CBCS SCHEME

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18ME61

Sixth Semester B.E. Degree Examination, July/August 2022
Finite Element Methods

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain steps in finite element method. **(10 Marks)**

b. Explain simplex, complex and multiplex elements. **(10 Marks)**

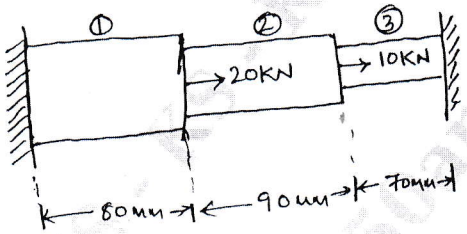
OR

2 a. Explain node numbering scheme. **(10 Marks)**

b. Obtain the shape functions for linear one dimension elements. **(10 Marks)**

Module-2

3 For the bar shown in Fig Q3, find the nodal displacements, stress in the middle portion and left support reaction.



$E_1 = 70$ GPa
$E_2 = 105$ GPa
$E_3 = 200$ GPa
$A_1 = 900$ mm^2
$A_2 = 400$ mm^2
$A_3 = 200$ mm^2

Fig Q3 **(20 Marks)**

OR

4 A four bar truss element as shown in Fig Q4, determine nodal displacement and stress in each element. Area = 100mm^2 E = 2×10^5 N/mm^2

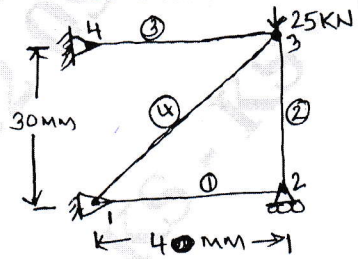


Fig Q4 **(20 Marks)**

Module-3

5 For the beam and loading shown in Fig Q5, determine mine the slopes at 2 and 3.

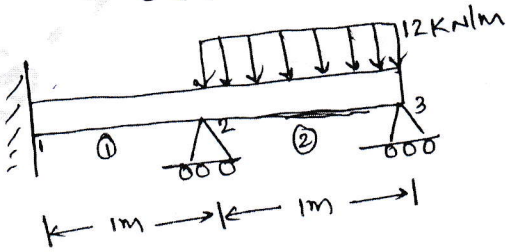


Fig Q5

Take : E = 200 GPa, I = 4×10^6mm^4 **(20 Marks)**

OR

6 A bar of circular cross section having a diameter 50mm is firmly fixed at its ends. It is subjected to torque as shown in Fig Q6. Determine the angle of twist and shear stress. Take $G = 7 \times 10^4$ N/mm^2, $E = 2 \times 10^5$ N/mm^2.

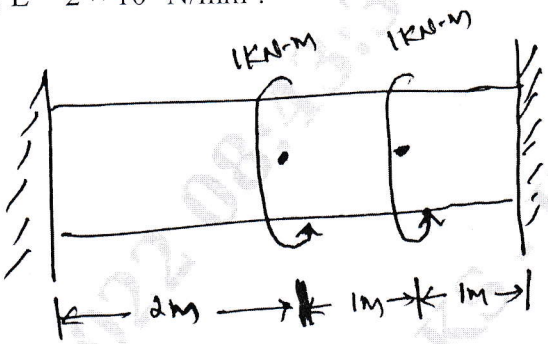
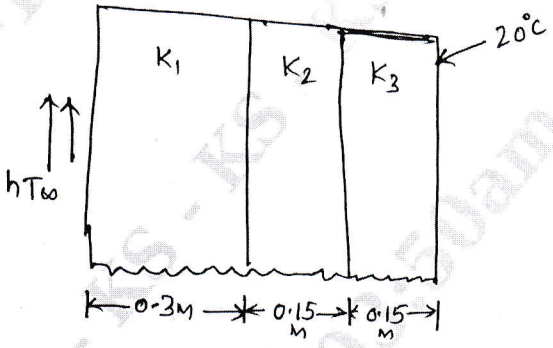


Fig Q6 **(20 Marks)**

Module-4

7 A composite wall consists of three materials, as shown in Fig Q7. The outer temperature is $T_0 = 20°C$, convective heat transfer takes place on the inner surface of the wall with $T_\infty = 800°C$ and $h = 25W/m^2°C$. Determine the temperature distribution in the wall.



$K_1 = 20W/m°C$
$K_2 = 30W/m°C$
$K_3 = 50W/m°C$

Fig Q7 **(20 Marks)**

OR

8 a. Derive stiffness matrix for flow through porous medium. **(10 Marks)**

b. Derive 1D heat conductive finite element matrix using variational method. **(10 Marks)**

Module-5

9 a. Derive shape function for axisymmetric triangular element. **(10 Marks)**

b. Derive stiffness matrix of axisymmetric bodies with triangular element. **(10 Marks)**

OR

10 For the stepped bar shown in Fig Q10, determine the Eigen values and Eigen vectors. Take $A_1 = 400mm^2$, $A_2 = 200mm^2$, $\rho = 7850$ kg/m^3, $E = 200GPa$.

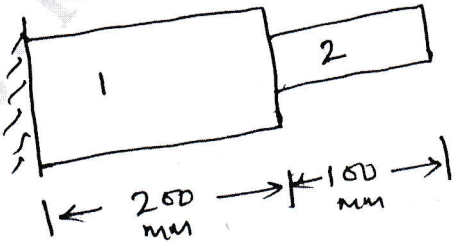


Fig Q10 **(20 Marks)**

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18ME62

Sixth Semester B.E. Degree Examination, July/August 2022
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 Handbook is permitted.

Module-1

1 a. Derive an expression for the stress induced in a helical spring with usual notations. **(10 Marks)**

b. Design a leaf spring for the following specifications for a truck total load = 120kN, number of springs = 4 material for the spring is chrome vanadium steel with permissible stress = 0.55GPa span of spring = 1100mm, width of central band = 100mm and allowable deflection = 80mm, number of full length leaves are 2 and graduated leaves 6. **(10 Marks)**

OR

2 a. Select a V-belt drive to transmit 10kW of power from a pulley of 200mm diameter mounted on a electric motor running at 720rpm to another pulley mounted on a compressor running at 200rpm. The approximate centre distance between the two pulleys is 600mm. The correction factor for service is 1.3. Find the number of belts and the correct centre distance. **(10 Marks)**

b. Select a suitable wire rope to a standard strand to lift a load of 10kN through a height of 600m from a mine. The weight of the bucket is 2.5kN. The load should attain a maximum speed of 50m/min in 2 seconds. **(10 Marks)**

Module-2

3 A 12kW motor running at 1170rpm drives a fan through a pair of spur gears forged steel SAE1030 pinion and cast iron gear with a reduction ratio of 3.9:1. Design the gear pair and check for dynamic and wear loads. **(20 Marks)**

OR

4 Design a steel helical gear pair from the following data power transmitted = 30kW, speed of pinion = 1500rpm, velocity ratio 4:1 number of teeth on pinion = 24, helix angle $\beta = 30°$, static stress for both pinion and gear = 50.7MPa $(BHN)_P = (BHN)_G = 350$ check the design from wear point of view also. **(20 Marks)**

Module-3

5 Design a pair of bevel gears to transmit a power of 25kW from a shaft rotating at 1200rpm to a perpendicular shaft to be rotated at 400rpm. **(20 Marks)**

OR

6 Complete the design and determine the input capacity of worm gear speed reducer unit which consists of hardened steel worm and phosphor bronze gear having 20° stub involute teeth. The center distance is to be 200mm and transmission ratio is 10 speed of the worm is 2000rpm. **(20 Marks)**

Module-4

7 a. Derive power transmitting capacity of a single plate clutch for:
i) Uniform pressure condition ii) Uniform wear condition. **(10 Marks)**

b. A plate clutch with a maximum diameter of 600mm has maximum lining pressure of 0.35MPa. The power to be transmitted at 400rpm is 135kW and $\mu = 0.3$, find the inside diameter and spring force required to engage the clutch if the spring with spring index 6 and material of the spring wire diameter, if 6 springs used. **(10 Marks)**

OR

8 a. In a band and block brake $\theta = 15°$ and effective diameter is 800mm, P = 0.4, a = 100mm, b = 25mm. The power absorbed at 600rpm is 450kW when the force applied at the end of levels at a distance of 1.20m from a fulcrum is 200N. Find the number of blocks. **(10 Marks)**

b. In a simple bank brake, the length of lever is 440mm. The tight end of the band is attached to the fulcrum of the lever and the slack end to a pin 50mm from the fulcrum. The diameter of the brake drum is 1m and arc of contact is 360°. The coefficient of friction between the band and the drum is 0.35. The brake drum is attached to a hoisting drum of diameter 0.65m that sustains a load of 20kN. Determine: i) Power required at the end ii) Width of steel if the tensile stress is $50N/mm^2$. **(10 Marks)**

Module-5

9 a. Derive Petroff's equation for a lightly loaded journal bearing with usual rotation. State the assumptions also. **(10 Marks)**

b. A full journal bearing 50mm diameter and 50mm long operates at 1000rpm and carries a load of 5kN. The radial clearance is 0.025mm. The bearing is lubricated with SAE 30 oil and the operating temperature is 80°C. Determine:
i) Bearing pressure
ii) Sommefeld number
iii) Minimum film thickness
iv) Heat generated
v) Heat dissipated, if the ambient temperature is 20°C
vi) Amount of artificial cooling necessary. **(10 Marks)**

OR

10 a. Explain the different types of bearings. What are the requirements of lubricant used in the bearings? **(10 Marks)**

b. Select a single-row deep groove ball bearing to carry a radial load of 4kN and a thrust load of 5kN operating at a speed of 1200rpm for an average life of 15 years working 10hrs/day. Assume there are 250 working days/year and loads are steady. **(10 Marks)**

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