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10ME61

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Computer Integrated Manufacturing

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define Automation. Highlight features of different automation types with examples. **(10 Marks)**

b. A certain part is routed through 6 machines in a batch production plant. The setup and operation times are given in the table below. The batch size is 100 units and the average non – operation time per machine is 12 hours.

Machines	1	2	3	4	5	6
Setup time (hrs)	4	2	8	3	3	4
Operation time (min)	5	3.5	10	1.9	4.1	2.5

Determine: i) Manufacturing Lead time ii) Production rates for operation 3 and 5. **(10 Marks)**

2 a. List and explain in detail different types of automated flow configurations. **(10 Marks)**

b. Explain with neat sketch, rack and pinion mechanism. **(05 Marks)**

c. A rotary worktable is driven by a Geneva mechanism with six slots. The driver rotates at 30 rev/min. Determine the cycle time, available process time and the lost time each cycle indexing the table. **(05 Marks)**

3 a. The ideal cycle time of an 20 station transfer line is 1.2 min. The probability of station breakdown per cycle is equal for all stations and P = 0.005 break downs/cycle. For each of the upper – bound and lower – bound approaches, determine
i) frequency of line stops per cycle ii) average actual production rate
iii) line efficiency. **(10 Marks)**

b. A fifteen station transfer line is divided into two stages of 7 and 8 stations in each stage. The ideal cycle time for each stage is 1.2 min and the constant downtime is 4 min. Determine the line efficiency of the transfer line for the following storage buffer capacities, using upper bound approach. i) $b = 0$; ii) $b = \infty$.
All of the stations in line have same probability of stopping p = 0.02. **(10 Marks)**

4 a. Briefly explain the following terminologies used in Line Balancing.
i) Minimum Rational work Element ii) Precedence diagram iii) Cycle time
iv) Balance delay. **(08 Marks)**

b. The table below shows the precedence relationships and element times for a new part. The ideal cycle time is 10 seconds. Construct the precedence diagram. Using Kilbridge and Wester's method, compute the balance delay and line efficiency. **(12 Marks)**

Element number	1	2	3	4	5	6	7	8	9	10	11	12
Predecessor element	-	1	2	1	4	3, 5	6	7	6	6	10	8, 9, 11
Time (seconds)	5	3	4	3	6	5	2	6	1	4	4	7

PART – B

5 a. List the principles used in product design for automated assembly systems. **(04 Marks)**

b. With neat sketch, explain elements of the parts delivery system for assembly operation. **(08 Marks)**

c. Explain Vehicle guidance and Routing system of an Automated guided vehicle system (AGVS). **(08 Marks)**

6 a. With block diagram, explain the steps involved in retrieval CAPP system. **(08 Marks)**

b. List the decision to be made for short term capacity planning adjustments. **(05 Marks)**

c. Requirements are to be planned for component C5 in product P1. Required deliveries for P1 are 50 and 100 units during week 8 & 10 respectively. The product structure for P1 consists of S2(2) , C5(2) and M5(2) i.e 2 units each for sub – assembly, component and material. Assembly lead time for products and sub assemblies is 1 week, manufacturing lead time for components is 2 weeks and ordering lead time for raw materials is 3 weeks. Determine the time phased requirements for S2, M5 and C5 to meet the master schedule. On – hand inventories are : 100 units for M5, 50 units for C5 and zero for S2. Scheduled receipts are zero for these items. **(07 Marks)**

7 a. With block diagram, explain the configuration of machine control unit (MCU) for CNC system. **(10 Marks)**

b. Write a CNC part program to profile mill the part shown in fig. Q7(b) using word address format. Assume suitable machining parameters. **(10 Marks)**

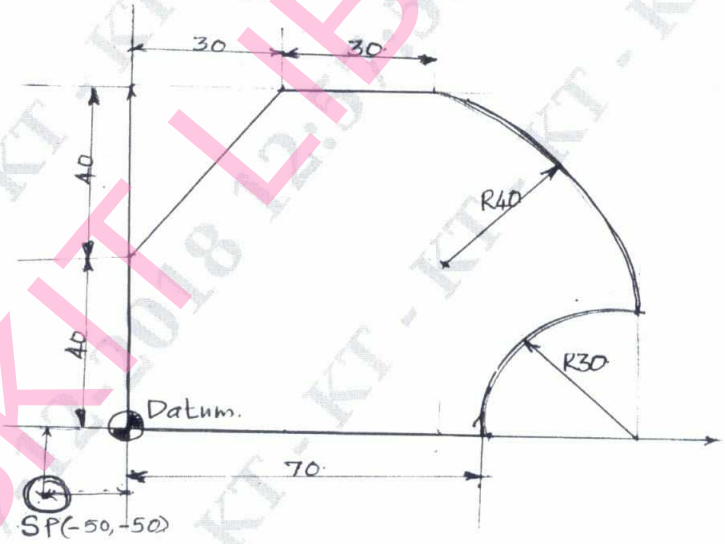

Fig.Q7(b)

8 a. Define Industrial Robotics. Briefly explain with neat sketches, physical configurations of an robot. **(12 Marks)**

b. Explain in detail sensors used in Industrial robots. **(08 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019

Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of design data hand book is permitted.***
3. ***Any additional data if required can be assumed.***

PART – A

1 a. The cross section of a steel crane hook is a trapezium with an inner side of 120 mm and outside 60 mm. The depth of the section is 90 mm. The load line is 15 mm away from the centre of curvature. Determine the safe load that the hook can carry, if the allowable stress of 90 MPa. **(10 Marks)**

b. A thick cylinder 120 mm inner diameter and 200 mm outer diameter carries fluid under a pressure of 9 MPa. Find the tangential and radial stresses across the wall and sketch the stress distribution. **(10 Marks)**

2 a. A 12 mm thick flat belt is required to transmit 12 KW of power from a pulley 300 mm diameter running at 900 rpm to another pulley to run at 500 rpm. The allowable stress for belt material is 2.1 MPa. Coefficient of friction is 0.25 and centre distance between pulley is 1.8 m. find the width and length of belt. Also find the initial tension in the belt. **(10 Marks)**

b. Select a V-belt drive to transmit 18 KW at 1500 rpm to another pulley to run at 750 rpm. **(10 Marks)**

3 a. What is equalized stresses or Nipping in spring leaves? Explain. **(06 Marks)**

b. Design a helical compression spring to support an axial load of 3000 N. the deflection under load is limited to 60 mm. The spring index is 6. The allowable shear stress of spring material is 345 N/mm^2. The modulus of rigidity is 79340 N/mm^2. **(14 Marks)**

4 It is required to transmit 25 KW of power from a shaft running at 1000 rpm to a parallel shaft with a speed reduction ratio of 2.5:1. The centre distance of the shaft is to be 300 mm. the material used for pinion is steel (σ_d = 200 N/mm^2, BHN = 250) and for gear is cast iron (σ_d = 180 N/mm^2, BHN = 200). Considering class II gear with tooth profile 20° full depth involute. Design the spur gear and check for dynamic and wear load. **(20 Marks)**

PART – B

5 A pair of 20° full depth involute teeth bevel gears connect two shafts at right angles having velocity ratio 3:1. The gear is made of cast steel 0.20% untreated and the pinion material is of steel C30 heat treated. The pinion has 20 number of teeth and transmits 40 KW at 750 rpm. Determine the module, face width, pitch diameter. Suggest suitable surface hardness for the gear pair. Assume width of gear face as 1/3 rd of the length of pitch cone $\left[b = \frac{L}{3} \right]$. **(20 Marks)**

6 a. A cone clutch has a semi cone angle of 15° and is used to transmit 10 KW at 1500 rpm. The width of the face is one-fourth of the mean diameter of friction lining. The normal intensity of pressure between contact surface is 0.12 MPa and coefficient of friction is 0.2, assuming uniform wear, design the clutch dimensions. Take C40 steel and FOS = 2.5. **(10 Marks)**

b. A 360 mm radius brake drum contacts a single shoe as shown in Fig.Q6(b) and sustains a power of 23.5 KW at 1000 rpm. Determine:

i) The normal force on the shoe
ii) The tangential force
iii) The operating force for clockwise rotation
iv) The operating force for counter-clockwise rotation
v) The value of distance 'c' for the brake to be self locking
vi) The rate of heat generated.

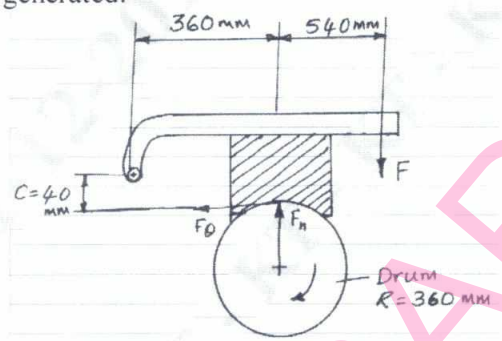

Fig.Q6(b) **(10 Marks)**

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

b. A 75 mm long full journal bearing of diameter 75 mm supports a radial load of 12 kN at the shaft speed of 1800 rev/min. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of oil is 0.01 Pas at the operating temperature. Determine the following:

i) Summerfield number
ii) The coefficient of friction based on McKee's equation
iii) Amount of heat generated
iv) Power loss due to friction. **(12 Marks)**

8 Design a suitable cast iron piston for a single acting four stroke diesel engine from the following data:
Maximum gas pressure = 3.5 MPa
Fuel consumption = 0.2 kg/brake power in KW/hour
Indicated mean effective pressure = 0.85 MPa
Speed = 300 rpm
Maximum permissible tension for cast iron for the design of head thickness is 30 MPa and for piston pin material is 120 MPa. Bearing pressure for piston pin should not exceed 20 MPa. Cylinder bore diameter is 300 mm and length of stroke is 450 mm. Assume any further data required of the design. **(20 Marks)**

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10ME63

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Heat and Mass Transfer

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain boundary conditions of first, second and third kind. **(06 Marks)**

b. A furnace wall is made of three layers. First layer of insulation (K = 0.6 W/mK) 12cm thick. Its face is exposed to gases at 870°C with convection coefficient of 110W/m^2K. It is covered with a 10cm thick layer of fire bricks (110 W/mk) with a contact resistance of 2.6×10^{-4} m^2k/w between the first and second layer. The third layer is a plate of 10cm thickness (K = 4 W/mk) with a contact resistance between second and third layers of 1.5×10^{-4} m^2k/w. The plate is exposed to air at 30°C with convection coefficient of 15W/m^2K. Determine the heat flow rate. **(06 Marks)**

c. Derive 3D conduction equation in Cartesian coordinates. **(08 Marks)**

2 a. A copper pipe carrying the refrigerant at -20°C is 10mm in outer diameter and is exposed to ambient at 25°C with convective coefficient of 50W/m^2K. It is proposed to apply the insulation material having thermal conductivity of 0.5W/mK. Determine the thickness beyond which the heat gain will be reduced. Calculate the heat loss for 2.5mm and 7.5mm thick layer of insulation over 1m length. **(04 Marks)**

b. A very long 25mm diameter (K = 380W/mk) rod extends from a surface at 120°C. The temperature of surrounding air at 25°C and the heat transfer coefficient over the rod is 10W/m^2k, Calculate the heat loss from the rod. **(08 Marks)**

c. A plane wall of thickness L is made of material whose thermal conductivity varies with temperature according to the relation $K = K_0 (1 + BT)$, where K_0 is the fundamentals derive an expression for temperature distribution. **(08 Marks)**

3 a. What is lumped system analysis? Derive an expression for temperature distribution and rate of heat transfer in case of lumped system analysis. **(08 Marks)**

b. What is Biot number? What is its physical significance? **(04 Marks)**

c. An aluminium sphere weighing 6kg and initially at temperature of 350°C is immersed in a fluid at 30°C with convection coefficient of 60W/m^2K. Estimate the time required to cool the sphere to 100°C. Take the thermophysical properties as C = 900 J/kgK, $\rho = 2700 kg/m^3$, K = 205 W/mK. **(08 Marks)**

4 a. Explain velocity and thermal boundary layer. **(06 Marks)**

b. Define Grashoff number. Explain the physical significance of Grashoff number. **(04 Marks)**

c. A hot plate 1m × 0.5m at 130°C is kept vertically in still air at 20°C. Find:

i) Heat transfer coefficient.

ii) Initial rate of cooling the plate in °C/min.

iii) Time required for cooling plate from 180°C to 80°C if the heat transfer is due to convection only.

Take mass of the plate as 20kg and C_p = 400J/kg K. Assume 0.5m side is vertical and convection takes place from both sides of the plate. **(10 Marks)**

PART – B

5 a. Derive an expression for forced convection heat transfer in terms of dimensionless parameters using dimensional analysis. **(10 Marks)**

b. Atmosphere air at 275K and free stream velocity of 20m/s flows over a long flat plate maintained at a uniform temperature of 325K, calculate:

i) Average heat transfer coefficient over the region of laminar boundary layer.

ii) Average heat transfer coefficient over the entire length of 1.5m.

iii) Total heat transfer coefficient over the entire length of 1.5m. **(10 Marks)**

6 a. Derive an expression for LMTD for a parallel flow heat exchanger. **(10 Marks)**

b. 16.5 kg/s of the product at 650°C (C_p = 3.55 kJ/kg°C) in a chemical plant, are to be used to heat 20.5kg/s of the incoming fluid from 100°C (C_p = 4.2 kJ/kg°C). If the overall heat transfer coefficient is 0.95kW/m^2°C and the installed heat transfer surface is 44m^2, calculate the fluid outlet temperature for the counter flow arrangement. **(10 Marks)**

7 a. Explain the different regimes of pool boiling using an appropriate boiling curve. Indicate CHF (Critical Heat Flux) and Leiden frost points on it. **(10 Marks)**

b. State Fick's law of diffusion. **(03 Marks)**

c. A vertical plate 500mm high and maintained at 30°C is exposed to saturated steam at atmospheric pressure. Calculate the following:

i) Rate of heat transfer.

ii) Condensate rate/hr/m width of plate for film condensation.

Properties of water at mean film temperature are $\rho = 980.3$ kg/m^3, $K = 66.4 \times 10^{-2}$ W/m°C, $\mu = 434 \times 10^{-6}$ kg/ms and $h_{fg} = 2257$kJ/kg.

Assume vapour density is small compared to that of condensate. **(07 Marks)**

8 a. Prove that the total emissive power of a black body is equal to π times the intensity of radiation. **(10 Marks)**

b. Two large parallel planes with emissivity of 0.6 are at 900K and 300K. A radiation shield with one side polished and having emissivity of 0.05, while the emissivity of other side is 0.4 is proposed to be used. Which side of the shield should face the hotter plate, if the temperature of shield is to be kept minimum? Justify your answer. **(10 Marks)**

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10ME64

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Finite Element Methods

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *No hand book required.*

PART – A

1 a. Explain the step-by-step procedure for the application of finite element method for structural problems. **(08 Marks)**

b. Derive the differential equations of equilibrium for a body subjected to a three dimensional stress system and body force. **(12 Marks)**

2 a. Derive the Euler-Lagrange's equation by considering the functional,

$$I = \int_{x_1}^{x_2} F(x, u, u', u'')dx$$

Also obtain the expressions for natural boundary conditions and essential boundary conditions. **(10 Marks)**

b. A system of springs is subjected to a force of 500 N as shown in Fig. Q2 (b). Determine the forces at points A and D, and displacement at points B and C. Apply the principle of minimum potential energy. **(10 Marks)**

Fig. Q2 (b)

3 a. For a constant strain triangular element (CST), derive (i) Shape functions in natural coordinates and draw the sketches showing distributions of shape functions, and (ii) Jacobian matrix. **(14 Marks)**

b. Compute the shape functions N_1, N_2 and N_3 at point P(8, 7) for the constant strain triangular element shown in Fig. Q3 (b). **(06 Marks)**

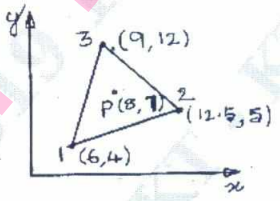

Fig. Q3 (b)

4 a. List three properties each of, (i) Shape functions and (ii) Stiffness matrix. **(06 Marks)**

b. A stepped bar with it's both ends fixed as shown in Fig. Q4 (b) is subjected to an increase in temperature of 50°C. Determine displacements and forces at points A, B, C and D. Take Young's moduli of steel, bronze and aluminium as $E_S = 200$ GPa, $E_B = 83$ GPa and $E_{AL} = 70$ GPa respectively. The coefficients of thermal expansions are $\alpha_S = 12 \times 10^{-6}/°C$, $\alpha_B = 19 \times 10^{-6}/°C$ and $\alpha_{AL} = 22 \times 10^{-6}/°C$. **(14 Marks)**

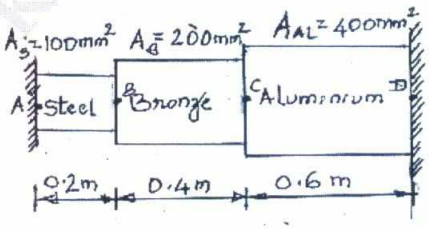

Fig. Q4 (b)

PART – B

5 a. Derive Lagrange shape functions for a bar element with cubic displacement distribution and show their distributions with neat sketches. **(12 Marks)**

b. Use two point Gaussian quadrature to evaluate the following integral:

$$I = \int_{-1}^{1}\int_{-1}^{1} (\xi^3 - 1)(\eta - 1)^2 \, d\xi d\eta .$$ **(08 Marks)**

6 a. Derive the expression for the stress induced in a truss member. Start from the expression for the stress (σ), which is a function of strain-displacement matrix, transformation matrix and displacement vector for the element. **(06 Marks)**

b. A truss is subjected to a force of 10 KN as shown in Fig. Q6 (b). Determine (i) Displacements and forces at points A, B and C (ii) Local forces on the member AB and (iii) Stress induced in the member BC. Take Young's modulus for the material of the truss as E = 210 GPa and cross sectional area of each truss member as A = 600 mm^2. **(14 Marks)**

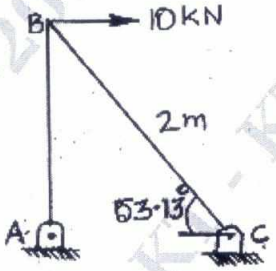

Fig. Q6 (b)

7 a. Derive the statically equivalent nodal force vector for a two noded beam element subjected uniformly distributed load (W). **(08 Marks)**

b. A beam with fixed end and roller support is subjected to a point force of 20 KN as shown in Fig. Q7 (b). Determine (i) Transverse forces and bending moments, and (ii) Deflections and slopes at points A, B and C. Take $E = 2\times10^8$ KN/m^2 and $I = 8\times10^{-6}$ m^4. **(12 Marks)**

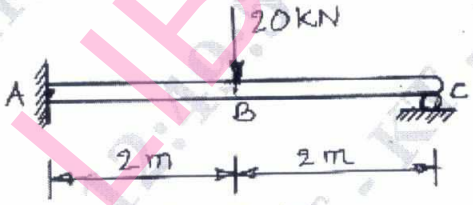

Fig. Q7 (b)

8 a. Explain the specified temperature and specified heat flux boundary conditions, with neat sketches. **(06 Marks)**

b. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convective heat transfer coefficient as shown in Fig. Q8 (b). The ambient temperature is $-5^\circ C$.
Consider area (A) of the wall to be 1 m^2. **(14 Marks)**

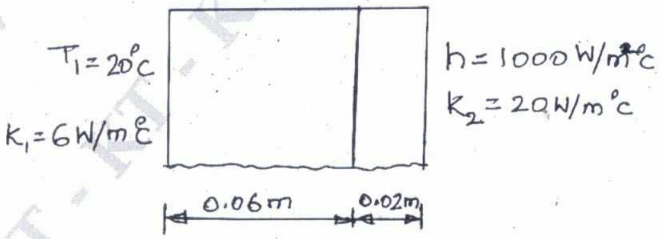

Fig. Q8 (b)

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10ME65

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Mechatronics and Microprocessor

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Draw a neat block diagram of a generalized measurement system showing its elements. **(08 Marks)**

b. What is meant by control and control system and how they are classified? **(04 Marks)**

c. Explain with block diagram of a general microprocessor based process control system. **(08 Marks)**

2 a. How transducers are classified based on type and nature of measure and, along with examples. **(04 Marks)**

b. With a neat sketch, explain the working principle of L.V.D.T. **(08 Marks)**

c. With a neat sketch, explain Hall-effect sensor/transducer. **(08 Marks)**

3 a. What is meant by stepper motor? What are its performance characteristics? **(06 Marks)**

b. Explain with a neat diagram the principle of working of mechanical switches. **(06 Marks)**

c. What are the factors influencing the speed of a D.C. motor? What are the different methods of speed control of a D.C. motor? **(08 Marks)**

4 a. What are the different types of OP-Amplifiers? Explain a generalized OP-Amp with a neat sketch. **(06 Marks)**

b. What is a digital multiplexer? State the basic principle of a two-channel multiplexer. **(08 Marks)**

c. Write a note on data acquisition. **(06 Marks)**

PART – B

5 a. What is a microprocessor? Explain the functions of each of following:
i) Accumulator
ii) Memory address
iii) Program counter register. **(06 Marks)**

b. Explain the following logic gates: i) AND ii) OR iii) NAND iv) NOR. **(06 Marks)**

c. Explain the various general-purpose registers available in the microprocessor. **(08 Marks)**

6 a. Illustrate multiplexed mode of operation of $AD_0 - AD_7$ bus of 8085A. **(08 Marks)**

b. Differentiate between microprocessor and microcontroller. **(06 Marks)**

c. Explain with block diagram of a microcontroller. **(06 Marks)**

7 a. Explain the different types of addressing modes in Intel 8085 with examples. **(08 Marks)**

b. Explain the instruction set for Intel 8085 (signal paths in 8085 Intel). **(06 Marks)**

c. What is assembly language programming explain briefly. **(06 Marks)**

8 a. What is an Interrupt cycle and what is executive cycle explain with example? **(06 Marks)**

b. Explain the main features of Intel 4004 microprocessor. **(08 Marks)**

c. With a neat sketch, explain the flow of data word in microprocessor. **(06 Marks)**

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