CBCS SCHEME

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15ME61

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Finite Element Method

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain the Basic steps involved in FEM. **(04 Marks)**

b. Write a note on Node Numbering and Node location. **(04 Marks)**

c. For the spring system show in Fig Q1(c), using the principle of minimum potential energy. Determine the nodal Displacements.

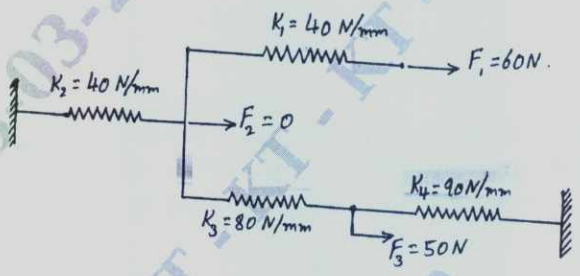


Fig Q1(c) **(08 Marks)**

OR

2 a. Write a note on simplex, complex and multiplex Elements. **(06 Marks)**

b. Write the Interpolation polynomial functions in global co-ordinates for 1D, 2D and 3D simplex Elements. **(06 Marks)**

c. Explain the Boundary conditions for structural, Heat transfer and fluid flow problems. **(04 Marks)**

Module-2

3 a. Derive the shape functions for the 8-noded Rectangular element in Lagrangian. **(08 Marks)**

b. Evaluate $I = \int_{-1}^{1} \left[a_0 + a_1\xi + a_2\xi^2 + a_3\xi^3\right] d\xi$, using 2-point Gaussian quadrature formula. **(08 Marks)**

OR

4 a. For the Bar shown in Fig Q4(a), determine the Nodal Displacement, Element stresses and support reactions, Take, $A_1 = 250mm^2$, $A_2 = 400mm^2$, $E_1 = E_2 = 200GPa$,

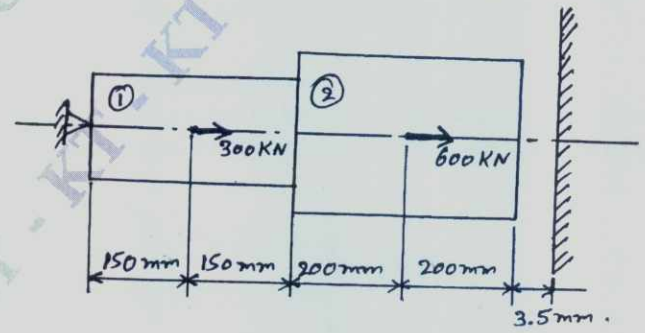
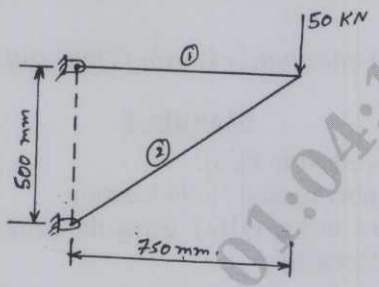


Fig Q4(a) **(08 Marks)**

b. A truss shown in Fig Q4(b) is made of 2 bars. Determine :
i) Nodal Displacements ii) Stresses in each elements.



$A_1 = 1000mm^2$
$A_2 = 1200mm^2$
$E_1 = E_2 = 200GPa$

Fig Q4(b)

(08 Marks)

Module-3

5 a. Derive the Hermite shape function for a Beam element. **(08 Marks)**

b. A cantilever beam subjected to point load of 250kN as shown in Fig Q5(b). Determine deflection at tip and support reactions, Take, E = 200GPa, $I = 4\times10^6 mm^4$ and $\ell_e = 0.8m$.

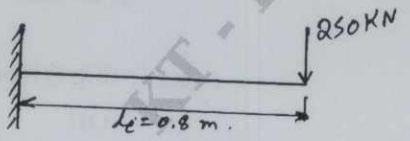


Fig Q5(b) **(08 Marks)**

OR

6 a. Derive the stiffness matrix for the torsion of shaft. **(08 Marks)**

b. A Bar of circular cross section having a diameter of 50mm is fixed at both ends and subjected to a torque at B and C as shown in Fig Q6(b). Determine maximum angle of twist and shear stresses. Take $G = 7\times10^4 N/mm^2$, $E = 2\times10^5 N/mm^2$.

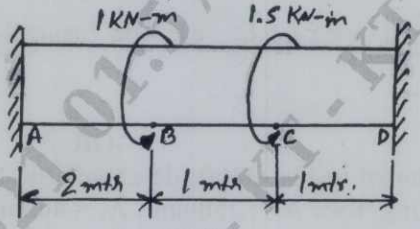


Fig Q6(b) **(08 Marks)**

Module-4

7 a. Calculate the temperature distribution in a 1-D fin with the physical properties given in Fig Q7(a). There is a uniform generation of heat inside the wall of $Q = 400W/m^3$.

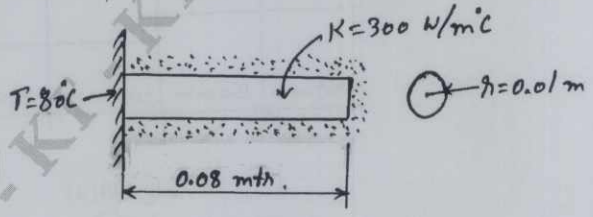


Fig Q7(a) **(08 Marks)**

b. Determine the temperature distribution through the composite wall as shown in Fig Q7(b). Convection heat loss occurs on the right surface. Assume a unit area.

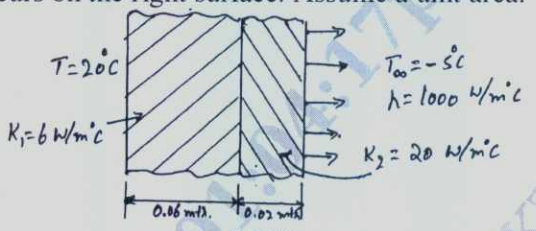


Fig Q7(b) **(08 Marks)**

OR

8 a. Derive the stiffness matrix for 1-D fluid flow system. **(08 Marks)**

b. For the smooth pipe shown in Fig Q8(b), with uniform cross section of $1m^2$, determine the flow velocities at the centre and right end, Take velocity at left $V_x = 2m/sec$.

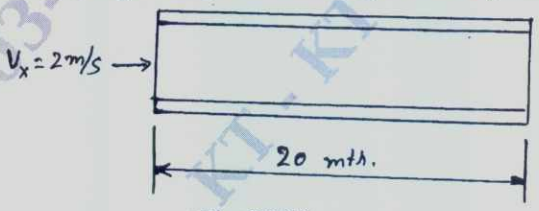


Fig Q8(b) **(08 Marks)**

Module-5

9 a. Derive the Jacobian matrix of axisymmetric body with triangular element. **(06 Marks)**

b. Evaluate the nodal forces used to replace the linearly varying surface traction shown in Fig Q9(b)

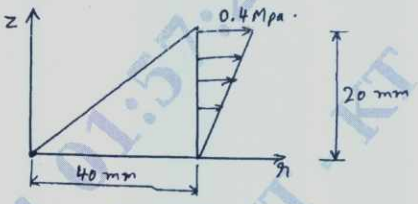


Fig Q9(b) **(10 Marks)**

OR

10 a. Derive an expression of element mass matrix for a bar element. **(06 Marks)**

b. Evaluate eigne value and eigen vector of longitudinal vibration of the constrained uniform circular bar shown in Fig Q10(b). Take minimum 2 elements. $E = 210GPa$, $\rho = 7860kg/m^3$.

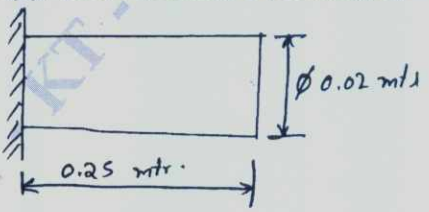


Fig Q10(b) **(10 Marks)**

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15ME63

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Heat Transfer

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of heat transfer data handbook is permitted

Module-1

1 a. Define the following terms: i) Convective heat transfer coefficient ii) Thermal diffusivity iii) Black body iv) Emissivity **(04 Marks)**

b. Consider a one dimensional steady state heat conduction in a plate with constant thermal conductivity in a region $0 \le x \le 1$. A plate is exposed to uniform heat flux 'q' W/M^2 at $x = 0$ and dissipates heat by convection at $x = L$ with heat transfer coefficient 'h' in the surrounding air at T_∞. Write the mathematical formulation of this problem for the determination of one dimensional steady state temperature. **(04 Marks)**

c. The walls of a house in cold region consists of three layers, an outer brick wall, 15cm thick, an inner wooden panel, 1.2cm thick, the intermediate layer is made of an insulating material, 7cm thick. The thermal conductivities of brick and wood used are 0.7W/mK and 0.18W/mK. The inside and outside temperature of composite wall are 21°C and -15°C. If the layer of insulation offers twice the thermal resistance of the brick wall. Calculate:
i) Rate of heat loss per unit area of wall ii) Thermal conductivity of insulating material. **(08 Marks)**

OR

2 a. Derive three dimensional heat conduction equation in cylindrical coordinate system for a isotropic material. **(08 Marks)**

b. A plane wall 4cm thick has one of its surfaces in contact with a fluid at 130°C with a surface heat transfer coefficient of $250 W/m^2K$ and the other surface is in contact with another fluid at 30°C with a surface heat transfer coefficient of $500 W/m^2K$. The thermal conductivity of wall varies with temperature is given by $K = 20 (1 + 0.001T)$, where T is the temperature. Determine the rate of heat transfer through the wall and surface temperatures of the wall. **(08 Marks)**

Module-2

3 a. Obtain an expression for temperature distribution through a rectangular fin when the end of fin is insulated. **(08 Marks)**

b. An electrical cable of 12mm diameter is insulated to increase the current carrying capacity by 15% without increasing the cable surface temperature above 70°C. The ambient air temperature is 30°C. Calculate the conductivity of insulating material required assuming that the heat transfer coefficient on bare and insulated wire is same as $14 W/m^2K$. **(08 Marks)**

OR

4 a. Show that the temperature distribution in a body during Newtonian heating or cooling is given by $\frac{T - T_\infty}{T_i - T_\infty} = e^{-BiFo}$ **(08 Marks)**

b. A steel cylinder 0.2m diameter and 3m long initially at 500°C is suddenly immersed in a fluid at 40°C. The convective coefficient between the cylinder surface and fluid is $200 W/m^2K$. Assume $K = 40 W/mK$, $\alpha = 1 \times 10^{-5} m^2/sec$. Calculate after 20 minutes
i) Temperature at a radius of 0.05m ii) Heat transferred during 20 mins. **(08 Marks)**

Module-3

5 a. Explain Implicit and Explicit method for discretization of 1-dimensional transient heat conduction problem. **(08 Marks)**

b. A steady state, finite difference analysis has been performed on a cylindrical fin with a diameter of 12mm and a thermal conductivity of 15W/mK. The convection process is characterized by a fluid temperature of 25°C and a heat transfer coefficient of 25W/m^{2}K.

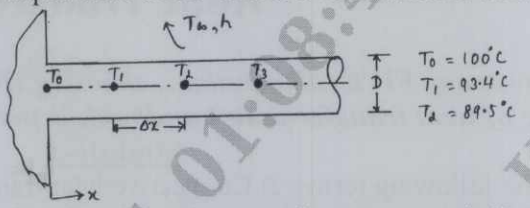

Fig.Q.5(b)

i) The temperatures for the first three nodes, separated by a spatial increment of x = 10mm. Determine the fin heat rate.

ii) Determine the temperature at node 3, T3. **(08 Marks)**

OR

6 a. State: i) Kirchoff's law ii) Stefan Boltzman law iii) Wein's displacement law. **(06 Marks)**

b. Calculate the net radiant heat exchange per m^2 area for two large parallel plates at temperature of 427°C and 27°C respectively. ε for hot plates is 0.9 and for cold plate is 0.6. If polished aluminium shield is placed between them. Find the percentage reduction in heat transfer ε (shield) = 0.4. **(10 Marks)**

Module-4

7 a. Explain the following:

i) Velocity boundary layer

ii) Thermal boundary layer. **(06 Marks)**

b. Air at 15°C and 1 atmospheric flows over a cylinder of 400mm diameter and 1500mm height at a velocity of 30kM/hr with surface temperature of 45°C. Estimate the rate of heat transfer from the cylinder. **(10 Marks)**

OR

8 a. Obtain fundamental relationship between Nusselt, Prandtl and Grashof numbers applied to natural convection using Buckingham π-theorem. **(08 Marks)**

b. A 350mm long glass plate is hung vertically in the air at 24°C, while its temperature is maintained at 80°C. Calculate the boundary layer thickness at the trailing edge of plate. Also calculate the average heat transfer coefficient over the entire length of plate. **(08 Marks)**

Module-5

9 a. Derive an expression for LMTD of parallel flow heat exchanger. **(08 Marks)**

b. In a double pipe counter flow heat exchanger, 10,000kg/hr of an oil having specific heat of 2095J/kgK is cooled from 80°C to 50°C by 8000 kg/hr of water entering at 25°C. Determine the heat exchanger area for an overall heat transfer coefficient of 300W/m^{2}K. Take specific heat of water as 4180J/kgK. **(08 Marks)**

OR

10 a. Distinguish between the nucleate boiling and film boiling. **(06 Marks)**

b. A tube of 2m length and 25mm outer diameter is to be condense saturated steam at 100°C. While the tube surface is maintained at 92°C. Estimate the average heat transfer coefficient and the rate of condensation of steam if the tube is kept at horizontal. The steam condenses on outside of the tube. **(10 Marks)**

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15ME64

Sixth Semester B.E. Degree Examination, Jan./Feb.2021
Design of Machine Elements – II

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Assume missing data suitably.*
3. *Design DHB is permitted to refer.*

Module-1

1 a. Determine the dimensions of I-section, as shown in Fig. Q1 (a) in which maximum fiber stresses are numerically equal in pure bending. Given $b_i + b_0 = 120$ mm **(12 Marks)**

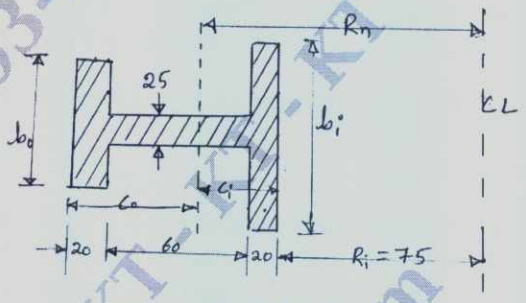

Fig. Q1 (a)

b. A thin cylinder of diameter 600 mm and 10 mm wall thickness is subjected to internal pressure of 1.5 MPa. Find the stresses induced in the wall. **(04 Marks)**

OR

2 a. A 100 mm inside and 150 mm outside sleeve is press fitted on to a shaft of 100 mm diameter, take E = 210 GPa, Poissons ratio of 0.28. The contact pressure is not to exceed 60 MPa. Determine
(i) The tangential stresses at the inner and outer surface of the sleeve and outside diameter of the shaft.
(ii) The radial stresses in the sleeve and shaft.
(iii) The original diameters of the shaft and hub before press fit. **(12 Marks)**

b. Discuss the differences between straight and curved beam. **(04 Marks)**

Module-2

3 a. A leathers belt 9mm × 250mm is used to drive a cast iron pulley 90 cm in diameter at 336 rpm. If the active arc of contact on the smaller pulley is 120° and the stress in the tight side is 2 MPa, find the power capacity of the belt which weighs 0.00098 kg/cm^3, m = 0.35 of leather. **(12 Marks)**

b. Discuss types of power transmission chaines. **(04 Marks)**

OR

4 The inlet valve of an IC engine operated by a spring exerts a force of 250 N when the valve is closed and 450 N when the valve is open. The lift is 8 mm. The material test gives the following results. $\tau_y = 600$ MPa, Endurance stress in tortion $\tau_{-1} = 450$ MPa, G = 80 GPa, $C = \frac{D}{d} = 6$, F.S = 1.5 **(16 Marks)**

Module-3

5 Design a pair of spur gears to transmit 24 kW at 1000 rpm to a parallel shaft to be rotated at 400 rpm. The center distance between the shaft is 175 mm. Assume $\alpha = 20^\circ$ FDI. Select cast steel for both gears ($\sigma_p = \sigma_g = 138$ MPa). **(16 Marks)**

OR

6 a. Define formative number of teeth for Bevel gears. **(02 Marks)**

b. A pair of Bevel gears transmitting 7.5 kW at 300 rpm of pinion. The pressure angle is 20°. The pitch diameters of pinion and gear at their large ends are 150 mm and 200 mm respectively. The face width of the gear is 40 mm. Determine the components of the resultant gear tooth forces acting on the pinion and the gear. **(14 Marks)**

Module-4

7 Design a worm gear drive to transmit 12 kW at 1200 rpm. The speed reduction designed is 30 : 1. The warm is made of hardened steel of $\sigma_0 = 210$ MPa and gear of phosphor bronze of $\sigma_0 = 90$ MPa. The teeth are $14\frac{1}{2}^\circ$. Check the heat capacity of the gear. **(16 Marks)**

OR

8 a. Discuss the types of clutches and their applications. **(06 Marks)**

b. A simple Band brake of drum, diameter 600 mm has a band passing over it with an angle of contact 225°. While one end is connected to the fulcrum, the other end is connected to the Break lever at a distance of 400 mm from the fulcrum. The brake lever is 1 m long. The break is to absorb a power of 15 kW at 720 rpm. Design the break lever of rectangular cross section, assuming depth to be thrice the width. Take $\sigma_b = 80$ MPa. **(10 Marks)**

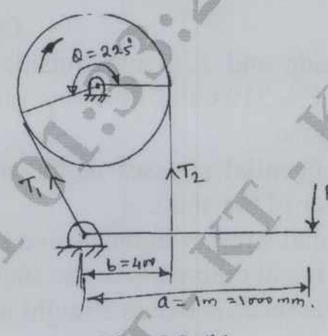

Fig. Q8 (b)

Module-5

9 a. A Journal bearing 75 mm long supports a load of 7.3 kN on a 50 mm diameter journal turning at 750 rev/min. The diametral clearance is 0.07 mm, what should be the viscosity of the oil if the operating temperature of the bearing surface is to be limited to 75°C when still air is at 20°C. **(12 Marks)**

b. Explain types of roller contact bearings. **(04 Marks)**

OR

10 Select a suitable ball-bearing required to be mounted on a shaft of diameter 45 mm to withstand a radial load of 6 kN and a load of 3 kN at a rated speed of 300 rpm. The bearing works for 50 hours/week for 3 years. Assume light shocks. **(16 Marks)**

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15ME653

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Metal Forming

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain Tresca and Von-Mises yield criterion. **(08 Marks)**

b. State the advantages and limitation of metal working processes. **(04 Marks)**

c. A copper wire has a nominal breaking strength of 300mpa. Its ductility is 77% reduction of area. Calculate the true stress for fracture. **(04 Marks)**

OR

2 a. Differentiate between cold working and hot working. **(08 Marks)**

b. A tensile specimen with a 12mm initial diameter and 50mm gauge length reaches a maximum load at 90KN and fractures at 70KN. The maximum diameter at fracture is 10mm find

i) Engineering stress at maximum load

ii) True fracture stress

iii) True strain and engineering strain at fracture. **(08 Marks)**

Module-2

3 a. Explain the effect of temperature, friction and lubrication on metal working processes. **(08 Marks)**

b. Write a note on:

i) Deformation Zone geometry.

ii) Residual stresses in wrought products. **(08 Marks)**

OR

4 a. Derive an expression for forging pressure and load in open die forging by slab analysis making suitable assumptions. **(12 Marks)**

b. Explain the typical defects in forged components. **(04 Marks)**

Module-3

5 a. Explain with neat sketch.

i) Tandem rolling mill ii) Planetary rolling mill **(08 Marks)**

b. A 360mm wide aluminum alloy steel is hot rolled in thickness from 20mm to 15mm. The rolls are 1m in diameter and operates at 100rpm. The uniaxial flow stress for the aluminium alloy is given by $140\epsilon^{0.2}$. Determine the rolling load and power required for this hot reduction. Use a factor which depends on percentage of reduction and ratio of roll radius thickness (Qp) as 1.5. **(08 Marks)**

OR

6 a. What is drawing process? Draw the cross section of a drawing die and explain different elements of drawing die. **(06 Marks)**

b. List and explain any four process variates that affect the drawing force in wire drawing process. **(04 Marks)**

c. A steel wire is drawn from a initial diameter of 12.5mm to a final diameter of 10mm at a speed of 120m/min. The half cone angle of the die is 6° and coefficient of friction at the die wire interface is 0.12. A tensile test on steel specimen has show a yield stress of 210N/mm^2. Determine the draw force and power required, assuming that there is no back tension applied. **(06 Marks)**

Module-4

7 a. Give the classification of extrusion process and explain hydrostatic extrusion. **(08 Marks)**

b. It is required to hot extrude an aluminium alloy at 400°c through square dies without lubrication from 125mm diameter to 40mm diameter. The extrusion speed is 45mm/sec and flow stress of material at 400°c is 250mpa. The length of the billet is 450mm and semi core angle 45° determine extraction load when $\mu = 0.1$. **(08 Marks)**

OR

8 a. Explain briefly the rubber forming process with respect to sheet metal forming. **(06 Marks)**

b. Explain with neat sketch a progressive die. **(06 Marks)**

c. A 25mm square hole is to be cut in sheet metal of 0.75mm thick. The shear strength of material is $2.86+10^5$KN/m^2 calculate the cutting force. **(04 Marks)**

Module-5

9 a. With neat sketch, explain electro hydraulic forming process. Also mention its advantages and limitations. **(10 Marks)**

b. What are the advantages and disadvantages of High Energy Rate Forming (HERF). **(06 Marks)**

OR

10 a. With a flow chart explain the operations involved in powder metallurgy process. **(08 Marks)**

b. List the applications of powder metallurgy components. **(04 Marks)**

c. List and explain any four important characteristics of metal powder. **(04 Marks)**

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15ME664

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Total Quality Management

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Discuss the contributions of any three Gurus of TQM. **(06 Marks)**
b. Bring out the potential benefits of TQM. **(04 Marks)**
c. Briefly explain with the help of a sketch TQM framework. **(06 Marks)**

OR

2 a. List the obstacles associated with TQM implementation and discuss any three. **(08 Marks)**
b. State the benefits of ISO registration. **(04 Marks)**
c. Explain how the requirements of ISO 9001 are met. **(04 Marks)**

Module-2

3 a. Justify the need of ethics in an organization and identify the root causes of unethical behavior. **(08 Marks)**
b. Elaborate the roles of TQM leaders in its implementation. **(08 Marks)**

OR

4 a. List and briefly explain the seven steps to strategic planning. **(08 Marks)**
b. Emphasize on the importance of communication in an organization. **(04 Marks)**
c. Discuss on the role of decision making in bringing success to organization. **(04 Marks)**

Module-3

5 a. Explain the need of achieving customer satisfaction. **(04 Marks)**
b. State the benefits of customer feedback and explain the actions to be taken to handle customer complaints. **(08 Marks)**
c. Emphasize on the importance of customer retention. **(04 Marks)**

OR

6 a. Explain the process of translating needs of customer into requirements **(08 Marks)**
b. Discuss the need of motivation and brief on the role of recognition and reward in motivating employee. **(08 Marks)**

Module-4

7 a. Briefly discuss about the process improvement strategies. **(08 Marks)**
b. List the factors on which kaizen improvement focuses. **(04 Marks)**
c. Briefly explain the concept of reengineering. **(04 Marks)**

OR

8 a. With relevant example explain the construction of cause and effect diagram. **(08 Marks)**
b. Quoting examples explain control chart and histogram. **(08 Marks)**

Module-5

9 a. List the reasons for benchmarking and elaborate on the steps involved is benchmarking process. **(08 Marks)**
b. State the importance of voice of customer and explain the construction of hence of quality. **(08 Marks)**

OR

10 a. State the benefits of Quality by design. **(04 Marks)**
b. Outline the steps involved in FMEA. **(06 Marks)**
c. Write a note on total productive maintenance. **(06 Marks)**

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