CBCS SCHEME

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15ME61

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Finite Element Method

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. List the type of elements with neat sketch. **(06 Marks)**

b. A simply supported beam subjected to point load at the centre. Derive an equation for maximum deflection using trigonometrically function by RR method. **(10 Marks)**

OR

2 a. List the advantages and disadvantages of FEM. **(03 Marks)**

b. Explain Elasticity matrix [D] for stress and plain strain. **(04 Marks)**

c. Explain simplex, complex and multiplex elements. **(09 Marks)**

Module-2

3 a. Derive the shape function, in natural coordinate system for:

(i) Constant strain triangle.

(ii) 1D bar element. **(08 Marks)**

b. Using two point Gaussian quadrature formula evaluate and compare with exact solution:

(i) $I = \int_{-1}^{+1} (1 + \xi + 2\xi^2 + 3\xi^3)\, d\xi$

(ii) $I = \int_{-2}^{+2} (4 - y)^2 dy$ **(08 Marks)**

OR

4 a. For the stepped bar shown in Fig. Q4 (a), determine the nodal displacement, element stresses and reaction at supports.

$E_1 = 70$ GPa; $E_2 = 200$ GPa; $P = 200$ KN; $A_1 = 2400$ mm^2; $A_2 = 600$ mm^2 **(08 Marks)**

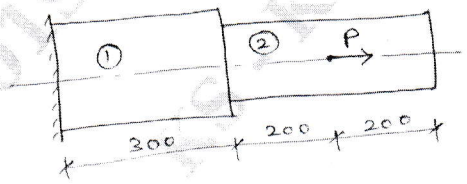


Fig. Q4 (a)

b. A plane truss shown in Fig. Q4 (b), determine nodal displacements, stresses in each element and reaction at supports.

$E = 200$ GPa ; $A_1 = 1200$ mm^2; $A_2 = 1000$ mm^2; $P = 50$ KN **(08 Marks)**

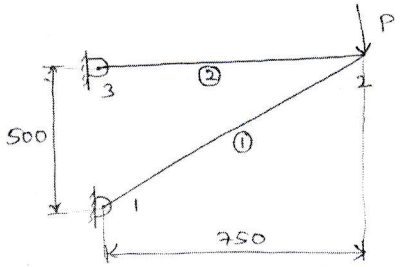


Fig. Q4 (b)

Module-3

5 a. Derive the Hermite function of a beam element. **(08 Marks)**

b. For the beam element shown in figure Q5 (b), determine the displacement and slope at the free end. Take E = 70 GPa, $I = 4\times10^{-4}$ m^4 **(08 Marks)**

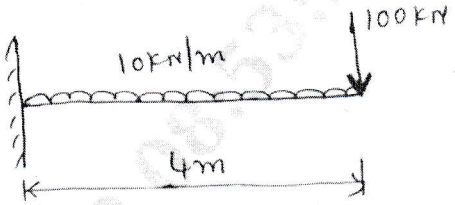
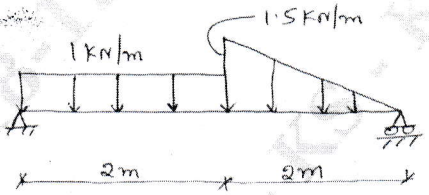


Fig. Q5 (b)

OR

6 a. Derive the stiffness matrix for a torsion element. **(06 Marks)**

b. Find the deflection and slopes at the nodes for the aluminium beam shown in Fig. Q6 (b). **(10 Marks)**



E = 70 GPa

$I = 2\times10^{-6} m^4$

Fig. Q6 (b)

Module-4

7 a. With brief explanation obtain the rate equation that describes the rate of energy flow for the following conditions:
(i) Conduction (ii) Convection (iii) Radiation **(06 Marks)**

b. Derive the shape function of a 1 D bar element with temperature T_1 and T_2 at the nodes. **(10 Marks)**

OR

8 a. Determine the temperature distribution in the rectangular fin shown in Fig. Q8 (a). Neglect convection heat transfer and assume heat generated inside the fin as 500 W/m^3 **(08 Marks)**

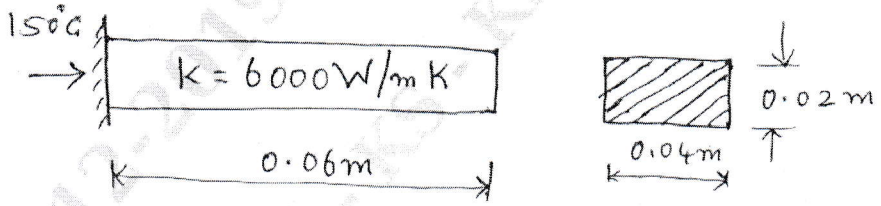


Fig. Q8 (a)

b. Derive the stiffness matrix for fluid flow in 1 D bar element. **(08 Marks)**

Module-5

9 Derive the shape function for axisymmetric triangular element. **(16 Marks)**

OR

10 Derive the consistent mass matrix for the following:
(i) 1 D bar element.
(ii) 1 D truss element. **(16 Marks)**

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CBCS SCHEME

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15ME62

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Discuss types of Automation relative to Production quantity and Product variety. **(08 Marks)**

b. Discuss Markov Chain Analysis for a two-stage automated production line under several down time distribution. **(08 Marks)**

OR

2 a. Explain the following :
(i) Production capacity (ii) Utilization and Availability
(iii) Manufacturing lead time (iv) Work in Progress. **(08 Marks)**

b. Explain the operation of walking beam transfer system. **(08 Marks)**

Module-2

3 a. Explain the role of computers in Design Process. **(08 Marks)**

b. A square with an edge length of 10 units is located on the origin. With one of the edge at an angle of 30° with the x-axis. Calculate the new position of the square if it is rotated about z-axis by an angle 30° in the clockwise direction. **(08 Marks)**

OR

4 a. Discuss retrieval-type process planning system. **(08 Marks)**

b. With a block diagram, explain the inputs to MRP. **(08 Marks)**

Module-3

5 a. With a sketch, explain FMS layout configurations. **(10 Marks)**

b. Explain the functions performed by FMS computer system. **(06 Marks)**

OR

6 a. Explain the types of AS/RS. **(10 Marks)**

b. Explain minimum rational Work Elements and Precedence constraints. **(06 Marks)**

Module-4

7 a. Explain the basic components of NC system. **(08 Marks)**

b. Write the manual part programming for the milling components shown in Fig.Q7(b) consider spindle speed as 800 rpm and feed rate as 100 mm/min and absolute positioning. Assume plate thickness as 10 mm and all dimensions are in mm.

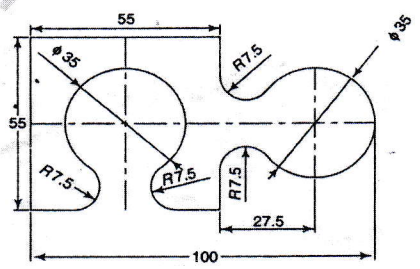

Fig.Q7(b) **(08 Marks)**

OR

8 a. Discuss various methods used to programme robots to perform a given work cycle. **(08 Marks)**

b. Discuss various application areas for industrial robots. **(08 Marks)**

Module-5

9 a. With a neat sketch, explain photo polymerization process in additive manufacturing. **(08 Marks)**

b. Discuss IOT applications in manufacturing. **(04 Marks)**

c. Define Big data and Cloud computing. **(04 Marks)**

OR

10 a. With a neat sketch, explain Sheet Lamination Process in additive manufacturing. **(08 Marks)**

b. Explain Industry 4.0 application in Manufacturing. **(08 Marks)**

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15ME63

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 is permitted.***

Module-1

1 a. Elaborate basic laws governing modes of heat transfer. **(06 Marks)**

b. Explain what do you mean by thermal contact resistance. **(02 Marks)**

c. The surface of a spherical container with 0.4 m outer diameter is at −195°C. Two layers of insulation each of 2.5 cm thickness is added. The thermal conductivities of the materials are 0.004 and 0.03 W/mK. The contact resistances are each of 5×10^{-4} $m^2°CW$. The outside is exposed to air at 30°C with a convection coefficient of 16 W/m^2K. Determine the heat gain and the temperatures at various surfaces and also the drops due to contact resistance. **(08 Marks)**

OR

2 a. Explain the types of boundary conditions involved in heat transfer problems. **(06 Marks)**

b. Write down the general heat conduction equation in (i) cylindrical coordinate system (ii) spherical coordinate system. **(02 Marks)**

c. A composite slab is made of three layers 15 cm, 10 cm and 12 cm thickness. The first layer is of material with K = 2.5 W/mK, and occupies 60% of area and the rest is of K = 1.45 W/mK. The second layer is made of material 12.5 W/mK for 50% area and remaining is of material with K = 18.5 W/mK. The third layer is of single material with K = 0.76 W/mK. The slab is exposed to warm air at 26°C and cold air at −20°c on the other side. The convective coefficients are 15 and 20 W/m^2K on the inside and outside respectively. Determine heat flow and interface temperatures. **(08 Marks)**

Module-2

3 a. Derive the equation of temperature distribution for long fin with usual notations. **(08 Marks)**

b. Circumferential fins of constant thickness of 1 mm are fixed on a 50 mm pipe at a pitch of 9 mm. The fin length is 20 mm. The wall temperature is 130°C. The K = 210 W/mK. The convective coefficient is 50 W/m^2K. Determine heat flow and effectiveness. **(08 Marks)**

OR

4 a. Derive equation of temperature distribution using lumped parameter model. **(08 Marks)**

b. A concrete wall initially at 30°C is exposed to gases at 900°C with h = 85 W/m^2K. The thermal diffusivity is 4.92×10^{-7} m^2/s. the K of material is 1.28 W/mK. Determine the temperature of the surface and temperatures at 1 cm depth and also 5 cm depth after 1 hr. Also estimate the heat flow at the surface at the instant. **(08 Marks)**

Module-3

5 a. Derive solution to differential equation for steady two dimensional conduction with usual notations. **(08 Marks)**

b. A plate 1m × 2m side has both its 2m sides and one 1m side at 100°C. The temperature along the fourth side is given by $T = 400\sin\left(\frac{\pi x}{l}\right) + 100$ where x is in m from the corner and t is in °C. Determine temperature taking 1m on x direction and 2m on y direction at following locations (i) (0.25, 0.5) (ii) (0.25, 1) (iii) (0.5, 1.5) (iv) (0.5, 2.0) **(08 Marks)**

OR

6 a. Define and explain the following:
i) Black body ii) Shape factor
iii) Wein's displacement law iv) Kirchoff's law **(08 Marks)**

b. Two large parallel planes are at 1000 K and 600 K. Determine the heat exchange per unit area.
(i) If surfaces are black
(ii) If the hot one has an emissivity of 0.8 and cooler one 0.5
(iii) If a large plate is inserted between these two, having emissivity of 0.2. **(08 Marks)**

Module-4

7 a. Explain formation of hydrodynamic and thermal boundary layers. **(08 Marks)**

b. A flat heater of circular shape of 0.2 m dia with a heat generation of 1.2 KW/m^2 is kept in still air at 20°C with heated surface facing downward and inclined at 15° to the horizontal. Determine heat transfer coefficient. **(08 Marks)**

OR

8 a. Write the importance of the following:
(i) Grashoff number
(ii) Prandtl number
(iii) Reynolds number
(iv) Stanton number **(08 Marks)**

b. Nitrogen at –20°C gets heated as it flows through a pipe of 25 mm dia at a flow rate of 13.72 kg/hr at 1 atm pressure. Determine the value of pipe temperature at the exit where pipe is heated with uniform heat flux of 500 W/m^2 and pipe is 4m long. Take Cp of nitrogen as 1030 J/kgK. **(08 Marks)**

Module-5

9 a. Sketch and explain regimes of pool boiling. **(08 Marks)**

b. Water at atmospheric pressure is boiling on a brass surface heated from below. If the surface is at 108°C, determine the heat flux and compare the same with critical heat flux. **(08 Marks)**

OR

10 a. Derive CMTD for parallel flow heat exchanger. **(08 Marks)**

b. In a shell and tube heat exchanger/condenser, the tube bank is 10 rows deep with ID of tube 20 mm and OD 25 mm. the tubes are arranged in square array of 50 mm pitch. Water flows across the tubes with V = 0.5 m/s. Sea water flows inside with 1 m/s. The water is cooled from 50°C to 30°C and sea water temperature changes from 15°C to 25°C. Assuming same properties for both side water, determine overall heat transfer coefficient. The tubes are of brass with K = 60.6 W/mK. Assume tube length of 4m. **(08 Marks)**

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CBCS SCHEME

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15ME64

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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.***
3. ***Missing data can be suitable assumed.***

Module-1

1 a. List differences between curved and straight beam. **(04 Marks)**

b. A chain link is made of 16 mm diameter steel rod. The mean radius of the semicircular end is 50 mm and the length of the straight portion of the link is 80 mm. Determine the maximum tensile and compressive stress when the link is subjected to a pull of 5 KN. **(12 Marks)**

OR

2 a. The following data refers a diesel engine:
Inside cylinder diameter = 150 mm, Explosion pressure = 5 N/mm^2; Material for the cylinder and head = Grey CI FG150; Factor of safety = 5
Design (i) Cylinder (ii) Head. **(05 Marks)**

b. A cast iron cylindrical pipe of outside diameter 300 mm and inside diameter 200 mm is subjected to an internal fluid pressure of 20 N/mm^2 and external pressure of 5 N/mm^2. Determine the tangential and radial stresses at the inner and outer surface. Also sketch the tangential stress and radial stress distribution across its thickness. **(11 Marks)**

Module-2

3 a. Explain concept of slip and creep in belt drive. **(04 Marks)**

b. Select a V-belt to transmit 10 kW of power from a pulley of 200 mm diameter mounted on an electric motor running at 720 rpm to another pulley mounted on compressor running at 200 rpm. The service is heavy duty varying from 10 Hrs to 14 Hrs per day and centre distance between centre of pulleys is 600 mm. **(12 Marks)**

OR

4 a. In a block and tackle mechanism, 3 pulleys at the top and 2 pulleys at the bottom block. Derive an expression for the effort required to raise the load in terms of load to be lift and pulley co-efficient. **(05 Marks)**

b. Explain any two types of chain used for power transmission. **(03 Marks)**

c. A loaded narrow gauge car weighs 18 KN and moving at velocity of 80 m/min is brought to rest by a buffer consists of two helical springs. In bringing the car to rest the spring undergoes a compression of 200 mm. The allowable shear stress is 0.3 GPa and the spring index is 8. Design a suitable spring. Take modulus of rigidity 84 GPa. **(08 Marks)**

Module-3

5 a. Give a detailed classification of gears. **(04 Marks)**

b. Design a pair of spur gears to transmit a power of 20 kW from a shaft at 1000 rpm to a parallel shaft which is to rotate at 310 rpm. Assume number of teeth on pinion 31 and 20° full depth involute tooth form. The material for pinion is C40 steel interated and for gear cast steel 0.20% C untreated. **(12 Marks)**

OR

6 a. Derive an equation for beam strength of helical gear. **(04 Marks)**

b. A pair of mitre gears has pitch diameter 280 mm and face width of 36 mm and runs at 250 rpm. The teeth are $14\frac{1}{2}^{\circ}$ involute profile and accurately cut and transmit 6 kW. Neglect friction angle, find the following:

(i) Outside diameter of gears.
(ii) Resultant tooth load tangent to pitch cone.
(iii) Radial load on the pinion.
(iv) Thrust on the pinion. **(12 Marks)**

Module-4

7 a. Complete the design and determine the input capacity of the worm gear speed reducer unit which consists of a hardened steel worm and a phosphor bronze gear having 20° stub involute teeth. The centre distance is 200 mm, transmission ratio is 10 and worm speed is 2000 rpm. **(12 Marks)**

b. Design a single plate clutch consists of two pairs of contacting surfaces for a torque capacity of 200 N-m. Due to space limitations the outside diameter of the clutch is to be 250 mm. **(04 Marks)**

OR

8 a. List friction materials used in clutch. Also derive an expression for torque transmitted by plate clutch. Assume uniform wear theory. **(06 Marks)**

b. A differential band brake has an operating lever 225 mm long. The ends of the brake band are attached so that their operating arms are 38 mm and 127 mm long. Brake drum diameter is 600 mm, Arc of contact is 300° and co-efficient of friction is 0.22. The band is 3.2 mm × 100mm .

(i) Find the least force required at the end of operating lever when the band is subjected to a stress of 55 N/mm^2.
(ii) What is the torque applied to the brake drum shaft?
(iii) Is this brake self locking? Proove your answer. **(10 Marks)**

Module-5

9 a. Derive Petroff's equation for a lightly loaded bearing. **(05 Marks)**

b. Design the main bearing of a steam turbine that runs at 1800 rpm. The load on the bearing is estimated to be 2500 N. Assume SAE 20 grade oil. **(11 Marks)**

OR

10 a. List and explain types of roller bearings. **(06 Marks)**

b. Derive an expression for reliability of a bearing. **(04 Marks)**

c. The rolling contact ball bearing are to be selected to support the overhung countershaft. The shaft speed is 720 rpm. The bearings are to have 99% reliability corresponding to a life of 24000 Hrs. The bearing is subjected to an equivalent radial load of 1 kN. Consider life adjustment factors for operating condition and material as 0.9 and 0.85 respectively. Find the basic dynamic load rating of the bearing from manufacture's catalogue, specified at 90% reliability. **(06 Marks)**

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CBCS SCHEME

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15ME662

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Industrial Safety

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Identify various types of work place hazard in a process industry. **(08 Marks)**

b. Distinguish between unsafe act and unsafe condition with suitable example. **(08 Marks)**

OR

2 a. Identify the need for Lockout and Tagout system. Illustrate with suitable examples. **(08 Marks)**

b. List the information described in MSDS and explain its significance in hazard control. **(08 Marks)**

Module-2

3 a. Apply the concept of fire triangle to discuss fire extinguishing process. **(08 Marks)**

b. Explain the various types of fire detection and Alarm system and justify its requirement in fire protection and loss prevention. **(08 Marks)**

OR

4 a. Develop the matrix on classification fire and recommend which type of fire extinguishing system is suitable for each class is fire. **(08 Marks)**

b. Explain with neat sketch of Carbon dioxide extinguisher. **(08 Marks)**

Module-3

5 a. Explain the safety measure for lathe and milling machine. **(08 Marks)**

b. Identify the general personal protective Equipment and explain any three. **(08 Marks)**

OR

6 a. Explain the general safety measure for machine shop. **(08 Marks)**

b. What are the basic safety procedure concerning corrosives. **(08 Marks)**

Module-4

7 a. List the various hazards of Electricity. **(04 Marks)**

b. Explain the effect of electric current on heart and lung. **(06 Marks)**

c. State the root causes of accident at construction site. **(06 Marks)**

OR

8 a. Explain the principle of unsafe acts and unsafe conditions behind electrical accident. Give an example. **(08 Marks)**

b. Identify ten preventive measures to prevent shocks in a substation. **(08 Marks)**

Module-5

9 a. Explain Acid hoods and handling of acids. **(04 Marks)**

b. Explain the safety precautions using CNC and LPG. **(06 Marks)**

c. Write a short note on safety Audit and risk assessment. **(06 Marks)**

OR

10 a. Explain eye washer's and shower. **(04 Marks)**

b. Write briefly safety thinking and accident investigation. **(06 Marks)**

c. Explain the safety policy of the company. **(06 Marks)**

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CBCS SCHEME

USN | 1 | K | S | 1 | 6 | M | E | H | 1 | 2 |

15ME655

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Automobile Engineering

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 different types of combustion chambers used in CI engine. **(08 Marks)**
b. Explain with a neat diagram the lubricating system used in a multi-cylinder engine. **(08 Marks)**

OR

2 a. Explain the significance of valve timing in compression ignition engine with a suitable diagram. **(08 Marks)**
b. Discuss the working of HCCI engine. **(08 Marks)**

Module-2

3 a. Explain with a neat sketch the working of torque converter. **(08 Marks)**
b. Explain Hotchkiss drive with a neat sketch. **(08 Marks)**

OR

4 a. Explain with a neat sketch the working of hydraulic brake system. **(08 Marks)**
b. Explain with a neat sketch the working of synchronizing unit of a synchromesh gear box. **(08 Marks)**

Module-3

5 a. Explain with a neat diagram the working of battery ignition system of a multi-cylinder engine. **(08 Marks)**
b. Explain with a neat sketch working of air suspension system. **(08 Marks)**

OR

6 a. Explain with a neat diagram the working of electronic ignition system. **(08 Marks)**
b. Explain the working of power steering system with a diagram. **(08 Marks)**

Module-4

7 a. Explain the working of common Rail Direct Injection system (RDI) with a neat diagram. **(08 Marks)**
b. Explain the working of turbocharger with a neat diagram. **(08 Marks)**

OR

8 a. Explain the Air fuel ratios for different speeds of a Car with a suitable diagram. **(08 Marks)**
b. List the alternate fuels for compression ignition engine and explain any two. **(08 Marks)**

Module-5

9 a. Explain how EGR (Exhaust Gas Recirculation) system reduces emission of NO_x (Oxide of Nitrogen). **(08 Marks)**
b. Explain with a neat diagram, evoportier loss control system. **(08 Marks)**

OR

10 a. Explain the working of catalytic converter with the help of a neat sketch. **(08 Marks)**
b. List the different emission for compression ignition engine and explain the reasons for the formation of these emissions. **(08 Marks)**

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