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10ME62

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting at least TWO questions from each part.*
2. Use of design data hand book is permitted.

PART – A

1 a. Crane hook of trapezoidal cross-section with an inner side of 120mm and outer side of 60mm. The depth of the section is 90mm. The centre of curvature is at a distance of 120mm from the inner edge of the section and the line of action of load is at a distance of 135mm from the inner edge. Determine the safe load that the hook can carry if it is made of steel having an allowable stress of 90 MPa. **(10 Marks)**

b. A 100mm inside and 150mm outside sleeve is press fitted on to a shaft of 100mm diameter? The modulus of elasticity of material is 210 GPa and Poisson ratio is 0.28. The contact pressure is not to exceed 60 MPa. Determine:

i) Tangential stress at inner and outer surface of the sleeve and outside diameter of the shaft.
ii) The radial stresses in the sleeve and shaft.
iii) The original diameters of the shaft and hub before press fit.
iv) The total interference. **(10 Marks)**

2 a. For a flat belt drive, the following data are given power transmitted = 9kW, speed of motor = 1500rpm, speed of driven pulley = 500 rpm, velocity of belt 16 m/sec, load factor = 1.2, density of leather = 9.8 kN/m^3. Small diameter to thickness of belt ratio = 36, factor of safety = 10, ultimate strength of belt material = 24 MPa, centre distance = 2.1m, coefficient of friction = 0.36. Design the belt. **(10 Marks)**

b. Select a r-belt drive to transmit 9 kW from a shaft rotating at 1200rpm to a parallel shaft to run at 300rpm. The diameter of smaller pulley is 120mm. The centre distance between shafts is 1.2m. **(10 Marks)**

3 a. Design a rectangular section helical spring to mount a buffer to sustain a load of 30kN. The deflection under load is 90mm. The spring is made of Z-nickel having a torsional ultimate stress of 830 MPa. The longer side of rectangle is twice the shorter side and the spring is wound with longer side of rectangle parallel to the axis. The spring index is 10. Take factor of safety = 2.5 and G = 75.51 GPa. **(12 Marks)**

b. A laminated spring having 6 graduated leaves is simply supported at ends at a distance of 0.9m. It is made of steel having allowable bending stress of 360 MPa. The width and thickness of leaves are 90mm and 6mm. Find the safe load that can be carried by this spring at the middle and the deflection under that load. Take $\in$ = 206 GPa. **(08 Marks)**

4 Design a pair of steel spur gears required to transmit 12kW at 2000 rpm of pinion. The velocity ratio received is 2.5:1. The allowable static stress for both may be taken as 138 MPa. Not less than 24 teeth are to be used on either gear. The teeth are 20° stub teeth. **(20 Marks)**

PART – B

5 Two shafts inclined at 60° are connected by a pair of bevel gears to transmit 9kW at 900rpm of 24 tooth cast steel pinion having allowable static stress of 138 MPa. The gear is made of high grade CI having allowable static stress of 103 MPa and is to run at 300rpm. The teeth are 14 ½° involute form. Design the gears completely. **(20 Marks)**

6 a. A multiplate clutch consists of 5 steel and 4 bronze plates. The inner and outer diameters of friction discs are 75mm and 150mm respectively. The coefficient of friction is 0.1 and allowable pressure is to be limited to 0.3 MPa. Assuming uniform pressure. Calculate:
i) The required axial force.
ii) Power that can be transmitted at 750 rpm. **(10 Marks)**

b. A 360mm radius brake drum contacts a single shoe as shown in Fig.Q.6(b) and sustains a power of 23.5 kW at 1000 rpm. Determine:
i) The normal force F_n on the shoe.
ii) The tangential force.
iii) The operating force for clockwise rotation.
iv) The value of distance 'C' for the brake to be self locking and
v) The rate of heat generated. **(10 Marks)**

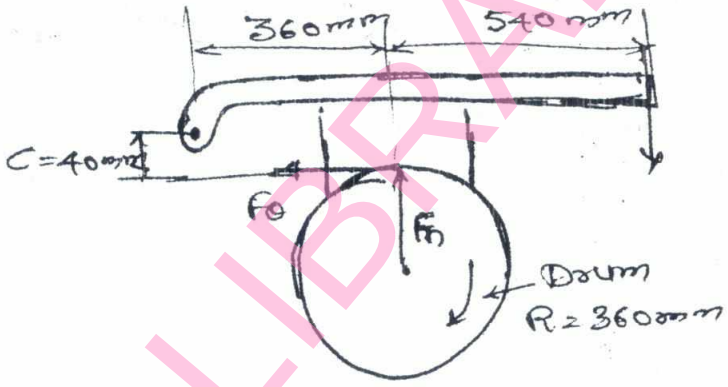

Fig.Q.6(b)

7 a. Derive the Petroff's equation for coefficient of friction. **(08 Marks)**

b. A full journal bearing 90mm diameter and 150mm long has a radial load of 2MPa per unit projected area. Shaft speed is 500rpm. The bearing is operating with SAE 20 oil at 50°C. The specific gravity of oil at the operating temperature is 0.985. Calculate the following:
i) Minimum film thickness
ii) Heat lost due to friction
iii) Whether artificial cooling is necessary. **(12 Marks)**

8 Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore: 100mm, stroke = 125mm, maximum gas pressure = 5 N/mm^2, indicated mean effective pressure = 0.75 N/mm^2, mechanical efficiency = 80%, fuel consumption = 0.15 kg, per brake power per hour, higher calorific value of fuel = 42×10^3 kJ/kg, speed = 2000 rpm. **(20 Marks)**

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10ME63

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Heat and Mass Transfer

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. ***Use of HMT data handbook is permitted.***

PART – A

1 a. Explain briefly the mechanism of conduction, convection and radiation heat transfer. **(03 Marks)**

b. Derive the three dimensional general heat conduction equation in Cartesian co-ordinates. **(08 Marks)**

c. The wall of a house in a cold region consists of three layers, an outer brick work 20cm thick, an inner wooden panel 1.4cm thick and an intermediate layer made of an insulating material 10cm thick. The inside and outside temperatures of the composite wall are 28^0C and -12^0C respectively. The thermal conductivity of brick and wood are 0.7W/m/K and 0.18 W/mK respectively. If the layer of insulation has a thermal conductivity of 0.023W/mK, find i) The heat loss per unit area of the wall ii) Overall heat transfer coefficient. **(09 Marks)**

2 a. Obtain an expression for temperature distribution and heat flow through a fin of uniform cross section with the end insulated. **(10 Marks)**

b. The aluminum square fins (0.6mm × 0.6mm), 12mm long are provided on the surface of a semi conductor electronic device to carry 2W of energy generated. The temperature at the surface of the device should not exceed 85^0C, when the surrounding is at 35^0C. Given K = 200 W/ m K, h = 15W/m^2 K. Determine the number of fins required to carry out the above duty. Neglect the heat loss from the end of the fin. **(10 Marks)**

3 a. Obtain an expression for instantaneous heat transfer and total heat transfer using lumped heat analysis for unsteady state heat transfer from a body to the surroundings. **(10 Marks)**

b. An Aluminum sphere weighting 6 kg and initially at a temperature of 420^0C is suddenly immersed in a fluid at 18^0C. The convective heat transfer coefficient is 45W/m^2 K. Estimate the time required to cool the sphere to 120^0C. Also find the total heat flow from the sphere to the surroundings when it cools from 300^0C to 120^0C. (For Aluminum, ρ = 2700 kg/m^3, C = 900 J/kg K , K = 200W/m K). **(10 Marks)**

4 a. Using dimensional analysis show that for free convection heat transfer $Nu = B\ Gr^a\ Pr^b$ with usual notations. **(10 Marks)**

b. A vertical plate 4m high and 6m wide is maintained at 60^0C and exposed to atmospheric air at 10^0C. Calculate the heat transfer from both sides of the plate. For air at 35^0C, take K = 0.027W/m K , $\gamma = 16.5 \times 10^{-6}$ m^2/s, Pr = 0.7. **(10 Marks)**

PART – B

5 a. Explain the significance of
i) Reynolds number ii) Prandtl number iii) Grashoff number iv) Stanton number v) Nusselt number. **(10 Marks)**

b. Water flows at a velocity of 12m/s in a straight tube of 60mm diameter. The tube surface temperature is maintained at 70^0C and the flowing water is heated from the in let temperature of 15^0C to an outlet temperature of 45^0C. Taking the physical properties of water at the mean bulk temperate of 30^0C as $\rho = 995.7 kg/m^3$, Cp = 4.174 kJ/kg K, K = 0.61718 W/m K , $\gamma = 0.805 \times 10^{-6}$ m^2/s and Pr = 5.42. Calculate i) heat transfer coefficient from the tube surface to the water ii) the heat transferred and iii) the length of the tube. **(10 Marks)**

6 a. Derive the expression for LMTD for a parallel flow heat exchanger. List out the assumptions made. **(10 Marks)**

b. Saturated steam at 140^0C is condensing on the outer surface of a single pass heat exchanger. The overall heat transfer coefficient is $1500 W/m^2$ K. Determine the surface area of the heat exchanger required to heat 2000 kg/h of water from 20^0C to 45^0C. Also determine the rate of condensation of steam in kg/h. Assume the latent heat of steam to be 2145 kJ/kg. **(10 Marks)**

7 a. With a neat sketch, explain the different regimes of pool boiling. **(10 Marks)**

b. Define Mass transfer coefficient. **(05 Marks)**

c. State Fick's law of diffusion. What are its limitations? **(05 Marks)**

8 a. Explain i) Stefan – Boltzman law ii) Wein's displacement law iii) Radiation shield iv) Radiosity v) Black body. **(10 Marks)**

b. Two large parallel plates having emissivity's of 0.3 and 0.6 are maintained at a temperature of 900^0C and 250^0C. A radiation shield having an emissivity of 0.05 on both sides is placed between the two plates. Calculate
i) Heat transfer without shield.
ii) Heat transfer with shield.
iii) Percentage reduction in the heat transfer due to shield.
iv) Temperature of the shield. **(10 Marks)**

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10ME64

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Finite Element Methods

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Explain the basic steps involved in FEM. **(06 Marks)**

b. Explain briefly about node location system and node numbering scheme. **(08 Marks)**

c. Explain plane stress and plane strain problem with examples and write the relation between stress and strain. **(06 Marks)**

2 a. Derive the stiffness matrix of bar element using direct approach. **(05 Marks)**

b. Using Rayleigh – Ritz method, determine the deflection of a cantilever beam subjected to point load at its end. **(10 Marks)**

c. Determine the displacement at nodes of spring system shown Fig. Q2(c) using principle of minimum potential energy, **(05 Marks)**
$K_1 = 40$ N/mm ; $K_2 = 60$N/mm ; $K_3 = 80$ N/mm ; $F_1 = 60$ N $F_2 = 50$ N.

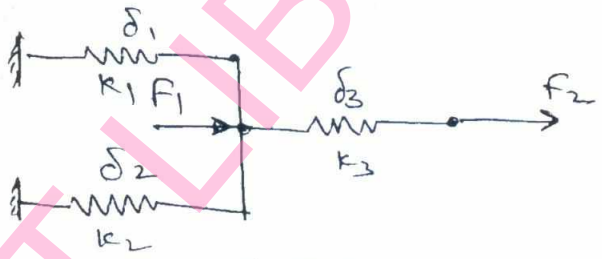

Fig. Q2(c)

3 a. Explain simplex, complex and multiplex elements using element shapes. **(06 Marks)**

b. Find the shape functions at point P for the CST element shown in Fig. Q3(b). Also find the area and Jacobian matrix for the element. **(08 Marks)**

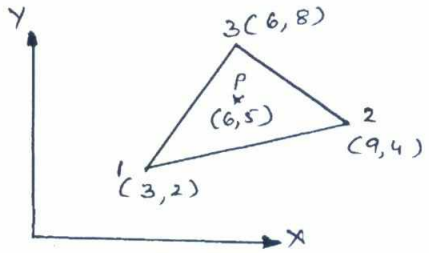

Fig. Q3(b)

c. What are the convergence requirements that an isoperimetric element should satisfy? Sketch and explain 2D Pascal triangle. **(06 Marks)**

4 a. Obtain the element stresses of the stepped bar shown Fig. Q4(a), take E = 200 GPA. $A_1 = 400\ mm^2$; $L_1 = 200$ mm ; $A_2 = 300\ mm^2$; $L_2 = 150$ mm. **(10 Marks)**

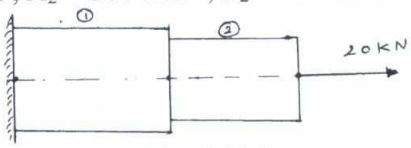

Fig. Q4(a)

b. Obtain the element stresses of the stepped bar shown in Fig. Q4(b) using penalty approach. $A_1 = 2400\ mm^2$ $L_1 = 150$ mm ; $E_1 = 70$ GPa ; $A_2 = 750\ mm^2$ $L_2 = 300$ mm $E_2 = 200$ GPa ; $P = 200 \times 10^3$N. **(10 Marks)**

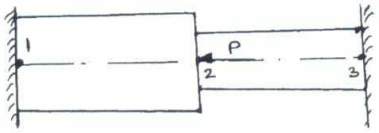

Fig. Q4(b)

PART – B

5 a. Explain briefly the iso-parametric, sub-parametric and super parametric elements, **(06 Marks)**

b. Derive the shape function of 2D quadrilateral element of linear model. **(08 Marks)**

c. Evaluate the following integral using two-point and 3–point gauss–integration method.

$$I = \int_{-1}^{+1} \left(3\xi^3 + 2\xi^2 + \xi + 2\right) d\xi \quad .$$ **(06 Marks)**

6 a. Derive the stiffness matrix for a 1 – D truss element. **(08 Marks)**

b. For the two – bar truss shown in Fig. Q6(b) determine the nodal displacement. Take E = 200 GPa ; $A_1 = A_2 = 200\ mm^2$. **(12 Marks)**

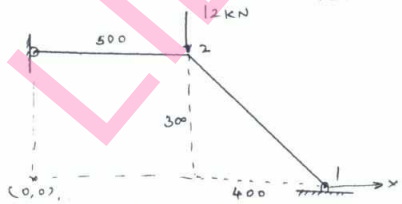

Fig. Q6(b)

7 a. Derive Hermite shape function for beam element. **(06 Marks)**

b. A uniform C – S beam is fixed at one end and supported by a roller at the other end. A concentrated load 20 kN is applied at the mid length of beam as shown in Fig. Q7(b). Determine the deflection under load. **(14 Marks)**

E = 200 GPa

$I = 2500 \times 10^4\ mm^4$

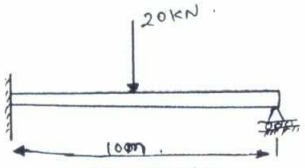

Fig. Q7(b)

8 a. Discuss the Galerkin approach for 1 – D heat conduction problem. **(10 Marks)**

b. Consider the brick wall of thickness L = 0.3m, k = 0.7 W/m°C. The inner surface is at 28°C and outer surface is exposed to cold air at –15°C. Heat transfer coefficient on outer surface $h = 40\ W/m^2°C$. Determine steady state temperature distribution with the wall and heat flux through the wall. Use two element model. **(10 Marks)**

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10ME65

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechatronics and Microprocessor

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define Mechatronics. With a block diagram, briefly explain the generalized measurement system. **(07 Marks)**

b. State and explain functions of basic elements of a closed loop control system, with a block diagram. **(06 Marks)**

c. Explain with a diagram, the working of an Engine Management system. **(07 Marks)**

2 a. Define Sensors and Transducers. Name any three types of sensors and transducers each. **(08 Marks)**

b. State and explain the working principle of Hall Effect sensor. **(06 Marks)**

c. What are proximity sensors? Explain capacitive proximity sensor, with a neat diagram. **(06 Marks)**

3 a. With sketch, explain solenoid and state its uses. **(06 Marks)**

b. Explain the working principle of a permanent magnet DC motor. How it is used for positive control drive. **(08 Marks)**

c. Sketch and explain the working of a stepper motor. **(06 Marks)**

4 a. Define signal conditioning. What are the necessity of signal conditioning? **(05 Marks)**

b. Define the following filters with frequency versus gain curve :
i) Low pass ii) High pass iii) Band pass iv) Band stop. **(10 Marks)**

c. What are the characteristics of an ideal operational amplifier? **(05 Marks)**

PART – B

5 a. Discuss briefly with a block diagram, organization of a typical microcomputer system. **(08 Marks)**

b. State Demorgan's theorems. Also draw logic circuits for the same. **(06 Marks)**

c. With the help of symbols and truth table, explain NOR and NAND gates. **(06 Marks)**

6 a. Explain with neat sketch, the architecture of INTEL 8085 microprocessor. **(12 Marks)**

b. What is a Microcontroller? How are microcontrollers classified? Briefly explain each. **(08 Marks)**

7 a. Explain the following terminology related to microprocessor : **(08 Marks)**
i) Program counter ii) Flag register iii) Stack pointer iv) Accumulator.

b. Explain the flow of instruction sets of a 8085 microprocessor. **(08 Marks)**

c. List out the functions of ALU. **(04 Marks)**

8 a. Define CPU and state its functions. **(06 Marks)**

b. How instructions and data flow occurs in microprocessors? **(08 Marks)**

c. Define the following : i) System clock ii) System clock frequency
iii) Clock period iv) Memory access time. **(06 Marks)**

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