q6(b)

Module-4

7 a. Find the temperature distribution in 1 – D fin as shown in Fig. Q7(a). **(10 Marks)**

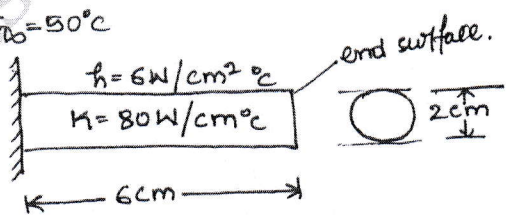

Fig.Q7(a)

b. Derive Fluid flow stiffness matrix for a 1 – D base element. **(10 Marks)**

OR

8 a. For the brick wall shown in Fig. Q8(a), the inner surface temperature is 28°C and outer surface is exposed to cold air at -15°C. Determine the temperature distribution in steady state within the wall by considering 2 one dimensional heat flow elements. **(08 Marks)**

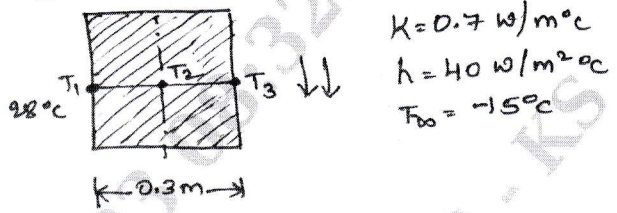

Fig.Q8(a)

b. Solve for temperature distribution in the composite wall as shown in Fig. Q8(b). Using 1 – D heat elements, use Penalty approach of handling boundary condition. **(12 Marks)**

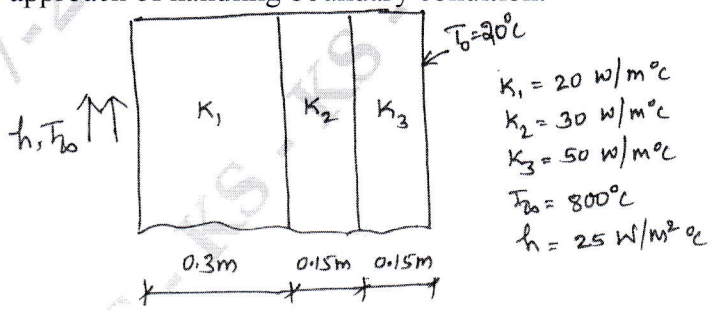

Fig.Q8(b)

Module-5

9 a. Derive an Strain displacement matrix [B] for an Axisymmetric Triangular Element. **(10 Marks)**

b. For the element of an axisymmetric body rotating with a constant angular velocity w = 100 rev/min as shown in Fig. Q9(b), evaluate the approximate body force matrix. Include the weight of the material, where weight density $\rho_w = 0.283$ lb/in^3. **(10 Marks)**

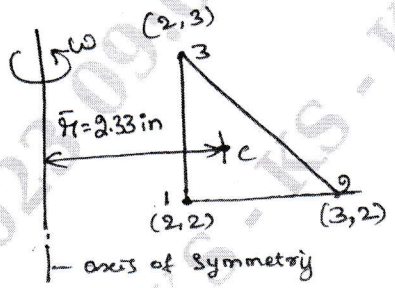

Fig.Q9(b)

OR

10 a. Derive an Consistent mass matrix for the bar element by Variational method. **(10 Marks)**

b. Derive an Consistent mass matrix for truss element in Global co-ordination system. **(10 Marks)**

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CBCS SCHEME

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17ME63

Sixth Semester B.E. Degree Examination, June/July 2023
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Heat Transfer data hand book is permitted, steam table is permitted.***

Module-1

1 a. Explain the different modes of heat transfer with laws governing them. **(09 Marks)**

b. What are the three thermal boundary conditions? Explain. **(06 Marks)**

c. Derive an expression for rate of heat transfer and variation of temperature with radius for a hollow cylinder. **(05 Marks)**

OR

2 a. Derive the generalized three dimensional conduction equation in Cartesian Co-ordinates under unsteady state with heat generation. State the assumptions made. **(10 Marks)**

b. A thin metal sphere of diameter 300 mm is used to store a liquefied gas at -200°C. To reduce heat leakage from atmosphere at 30°C, it is insulated by two layers of insulation each 30 mm thick. The first layer of insulating material has a thermal conductivity of 0.06 W/m-K and second layer has a thermal conductivity of 0.6 W/m-K.
Determine the heat leakage,
(i) When the better insulator is next to sphere
(ii) When the better conductor is next to sphere. **(10 Marks)**

Module-2

3 a. Derive an expression for critical thickness of insulation for a cylinder and explain its significance. **(08 Marks)**

b. An casing of electric motor is an approximate cylinder of 250 mm diameter and 500 mm long. There are 30 equispaced longitudinal fins of thickness 5 mm, height 25 mm on the pheripherry of casing. If the temperature of casing is 56°C and ambient temperature is 26°C. Determine heat dissipation from casing body. Take $h = 25$ W/m^{2}K and K(fin) = 30 W/m-K. Assume that fins are insulated at the tip. **(12 Marks)**

OR

4 a. Derive an expression for the temperature distribution and rate of heat transfer for a pin fin, when the tip of the fin is insulated. **(12 Marks)**

b. A 12 cm diameter long bar initially at a uniform temperature of 40°C is placed in a medium at 650°C with a convective co-efficient of 22 W/m^{2}K. Calculate time required for a bar to reach 255°C. Take K = 20 W/m-K, $\rho = 580$ kg/m^3, C = 1050 J/kg-K for material of bar. **(08 Marks)**

Module-3

5 a. Explain the physical significance of,
(i) Prandtl number (ii) Reynold's number
(iii) Nusselt number (iv) Grashoff number. **(08 Marks)**

b. A square plate (0.5m × 0.5m) with one surface insulated and the other surface maintained at temperature of 385 K is placed in ambient air at a temperature of 315 K. Calculate the average heat transfer co-efficient for free convection for the following orientations of the hot surface :
   (i) The plate is horizontal and hot surface faces up.
   (ii) The plate is horizontal and hot surface faces down. **(12 Marks)**

OR

6 a. Using dimensional analysis, obtain the dimensionless parameters in-forced convection heat transfer. **(10 Marks)**

b. Air at 25°C and atmospheric pressure flows across a heated cylinder of diameter 7.5 cm. If the velocity of air flow is 1.2 m/s and the cylinder surface is maintained at 95°C, compute the rate of heat transfer. **(10 Marks)**

Module-4

7 a. State and explain the following laws of radiation:
   (i) Kirchoff's law.
   (ii) Plank's law.
   (iii) Weins displacement law
   (iv) Lambert cosine law **(08 Marks)**

b. Two large parallel plates of equal area are at temperature 150°C and 40°C while their emmisivities are 0.6 and 0.7. If the radiation shield of emissivity 0.04 is inserted between the plates. Estimate the percentage reduction in heat transfer and equilibrium temperature of radiation shield. **(12 Marks)**

OR

8 a. Explain briefly the concept of black body. **(05 Marks)**

b. For a black body enclosed in a hemispherical space, prove that emissive power of the black body is π times the intensity of radiation. **(07 Marks)**

c. Define : (i) Emissive power (ii) Radiation shield
   (iii) Radiation shape factor (iv) Radiosity **(08 Marks)**

Module-5

9 a. Define LMTD and obtain an expression for LMTD for parallel flow heat exchanger. **(10 Marks)**

b. A counter flow concentric tube heat exchanger is used to cool the engine oil [C_P = 2130 J/kgK] from 160°C to 60°C with water available at 25°C as the cooling medium. The flow rate of cooling water through inner tube of 0.5 m diameter is 2 kg/s. While flow rate of oil through outer annulus of diameter 0.7 m is also 2 kg/s. If the value of overall heat transfer co-efficient is 300 W/m^{2}K. How much length the heat exchanger should be to meet its cooling requirement. **(10 Marks)**

OR

10 a. With neat sketch, explain different regims of pool boiling. **(08 Marks)**

b. Explain filmwise and dropwise condensation. **(06 Marks)**

c. Air free saturated steam at a temperature of 65°C condenses on a vertical outer surface of a 3 m long vertical tube maintained at a uniform temperature of 35°C. Assuming film condensation, calculate the average heat transfer co-efficient over the entire length of the surface. **(06 Marks)**

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CBCS SCHEME

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17ME64

Sixth Semester B.E. Degree Examination, June/July 2023
Design of Machine Elements – II

Time: 3 hrs. Max. Marks: 100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. Use of design data hand book is permitted.
3. Missing data, if any, may be suitably assumed.

Module-1

1 a. The section of a crane book is rectangular in shape whose width is 30mm and depth is 60mm. The centre of curvature of the section is at a distance of 125mm from the inside section and the load line is 100mm from the same point. Find the capacity of the hook if the allowable stress in tension is 75N/mm^2. **(10 Marks)**

b. Determine the maximum tensile stress of the machine component shown in Fig.Q1(b) and indicate the location.

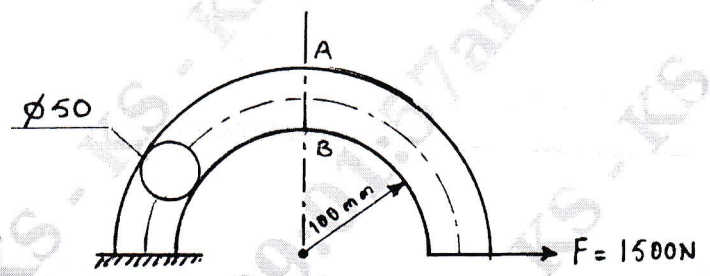

Fig.Q1(b) **(10 Marks)**

OR

2 a. A cast iron cylindrical pipe of outside diameter 300mm and inside diameter 200mm is subjected to an internal fluid pressure of 20N/mm^2 and external fluid pressure of 5N/mm^2. Determine the tangential and radial stresses at the inner, middle and outer surface. **(10 Marks)**

b. A solid shaft of 125mm diameter is to be pressed into a steel flange which has outside diameter of 150mm and length of 100mm. Take E = 21 × 10^{4}N/mm^3, γ = 0.3 and μ = 0.2. Determine :
i) Pressure between hub and shaft
ii) Proper size of bore so that the maximum stress in the bore does not exceed 160N/mm^2
iii) Force required to press the parts together
iv) Torque capacity of the press fit. **(10 Marks)**

Module-2

3 a. Obtain an expression for the ratio of belt tension in an flat belt. **(06 Marks)**

b. Select a v-belt drive to connect at 15KW, 2880 rpm motor to a centrifugal pump, running at approximately 2400 rpm for a service of 18hr per day. The centre distance should be approximately 400mm. Assume the pitch diameter of driving pulley as 125mm. **(14 Marks)**

OR

4 a. Derive an expression for the deflection of a close coiled helical spring. **(06 Marks)**

b. A railway wagon weighing 50kN and moving with a speed of 8km/hr has to be stopped by four buffer springs in which the maximum compression allowed is 220mm, Find the number of turns or coils in each spring of mean diameter 150mm. The diameter of spring wire is 25mm. Take G = 84GPa, Also find the shear stress. **(14 Marks)**

Module-3

5 A compressor running at 250rpm is driven by a 18kw, 1000rpm motor through a 20° FDI spur gear. The centre distance 160mm. The pinion is made of steel, SAE3245 having static allowable stress 500MPa. Gear is made of steel SAE4640 of static allowable stress 379MPa. The pinion has 20 teeth. Considering class – III precision gears suggest suitable surface hardness for the gear pair. Consider service factor = C_S = 1.5. **(20 Marks)**

OR

6 Design a pair of Bevel gear to connect two shafts at 60°. The gears are alloy steel of case hardened having allowable stress 345MPa and precision cut with form cutters. The gear ratio is 5 : 1. The power transmitted and 30KW at 900rpm of the pinion. The teeth are 20° full depth. The pinion has 24 teeth service factor, C_S = 1.5. Suggest suitable surface hardness for the gear pair. **(20 Marks)**

Module-4

7 a. Explain self locking in worm gearing. **(02 Marks)**

b. Complete the design and determine the input capacity of a worm gear speed reducer unit which consists of a hardened steel worm and ordinary cast iron gear having 20° stub involute teeth. The centre distance is to be 200mm and transmission ratio is 10 and the worm speed is 2000rpm. **(18 Marks)**

OR

8 a. Determine the power transmitted by a single pair plate clutch, assuming uniform pressure distribution. The friction surface have an outside diameter of 350mm and inner diameter of 280mm. The co-efficient of friction is 0.25 and the maximum allowable pressure is 0.85MPa. Consider the speed 1000rpm. **(10 Marks)**

b. A band brake shown in Fig.Q8(b), uses a v-belt. The pitch diameter of the v-grooved pulley is 400mm. The groove angle is 45° and the co-efficient of friction is 0.3. Determine the power rating.

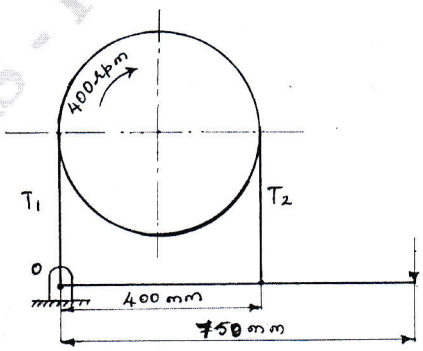

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. Derive Petroff's equation for co-efficient of friction in Journal bearing. **(08 Marks)**

b. Explain the following :
   i) Oiliness
   ii) Flash point
   iii) Fire point
   iv) Pour point. **(04 Marks)**

c. Determine the power loss for a Petroff bearing 100mm in diameter and 150mm long. The radial clearance 0.05mm. Speed of the journal is 1000rpm. The lubricating oil is SAE 10 and bearing operating temperature is 60°C. **(08 Marks)**

OR

10 a. Explain the following :
   i) Hydrostatic lubrication
   ii) Hydrodynamic lubrication
   iii) Elasto hydro dynamic lubrication
   iv) Thrust bearing
   v) Journal bearing. **(10 Marks)**

b. Design a full journal bearing subjected to 6kN at 1000rpm of journal. The journal is of hardened steel and the bearing is of babbit material having bearing modulus 48.5×10^{-9} for hydrodynamic lubrication. The bearing is operated with SAE 40 oil at 70°C and the ambient temperature is 30°C having absolute viscosity of 31cP. The length and diameter of journal is equal. Also determine the amount of artificial cooling required and sommerfeld number. Consider $K_a = 1.95 \times 10^{11}$ and clearance ratio $\psi = 0.001$, $K' = 0.273$, $\Delta\mu = 0.002$. **(10 Marks)**

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CBCS SCHEME

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17ME655

Sixth Semester B.E. Degree Examination, June/July 2023
Automobile Engineering

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the different types of the cylinder arrangements with the help of a neat sketch. **(12 Marks)**

b. With the help of a neat sketch explain the Construction of dry and wet liners. Also differentiate between dry and wet liners. **(08 Marks)**

OR

2 a. Explain the process of pump circulation system with the help of neat sketch. Also mention the advantages of pump circulation system of cooling over Thermosyphon cooling system. **(10 Marks)**

b. Mention the requirements of the lubrication system in an automobile engine and explain the process of splash lubrication system with the help of a diagram. **(10 Marks)**

Module-2

3 a. With the help of a neat sketch explain the working mechanism of multi plate clutch system. **(10 Marks)**

b. What are the applications of fluid flywheel? Explain its working with the help of a neat sketch. **(10 Marks)**

OR

4 a. Explain the operation of a differential with the help of a neat sketch. **(08 Marks)**

b. Mention the requirement of the brake system. **(04 Marks)**

c. Explain the working principle of disc brake with the help of the diagram. **(08 Marks)**

Module-3

5 a. Explain the following steering geometry with the help of relevant diagrams.
a) Camber. b) Castor. c) Toe in and Toe out **(12 Marks)**

b. How the hydraulic power steering works? Explain with the help of the diagram. **(08 Marks)**

OR

6 a. Explain the working principle of magneto Ignition system, with the help of a diagram. **(10 Marks)**

b. How the independent front wheel suspension works? Explain with the help of diagram. Also mention its advantages and disadvantages. **(10 Marks)**

Module-4

7 a. Explain the process of supercharging with turbine, with the help of a neat diagram. Also mention its advantages and disadvantages. **(10 Marks)**

b. Explain the working principle of Exhaust turbo charging with the help of a neat diagram. Also mention its limitations. **(10 Marks)**

OR

8 a. Write a short note on the different types of alternative fuels. **(08 Marks)**

b. With the help of a neat sketch explain the following process of fuel injection system.
a) Direct injection system.
b) Port injection system.
c) Throttle body injection system. **(12 Marks)**

Module-5

9 a. Explain the process of Exhaust gas Recirculation system. With the help of a neat diagram. **(10 Marks)**

b. How the process of evaporative control system is used to control the evaporative emission? Explain with the help of a neat diagram. **(10 Marks)**

OR

10 a. Explain the process of positive crank case ventilation for controlling crank case ventilation, with the help of schematic diagram. **(12 Marks)**

b. Write a short note on different emission standards followed in India. **(08 Marks)**

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CBCS SCHEME

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17ME662

Sixth Semester B.E. Degree Examination, June/July 2023
Industrial Safety

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define Industrial Safety in context with OHS. What are the issues and topics it covers pertaining to industry? **(10 Marks)**

b. Explain types of Ladders and Scaffoldings. **(10 Marks)**

OR

2 a. Explain material safety data sheet contents and explain Lockout and Tagout procedures. **(10 Marks)**

b. In construction, explain the hazards related to scaffolding and fall. What are the measures to be taken for protection? **(10 Marks)**

Module-2

3 a. What are the different classes of fire? Explain with examples. **(10 Marks)**

b. What is fire tetrahedron? Discuss various types of fire extinguisher and their applications. **(10 Marks)**

OR

4 a. List and explain common fire hazards and how they can be prevented. **(10 Marks)**

b. In case of fire accidents, what are the intervention methods and technique to be adopted to control fire? **(10 Marks)**

Module-3

5 a. Explain different Personal Protective Equipments (PPEs) and safety guards used during mechanical work. **(10 Marks)**

b. Explain safety acts carried out while working with machine tools like
i) Lathe ii) Drill press iii) Power saws iv) Band saws **(10 Marks)**

OR

6 a. Explain safety precautions taken during
i) Welding ii) Forging iii) Pressing iv) Grinding machines **(10 Marks)**

b. Explain safety precautions taken while handling material, compressed gas cylinders and corrosive substance. **(10 Marks)**

Module-4

7 a. Define Electrical Safety. List the basic factors to be considered to ensure electrical safety in industries. **(10 Marks)**

b. What kind of injuries result from electrical current? Discuss briefly the preventive measures related to electrical hazards. **(10 Marks)**

OR

8 a. List and explain various personal protection equipment used in handling electrical equipment. **(10 Marks)**

b. Explain safety precautions taken against electric shock in residential building and shops and electric shock in electric plant. **(10 Marks)**

Module-5

9 a. Explain different safety policies present in the company and safety loss prevention. **(10 Marks)**

b. Define chemical safety and explain labelling of chemicals and acid hoods. **(07 Marks)**

c. Explain concept of safety thinking and accident investigation. **(03 Marks)**

OR

10 a. Explain safety precaution taken using CNG and Safety audit. **(08 Marks)**

b. Explain risk assessment followed during chemical safety and give checklist for LPG installations. **(08 Marks)**

c. Explain fire prevention acts taken during chemical safety. **(04 Marks)**

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