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10ME63

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Heat and Mass Transfer

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain briefly:
i) Thermal resistance concept
ii) Convective heat transfer coefficient
iii) Boundary condition of 3rd kind. **(06 Marks)**

b. Heat is generated at a constant rate g_0 W/m^3 in a copper rod of radius r = a by the passage of electric current. The heat is dissipated by convection from the boundary surface at r = a into the ambient air at temperature T_∞ with a heat transfer coefficient h. Write the mathematical formulation of this heat conduction problem for the determination of one dimensional steady state temperature distribution T(r) within the rod. **(04 Marks)**

c. A furnace wall is made of composite wall of total thickness 55cm. The inside layer is made of refractory material of K = 2.3 W/m K and outside layer is made of an insulating material of K = 0.2 W/m K. The mean temperature of the gases inside furnace is 900°C and interface temperature is 520°C. The heat transfer coefficient between gases and inner surface can be taken as 230 W/m^2 K and between outer surface and atmosphere as 46 W/m^2 K. Assuming temperature of surrounding as 30°C, Calculate: i) Required thickness of each layer ii) rate of heat loss per unit area and iii) the temperature of surface exposed to gases and of the surface exposed to atmosphere. **(10 Marks)**

2 a. Show that for a sphere, critical radius of insulation is given by : $r_c = \frac{2K_{ins}}{h}$. **(06 Marks)**

b. "Adition of fins may not necessarily increase the heat transfer from a surface; it may even decrease the heat transfer". Comment on this statement. **(04 Marks)**

c. Aluminium square fins (0.5mm × 0.5mm) of 10mm length are provided on the surface of an electronic device to carry 1W of energy generated by the device. The temperature at the surface of the device should not exceed 80°C, while temperature of the surrounding medium is 40°C. Assume K for aluminium 190 W/m K, h = 120 W/m^2 K. Find the number of fins required, neglecting heat loss from the end of the fin. **(10 Marks)**

3 a. What is lumped system analysis? What is the criterion to apply lumped system analysis? **(04 Marks)**

b. What is a semi-infinite medium? Give examples of solid bodies that can be treated as semi-infinite medium for heat transfer purposes. **(04 Marks)**

c. An orange of diameter 10cm is initially at a uniform temperature of 30°C. It is placed in a refrigerator in which air temperature is 2°C. If heat transfer coefficient between air and orange is 50W/m^2 K; determine the time required for the centre of the orange to reach 10°C. Assume the thermal properties of the orange are the same as that of water at the same temperature. Also calculate the temperature at 3cm from the surface of orange at that time. **(12 Marks)**

4 a. The exact expression for the local drag co-efficients C_x for laminar flow over a flat plate is given by $C_x = \frac{0.664}{\sqrt{R_{ex}}}$. Air at atmospheric pressure and at T_∞ =300K flows with a velocity of u_∞ = 1.5 m/s along the plate. Determine the distance from the leading edge of the plate where transition begins from laminar to turbulent flow. Calculate the drag force acting per 1-m width of the plate over the distance from x = 0 to where the transition starts. **(10 Marks)**

b. A horizontal steam pipe of 10cm OD runs through a room where the ambient air is at 20°C. If the outside surface of the pipe is at 180°C, and the emissivity of the surface is 0.9, find out the total heat loss per metre length of pipe. **(10 Marks)**

PART – B

5 a. Water flows in a tube of ID 1.5cm at the rate of 0.05 m^3/hr. If receives a uniform wall heat flux 1000 W/m^2. Calculate: i) The value of local heat transfer co-efficient ii) The wall temperature at a section where both the velocity and temperature profiles are fully developed and the local bulk mean temperature is 40°C. **(10 Marks)**

b. A refrigerated truck is moving at a speed of 85 km/hr where ambient temperature is 50°C. The body of truck is of rectangular shape of size 10m(L) × 4m(W) × 3m(H). Assume the boundary layer is turbulent and the wall surface temperature is at 10°C. Neglect the heat transfer from vertical front and backside of truck and flow of air is parallel to 10m long side. Calculate heat loss from the four surfaces. **(10 Marks)**

6 a. Draw temperature v/s length of heat exchanger profiles for i) Condenser ii) Evaporator iii) Counter flow heat exchanger with $c_h = c_c$. **(06 Marks)**

b. Briefly explain compact heat exchangers. **(04 Marks)**

c. Water enters a counterflow double pipe heat exchanger at 15°C flowing at a rate of 1300 kg/hr. It is heated by oil (c_p = 2000 J/kg K) flowing at the rate of 550 kg/hr from an inlet temperature of 94°C for an area 1m^2 and overall heat transfer coefficient of 1075 W/m^2 K. Determine the total heat transfer and outlet temperature of water and oil. **(10 Marks)**

7 a. State the Fick's law of diffusion and explain its analogy with Fourier's law of heat conduction. **(04 Marks)**

b. Define the following:
   i) Mass diffusion coefficient
   ii) Mass transfer co-efficient
   iii) Correction for convection mass transfer. **(06 Marks)**

c. Dry saturated steam at a pressure of 2.45 bar condenses on the surface of a vertical tube of height 1m. The tube surface temperature is kept at 117°C. Estimate the thickness of condensate film and local heat transfer co-efficient at a distance of 0.2m from the upper end of the tube. **(10 Marks)**

8 a. Explain the following:
   i) Emissivity
   ii) Black body and grey body
   iii) Plank's law of monochromatic radiation. **(06 Marks)**

b. Prove that emissive power of a black body is π times the intensity of the emitted radiation. **(08 Marks)**

c. A cubical room 4m × 4m × 4m is heated through the ceiling by maintaining if at uniform temperature by 350K, while walls and the floor are at 300K. Assuming that all surfaces have an emissivity of 0.8, determine the rate of heat loss from ceiling by radiation. **(06 Marks)**

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10ME64

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

Time: 3 hrs. Max. Marks:100

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

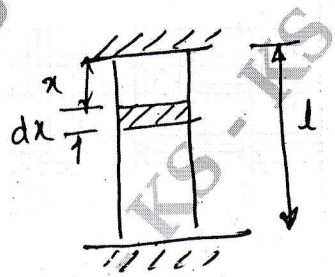
PART – A

1 a. Explain the concept of stress-strain relations for plane stream and plane strains. **(10 Marks)**

b. Explain the concept of FEM, applications, Advantages and disadvantages. **(05 Marks)**

c. Discuss the basic steps in the formulation of FEA. **(05 Marks)**

2 a. Use Rayleigh Ritz method to find the displacement at the midpoint of the rod shown in the Fig Q2(a).



Body force/unit length
g = 1, E = 1, A = 1.

Fig Q2(a) **(10 Marks)**

b. Determine the expression for displacement at load point is as shown in Fig Q2(b), using Galerkin method.

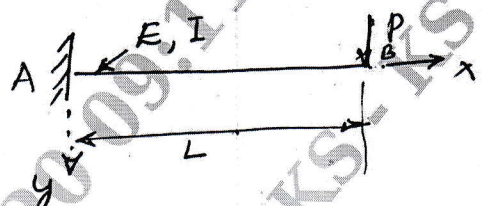


Fig Q2(b) **(10 Marks)**

3 a. Derive an shape function for CST element in general co-ordinate system. **(10 Marks)**

b. For the triangular plate shown in Fig Q3(b) below, compute the strain displacement matrix considering the plate as one element

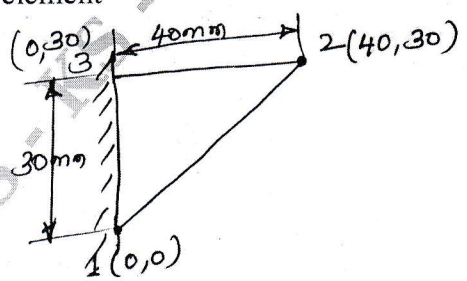


Fig Q3(b) **(06 Marks)**

c. Explain simplex, complex and multiplex elements. **(04 Marks)**

4 a. Figure Q4(a) shows a bar subjected to uniformly distributed load 'P_0' as shown Fig Q4 (a). Taking E = 70GPa, Area A = 10^4mm^2, determine : i) Nodal displacement ii) Stresses

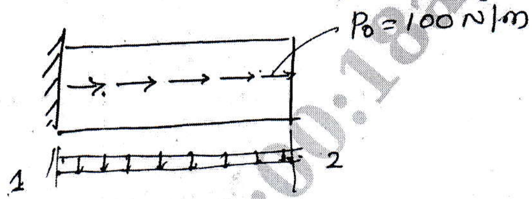


Fig Q4(a) **(10 Marks)**

b. Using penalty method, find out nodal displacement, stress in each elements and support reactions for the bar shown in Fig Q4(b) E_{steel} = 200GPa, E_{cu} = 100GPa.

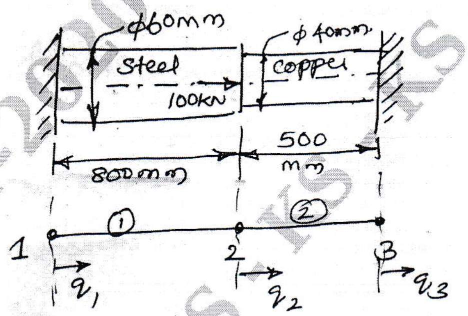


Fig Q4(b) **(10 Marks)**

PART – B

5 a. Explain with a sketch variation of shape function for 3 noded 1D quadratic bar element. **(10 Marks)**

b. Derive shape function for linear quadrilateral element. **(10 Marks)**

6 a. Consider a 3 bar truss as shown below in Fig Q6(a). Determine the nodal displacement and elemental stresses

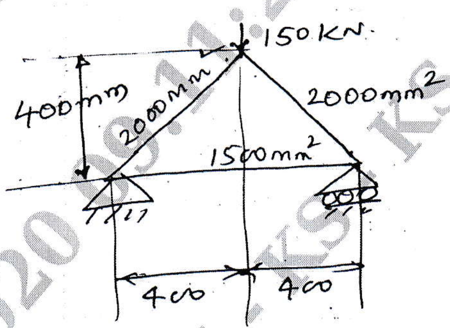


Fig Q6(a) **(14 Marks)**

b. Define truss? What are the assumptions made in the analysis of truss? **(06 Marks)**

7 a. Derive an equation for Hermite shape function of a beam element. **(10 Marks)**

b. For the beam and loading as shown in Fig Q7 (b). Find out

i) Steps at 2 and 3

ii) The vertical deflection at the midpoint of the UDL

Take E = 200GPa, J = 4 × 10^6mm^4

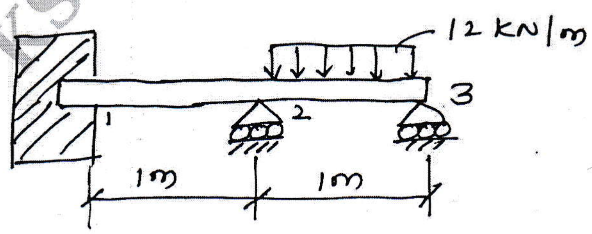


Fig Q7(b) **(10 Marks)**

8 a. Find the temperature distribution in one dimensional fin shown in Fig Q8(a)

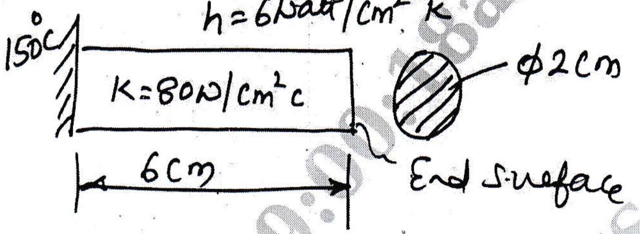


Fig Q8(a) **(10 Marks)**

b. Solve for temperature distribution in the composite wall shown in Fig Q8(b), using 1D heat elements the penalty approach of handling boundary conditions

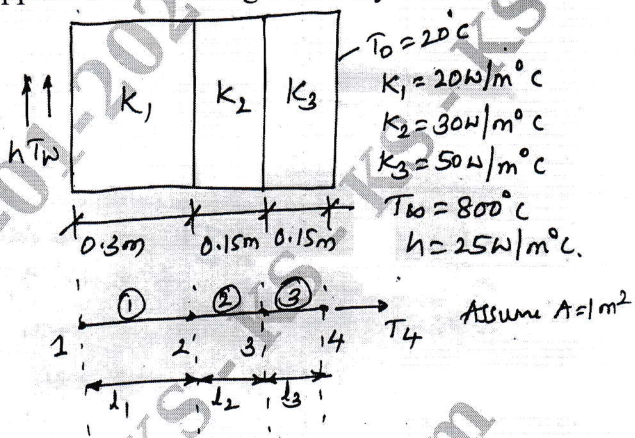


Fig Q8(b) **(10 Marks)**

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10ME65

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. What is Mechatronics? What are the objectives of Mechatronics? **(05 Marks)**
b. Explain with the block diagram of generalized measurement system. **(08 Marks)**
c. Explain with the block diagram, how a microprocessor based control system is used to control the focusing and exposure of an automatic camera. **(07 Marks)**

2 a. What is Transducer? Explain the types of transducers in briefly. **(10 Marks)**
b. What is light sensor? Explain the basic types of light sensors. **(10 Marks)**

3 a. What is an Electrical Actuators? List the categories of electrical actuators with examples. **(05 Marks)**
b. Explain briefly the terms bouncing and debouncing as applied to mechanical switches. **(05 Marks)**
c. Explain briefly the important solid – state switches. **(05 Marks)**
d. What are Stepper Motors? State the advantages and applications. **(05 Marks)**

4 a. Define Single Conditioning. What are the necessity for signal conditioning? **(05 Marks)**
b. What is the term filtering and filter? How are filters classified? **(05 Marks)**
c. Write a short note on : i) Wheat stone bridge ii) Digital signals iii) Multiplexers iv) Data acquisition. **(10 Marks)**

PART - B

5 a. Explain briefly the evolution of microprocessor. **(06 Marks)**
b. What is a Logic gates? What are the logic gates and gate networks? **(08 Marks)**
c. Prove $(A + B)(\overline{A}\ \overline{B} + C)\left(\overline{\overline{B} + AC}\right) = \overline{A}\ B\ C$. **(02 Marks)**
d. What is the concept of overflow and underflow, with an example? **(04 Marks)**

6 a. List the difference between microprocessor and microcontroller. **(04 Marks)**
b. What is a Clock? Why a clock is necessary in a microprocessor? Draw the ideal and non – ideal clock. **(06 Marks)**
c. Explain the requirements for control and their implementation in micro controllers. **(10 Marks)**

7 a. Explain with block diagram of INTEL 8085 micro processor. **(10 Marks)**
b. Explain the flow of instruction word and flow of data word in a microprocessor. **(06 Marks)**
c. Write short notes on the Assembly Language Programming. **(04 Marks)**

8 a. Explain with a block diagram of Central processing unit of microprocessor. **(08 Marks)**
b. Enumerate the difference between INTEL 8085 and INTEL 4004 register organization. **(06 Marks)**
c. What is a timing and control unit basic concepts? **(06 Marks)**

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10ME665

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Non-Traditional Machining

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain briefly the classification of non-traditional machining process. **(06 Marks)**
b. Justify the need of unconventional machining process **(05 Marks)**
c. Briefly explain the following elements of the ultrasonic machining :
(i) Work material (ii) Amplitude of vibration (iii) Slurry concentration **(09 Marks)**

2 a. With an illustration explain working principle and operations of AJM. **(10 Marks)**
b. Write a note on abrasives used in AJM with applications. **(05 Marks)**
c. What are the advantages and limitations of AJM? **(05 Marks)**

3 a. With an illustration explain working principle and operations of Electro Chemical Machining process. **(10 Marks)**
b. Explain the material removal rate in Electro Chemical Machining process. **(05 Marks)**
c. Briefly discuss merits and demerits of ECM. **(05 Marks)**

4 a. Discuss briefly the following in ECM tool :
(i) Insulation (ii) Slug formation **(10 Marks)**
b. Explain the following :
(i) Electrochemical Grinding (ii) Electrochemical Shaping **(10 Marks)**

PART – B

5 a. Describe the working principle of chemical machining process. **(05 Marks)**
b. Write a note on 'echants' in chemical machining process. **(05 Marks)**
c. Explain chemical blanking with the flow chart showing all the principle process steps. **(10 Marks)**

6 a. With an illustration explain working principle and operations of EDM. **(10 Marks)**
b. Define flushing. Explain any two different types of flushing methods. **(10 Marks)**

7 a. Discuss briefly the "Generation of Plasma" in Plasma arc machining. **(06 Marks)**
b. Explain the process characteristics of Plasma arc machining. **(04 Marks)**
c. Explain the different types of parameters in Plasma arc machining. **(10 Marks)**

8 a. With an illustration explain working principle and operations of EBM. **(10 Marks)**
b. With an illustration explain working principle and operations of LBM. **(10 Marks)**

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