CBCS Scheme

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15ME61

Sixth Semester B.E. Degree Examination, June/July 2018
Finite Element Analysis

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define FEM. Discuss various applications of FEA in different domain. **(04 Marks)**

b. Explain convergence requirements of a displacement field. **(04 Marks)**

c. Using minimum potential energy determine the nodal displacement of a spring system shown in Fig. Q1(c). **(08 Marks)**

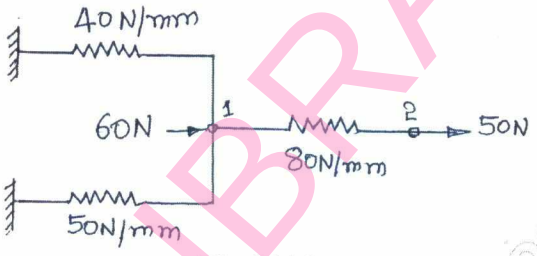

Fig.Q1(c)

OR

2 a. Using Rayleigh – Ritz method, determine the displacement at midpoint and stress variation in a one dimensional rod as shown in Fig.Q2(a). **(09 Marks)**

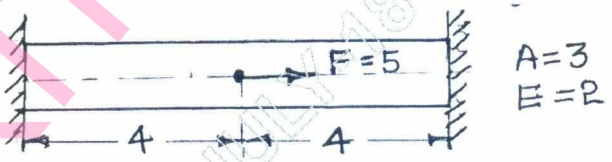

Fig.Q2(a)

b. Write stress-strain relations for plain stress and plain strain conditions. **(04 Marks)**

c. What do you mean by simplex, complex and multiplex elements? **(03 Marks)**

Module-2

3 a. What are higher order element? Derive shape function for 1D quadratic element in natural co-ordinates. **(06 Marks)**

b. Deduce expression for shape function for four noded tetrahedral element (TET4) using Lagrange interpolation functions. **(06 Marks)**

c. Evaluate $\int_{-1}^{+1} (x^2 + \sin\frac{\pi x}{2})\,dx$ using suitable Gauss points numerical integration. **(04 Marks)**

OR

4 a. For the stepped bar shown in Fig.Q4(a). Determine the nodal displacements, stress in each element and left support reaction. **(10 Marks)**

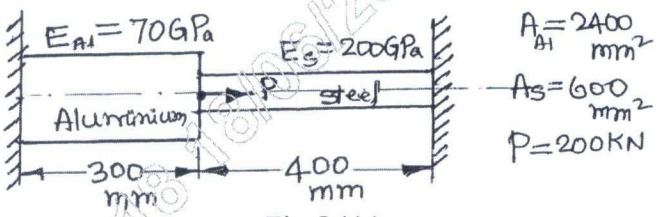

Fig.Q4(a)

b. With assumptions, deduce element stiffness matrix used for analysis of trusses. **(06 Marks)**

Module-3

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

b. For the beam and loading as shown in Fig.Q5(b), determine deflection, slope and support reaction. Take E = 110GPa, I = $5 \times 10^{-4} m^4$. **(08 Marks)**

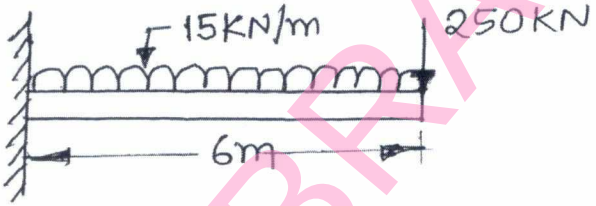

Fig.Q5(b)

OR

6 a. Derive torsional stiffness matrix for a circular shaft subjected to pure torsion. **(06 Marks)**

b. For the circulars stepped shaft shown in Fig.Q6(b) determine stresses and angle of twist. **(10 Marks)**

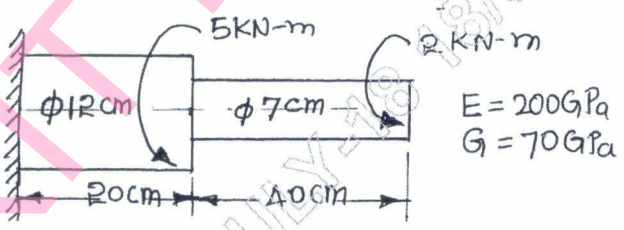

Fig.Q6(b)

Module-4

7 a. Briefly describe rate equations and boundary conditions in heat transfer analysis. **(06 Marks)**

b. Determine the temperature distribution through composite wall shown in Fig.Q7(b) when the convective heat loss occurs on the right surface. Take K_1 = 6W/m°C and K_2 = 20 W/m°C. **(10 Marks)**

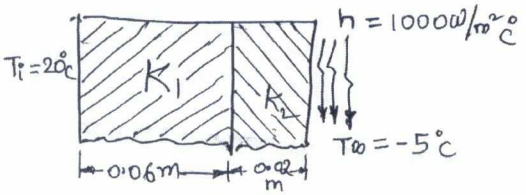

Fig.Q7(b)

OR

8 a. Deduce the governing differential equation for one-dimensional fluid flow through a process medium. **(06 Marks)**

b. For the smooth pipe of variable c/s shown in Fig.Q8(b). Determine the potential at the junction the velocities in each section of pipe and the volumetric flow rate. The potential at the left end is $P_1 = 12m^2/S$ and that at right end is $P_4 = 3\ m^2/S$. Take $K_x = 1$. **(10 Marks)**

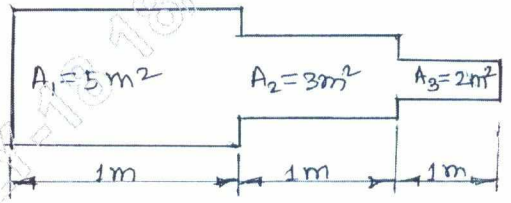

Fig.Q8(b)

Module-5

9 a. What is an axisymmetric element? Derive Jacobian matrix for axisymmetric triangular element. **(08 Marks)**

b. For the element of an axisymmetric body rotating with constant angular velocity W = 1000 rev/min as shown in Fig.Q9(b). Determine the body force vector including weight of material with specific density is 7850 kg/m^3. **(08 Marks)**

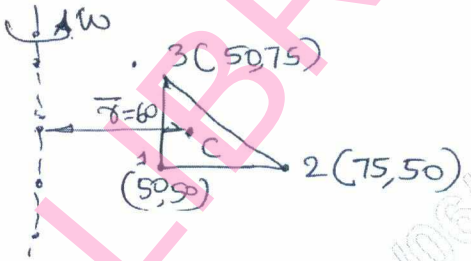

Fig.Q9(b)

OR

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

b. For the stepped bar shown in Fig.Q10(b) determine the eigen values and eigen vector. Take $A_1 = 400mm^2$, $A_2 = 200mm^2$, $\rho = 7850\ kg/m^3$, $E = 200GPa$. **(10 Marks)**

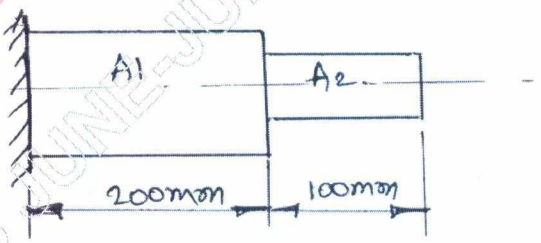

Fig.Q10(b)

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CBCS SCHEME

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15ME62

Sixth Semester B.E. Degree Examination, June/July 2018
Computer Integrated Manufacturing

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define automation. Distinguish between fixed and programmable automation with examples. **(08 Marks)**

b. State and explain the different reasons for automation. **(08 Marks)**

OR

2 a. Explain upper bound and lower bound approach with respect to automated transfer lines. **(08 Marks)**

b. The average part produced in a certain batch manufacturing plant must be processed through an average of 8 machines, 15 new batches are launched each week. Operating time is 8 min, average set up time is 8 hours, batch size is 30 minutes, average non-operation time is 15 hrs/machine. Number of machines available in the plant is 20. The plant operates on an average of 80 production hrs/week. Determine (i) manufacturing lead time (ii) production rate (iii) plant utilization (iv) Work-in-process. **(08 Marks)**

Module-2

3 a. State and explain the different steps in computer aided design process. **(08 Marks)**

b. Explain the functions of a graphics package. **(08 Marks)**

OR

4 a. Define computer aided process planning. With a block diagram explain variant approach type of CAPP system. **(08 Marks)**

b. What do you mean by material requirement planning (MRP)? What are MRP inputs and outputs? **(08 Marks)**

Module-3

5 a. Define flexible manufacturing system? List and explain the different types of flexibility. **(08 Marks)**

b. Explain in brief with diagram the structure of AS/RS system. What are the advantages of it? **(08 Marks)**

OR

6 a. Explain the terminology with formulas:
(i) Minimum rational work element
(ii) Cycle time (iii) Precedence constraints and precedence diagram. **(06 Marks)**

b. A project has the following tasks. Its immediate predecessor and task times are given below. Using largest candidate rule balance the line and determine
(i) Number of work stations
(ii) Balance delay of line and
(iii) Line efficiency
Take cycle time = 1 min.

Tasks	1	2	3	4	5	6	7	8	9	10	11	12
Proceded by	-	-	1	1, 2	2	3	3	3, 4	6, 7, 8	5, 8	9, 10	11
T_e (min)	0.2	0.4	0.7	0.1	0.3	0.11	0.32	0.6	0.27	0.38	0.5	0.12

(10 Marks)

Module-4

7 a. With a sketch explain the classification of NC/CNC's system based on motion control systems. **(09 Marks)**

b. Write a manual part programme for machining the profile as shown in the Fig.Q7(b)? **(07 Marks)**

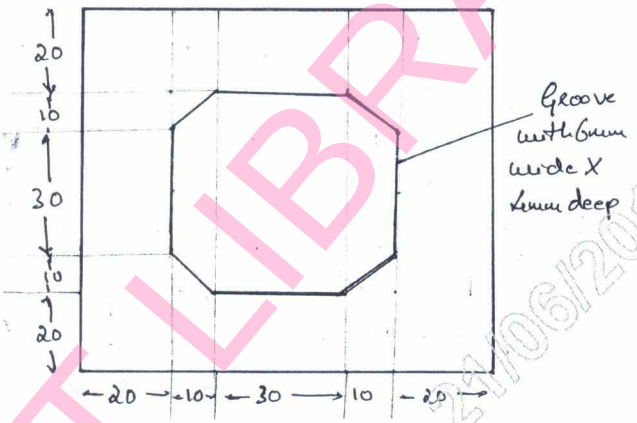

Fig.Q7(b)

OR

8 a. Explain with a neat sketch the robot configuration. **(07 Marks)**

b. Explain briefly with diagram if necessary :
(i) Slip sensors (ii) Range sensors (iii) Advantages and disadvantages. **(09 Marks)**

Module-5

9 a. Explain briefly the different steps involved in additive manufacturing system. **(08 Marks)**

b. With a neat sketch, explain the working principle of selective laser sintering. Discuss the advantages for it. **(08 Marks)**

OR

10 a. Explain the components of Industry 4.0. **(08 Marks)**

b. List and explain IOT applications in manufacturing. **(08 Marks)**

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CBCS SCHEME

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15ME63

Sixth Semester B.E. Degree Examination, June/July 2018
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 hand book, steam table are permitted.

Module-1

1 a. What do you mean by boundary condition of 1st, 2nd and 3rd kind? **(06 Marks)**

b. Explain briefly the mechanism of conduction, convection and radiation of heat transfer. **(06 Marks)**

c. A mild steel tank of wall thickness 20 mm is used to store water at 95°C. Thermal conductivity of mild steel is 45 W/m °C, and the heat transfer coefficient inside and outside the tank are 2850 W/m^2 °C and 10 W/m^2 °C respectively. If surrounding air temperature 20°C, calculate Rate of heat transfer per unit area of the tank. **(04 Marks)**

OR

2 a. Derive the general three dimensional heat conduction equation in Cartesian coordinate and state the assumption made. **(08 Marks)**

b. The wall of a house in cold region consists of three layers, an outer brick work 15 cm thick, the inner wooden panel 1.2 cm thick, the intermediate layer is insulator of 7 cm thick. The 'k' for brick and wood are 0.7 and 0.18 W/mK. The inside and outside temperature of wall are 21 and – 15°C. If insulation layer offer twice the thermal resistance of the brick wall, calculate (i) heat loss per unit area (ii) 'k' of insulator. **(08 Marks)**

Module-2

3 a. Derive the expression for critical thickness of insulation for cylinder. **(06 Marks)**

b. Differentiate between effectiveness and efficiency of fins. **(04 Marks)**

c. A rod [k = 200 W/mK] 5 mm in diameter and 5 cm long has its one end maintained at 100°C. The surface of the rod is exposed to ambient air at 25°C with convection heat transfer coefficient of 100 W/m^{2}K. Assuming other end is insulated. Determine (i) the temperature of rod at 20 mm distance from the end at 100°C (ii) Heat dissipation rate from the surface of rod (iii) Effectiveness. **(06 Marks)**

OR

4 a. Derive the expression for temperature variation and heat flow using Lumped Parameter Analysis. **(06 Marks)**

b. Explain significance of Biot and Fourier number. **(04 Marks)**

c. The average heat transfer coefficient for flow of 100°C air over a flat plate is measured by observing the temperature time history of a 3 cm thick copper slab exposed to 100°C air, in one test run, the initial temperature of slab was 210°C and in 5 min the temperature is decreased by 40°C. Calculate the heat coefficient for this case. Assume ρ = 9000 kg/m^3 ; C = 0.38 kJ/kgK , K = 370 W/mK. **(06 Marks)**

Module-3

5 a. Explain formulation of differential equation 1-D steady heat conduction. **(06 Marks)**

b. Explain different solution method used in numerical analysis of heat conduction. **(06 Marks)**

c. Explain applications and computation error of numerical analysis heat conduction. **(04 Marks)**

OR

6 a. Define (i) Blackbody (ii) Planks law (iii) Wein displacement law (iv) Lamberts law. **(06 Marks)**

b. Prove that emissive power of the black body in hemispherical enclosures in π terms of intensity of radiation. **(06 Marks)**

c. The temperature of black surface of 0.2 m^2 area is 540°C. calculate (i) the total rate of energy emission (ii) the intensity of normal radiation (iii) the wavelength of maximum monochromatic emission power. **(04 Marks)**

Module-4

7 a. Explain with neat sketches (i) Velocity Boundary layer (ii) Thermal boundary layer. **(08 Marks)**

b. Air flows over a flat plate at 30°C, 0.4m wide and 0.75m long with a velocity of 20m/s. Determine the heat transfer from the surface of plate assuming plate is maintained at 90°C.

Use $N_{UL} = 0.664\ R_e^{0.5}\ Pr^{0.33}$ for laminar

$N_{UL} = \left[0.036\ R_e^{0.8} - 0.836\right] Pr^{0.333}$ for turbulent. **(08 Marks)**

OR

8 a. Explain the physical significance of the following dimensionless number:
(i) Reynold's number (ii) Prandtl number (iii) Nusselt number
(iv) Stantor number. **(06 Marks)**

b. A stream pipe 5 cm in diameter is lagged with insulating material of 2.5 cm thick. The surface temperature is 80°C and emissivity of the insulating material surface is 0.93. Find the total heat loss by natural convection and radiation. The temperature of the air surrounding the pipe is 20°C. Also find the overall heat transfer coefficient. **(10 Marks)**

Module-5

9 a. Derive expression for LMTD for parallel flow heat exchanger and state the assumption made. **(08 Marks)**

b. Water enters a counter flow heat exchanger at 15°C flowing at a rate of 1300 kg/h. It is heated by oil [c_p = 2000 J/kgK] flowing at the rate of 550 kg/h with an inlet temperature of 94°C for an area 1 m^2 and overall heat transfer coefficient of 1075 W/m^2K. Determine the total heat transfer and outlet temperature of water and oil. **(08 Marks)**

OR

10 a. Explain different regimes of pool boiling with neat sketches. **(08 Marks)**

b. Draw saturated stream at a pressure of 2.0 bar condenses on the surface of vertical tube of height 1 m. The tube surface is kept at 117°C. Estimate the thickness of the condensate film and heat transfer coefficient at a distance of 0.2 m from the upper end of the tube. Assume the condensate film to be laminar. Also calculate the average heat transfer coefficient over the entire length of the tube. **(08 Marks)**

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CBCS SCHEME

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15ME64

Sixth Semester B.E. Degree Examination, June/July 2018
Design of Machine Elements – II

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer FIVE full questions, choosing one full question from each module.***
2. ***Use of design data hand book is permitted.***

Module-1

1 a. Explain the compounding in cylinders. **(04 Marks)**

b. The C-frame of a 100 kN capacity press is shown in Fig. Q1 (b). The material of the frame is grey cast iron FG200 and the factor of safety is 3. Determine the dimensions of the frame. **(12 Marks)**

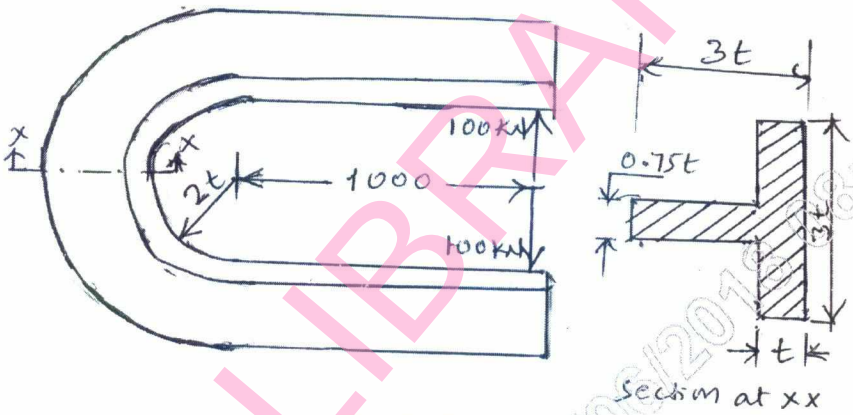


Fig. Q1 (b)

OR

2 a. Differentiate between a straight beam and a curved beam. **(04 Marks)**

b. The inner diameter of a cylinder is 250 mm. The pressure is limited to 15 MPa. The cylinder is made of plain Carbon steel with $\sigma_{ut} = 340$ N/mm^2 and $\mu = 0.27$. Taking the factor of safety as 5, calculate the cylinder wall thickness if,

(i) The ends are closed.

(ii) The ends are open. **(12 Marks)**

Module-2

3 a. Enumerate the objectives of chain lubrication. **(04 Marks)**

b. A leather belt drive transmitting 15 kW power with the help of a flat belt made of leather of mass density 0.95 g/cc. The centre distance between the pulleys is twice the diameter of the bigger pulley. The smaller pulley rotates at 1440 rpm and the speed of bigger pulley is 480 rpm. The belt should operate at a velocity of 20 m/s approximately and the stresses in the belt should not exceed 2.25 N/mm^2. The coefficient of friction is 0.35. The thickness of the belt is 5 mm. Calculate

(i) The diameter of the pulleys.

(ii) The length and width of the belt.

(iii) The belt tensions. **(12 Marks)**

OR

4 a. Explain the advantages of regular-lay ropes. **(04 Marks)**

b. Determine the percentage increases in power capacity made possible in changing over from a flat belt to a V-belt drive. The diameter of the flat pulley is the same as the pitch diameter of the grooved pulley. The pulley rotates at the same speed as the grooved pulley. The coefficient of friction for the flat belt and the V-belt is the same, 0.3. The V-belt pulley groove angle is 60°. The belts are of the same material and have the same cross section area. In each case the angle of wrap is 150°. **(04 Marks)**

c. A helical compression spring made of circular wire, is subjected to an axial force, which varies from 2.5 kN to 3.5 kN. Over this range of force, the deflection of the spring should be approximately 5 mm. The spring index can be taken as 5. The spring has square and ground ends. The spring is made of patented and cold-drawn steel wire with ultimate tensile strength of 1050 N/mm^2 and modulus of rigidity of 81370 N/mm^2. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Calculate
(i) Wire diameter (ii) Mean coil diameter (iii) Number of active coils (iv) Total number of coils (v) Solid length of the spring (vi) free length of the spring (vii) required spring rate ; and (viii) actual spring rate. **(08 Marks)**

Module-3

5 It is required to design a pair of spur gears with 20° full-depth involute teeth based on the Lewis equation. The velocity factor is to be used to account for dynamic load. The pinion shaft is connected to a 10 kW, 1440 rpm motor. The starting torque of the motor is 150% of the rated torque. The speed reduction is 4 : 1. The pinion as well as the gear is made of plain carbon steel with $\sigma_d (\text{or } \sigma_0) = 200\ \text{N/mm}^2$. Take number of teeth on pinion = 18. Design the gears specify their dimensions and suggest suitable hardness. Assume carefully cut gears (Class II). **(16 Marks)**

OR

6 A pair of bevel gears with 20° pressure angle, consists of a 20 teeth pinion meshing with a 30 teeth gear. The module is 4 mm, while the face width is 20 mm. The material for the pinion and gear is steel (σ_0 = 250 N/mm^2). The gear teeth are lapped and ground (Class 3) and the surface hardness is 400 BHN. The pinion rotates at 500 rpm and receives 2.5 kW power from the electric motor. The starting torque of the motor is 150% of the rated torque. Determine the factor of safety against bending failure and against pitting failure. **(16 Marks)**

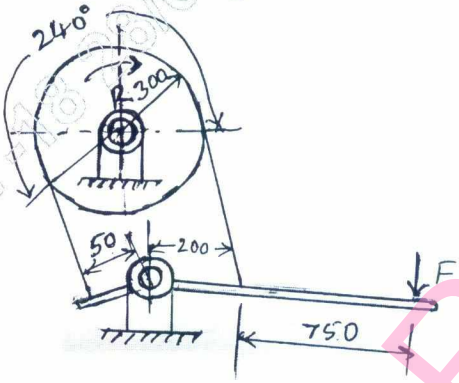
Module-4

7 Complete the design and determine the input power capacity of a worm gear speed reduces unit composed of a hardened steel worm and a phosphor bronze gear having 20° stub involute teeth. The center distance C is to be 200 mm, the transmission ratio is to be 10, and the worm speed is to be 1750 rev/min. **(16 Marks)**

OR

8 a. An automotive plate clutch consists of two pairs of contacting surfaces with asbestos friction lining. The maximum engine torque is 250 Nm. The coefficient of friction is 0.35. The inner and outer diameters of friction lining are 175 mm and 250 mm respectively. The clamping force is provided by nine springs, each compressed by 5 mm to give a force of 800 N, when the clutch is new:
(i) What is the factor of safety with respect to slippage when the clutch is brand new?
(ii) What is the factor of safety with respect to slippage after initial wear has occurred?
(iii)How much wear of friction lining can take place before the clutch will slip? **(08 Marks)**

b. A differential band brake is shown in Fig. Q8 (b). The width and thickness of the steel band are 100 mm and 3 mm respectively and the maximum tensile stress in the band is 50 N/mm^2. The co-efficient of friction between the friction lining and the brake drum is 0.25. Calculate (i) The tensions in the band (ii) The actuating force and (iii) The torque capacity of the brake. Find out whether the brake is self locking. **(08 Marks)**



All dimensions are in mm
Fig. Q8 (b)

Module-5

9 a. List the applications of anti-friction bearings. **(04 Marks)**

b. A 75 mm long full journal bearing of diameter 75 mm supports a load of 12 kN on a journal turning at 1800 rpm. Assuming a $\frac{\gamma}{C}$ ratio of 1000, and an oil having viscosity of 0.01 kg/mS at the operating temperature, determine the coefficient of friction by using (i) the McKee equation, (ii) the Raimondi and Boyd curve (iii) also determine the amount of heat generated using the co-efficient of friction as calculated by the McKee equation. **(12 Marks)**

OR

10 a. Define hydrodynamic lubrication. Explain the principle of hydrodynamic lubrication. **(06 Marks)**

b. A single row deep groove ball bearing is subjected to a radial force of 7 kN and thrust force of 2.2 kN. The shaft rotates at 1200 rpm. The expected life L_{10h} of the bearing is 20000h. The minimum acceptable diameter of the shaft is 75 mm. Select a suitable ball bearing for this application. Take X = 0.56 and Y = 1.8. **(10 Marks)**

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CBCS SCHEME

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15ME653

Sixth Semester B.E. Degree Examination, June/July 2018
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. How are metal forming processes classified? Explain with simple sketches. **(08 Marks)**

b. Discuss the advantages , limitations and applications of hot forming processes. **(08 Marks)**

OR

2 a. Derive an expression for true strain in terms of engineering strain. **(08 Marks)**

b. A tensile specimen having initial dimension of 12mm diameter and 50mm gauge length reaches a maximum load of 90kN and fractures at 70kN. The maximum diameter at fracture is 10mm. Find i) The engg. stress at maximum load and true fracture stress.
ii) True strain and engg. strain at fracture. **(08 Marks)**

Module-2

3 a. Discuss the effects of strain rate and deformation zone geometry on metal forming, with neat sketches. **(08 Marks)**

b. Explain Plastic deformation by slip and twining, with neat sketches. **(08 Marks)**

OR

4 a. Derive a relationship for the die pressure under compressive loading with sticking friction. Hence show the pressure distribution with sticking friction using a neat sketch in forging. **(08 Marks)**

b. What is the forging load required to convert a cylindrical bloom of 1m diameter into a square section of the same area of cross section? The average tensile yield strength of the metal is 104MPa and coefficient of friction is 0.5. Assume plane strain condition for forging. **(08 Marks)**

Module-3

5 a. With neat sketches, explain the different types of rolling mill arrangements. **(08 Marks)**

b. Discuss the maximum possible reduction in the rolling process, with a neat sketch. **(08 Marks)**

OR

6 a. With neat sketches, explain any two types of tube drawing process. **(08 Marks)**

b. A steel wire is drawn from an initial diameter of 6mm to a final diameter of 5.2mm. The die angle is 18^0, coefficient of friction at the die – wire interface is 0.15. Yield strength of the material is $255N/m^2$. Calculate the drawing stress in the absence of back tension. **(08 Marks)**

Module-4

7 a. Explain Direct and Indirect extrusion, with neat sketches. **(08 Marks)**

b. Discuss the defects in extrusion products. Explain the causes and possible remedies. **(08 Marks)**

OR

8 a. Explain the following sheet metal forming processes, with neat sketches :
i) Roll bending ii) Deep drawing. **(08 Marks)**

b. A circular blank of 30mm diameter is to be cut from a 2mm thick steel sheet. Determine the die and punch sizes. Estimate the punch force and stripping force needed. Shear strength of steel is 310 MPa. **(08 Marks)**

Module-5

9 a. How are High Energy Rate Forming [HERF] processes classified? Explain any two methods, with suitable sketches. **(08 Marks)**

b. Discuss the advantages, limitations and applications of High Energy Rate Forming [HERF] methods. **(08 Marks)**

OR

10 a. Explain the operations involved in making powder metallurgy parts with the help of a flow chart. **(08 Marks)**

b. Explain Hot Isostatic Pressing [HIP], with a neat sketch. **(08 Marks)**

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CBCS SCHEME

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15ME664

Sixth Semester B.E. Degree Examination, June/July 2018
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. Define TQM. List out the six basic approaches to TQM. **(04 Marks)**
b. Sketch and explain TQM framework. **(08 Marks)**
c. Define quality and brief on historical review of quality control. **(04 Marks)**

OR

2 a. Explain briefly the contribution of Guru's of TQM. **(07 Marks)**
b. What are the obstacles associated with the implementation of TQM? Explain any five. **(05 Marks)**
c. What are the benefits of TQM? **(04 Marks)**

Module-2

3 a. List seven habits of highly effective people. **(02 Marks)**
b. Explain Deming's 14 points. **(14 Marks)**

OR

4 a. Explain the characteristics of quality leaders. **(06 Marks)**
b. Explain the role of TQM leaders. **(10 Marks)**

Module-3

5 a. Explain customer perception of quality. **(06 Marks)**
b. With a neat sketch, explain how a KANO model helps in translating needs into requirements. **(10 Marks)**

OR

6 a. What is motivation? Explain Maslow's hierarchy of needs with a block diagram. **(10 Marks)**
b. Brief on performance appraisal. **(06 Marks)**

Module-4

7 a. Sketch the continuous process improvement cycle. **(03 Marks)**
b. Brief on PDSA cycle with a sketch. **(03 Marks)**
c. Sketch and explain Juran's triology. **(10 Marks)**

OR

8 Explain the following briefly with necessary diagrams:
a. Pareto diagram
b. Process flow diagram
c. Cause - and - effect diagram
d. Scatter diagrams. **(16 Marks)**

Module-5

9 Discuss briefly the following quality management tools:
a. Nominal group technique
b. Why Why analysis
c. Affinity diagram
d. Activity network diagram. **(16 Marks)**

OR

10 a. What is Benchmarking? Explain the process of benchmarking. **(08 Marks)**
b. What are the advantages of quality of design? **(04 Marks)**
c. Discuss the 4-stages of Failure mode effect analysis. **(04 Marks)**

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