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10ME62

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
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 permitted.
3. Missing data, if any may be suitably assumed.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Determine the dimensions of I-section, shown in Fig. Q1 (a) in which maximum fibre stresses are numerically equal in pure bending, given $b_i + b_0 = 120$ mm **(10 Marks)**

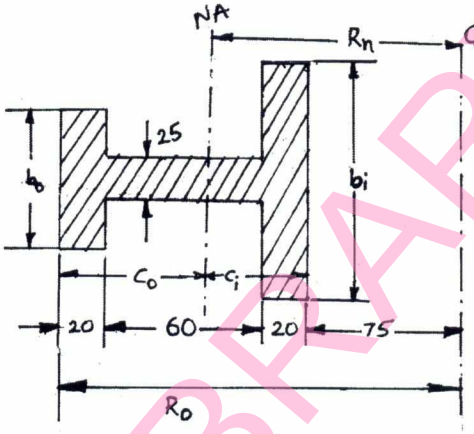

Fig. Q1 (a)

b. A solid shaft of 125 mm diameter is to be pressed into a steel flange which has an outside diameter of 150 mm and length of 100 mm. Take E = 210 GPa, ν = 0.3. Determine,
i) Pressure between hub and shaft.
ii) Proper size of bore, if maximum stress does not exceed 160 MPa.
iii) Force required to press the parts together. Assume μ = 0.1 for press fit.
iv) Torque capacity of press fit. **(10 Marks)**

2 a. Select a V-belt drive to transmit 18 kW at 1500 rpm to another pulley to run at 750 rpm. The dia of smaller pulley is 100 mm. The centre distance is 2 times the diameter of larger pulley. **(10 Marks)**

b. Select a number of wire ropes required to be used with a drum diameter of 2 meter. A load of 30 kN is to be lifted by 25 mm diameter 6×7 ropes form a height of 450 meter. A velocity of 15 m/sec is to be attained in 10 second. Assume the skip weight to be 30% of load capacity and factor of safety of 6. **(10 Marks)**

3 a. A free end of a torsional spring deflects through 60° when subjected to a torque of 6 N-m. The allowable stress in the spring material is 400 MPa and the spring index is 6. Determine the wire diameter and the number of effective turns. Take $E = 206.8 \times 10^3$ N/mm^2. **(08 Marks)**

b. A Belleville spring made from 5 mm thick steel sheet having outside diameter 150 mm and inside diameter 70 mm. The height of the spring is 10 mm. Using γ = 0.3, $E = 20 \times 10^4$ MPa. Find i) The deflectionn of spring. ii) The load the spring can carry.
iii) Stress at the outer edge.
Limit the maximum stress at the inner edgee to 450 MPa. **(12 Marks)**

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4 a. Design a pair of spur gear to transmit 40 kW at 4000 rpm of pinion to the gear 800 rpm. Select Chromium – Nickel steel for both gears. Assume pinion teeth as 20 and service factor as 1.5. Determine dynamic load, wear load and recommend BHN values. Assume $\alpha = 20^0$ FDI. **(12 Marks)**

b. A 24 teeth cast steel gear pinion (σ_{0_1} = 51.7 MPa) drives a high grade C.I. gear having (σ_{0_2} = 31 MPa) 50 teeth. The teeth are 20° full depth involute in the normal plane. The helix angle is 45°. Normal module is 3 mm. Find the safe power that can be transmitted by these gears at a pinion speed of 500 rpm. Assume face width is 10 times normal module and scant lubrication $C_W = 1.25$. **(08 Marks)**

PART – B

5 a. Design a pair of mitre bevel gears to transmit 9 kW at 1200 rpm. The pitch line velocity of gear is not exceed 15 m/sec. **(12 Marks)**

b. A hardened steel worm at 1250 rpm transmits power to a phosphor bronze gear with a transmission ratio of 20 : 1. The centre distance is 200 mm. Determine the input power capacity. Assume $\alpha = 14\frac{1}{2}^\circ$ FDI. **(08 Marks)**

6 a. Design a cone clutch to transmit 15 kW at 1200 rpm. Assume semi cone angle as 12.5°, co-efficient of friction for lining 0.4 and P = 0.2 MPa. **(08 Marks)**

b. A single band brake shown in Fig. Q6 (b) is to be designed to stop the rotation of a shaft transmitting a power of 45 kW at a rated speed of 500 rpm. Selecting suitable materials determine,

i) Dimensions of rectangular cross section of band.

ii) Dimensions of rectangular cross section of brake lever. (Assume $h_1 = 2\ b_1$).

iii) Diameter of fulcrum pin.

Assume $l_p = 1.5$ dp, bearing stress σ_b = 10 MPa. **(12 Marks)**

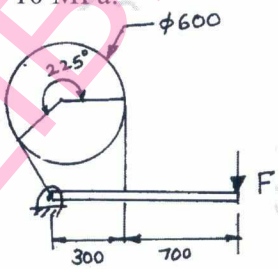

Fig. Q6 (b)

7 a. A full journal bearing of length 100 mm and the journal diameter of 80 mm supports a load of 2.5 kN at 600 rpm. What viscosity oil should be used to limit the bearing surface temperature to 60°C . The room temperature is 20°C and the clearance ratio is 0.001, use Mckee's equation. **(08 Marks)**

b. Determine the power loss for a Petroff bearing 100 mm in diameter and 150 mm long. The radial clearance is 0.05 mm. Speed of the journal is 1000 rpm. The lubricating oil is SAE10 and bearing operating temperature is 60°C. **(12 Marks)**

8 a. List and explain the functions of parts of internal combustion engine. **(04 Marks)**

b. Design a cast iron trunk type piston for four stroke internal combustion engine for the following data: Cylinder bore = 150 mm, Stroke = 200 mm, Indicated mean effective pressure = 6 bar, Fuel consumption = 4 kg/hr, Maximum gas pressure = 5 MPa,
Higher calorific value of fuel = 4100 KJ/kg, Speed of engine = 600 rpm,
Mechanical efficiency = 75% , Allowable stress for piston = 30 N/mm^2,
Allowable tensile stress for piston ring = 90 MPa,
Allowable bending stress in piston pin = 80 MPa. **(16 Marks)**

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10ME63

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Heat and Mass Transfer

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of heat transfer data hand book and steam tables are permitted.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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PART – A

1 a. State the laws governing three basic modes of heat transfer. **(06 Marks)**

b. Write the 3-D heat conduction equation in Cartesian co-ordinate system. Explain the terms involved. **(04 Marks)**

c. A furnace has a composite wall constructed of a refractory material for the inside layer and an insulating material on the outside. The total wall thickness is limited to 60 cm. The mean temperature of the gases within the furnace is 850°C, the external ambient temperature is 30°C and the interface temperature is 500°C. The thermal conductivities of refractory and insulating materials are 2 W/m – K and 0.2 W/m – K. The combined co-efficient of heat transfer by convection and radiation between gases and the refractory surface is 200 W/m^2–K and between outside surface and atmosphere is 40 W/m^2–K. Find :
i) The required thickness of each material.
ii) The rate of heat loss to atmosphere is kW/m^2.
iii) The temperatures of the external and internal surfaces. **(10 Marks)**

2 a. Derive an expression for critical thickness of insulation for a cylinder. Discuss the design aspects for providing insulation scheme for cable wires and steam pipes. **(10 Marks)**

b. Find the amount of heat transferred through an iron fin of thickness of 5 mm, height 50 mm and width 100 cm. Also, determine the temperature difference 'θ' at the tip of fin assuming atmospheric temperature of 28°C and base temperature of fin to be 108°C. Take $K_{fin} = 50$ W/m – K, h = 10 W/m^2-K. **(10 Marks)**

3 a. Define Biot number and explain its significance. **(02 Marks)**

b. Derive an expression for the instantaneous and total heat flow in terms of the product of Biot number and Fourier number is one dimensional transient heat conduction. **(08 Marks)**

c. Aluminium rod of 5 cm diameter and 1 metre long at 200°C is suddenly exposed to a convective environment at 70°C. Calculate the temperature of a radius of 1 cm and heat lost per metre length of the rod 1 minute after the cylinder is exposed to the environment – properties of Al $\rho = 2700$ kg/m^3, $C_p = 900$ J/KG-K, K = 215 W/m-K, h = 500 W/m^2-K, $\alpha = 8.5 \times 10^{-5}$ m^2/S. **(10 Marks)**

4 a. Using dimensional analysis, derive an expression relating Nusselt number, Prandtl and Grashoff numbers for natural convection. **(10 Marks)**

b. A plate of length 750 mm and width 250 mm has been placed longitudinally in a stream of crude oil which flows with a velocity of 5 m/s. If the oil has a specific gravity of 0.8 and kinematic visocosity of 10^{-4} m^2/s, calculate:
i) Boundary layer thickness at the middle of plate.
ii) Shear stress at the middle of plate and
iii) Friction drag on one side of the plate. **(06 Marks)**

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4 c. Two horizontal steam pipes having 100 mm and 300 mm are so laid in a boiler house that the mutual heat transfer may be neglected. The surface temperature of each of the steam pipes is 475°C. If the temperature of the ambient air is 35°C, calculate the ratio of heat transfer co-efficients and heat losses per metre length of the pipes. **(04 Marks)**

PART – B

5 a. Define stanton number and explain its physical significance. **(04 Marks)**

b. Prove that $\frac{N_{u_x}}{R_{e_x}.Pr} = \frac{C_{fx}}{2}$ with usual notations. **(08 Marks)**

c. Air at a temperature of 20°, flows over a flat plate at 3 m/s. The plate is $50cm \times 25cm$. Find the heat lost per hour if air flow is parallel to 50 cm side of the plate. If 25 cm side is kept parallel to the air flow, what will be the effect on heat transfer? Temperature of the plate is 100°C. **(08 Marks)**

6 a. Derive an expression for LMTD of parallel flow heat exchanger. State the assumptions made. **(10 Marks)**

b. A heat exchanger is used for cooling oil at 180°C using water available at 25°C. The mass flow rates of oil and water are 2.5 kg/s and 1.2 kg/s respectively. If the heat exchanger has 16 m^2 area available for heat transfer. Calculate the outlet temperatures of oil and water for,

i) Parallel flow and

ii) Counter flow arrangement.

Take $C_{P(oil)} = 1900 J/KG - K$, $C_{P(water)} = 4184 J/KG - K$, $U = 285 W/m^2\text{-}K$. **(10 Marks)**

7 a. Explain the influence of the non-condensable gases in condensation process. **(04 Marks)**

b. Differentiate between the mechanism of filmwise and dropwise condensation. Explain why dropwise condensation is preferred over filmwise condensation. **(06 Marks)**

c. A metal-clad heating element of 10 mm diameter and of emissivity 0.92 is submerged in a water bath horizontally. If the surface temperature of the metal is 260°C under study boiling conditions, csalculate the power dissipation per unit length of the heater. Assume that the water is exposed to atmospheric pressure and is at uniform temperature. **(10 Marks)**

8 a. Explain briefly the concept of black body. **(04 Marks)**

b. State and explain the following laws:

i) Stefan-Boltzman law.

ii) Kirchoff's law.

iii) Planck's law.

iv) Wiens displacement law. **(08 Marks)**

c. Calculate the net radiant heat exchange per m^2 area for two large parallel planes at temperatures of 427°C and 27°C respectively. Take $\in$ for hot and cold planes to be 0.9 and 0.6 respectively. If a polished aluminium shield is placed between them, find the percentage reduction in the heat transfer, given $\in$ for shield = 0.04. **(08 Marks)**

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10ME64

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Finite Element Methods

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data may suitably be assumed.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Obtain an equilibrium equations of a 3-D elastic body subjected to a body force. **(08 Marks)**
b. Discuss the types of elements based on geometry. **(06 Marks)**
c. Explain the general description of finite element method. **(06 Marks)**

2 a. Derive an expression for Total potential energy of an elastic body subjected to body force, traction force and a point force. **(08 Marks)**
b. Using Raleigh's Ritz method find a deflection of a simply supported beam of length L subjected to a uniformly distributed load of P_0 N/m. **(12 Marks)**

3 a. Write an interpolation polynomial for linear, quadratic and cubic element. **(06 Marks)**
b. Obtain an expression for a strain displacement matrix of a rectangular element. **(14 Marks)**

4 a. Determine the nodal displacements, reactions and stresses for the Fig. Q4 (a) using penalty approach. Take E = 210 GPa, Area = 250 mm^2. **(12 Marks)**

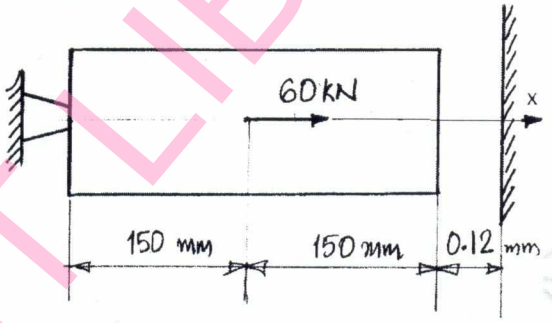
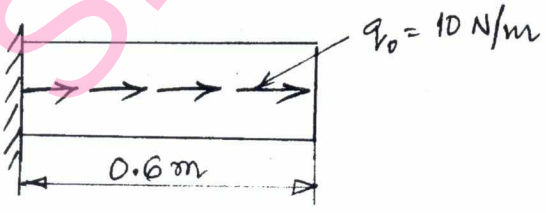


Fig. Q4 (a)

b. Find the nodal displacement, stress and strain of the system shown in Fig. Q4 (b). Take E = 70 GPa, Area = 1 m^2. **(08 Marks)**



(Linear varying load)

Fig. Q4 (b)

PART – B

5 a. Find the shape functions of a 2-D quadrilateral quadratic (9 noded) element. **(14 Marks)**
b. With a sketch define Iso, Sub and Super parametric elements. **(06 Marks)**

6 a. Obtain an expression for stiffness matrix of a truss element. **(08 Marks)**

b. Find the nodal displacement, stress and reaction of truss element shown in Fig. Q6 (b). Take E = 70 GPa, Area = 200 mm^2. **(12 Marks)**

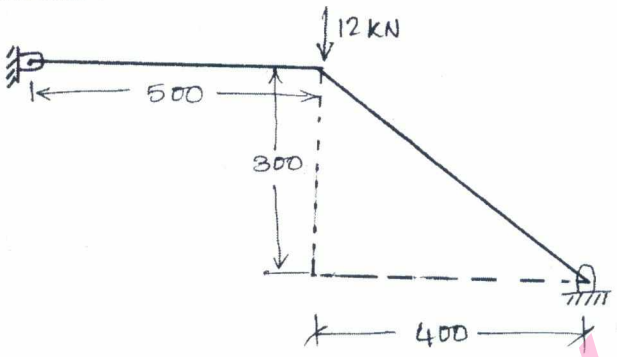


Fig. Q6 (b)

7 a. Derive the Hermite shape functions of a beam element. **(08 Marks)**

b. For the beam and loading shown in Fig. Q7 (b), determine the slopes at 2 and 3 and the vertical deflection at the midpoints of the distributed load. Take E = 200 GPa, $I = 4 \times 10^6 mm^4$. **(12 Marks)**

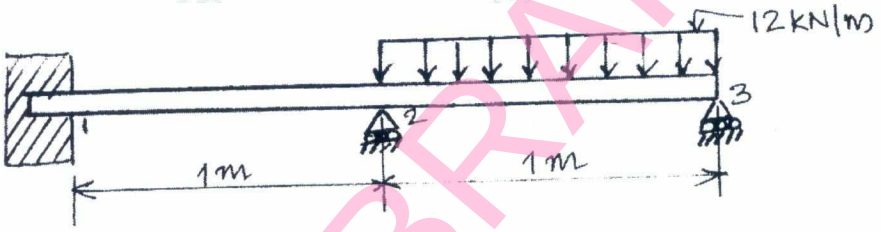


Fig. Q7 (b)

8 a. Discuss the derivation of one dimensional heat transfer in thin films. **(08 Marks)**

b. A composite wall consists of 3 materials shown in Fig. Q8 (b). The outer temperature is $T_0 = 20^0 C$, determine the temperature distribution in the wall. Convection heat transfer takes place at inner surface with $T_\infty = 800^0 C$. Take h = 25 $w/m^{2o}C$, Area = 1 m^2 **(12 Marks)**

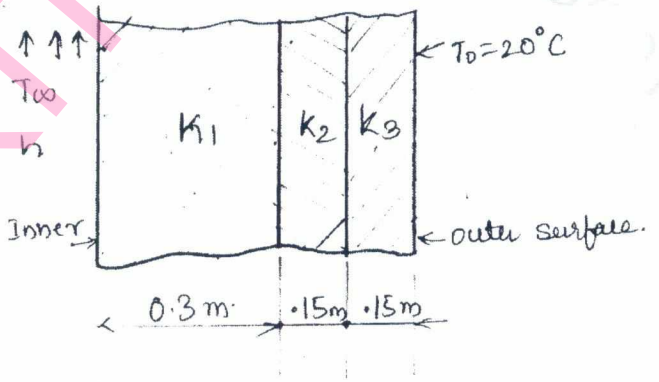


Fig. Q8 (b)

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10ME65

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Mechatronics & Microprocessor

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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PART – A

1 a. Define mechatronics. List the advantages and disadvantages of mechatronics. **(04 Marks)**

b. Explain briefly elements of closed loop control system with a example. **(08 Marks)**

c. Explain with the block diagram, how a microprocessor control system is used to control the focusing and exposure in an automatic camera. **(08 Marks)**

2 a. Define the following terms: i) Hystresis error ii) Accuracy **(04 Marks)**

b. What is hall effect? Explain the principle of hall effect with neat sketch. **(08 Marks)**

c. Explain how sensing is achieved by an incremental optical encoder. Write its applications. **(08 Marks)**

3 a. What is a actuator? Name any four important solid state switches and explain each in brief. **(10 Marks)**

b. Write and explain non-permanent magnet type DC motors with schematic diagrams. **(10 Marks)**

4 a. Define signal conditioning, what are the necessity for signal conditioning. **(04 Marks)**

b. Explain balance mode of wheat stone bridge and hence deduce the expression for change in output voltage. **(10 Marks)**

c. With block diagram, explain data acquisition system. **(06 Marks)**

PART – B

5 a. Explain the concept of overflow and underflow with an example. **(04 Marks)**

b. What is logic gate? Explain AND, OR, NOR and NAND gates with symbols and truth tables. **(10 Marks)**

c. Convert the following:

i) $(3FD)_{16} = (\_\_\_\_\_)_{10}$

ii) $(3509)_{10} = (\_\_\_\_\_)_{16}$

iii) $(475.25)_{8} = (\_\_\_\_\_)_{10}$

iv) $(1101.1)_{2} = (\_\_\_\_\_)_{10}$ **(06 Marks)**

6 a. What are micro-controllers? Distinguish between a micro-processor and micro-controllers. **(06 Marks)**

b. Explain with a neat sketch. The internal architecture of Intel 8085 microprocessor. **(14 Marks)**

7 a. Briefly explain the classification of instructions provided by 8085. **(10 Marks)**

b. Write a program for multiply two 8-bit numbers stored in memory locations 2200 H and 2201 H. Store the result in memory locations 2300 H and 2301 H. **(10 Marks)**

8 a. Explain the flow of instruction and data in the 8085 microprocessor. **(10 Marks)**

b. List the four operations performed by CPU. **(04 Marks)**

c. Distinguish between instruction cycle, machine cycle and T-state. **(06 Marks)**

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