CBCS SCHEME

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18ME61

Sixth Semester B.E. Degree Examination, Jan./Feb. 2023
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 the steps involved in finite element method to solve engineering problems. **(08 Marks)**

b. A simply supported beam subjected to uniformly distributed load over the entire span. Derive the expression for maximum deflection using Rayleigh-Ritz method. Assume $y = C_1 \sin\left(\frac{\pi x}{L}\right) + C_2 \sin\left(\frac{3\pi x}{L}\right)$ as an admissible displacement function. **(08 Marks)**

c. What are confirming and non-confirming elements? **(04 Marks)**

OR

2 a. Explain the importance of node numbering scheme with suitable example. **(06 Marks)**

b. Explain Simplex, Complex and multiplex elements with examples. **(06 Marks)**

c. Derive strain-displacement relations for a two – dimensional elastic body. **(08 Marks)**

Module-2

3 a. Derive a shape function for one-dimensional quadratic element in natural co-ordinate system. **(06 Marks)**

b. Derive strain-displacement matrix [B] for a 3-noded triangular element. **(06 Marks)**

c. For the truss configuration shown in Fig Q3(c), determine the stiffness values K_{11}, K_{12}, K_{22} and K_{66} of the global stiffness matrix. Assume E = 210GPa, A = $6 \times 10^{-4} m^2$ for both the truss member.

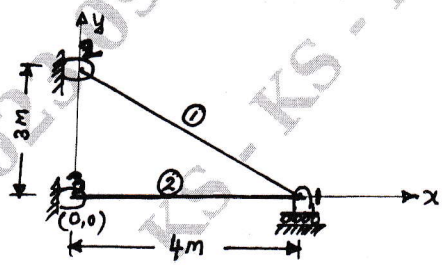

Fig Q3(c) **(08 Marks)**

OR

4 a. Evaluate the integral by 3-point gauss quadrate formula

$$I = \int_{-1}^{+1} (x^3 - 2x^2 + 5x - 7)dx$$ **(04 Marks)**

b. Derive stiffness matrix for a plane truss element. **(08 Marks)**

c. An axial bar subjected to force as shown in Fig Q4(c). Determine nodal displacement, stress in each material and reaction forces.

Assume : $E_{steel} = 200GPa$ $E_{Aluminum} = 70GPa$

$A_{steel} = 2400mm^2$ $A_{Aluminum} = 1200mm^2$

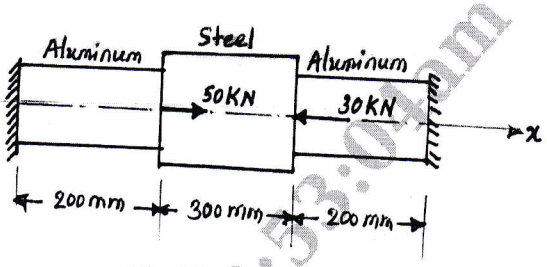

Fig Q4(c) **(08 Marks)**

Module-3

5 a. Derive the Hermite shape function for beam element and plot them. **(10 Marks)**

b. For the beam and loading as shown in Fig Q5(b) find the deflection at the centre of the beam. Assume E = 200GPa, I = $4 \times 10^6 mm^4$

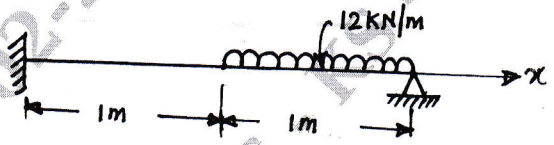

Fig Q5(b) **(10 Marks)**

OR

6 a. Derive stiffness matrix for a circular shaft subjected to pure torsion. **(10 Marks)**

b. A circular shaft subjected to torque at section "B" and "C" as shown in Fig Q6(b). Determine the maximum angle of twist and shear stress by taking modulus of rigidity for the shaft material as 70GPa.

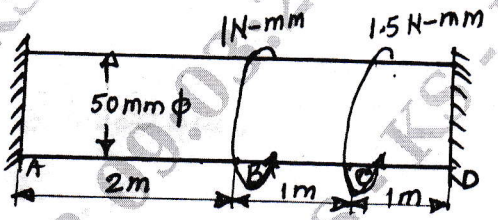

Fig Q6(b) **(10 Marks)**

Module-4

7 a. Explain different types of boundary conditions used in heat transfer problems. **(08 Marks)**

b. Heat is generated in a large plat at the rate of $4000 W/m^3$. The plate is 25mm thick. The outside surfaces of the plate are exposed to ambient air at 30°C with a convective heat transfer co-efficient of $20 W/m^2{}^oC$. Determine the temperature distribution in the wall. Assume the thermal conductivity for the plate material as 0.8W/m°C. Model the plate with 2 bar elements. **(12 Marks)**

OR

8 a. Derive differential equation in one – dimensional for fluid flow through porous medium. **(10 Marks)**

b. For the Smooth pipe with stepped cross-section as shown in Fig Q8(b), determine the potentials at the junctions. The potentials at the left end is 10m and that at the right end is 2m. Assume the permeability coefficient is 1m/sec.
$A_1 = 3m^2$, $A_2 = 2m^2$, $A_3 = 1m^2$

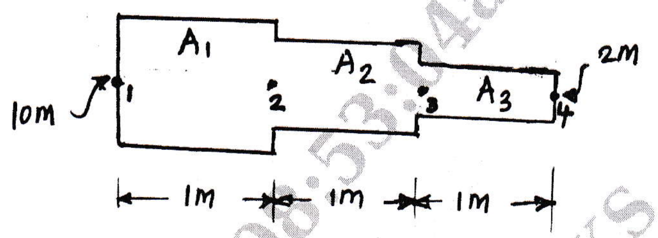

Fig Q8(b) **(10 Marks)**

Module-5

9 a. Derive the strain displacement matrix for axisymmetric constant strain triangle element. **(12 Marks)**

b. For the axisymmetric element shown in Fig Q9(b), determine the strain displacement matrix [B]. Take E = 200GPa, and $\upsilon = 0.3$

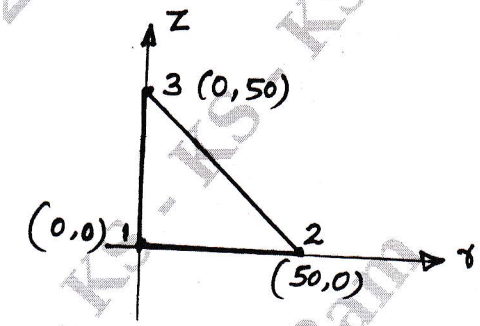

Fig Q9(b) **(08 Marks)**

OR

10 a. Derive the consistent mass matrix for two-noded bar element. **(06 Marks)**

b. Determine the eigenvalues and eigenvectors for the stepped bar as shown in Fig Q10(b). Take E = 200GPa, $\rho = 7830\ Kg/m^3$

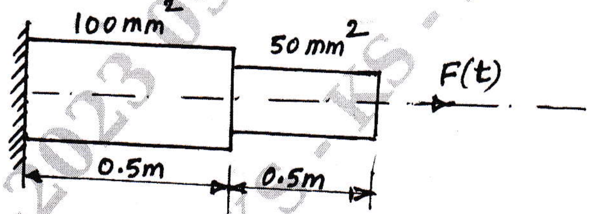

Fig Q10(b) **(14 Marks)**

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18ME62

Sixth Semester B.E. Degree Examination, Jan./Feb. 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 suitably be assumed.

Module-1

1 a. A railway Wagon moving at a velocity of 1.5 m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the Wagon is 15,000 kg. The springs are compressed by 150 mm in bringing the Wagon to rest. The spring index can be taken as 6. The springs are made of oil-hardened and tempered steel wire with ultimate tensile strength of 1250 N/mm^2 and modulus of rigidity of 81,370 N/mm^2. The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. The springs should have square and ground ends. Design the spring. **(10 Marks)**

b. Discuss the significance of nipping of leaf springs with appropriate sketch. **(04 Marks)**

c. A semi-elliptic leaf spring used for automobile suspension consists of three extra-full length leaves and 15 graduated length leaves including the master leaf. The centre-to-centre distance between two eyes of the spring is 1 m. The maximum force that can act on the spring is 75 kN. For each leaf, the ratio of width to thickness is 9 : 1. The modulus of elasticity of the leaf material is 207 GPa. The leaves are pre-stressed in such a way that when the force is maximum, the stresses induced in all leaves are same and equal to 450 N/mm^2. Determine (i) the width and thickness of leave ; (ii) the initial nip (iii) the initial pre-load required to close the gap 'C'. **(06 Marks)**

OR

2 a. Describe the phenomenon of creep and slip in the belt drive. **(04 Marks)**

b. It is required to select a V-belt drive from a normal torque motor of 5 kW capacity, which runs at 1440 rpm to a light duty compressor running at 970 rpm. The compressor runs for 24 hours per day. Space is available for a centre distance of about 500 mm. Assume that the pitch diameter of the driving pulley is 150 mm. Design the V-belt. **(08 Marks)**

c. It is required to select a 6×19 wire rope with 1569 as tensile designation for a hoist on the basis of long life. The weight of the hoist along with the material is 5 KN. It is to be raised from a depth of 100 m. The maximum speed of 5 m/s is attained in 5 seconds. Determine the size of wire rope and the sleave diameter for long life on the basis of the fatigue as failure criterion. Take 0.5 kg/m as mass per unit length of the wire rope. 70 KN as the breaking strength of the wire rope. What is the factor of safety of this wire rope under static conditions? Take the dimensionless quantity $\frac{P}{S_{ut}} = 0.0015$ for long fatigue life. **(08 Marks)**

Module-2

3 a. Describe gear tooth failure modes. **(04 Marks)**

b. 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 an allowable static stress of 200 N/mm^2. Design the gears, specify their dimensions and suggest suitable surface hardness for the gears. Take a f.o.s 1.5 for beam strength. The minimum number of teeth on pinion is 18. Endurance limit for checking the beam strength of the teeth is 259 N/mm^2. Take face width to module ratio as 10. Assume carefully cut gears (class II). **(16 Marks)**

OR

4 a. Obtain Lewis equation for the beam strength of a spur gear tooth. **(04 Marks)**

b. A pair of helical gears with a 23° helix angle is to transmit 2.5 kW at 10,000 rpm of pinion. The velocity ratio is 4 to 1. Both pinion and gear are to be made of hardened steel with an allowable stress $\sigma_d = 100$ MPa. The gears are 20° stub and the pinion to have 24 teeth. Determine minimum diameter of the gear that may be used and the required BHN. Take wear and lubrication factor as 1.15. Ratio of face width to normal module as 10. **(16 Marks)**

Module-3

5 a. Describe formative number of teeth for a bevel gear. **(02 Marks)**

b. A pair of right angle bevel gears is to be used to transmit 9 kW. The number of teeth an pinion is 21 and on the gear is 60. The material of the pinion is steel with allowable static stress of 85 MPa and that of the gear is C.I with 55 MPa. The pinion rotates at 1200 rpm and the gear at 420 rpm. The tooth profile is $14\frac{1}{2}^{\circ}$ (14.5 degree) composite. The teeth are to be generated. Take $C_S = 1.5$, b = 10 m. The gears are expected to be precission cut. Determine the required module and diameters of the gears. Design for strength using the Lewis equation and check for wear, considering the effect of overhanging. Suggest suitable surface hardness for the gear pair. **(18 Marks)**

OR

6 a. List any four applications of worm gears. **(02 Marks)**

b. A pair of worm and worm wheel is designated as, 1/30/10/10. The input speed of the worm is 1200 rpm, The worm wheel is made of centrifugally cast, phosphor bronze and the worm is made of case-hardened carbon steel. Determine the power transmitting capacity based on, (i) the beam strength (ii) wear strength
Bending stress factor for worm = 28.2
and worm wheel = 7
Speed factor for strength of worm = 0.25 and
For worm wheel = 0.48
Speed factor for wear of worm = 0.112
and for worm wheel = 0.26
Surface stress factor for worm = 4.93
and for worm wheel = 1.55
zone factor = 1.143 **(18 Marks)**

Module-4

7 a. Explain any six desirable properties of a good friction material used in clutches. **(06 Marks)**

b. A multi-disk clutch consists of five steel plates and four bronze plates. The inner and outer diameters of the friction disks are 75 and 150 mm respectively. The coefficient of friction is 0.1 and the intensity of pressure on friction lining is limited to 0.3 N/mm^2. Assuming uniform wear theory, calculate (i) the required force to engage the clutch, and (ii) Power transmitting capacity at 750 rpm. **(06 Marks)**

c. A cone clutch with asbestor friction lining transmits 30 kW power at 500 rpm. The coefficient of friction is 0.2 and the permissible intensity of pressure is 0.35 N/mm^2. The semi cone angle is 12.5°. The outer diameter is fixed as 300 mm from space limitations. Assuming uniform wear theory, calculate ;

(i) The inner diameter.
(ii) The face width of the friction lining
(iii) The force required to engage the clutch. **(08 Marks)**

OR

8 a. A single block brake with a torque capacity of 250 Nm is shown in Fig.Q8 (a). The brake drum rotates at 100 rpm and the co-efficient of friction is 0.35. Calculate

(i) The actuating force and hinge-pin reaction for clockwise rotation of the drum.

(ii) The actuating force and hinge-pin reaction for anticlockwise rotation of the drum.

(iii) The dimensions of the block, if the intensity of pressure between the block and brake drum is 1 N/mm^2. The length of the block is twice its width.

State whether the brake is self locking

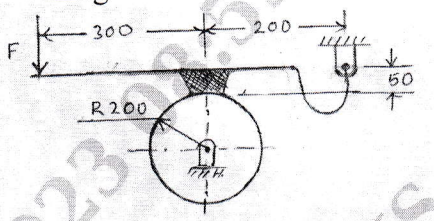

Fig. Q8 (a) **(12 Marks)**

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 coefficient of friction between the friction lining and the brake drum is 0.25. Calculate (i) the tensions in the band (ii) the actuating force (iii) the torque capacity of the brake. Find out whether the brake is self-locking

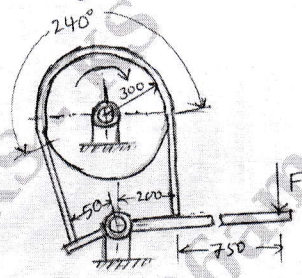

Fig. Q8 (b) **(08 Marks)**

Module-5

9 a. Obtain Petroff's equation for co-efficient of friction. Mention two assumptions. **(06 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 r/c ratio of 1000, and an oil of viscosity 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 coefficient of friction as calculated by the McKee equation, and (iv) determine the probable surface temperature of the bearing, using the following equation and assuming that the heat generated in all dissipated in still air at 20°C.

$$H_d = \frac{(\Delta T + 18)^2}{0.484} LD \times 10^{-6}$$

(14 Marks)

OR

10 a. Describe (i) Static load carrying capacity and (ii) Dynamic load carrying capacity with respect to anti-friction bearings. **(04 Marks)**

b. A single-row deep groove ball bearing is subjected to a radial force of 8 KN and a thrust force of 3 KN. The shaft rotates at 1200 rpm. The expected life L_{10h} of the bearing is 20,000h. The minimum acceptable diameter of the shaft is 75 mm. Select a suitable ball bearing for this application. **(10 Marks)**

c. A single row deep groove ball bearing is subjected to an axial thrust of 1000 N and a radial load of 2200 N. Find the expected life that 50% of the bearings will complete under this condition. Take C_O = 2500 N and C = 5590 N. **(06 Marks)**

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18ME63

Sixth Semester B.E. Degree Examination, Jan./Feb. 2023
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. Heat transfer data hand book permitted.

Module-1

1 a. Derive the general three dimensional heat conduction equation in Cartesian co-ordinate system. **(10 Marks)**

b. A wall of a furnace is made up of inside layer of silica brick 120mm thick (1.7w/m°k) covered with a layer of magnetite brick 240mm thick (5.8w/m°k). Temperature at the inside surface of silica and outside surface of magnetite brick wall are 725°C and 110°C respectively. The thermal contact resistance between two walls is 0.0035°k/w per unit area. Calculate : i) Heat flux ii) Temperature drop at interface. **(10 Marks)**

OR

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

b. Derive critical thickness and insulation of cylinder. **(06 Marks)**

c. A composite wall consists of 10cm layer of building brick (0.7 w/m°C) and 3 cm plaster (0.5 w/m°k). An insulating material of K = 0.08 w/m°C is to be added to reduce the heat transfer through the wall by 70%. Determine the thickness of insulating layer. **(08 Marks)**

Module-2

3 a. Derive an expression for the temperature distribution for a long fin of uniform cross section with insulated trip. **(10 Marks)**

b. A rod (K = 200w/m°k) 10mm in diameter and 5cm long has its one end maintained at 100°C. The surface of the rod is exposed to ambient air at 30°C with convective HTC of 100w/m^{2}K. Assuming other end insulated, determine :

i) Temperature of rod at 25mm distance from the end at 100°C
ii) Heat dissipation rate
iii) Effectiveness. **(10 Marks)**

OR

4 a. Obtain an expression for temperature distribution of solid in lumped heat transfer analysis in dimensional numbers. **(10 Marks)**

b. A 15 mm diameter mild steel sphere K = 42 w/m°C is exposed to cooling air flow at 20°C with h = 120 w/m^2°C. Determine the following :

i) Time required to cool from 550°C to 90°C
ii) Instantaneous heat transfer rate 2 minutes after start of cooling. **(10 Marks)**

Module-3

5 a. Explain the energy balance procedure to obtain the finite difference formulation of one – dimensional conduction problem in Cartesian coordinates. **(08 Marks)**

b. One face of a slab of thickness 1 cm (K = 20w/mk) is maintained at 40°C and the other surface is subjected to a convection heat transfer with fluid at 100°C and h = 4000w/m^2°k. There is uniform internal heat generation of 8 × 10^{7}w/m^3. Dividing slab into 5 equally spaced subregions.

i) Find temperature at different nodes. Assume one dimensional steady state conduction.
ii) If the left surface is insulated. What is the temperatures at surface in steady state. **(12 Marks)**

OR

6 a. State and explain :
i) Kirchoff's law
ii) Plank's law
iii) Wein's Displacement law
iv) Stefan – Boltzamann law. **(08 Marks)**

b. Explain the concept of Black body. **(04 Marks)**

c. Calculate the net radiant heat exchange per unit area for two large parallel plates at temperature of 427°C and 27°C respectively. $E_{hot} = 0.9$, $E_{cold} = 0.6$. If a polished aluminium shield is placed between them. Find the percentage reduction in heat transfer $\in_{shield} = 0.4$. **(08 Marks)**

Module-4

7 a. With reference to fluid flow over a flat plate, discuss the concepts of velocity boundary layer and thermal boundary layer, with necessary sketches. **(08 Marks)**

b. Air at 0°C and 20 m/sec flows over a flat plate of length 1.5m, that is maintained at 50°C. Calculate the average heat transfer coefficient over the region where flow is laminar. Find the average heat transfer coefficient and the heat loss for the entire plates per unit width. **(12 Marks)**

OR

8 a. Explain the significance of :
i) Nusselt number
ii) Reynolds's number
iii) Prandtl number
iv) Groshoff number. **(08 Marks)**

b. Consider a square plate size of 0.6m in a room with stagnant air at 20°C. One side of plate is maintained at 100°C, while the other side is adiabatic. Determine the heat loss if the plate is:
i) Vertical ii) Horizontal with hot surface facing NP. **(12 Marks)**

Module-5

9 a. Derive an expression for LMTD for a parallel flow heat exchanges. **(10 Marks)**

b. Oil at 100°C (C_p = 3.6kJ/kg°K) flows at rate of 30,000kg/hr and enters a parallel flow heat exchanges. Cooling water (C_P = 4.2kJ/kg°K) enters heat exchanges at 10°C at the rate of 50,000kg/hr. The heat transfer area is $10m^2$ and u = $1000w/m^2k$ calculate outlet temperature of oil and water. Also find maximum possible temperature of oil and water at exit. **(10 Marks)**

OR

10 a. Clearly explain the regions of pool boiling with neat sketch. **(08 Marks)**

b. A vertical tube of 60mm outside diameter and 1.2m long is exposed at atmospheric pressure. The outer surface of the tube is maintained at a temperature of 30°C. Calculate the following:
i) Rate of heat transfer
ii) Rate of steam condensation per second. **(12 Marks)**

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18ME653

Sixth Semester B.E. Degree Examination, Jan./Feb. 2023
Supply Chain Management

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Brief the key concept of Supply Chain Management. **(05 Marks)**

b. Explain the decisions in Supply Chain Management, with a suitable example. **(15 Marks)**

OR

2 a. Explain the evolutions of Supply Chain Management, with a suitable example. **(10 Marks)**

b. Explain the Supply Chain strategy, with a suitable example. **(10 Marks)**

Module-2

3 a. Describe Outsourcing and its benefits in Supply Chain Management, with a suitable example. **(10 Marks)**

b. Brief the auctions and its mechanisms adopted in Supply Chain Management. **(10 Marks)**

OR

4 a. Explain how is creating a World – Class Supply base improves the Supply Chain Management. **(10 Marks)**

b. How does the make Vs buy continuum play a major role in Supply Chain Management? **(10 Marks)**

Module-3

5 a. Brief the Store's system and procedure in Supply Chain Management. **(10 Marks)**

b. Explain how to maintain the obsolete stocks in Supply Chain Management. **(10 Marks)**

OR

6 a. Explain the role of transportation in Supply Chain Management. **(10 Marks)**

b. Explain the Supply Chain Capacity allocation. **(10 Marks)**

Module-4

7 a. Explain the Network design decision using decision tree in Supply Chain Management. **(10 Marks)**

b. List the various factors influencing network distribution decision in Supply Chain Management and explain any three. **(10 Marks)**

OR

8 a. Explain the impact of uncertainty on the network design in a Supply Chain with a suitable example. **(10 Marks)**

b. Explain the Multiple location inventory management in a Supply Chain. **(10 Marks)**

Module-5

9 a. Briefly explain the building partnership and trust in a Supply Chain in Supply Chain Management. **(10 Marks)**

b. Explain the Supply Chain mapping in Supply Chain Management, with a suitable example. **(10 Marks)**

OR

10 a. Explain the future of IT in a Supply Chain, with a suitable example. **(10 Marks)**

b. Explain the Supply Chain Integration, with a suitable example. **(10 Marks)**

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