Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 40834

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth/Sixth Semester

Mechanical Engineering

ME 8593 — DESIGN OF MACHINE ELEMENTS

(Common to Automobile Engineering/Industrial Engineering/
Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/
Mechatronics Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. How are the plain carbon steels designated in BIS?

2. State four methods to reduce stress concentration.

3. What are the advantages of flexible coupling over rigid coupling?

4. List four required properties of good shaft materials.

5. State any two conditions under which the use of knuckle joints are recommended.

6. Classify adhesives used in adhesive joint.

7. Write short notes on the working of fly wheel as a speed regulator.

8. What do you mean by inertial bending in the design of connecting rod?

9. What is bearing modulus?

10. Define dynamic load rating.

PART B — ($5 \times 13 = 65$ marks)

11. (a) (i) A rod of length 100 mm and ϕ 20 mm is subjected

(1) Pure torsion

(2) Pure bending and

(3) Combined bending and torsional load.

Then, draw the typical stress distribution on the critical section of each case. (6)

(ii) A rod is subjected to axial tensile load of 20 KN and torsional load of 10 KNm. Determine the diameter of rod according to

(1) Rankine's theory

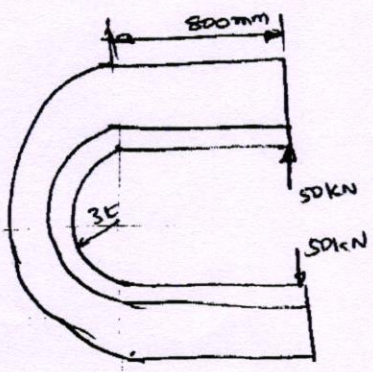
(2) St. Venant's theory

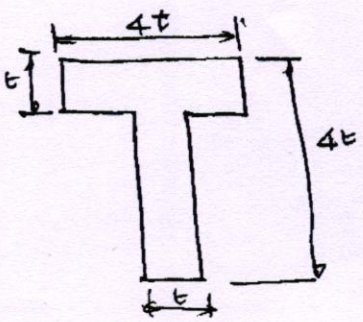
(3) Tresa theory.

Take factor of safety = 2.5, Poisson's ratio = 0.25, $\sigma_y = 300\,N/mm^2$. (7)

Or

(b) A punch press of capacity 50 KN has a c-frame of 'T' cross section as shown in the fig. The Tensile strength of material is 350 MPa. Take F 0.5 as 3.5. Determine the dimensions of C-frame (13)





12. (a) (i) Design a Wood-Ruff key to transmit 4 KW power at 400 rpm. The key is made up of C 45 steel and take F.O.S.=2 (9)

(ii) Write short note on design of shaft based on critical speed. (4)

Or

(b) Design a rigid coupling used to comment two shafts transmitting 20 KW at 200 rpm. The shaft, key and bolts are made up of C45 steel and coupling is of cast iron. Design the coupling. (13)

13. (a) (i) Write the significance of weld specifications. (5)

(ii) A plate 100 mm wide and 12 mm thick is to be welded to another plate by parallel fillet welds. The plates are subjected to a load of 50 KN. Find the length of weld so that the maximum stress induced in the weld should not exceed 50 N/mm^2. (8)

Or

(b) Design a cotter joint to support a completely redressed axial load of 30 KN. Use steel for all components. The allowable stress for steel are : in tension 40 N/mm^2, in compression 50 N/mm^2 and in shear 30 N/mm^2. (13)

14. (a) (i) A safety valve of 70 mm dia is to blow off pressure at 1MPa. It is placed on its seat by a closed coil helical spring of circular steel wire. The mean dia of each coil is 150 mm and compression of the spring is 25 mm. Find the dia of the spring wire and active number of turns required, if the allowable shear stress of wire material is 120 N/mm^2. (8)

(ii) Explain the method adopted for design of economic rivetted joint. (5)

Or

(b) (i) A single cylinder internal combustion engine working four stroke cycle develops 75 KN at 360 rpm. The fluctuation of energy can be assumed to be 0.9 times the energy developed per cycle. If the fluctuation of speed is not to exceed 1% and the maximum centrifugal stress in the fly wheel is to be 5.5 MPa, then estimate the mean diameter and cross sectional area of the rim. The material of the rim has density of 7200 kg/m^3. (8)

(ii) Write notes on rubber spring. (5)

15. (a) (i) A ball bearing has to be selected for an application in which the radial load is 2000 N during 90% of the time and 8000 N during 10% of time. The shaft is to rotate at 150 rpm. Determine the minimum value of the basic dynamic load rating for 5000 hours of operation with not more than 10% failures. (8)

(ii) Discuss about lubrication of ball/roller bearing. (5)

Or

(b) (i) State the essential requirements to develop thin film for hydro dynamic action (4)

(ii) A 100 mm long and 60 mm diameter journal bearing supports a load of 2500 N at 600 rpm. If the room temperature is 20°C, what should be the viscosity of oil to limit the bearing surface temperature to 60°C? The diameteral clearance is 0.06 mm and energy dissipation coefficient based on projected area of bearing is 210 W/m^2/°C. (9)

PART C — (1 × 15 = 15 marks)

16. (a) (i) Suggest suitable materials for the following parts stating the special property which makes it more suitable use in manufacturing

(1) Ball bearing

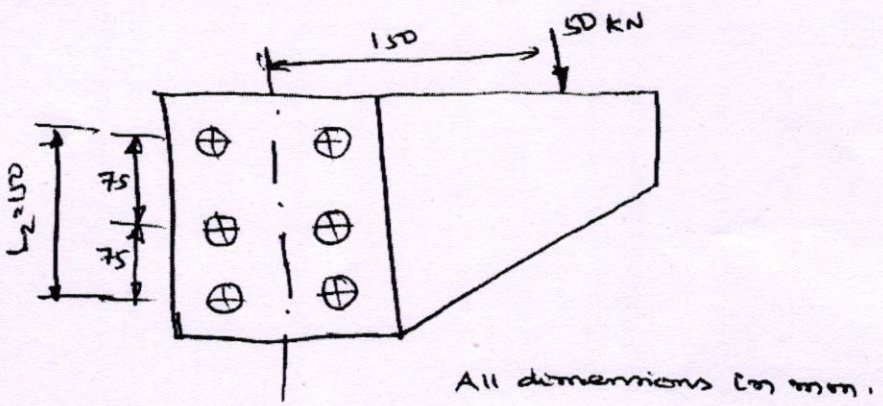
(2) Helical spring

(3) Keys (8)

(ii) State the reasons why the size of multi cylinder engine flywheel size is smaller than that of single cylinder engine. (7)

Or

(b) A bracket is bolted to a column by six bolts as shown in fig. It carries a load of 50 KN at a distance of 150 mm, from the center of column. If the maximum stress in the bolts is to be limited to 150 MPa, determine the diameter of the bolt. (15)



———————

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 50885

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Sixth/Seventh Semester

Mechanical Engineering

ME 8692 — FINITE ELEMENT ANALYSIS

(Common to Automobile Engineering/Manufacturing Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Production Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List any four points that a user must know to use the FEA packages properly.

2. Illustrate your understanding about the term "convergence" in FEA.

3. Find the temperature at a distance of 25 mm from origin for an element of length 45 mm. The temperature is linearly varying and its values at nodes 1 and 2 are 90°C and 120°C, respectively.

4. Give the conduction, convection and thermal load matrices for 1 D heat transfer through compressor fin.

5. Evaluate the shape functions N_1, N_2 and N_3 at the interior point 'P' for the triangular element having coordinates (3, 2), (7, 4) and (5, 8).

6. Give your view about higher-order elements.

7. Distinguish between plane stress and plane strain conditions.

8. List the conditions to be satisfied for a problem to be treated as axisymmetric.

9. Compare isoparametric, super parametric and sub-parametric elements.

10. Differentiate dynamic analysis from static analysis.

PART B — (5 × 13 = 65 marks)

11. (a) Find the deflection at the centre of a simply supported beam of span length l subjected to uniformly distributed load throughout its length as shown in Figure 11 (a), using

(i) Least squares method, and

(ii) Galerkin's method.

Use trigonometric series trial function.

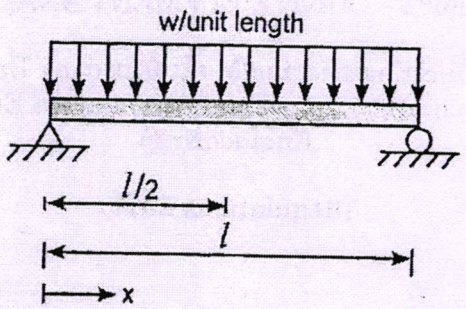


Figure 11 (a)

Or

(b) A bar of uniform cross-section is fixed at one end and left free at the other end and it is subjected to a uniform axial load F as shown in Figure 11 (b). Calculate the displacement and stress using Rayleigh's-Ritz procedure with two term polynomial function.

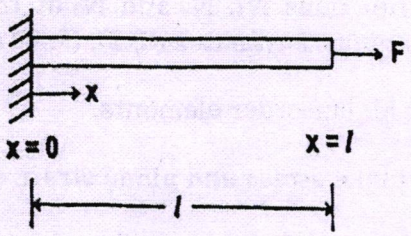


Figure 11 (b)

12. (a) A thin plate of uniform thickness 20 mm, is as shown in Figure 12 (a). In addition to the self-weight, the plate is subjected to a point load of 400 N at mid-depth. The Young's modulus $E = 2 \times 10^5$ N/mm^2 and density $\rho = 0.8 \times 10^{-4}$ N/mm^3. Analyze the plate after modeling it with two elements and find the stresses in each element. Determine the support reactions also.

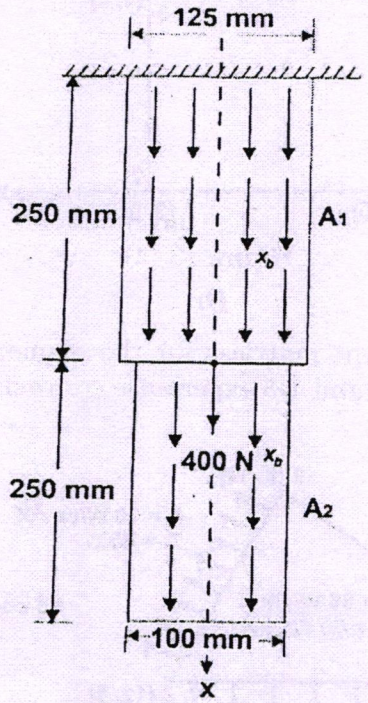


Figure 12 (a)

Or

(b) For the two-bar truss as shown in Figure 12 (b), determine the displacements at node 2 and the stresses in both elements.

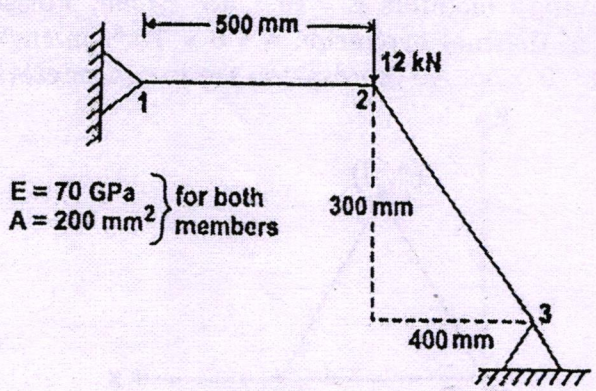


Figure 12 (b)

R RAJA
Digitally signed by R RAJA
Date: 2024.06.25 21:11:34 +05'30'

13. (a) For a four noded rectangular element shown in Figure 13 (a), determine the temperature at the point (2, 1). The nodal temperatures are $T_1 = 42°C$, $T_2 = 54°C$ $T_3 = 56°C$ and $T_4 = 46°C$.

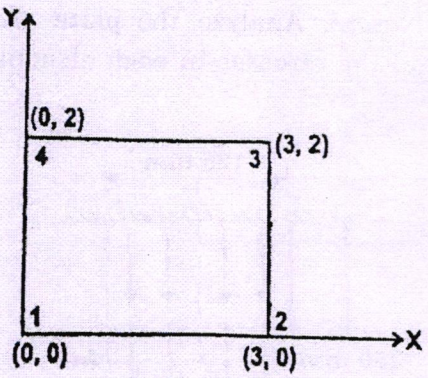


Figure 13 (a)

Or

(b) Compute the element matrices for the element shown in Figure 13 (b), when the edges 2-3 and 1-3 experience convection heat loss.

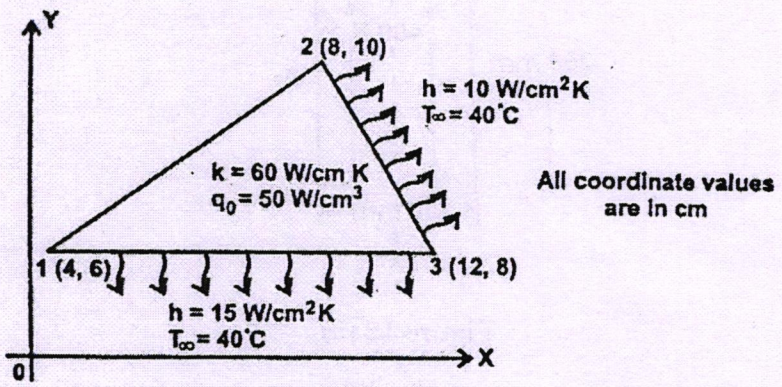


Figure 13 (b)

14. (a) Calculate the thermal force vector for the plane stress element shown in Figure 14 (a). The element experience a 10°C increase in temperature. Assume Young's modulus $E = 15 \times 10^6$ N/cm², Poisson's ratio $\mu = 0.25$, coefficient of thermal expansion $\alpha = 6 \times 10^{-6}$ cm/cm°C and the element thickness $t = 0.5$ cm. All coordinates are in centimeters.

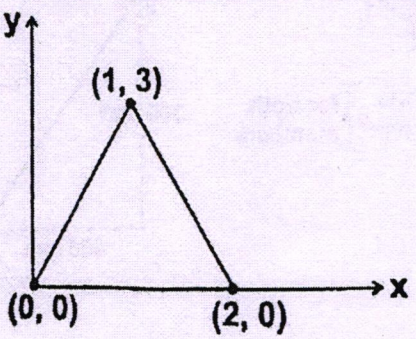


Figure 14 (a)

Or

(b) Derive the strain-displacement matrix for the axisymmetric triangular element shown in Figure 14 (b).

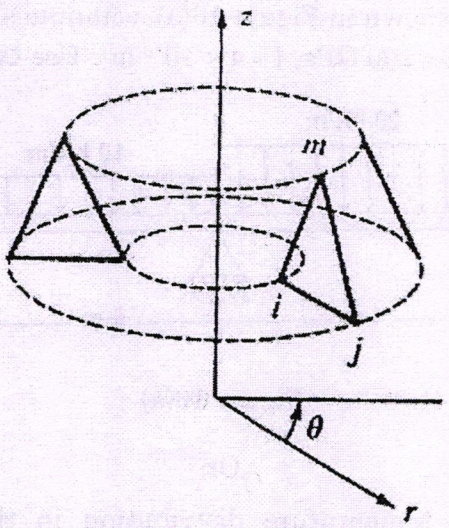


Figure 14 (b)

15. (a) Assemble Jacobian matrix and strain displacement matrix corresponding to the Gauss point (0.57735, 0.57735) for the element shown in Figure 15 (a).

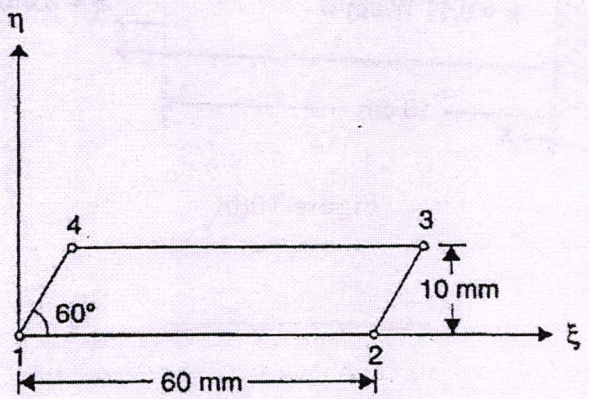


Figure 15 (a)

Or

(b) (i) Evaluate the integral (5)

$$f(r) = \int_{-1}^{1} (r^2 - 3r + 7)\,dr$$

Using Gaussian quadrature so that the result is exact. Take $r_i = \pm 0.5773503$ and $w_i = 1$.

(ii) Use Gaussian quadrature to obtain an exact value for the integral. Consider, r_i and $s_i = \pm\ 0.5773503$ and $w_i = 1$. (8)

$$I = \int_{-1}^{1}\int_{-1}^{1} (r^3 - 1)(s-1)^2\,dr\,ds$$

PART C — (1 × 15 = 15 marks)

16. (a) For the beam shown in Figure 16(a), compute slope at the hinged support points, Take E = 200 GPa, I = 4×10^{-6} m^4. Use two beam elements.

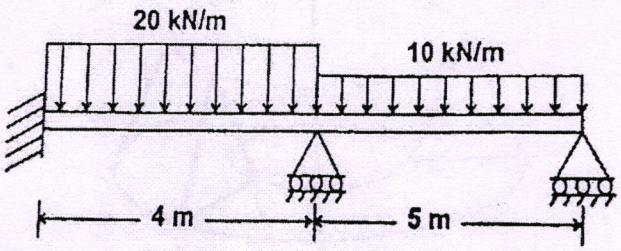


Figure 16(a)

Or

(b) Calculate the temperature distribution in the stainless steel fin of circular cross section shown in Figure 16(b). The cross section of the fin is circular with diameter of 2 cm. Discretize the fin into 5 elements.

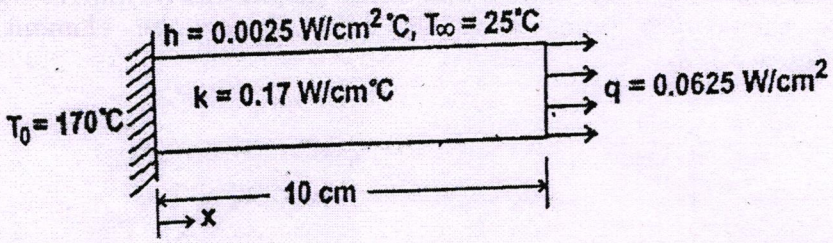


Figure 16(b)
