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10ME61

Sixth Semester B.E. Degree Examination, Aug./Sept.2020
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. Derive a relation for computing manufacturing lead time for a batch production situation. State the assumptions. **(06 Marks)**

b. Distinguish between Production Rate and Plant Capacity. **(04 Marks)**

c. There are nine machines in a machine shop. Average set up time for these machines is 6 hours. The average batch size of parts processed in this shop is 90. The average operation time is 8.0 min. An operator is permitted to operate 3 machines. There are 3 operators in the shop for 9 machines. There are two setup operators who perform machine setup exclusively. The shop runs one 8 hour shift per day, 6 days per week. An average of 15% of the production is lost due to machine breakdowns. Scrap losses are negligible. As per production control manager capacity of the shop is 1836 parts per week. However actual output averages only 1440 parts/week. What is the problem? Recommend a solution. **(10 Marks)**

2 a. Write a note on pallet fixtures. **(04 Marks)**

b. Distinguish between instantaneous control and memory control. **(06 Marks)**

c. A rotary worktable is driven by a Geneva mechanism with six slots. The drives rotates at 12 RAM. Determine (i) Cycle time (ii) Available process time (iii) Index time (iv) Angle of rotation of drives for indexing and processing. **(10 Marks)**

3 a. An 8-station rotary indexing machine operates with an ideal cycle time of 20 seconds. The frequency of line stop occurrences is 0.06 stop per cycle. When stop occurs, it takes an average of 3 mins to repair. Determine

(i) Average production time
(ii) Average production rate
(iii) Line efficiency
(iv) Proportion of Downtime.

If the costs associated with the operation of the indexing machine are as follows:

(i) Cost of Raw work part Rs. 25 per part
(ii) Cost of operating line Rs. 40 per min
(iii) Cost of disposable tooling Rs. 15 per part

Compute the average cost per part produced in the rotary indexing machine. **(10 Marks)**

b. In a 12 station in-line transfer machine probability of line stop for all stations is 0.01 (equal proportion of failure). Cycle time is 0.3 min and down time for repair is 3 mins. Using lower bound and upper bound approaches compute.

(i) F frequency of line stops.
(ii) R_p average production rate
(iii) Line efficiency E
(iv) Proportion downtime D. **(10 Marks)**

4 a. Work elements, their times and precedence constraints of an assembly line as following.

Element	Time (min)	Preceded by
1	04	-
2	07	1
3	05	1
4	08	2
5	10	2, 3
6	02	3
7	03	4
8	09	4, 9
9	03	5, 6
10	05	7, 8

Assuming 5-work stations, compute balance delay.
(i) Draw precedence diagram
(ii) Using ranked positional weight method balance the line and compute balance delay. **(12 Marks)**

b. Using largest candidate rule method balance the line and calculate balance delay for the above problem in Q4(a). **(08 Marks)**

PART – B

5 a. Explain the methods adopted in Traffic control of AGVs. **(06 Marks)**

b. With a neat sketch explain the analysis of multi-station assembly machine. **(06 Marks)**

c. An auto-guided vehicle has an average travel distance of 200m/delivery and an average empty travel distance of 150m. The load and unload times are 24 sec each and the speed of AGV is 1 m/sec. Traffic factor is 0.9. How many vehicles are needed to satisfy a delivery requirement of 30 deliveries per hour? Assume an availability of 0.95 and Wankel efficiency of 1.0 . **(08 Marks)**

6 a. What are the two approaches to computer aided process planning? With the help of a block diagram explain any one of them. **(10 Marks)**

b. With the help of a block diagram, explain the various activities in a typical computerized manufacturing planning system. **(10 Marks)**

7 a. Prepare a manual part program to machine the component shown in Fig.Q7(a) below, using an end mill of 20mm diameter and "without using cutter compensation codes". Show the tool path and write comments for each block. The program should be complete in all respects. Assume suitable speed feed and depths.

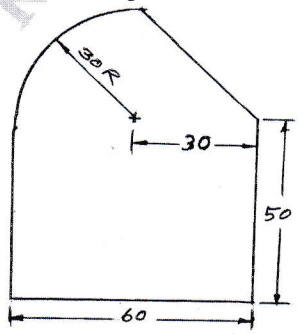

Fig.Q7(a) **(12 Marks)**

b. Distinguish between with appropriate sketches :
   (i) Straight-cut CNC and contouring CNC system.
   (ii) Open-loop and closed loop CNC system. **(08 Marks)**

8 a. With the help of a neat sketch, illustrate 6 degrees of freedom of a TRL:TRR Robot. Name the configuration of this Robot. **(08 Marks)**

b. Discuss the use of various sensors in an industrial robot. **(06 Marks)**

c. Distinguish between Walk-through and Lead-through programming of a Robot. Briefly explain Lead through programming method. **(06 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, Aug./Sept. 2020
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 data hand book is permitted.***
3. ***Missing data if any may be suitably assumed.***

PART – A

1 a. The horizontal cross section of a crane hook is an isosceles triangle of 120 mm deep, the inner width being 90 mm. The hook carries a load of 50 kN. Inner radius of curvature is 100 mm. The load live passes through the centre line of curvature. Determine the stresses at the extreme fibres? **(10 Marks)**

b. A cast iron cylinder of internal diameter 500 mm and 75 mm thick is filled with a fluid of pressure 6 N/mm^2. Determine the tangential and radial stresses at the inner, middle and outer surfaces. Also sketch the tangential stress and radial stress distribution across its thickness L. **(10 Marks)**

2 a. Design a flat belt drive to transmit 25 kW from a motor shaft rotating at 1500 rpm to a compressor running at 500 rpm. The motor pulley is 96 mm effective diameter and centre distance between the shaft is 1.5 m. **(10 Marks)**

b. Select a wire rope to left a load of 10 kN through a height of 500 m from a mine. The weight of bucket is 2.5 kN. The load should attain a maximum speed of 50 m/min in 2 secs. **(10 Marks)**

3 a. A helical value spring is to be designed for an operating load range of approximately 90 to 135 N. The deflection of the spring for the load ranges is 7.5 mm. Assume a spring index of 10 and factor of safety = 2. Design the spring. **(10 Marks)**

b. A multi leaf spring with camber fitted to the chasis of an automobile over a span of 1.2 m to absorb shocks due to a maximum load of 20 kN. The spring material can sustain a maximum stress of 0.46 Pa. All the leaves of spring were to receive the same stress. The spring is required at least 2 full length leaves out of 8 leave. The leaves are assembled with both over a span of 150 mm width at the middle. Design the spring for a maximum deflection of 50 mm. **(10 Marks)**

4 a. Derive the Lewis equation for the beam strength of a gear tooth. Also list the assumptions. **(04 Marks)**

b. A pair of carefully cut spur gear with 20° full depth involute profile is used to transmit 12 kW at 1200 rpm of pinion. The gear has to rotate at 300 rpm. The material used for both pinon and gear is medium carbon steel whose allowable bending stress may be taken as 230 MPa. Determine the module and facewidth of the spur pinion and gear. Suggest suitable hardness. Take 24 teeth on pinion, modulus of elasticity may be taken as 210 GPa. **(16 Marks)**

PART – B

5 a. A pair of bevel gear transmitting 7.5 kW at 300 rpm of pinion. The pressure angle is 20°. The pitch diameter of pinion and gear at their large ends are 150 mm and 200 mm respectively. The face width of the gears is 40mm. Determine the components of the resultant gear tooth force and draw a free body diagram of forces acting on the pinion and gear. **(10 Marks)**

b. A two teeth right hand worm transmits 2 kW at 1500 rpm to a 36 teeth wheel. The module of the wheel is 5 mm and the pitch diameter of the worm is 60 mm. The normal pressure angle is 14.5° The coefficient of friction is found to be 0.06. (i) Find the centre distance, the lead and lead angle (ii) Determine the forces (iii) Determine the efficiency of the drive. **(10 Marks)**

6 a. Design a cone clutch to transmit a power of 40 kW at a rated speed of 750 rpm. Also determine
(i) Axial force necessary to transmit torque.
(ii) Axial force to necessary to engage the cone clutch. **(10 Marks)**

b. A single block brake with a torque capacity of 250 N-mt as shown in figure Fig. Q6 (b) below. The brake drum rotates at 100 rpm and the coefficient of friction is 0.35. Calculate
(i) Actuating force and hinge pin reaction.
(ii) Rate of heat generated during braking action.
(iii) The dimensions of the block if the intensity of pressure between the block and brake drum is 1 MPa. The length of the block is twice its width. **(10 Marks)**

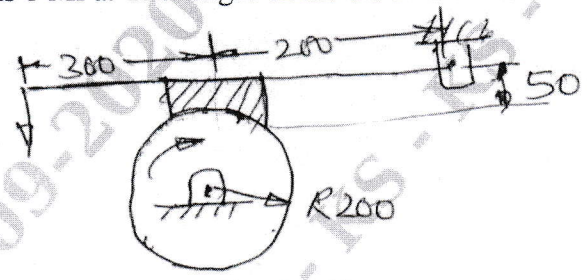

Fig. Q6 (b)

7 a. Derive Petroff's equation for a coefficient of friction of a lightly loaded journal bearing. **(05 Marks)**

b. A 75 mm diameter full journal bearing supports a radial load of 3500 N. The bearing is 75 mm long and the shaft operates at 400 rpm. Assume a permissible minimum film thickness of 0.02 mm and normal running fit for the bearing bore. Using Raimodi and Boyd curves determine
(i) Absolute visocosity of the oil.
(ii) Coefficient of friction.
(iii) Heat generated.
(iv) Amount of oil pumped through bearing.
(v) Amount of end leakage.
(vi) Temperature rise of the oil flowing through the bearing. **(15 Marks)**

8 Design a connecting rod for a petrol engine from the following data:
Cylinder bore or diameter of the piston = 100 mm
Length of connecting rod = 350 mm
Maximum gas pressure or explosion pressure = 3 N/mm^2.
Length of stroke = 150 mm
Engine speed = 1500 rpm
Weight of reciprocating parts = 25 N
Compression ratio = 4 : 1
Assume any further data required for design. **(20 Marks)**

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10ME63

Sixth Semester B.E. Degree Examination, Aug./Sept.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 transfer data hand book is permitted.

PART – A

1 a. Explain the three types of boundary conditions used in conduction heat transfer with examples. **(06 Marks)**

b. Derive an expression for the temperature distribution and the rate of heat transfer for a hollow cylinder. **(08 Marks)**

c. A hollow sphere is made of steel of thermal conductivity 40W/m°C. It is heated by means of coil of resistance 100Ω which causes current of 5amps, the coil is located inside the hollow space at the center. The outer surface area of sphere is $0.2m^2$ white the sphere weights 32kgs, assuming density of the material of the sphere to be 8gms/cc. Find the temperature difference between outer and inner surfaces. **(06 Marks)**

2 a. Derive an expression for critical thickness of insulation put on an electrical cable. **(06 Marks)**

b. A small electric heating application uses wire of 2mm diameter with 0.8mm thick insulation (K = 0.12W/m°C). The heat transfer coefficient on the insulated surface is $35W/m^2°C$. Determine the critical thickness of insulation in this case and percentage change in the heat transfer rate if the critical thickness is used, assuming the temperature difference between the surface of the wire and surrounding air remain unchanged. **(06 Marks)**

c. Two rods A and B of the same length and diameter protrude from a surface at 120°C and are exposed to air at 25°C. The temperatures measured at the end of the rods are 50°C and 75°C. If thermal conductivity of material A is 20W/m°C. Calculate the thermal conductivity of material B. Adopt the condition of a fin insulated at the tip. **(08 Marks)**

3 a. Derive an expression for temperature distribution in a lumped system and show the nature of graph of temperature variation Vs dimensionless parameter. **(10 Marks)**

b. A metallic sphere of radius 10mm is initially at a uniform temperature of 400°C. It is heat treated by first cooling it in air ($h = 10W/m^2K$) at 20°C until its central temperature reaches 335°C. It is then quenched in a water bath at 20°C with $h = 6000W/^2K$ until the center of the sphere cools from 335° to 50°C. Compute the time required for cooling in air and water for the following physical properties of the sphere. $\rho = 300kg/m^3$, C = 1000J/kgK, K = 20W/mK, $\alpha = 6.66 \times 10^{-6} m^2/s$. Also calculate the surface temperature at the end of cooling in water. **(10 Marks)**

4 a. Explain briefly with sketches:
i) Velocity boundary layer thickness
ii) Thermal boundary layer thickness. **(08 Marks)**

b. A thin 80cm long and 8cm wide horizontal plate is maintained at a temperature of 130°C in a large tank full of water at 70°C. Estimate the rate of heat input into the plate necessary to maintain the temperature of 130°C. **(12 Marks)**

PART – B

5 a. With the help of dimensional analysis derive expression which relates Reynolds number, Nusselt number and Prandtl number. **(10 Marks)**

b. The main trunk duct of an air conditioning system is rectangular in cross section (400 × 800mm) and has air at atmosphere pressure and at 20°C flowing with a velocity of 7m/s. Estimate the heat leakage per meter length per unit temperature difference. The relevant physical properties of air are: $\nu = 15.06 \times 10^{-6} m^2/s$ $\alpha = 7.71 \times 10^{-2} m^2/s$ $K = 0.0259 W/mK$. **(10 Marks)**

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

b. Exhaust gases (CP = 1.12kJ/kg°) flowing through a tubular heat exchanger at the rate of 1200kg/hr are cooled from 400°C to 120°C. The cooling is affected by water (CP = 4.18kJ/kgK) that enters the system at 10°C at the rate of 1500kg/hr. If the overall heat transfer coefficient is $500 kg/m^2hr°$. What heat exchanger area is required to handle the load for i) Parallel flow and ii) Counter flow arrangement. **(10 Marks)**

7 a. Sketch and explain boiling curve. **(06 Marks)**

b. State and explain Ficks law of diffusion. **(04 Marks)**

c. The outer surface of a vertical tube which is of length 1.25m and outer diameter 50mm is exposed is saturated steam at atmospheric pressure. If the tube surface is maintained at 80°C by the flow of cooling water through it, determine the rate of heat transfer to the coolent and the rate at which steam is condensed at the tube surface. **(10 Marks)**

8 a. State and explain the following:

i) Stefan – Boltzman law
ii) Kirchoif's law
iii) Planck's law
iv) Wien's displacement law
v) Lamber's cosine law **(10 Marks)**

b. A thermos flask has a double walled bottle and the space between the walls is evacuated so as to reduce the heat flow. The bottle surfaces are silver plated and the emissivity of each surface is 0.025. If the contents of the bottle are 375K, find the rate of heat loss from the thermo battle to the ambient air at 300K. What thickness of cork ($K = 0.03 W/m°$) would be required if the same insulating effect is to be achieved by the use of cork? **(10 Marks)**

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10ME64

Sixth Semester B.E. Degree Examination, Aug./Sept.2020
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. Briefly explain the basic steps involved in FEM for stress analysis of elastic solid bodies. **(10 Marks)**

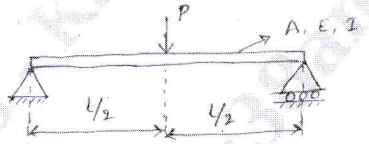
b. Explain with a sketch Plane stress and Plane strain. **(04 Marks)**

c. Discuss the types of elements (1D, 2D, 3D) based on geometry. **(06 Marks)**

2 a. Derive the stiffness matrix for 1 dimensional bar element using Direct Stiffness method. **(08 Marks)**

b. Using Rayleigh – Ritz method, derive an expression for maximum deflection of the simply supported beam subjected to load 'P' as shown in fig.Q2(b). Use trigonometric function. Take E = Young's modulus I – Moment of inertia. A – Area of cross section of the beam. **(12 Marks)**

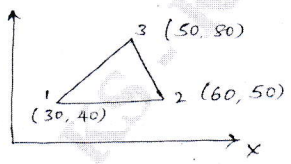
Fig. Q2(b)



3 a. Derive the shape function for one dimensional bar element in Cartesian coordinates/global coordinate system. **(10 Marks)**

b. For the triangular element shown in fig. Q3(b) , obtain the strain displacement matrix 'B' and determine the strains $\in_x$, $\in_y$ and γ_{xy} .
Nodal displacements $\{q\} = \{2\ 1\ 1\ -4\ -3\ 7\} \times 10^{-2}$ mm. **(10 Marks)**

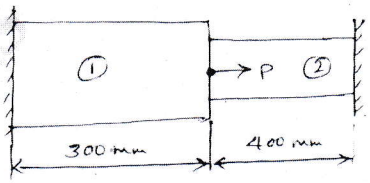
Fig. Q3(b)



4 a. Solve the following system of simultaneous equation by Gaussian Elimination method.
$x_1 - 2x_2 + 6x_3 = 0$
$2x_1 + 2x_2 + 3x_3 = 3$
$-x_1 + 3x_2 = 0.$ **(08 Marks)**

b. Consider the bar shown in fig. Q4(b). An axial load $P = 200 \times 10^3$N is applied as shown. Using Penalty method, determine the following :
i) Nodal displacement ii) Stress in each material. **(12 Marks)**

Fig. Q4(b)



$A_1 = 2400$ mm^2
$E_1 = 70$ GPa
$A_2 = 600$ mm^2
$E_2 = 200$ GPa

PART - B

5 a. With neat sketches, define ISO, Sub and Super parametric elements. **(06 Marks)**

b. Using two point Gaussian quadrature formula evaluate following integral.

$$I = \int_{-1}^{+1}\int_{-1}^{+1}(r^2 + 2rs + s^2)dr\,.\,ds\,.$$ **(06 Marks)**

c. Using Lagrangian method derive the shape function of a 3 – noded one dimension (1D) Bar element (Quadratic Bar element). **(08 Marks)**

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

b. For the two bar truss shown in fig.Q6(b), determine the nodal displacement and stress in each member. Also find support reaction. Take E = 200GPa. **(12 Marks)**

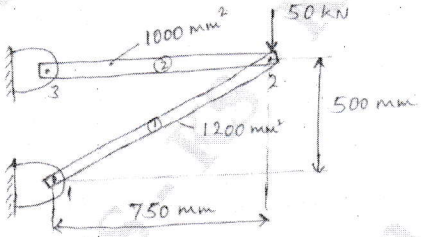


Fig. Q6(b)

7 a. Determine maximum deflection in the uniform cross section of cantilever beam shown in fig. Q7(a) by assuming beam as a single element. Take $E = 7 \times 10^9$ N/m^2, $I = 4 \times 10^{-4}$ m^4.

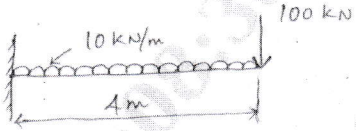


Fig. Q7(a) **(10 Marks)**

b. A simply supported beam of span 6m and uniform flexural rigidity EI = 40000 KN-m^2 is subjected to clock wise couple of 300KN – m at a distance of 4m from left end as shown in fig. Q7(b). Find the deflection at the point of application of couple and internal loads.

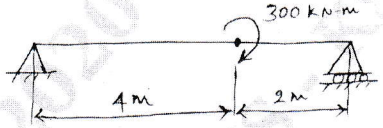


Fig. Q7(b) **(10 Marks)**

8 a. Derive the Finite element equation for one dimension (1D) heat conduction with free end convection. **(08 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^{0}C. **(12 Marks)**

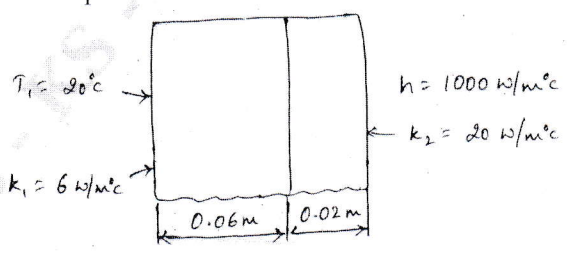


Fig. Q8(b)