USN | | | | | | | | | | |

10ME61

Sixth Semester B.E. Degree Examination, Dec.2013/Jan.2014

Computer Integrated Manufacturing

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Discuss the following automation strategies:
   i) Specialization of operations
   ii) Increased flexibility
   iii) On-line inspection **(06 Marks)**

   b. With sketch explain the automation migration strategy. **(06 Marks)**

   c. There are total 24 machines in the manufacturing plant and the part produced in a batch must be processed through an average of eight machines. 24 new batches are launched each week. Average operation time is 6 min, average batch size is 30 parts, average set-up time is 6 hr and average non-operation time per batch is 12 hr/machine. The plant operates an average of 80 production hours per week and assume A = 95%. Determine:
   i) Manufacturing lead time for an average part
   ii) Production rate
   iii) Plant capacity
   iv) Plant utilization
   v) WIP
   vi) WIP ratio **(08 Marks)**

2 a. Discuss the general methods of transporting work pieces on flow lines. **(08 Marks)**

   b. With sketch explain linear walking beam and Geneva wheel, work transfer mechanisms. **(08 Marks)**

   c. State the importance of Buffer storage. **(04 Marks)**

3 a. Enumerate the difference between 'upper bound approach' and 'lower bound approach'. **(06 Marks)**

   b. Explain the following terms used in the analysis of an automated flow lines:
   i) Partial automation
   ii) Lower bound approach **(06 Marks)**

   c. A transfer line has ten station with an ideal cycle time of 30 sec. The frequency of the line stop occurrence is 0.06 stop/cycle on an average. When a stop occurs, it takes an average of 5 min to make repairs. Determine:
   i) Average production time, T_p
   ii) Average production rate, R_e
   iii) Line efficiency, E
   iv) Proportion of down time. **(08 Marks)**

4 a. Discuss the following:
   i) Minimum rational work element
   ii) Cycle time
   iii) Line efficiency
   iv) Precedence constraints **(08 Marks)**

   b. Explain different methods to solve assembly line balancing problems. **(12 Marks)**

PART – B

5 a. State and briefly explain the important design principles for automated assembly system. **(06 Marks)**

b. List the parts feeding devices in delivery system and with sketch explain pick and place mechanism. **(06 Marks)**

c. An ten station assembly line has an ideal cycle time of 0.2 min. The fraction defection rate at each of the ten stations is q = 0.020 and the system operates using the instantaneous control strategy. When the breakdown occurs, it takes 1 min, an average, for the system to be put back into operation. Determine the production rate for the assembly line, the yield of good products and the proportion uptime of the system. **(08 Marks)**

6 a. Describe the three main components used in an MRP system. **(10 Marks)**

b. Define capacity planning and explain its decisions. **(05 Marks)**

c. Explain retrieval approach used for computer aided process planning systems. **(05 Marks)**

7 a. Give the classification of machining centres and explain any two machine centres. **(10 Marks)**

b. State and explain the steps involved in part programming. **(10 Marks)**

8 a. State and draw five types of joints commonly used in industrial robot construction. **(05 Marks)**

b. Draw the robot configurations for the given joint notations and briefly explain:
i) TRR ii) VRO **(10 Marks)**

c. Explain end effectors. **(05 Marks)**

USN | | | | | | | | | | |

10ME62

Sixth Semester B.E. Degree Examination, Dec.2013/Jan.2014
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 handbook is permitted.
3. Missing data may be suitably assumed.

PART – A

1 a. A curved link mechanism made from a round steel bar is shown in Fig.Q1(a). The material for link is plain carbon steel 30C8 with an allowable yield strength of 400 MPa. Determine the factor of safety. **(10 Marks)**

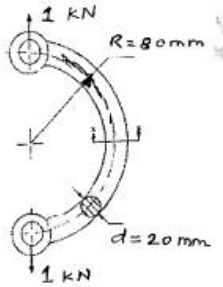


Fig.Q1(a)

b. A high pressure cylinder consists of a steel tube with inner and outer diameter of 20 mm and 40 mm respectively. It is jacketed by an outer steel tube with an outer diameter of 60 mm. The tubes are assembled by shrinking process in such a way that maximum principal stress induced in any tube is limited to 100 MPa. Calculate the shrinkage pressure and original dimensions of the tubes. Take the Young's modulus as 207 GPa. **(10 Marks)**

2 a. Write a note on construction of flat and 'V' belt. **(05 Marks)**

b. It is required to design a 'V' belt drive to connect a 7.5 kW, 1440 r/min induction motor to a fan, running at approximately 480 r/min for a service of 24 hr/day. Space is available for a centre distance of about 1 m. Determine the pitch length of the belt and number of belts required. **(15 Marks)**

3 a. Enumerate the applications of springs. Also derive an expression for the deflection of a close coiled helical spring. **(06 Marks)**

b. A spring is subjected to a load varying from 500 N and 1200 N. It is to be made of oil tempered cold drawn wire. Design factor based on Wahl's line is 1.25. The spring index is to be 6. The compression in the spring for the maximum load is 30 mm. Determine the wire diameter, mean coil diameter and free length of the spring. Take the yield stress in shear as 700 MPa and endurance stress in shear as 350 MPa for the material of the wire. **(14 Marks)**

4 a. Write a note on design of gears based on dynamic loading and wear. **(06 Marks)**

b. A cast steel 24 teeth spur pinion operating at 1150 r/min transmits 3 kW to a cast steel 56 teeth spur gear. The gears have the following specifications:

Module : 3 mm	Allowable stress : 100 MPa
Face width : 35 mm	Tooth form : 14½° full depth profile
Factor of dynamic loading, C= 350N/mm	Wear load factor, K = 0.28 MPa.

Determine the induced stress in the weaker gear. Also determine the dynamic load and wear load. Comment on the results. **(14 Marks)**

PART – B

5 a. Write a note on formative number of teeth in bevel gear. **(04 Marks)**

b. Hardened steel worm rotates at 1250 r/min and transmits power to a phosphor bronze gear with a transmission ratio of 15:1. The centre distance is to be 225 mm. Design the gear drive and give estimated power input ratings from the stand point of strength, endurance and heat dissipation. The teeth are of 14½° full depth involute. **(16 Marks)**

6 a. A cone clutch has a semi cone angle of 12°. It is to transmit 10 kW power at 750 r/min, the width of the face is one fourth of the mean diameter of friction lining. If the normal intensity of pressure between contacting surfaces is not to exceed 0.085 N/mm^2 and the coefficient of friction is 0.2, assuming uniform wear conditions, calculate the dimensions of the clutch. **(10 Marks)**

b. A band break arrangement is shown in Fig.Q6(b). It is used to generate a maximum braking torque of 200 N-m. Determine the actuating force 'P', if the coefficient of friction is 0.25. The angle of wrap of the band is 270°. Determine the maximum intensity of pressure, if the band width is 30 mm. **(10 Marks)**

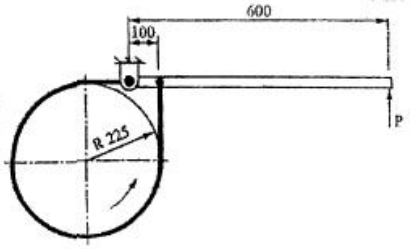


Fig.Q6(b)

7 a. Explain the following types of lubrication:
(i) Hydrodynamic lubrication (ii) Hydrostatic lubrication
(iii) Boundary lubrication (iv) Elasto hydro dynamic lubrication. **(08 Marks)**

b. The following data are given for a 360° hydro-dynamic bearing:

Bearing diameter : 50.02 mm	Journal diameter : 49.93 mm
Bearing length : 50 mm	Journal speed : 1440 r/min
Radial load = 8 kN	Viscosity of lubricant : 12 cp.

The bearing is machined on a lathe from bronze casting, while the steel journal is hardened and ground. The surface roughness values for turning and grinding are 0.8 and 0.4 microns respectively. For thick film lubrication the minimum film thickness should be five times the sum of surface roughness values for the journal and the bearing. Calculate:
(i) The permissible minimum film thickness
(ii) The actual film thickness under the operating conditions
(iii) Power loss in friction.
(iv) Flow requirement. **(12 Marks)**

8 a. Explain the considerations given in the design of pistons for IC engines. **(05 Marks)**

b. Design a trunk piston for an IC engine. The piston is made of cast iron with an allowable stress of 38.5 MPa. The bore of the cylinder is 200 mm and the maximum explosion pressure is 0.4 MPa. The permissible bending stress of the material of the gudgeon pin is 100 MPa. The bearing pressure in the gudgeon pin bearing of the connecting rod is to be taken as 200 MPa. **(15 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME63

Sixth Semester B.E. Degree Examination, Dec.2013/Jan.2014
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 book is permitted.

PART – A

1 a. Explain briefly the mechanism of conduction, convection and radiation heat transfer. **(06 Marks)**

b. With sketches, write down the mathematical representation of three commonly used different types of boundary conditions for one dimensional heat equation in rectangular coordinates. **(08 Marks)**

c. A plate of thickness 'L' whose one side is insulated and the other side is maintained at a temperature T_1 is exchanging heat by convection to the surrounding area at a temperature T_2, with atmospheric air being the outside medium. Write mathematical formulation for one dimensional, steady state heat transfer, without heat generation. **(06 Marks)**

2 a. An electric cable of 10mm diameter is to be laid in atmosphere at 20°C. The estimated surface temperature of the cable due to heat generation is 65°C. Find the maximum percentage increase in heat dissipation, when the wire is insulated with rubber having K = 0.155 W/mK. Take h = 8.5 W/m^{2}K. **(06 Marks)**

b. Differentiate between the effectiveness and efficiency of fins. **(04 Marks)**

c. In order to reduce the thermal resistance at the surface of a vertical plane wall (50 × 50cm), 100 pin fins (1 cm diameter, 10cm long) are attached. If the pin fins are made of copper having a thermal conductivity of 300 W/mK and the value of the surface heat transfer coefficient is 15 W/m^{2}K, calculate the decrease in the thermal resistance. Also calculate the consequent increase in heat transfer rate from the wall if it is maintained at a temperature of 200°C and the surroundings are at 30°C. **(10 Marks)**

3 a. Show that the temperature distribution in a body during Newtonian heating or cooling is given by $\frac{T-T_a}{T_i-T_a}=\frac{\theta}{\theta_i}=\text{Exp}\left(\frac{-hA_st}{\rho CV}\right)$. **(06 Marks)**

b. The steel ball bearings (K = 50 W/mK, $\alpha = 1.3 \times 10^{-5}$ m^2/sec), 40mm in diameter are heated to a temperature of 650°C. It is then quenched in a oil bath at 50°C, where the heat transfer coefficient is estimated to be 300 W/m^{2}K. Calculate:

i) The time required for bearings to reach 200°C.
ii) The total amount of heat removed from a bearing during this time and
iii) The instantaneous heat transfer rate from the bearings, when they are first immersed in oil bath and when they reach 200°C. **(14 Marks)**

4 a. With reference to fluid flow over a flat plate, discuss the concept of velocity boundary and thermal boundary layer, with necessary sketches. **(05 Marks)**

b. The exact expression for local Nusselt number for the laminar flow along a surface is given by $Nu_x=\frac{h_x x}{k}=0.332\ R_{ex}^{1/2}\ P_r^{1/3}$. Show that the average heat transfer coefficient from x = 0 to x = L over the length 'L' of the surface is given by $2h_L$ where h_L is the local heat transfer coefficient at x = L. **(05 Marks)**

c. A vertical plate 15cm high and 10cm wide is maintained at 140°C. Calculate the maximum heat dissipation rate from both the sides of the plates to air at 20°C. The radiation heat transfer coefficient is 9.0 W/m^2K. For air at 80°C, take $r = 21.09 \times 10^{-6}$ m^2/sec, $P_r = 0.692$, $k_f = 0.03$ W/mK. **(10 Marks)**

PART – B

5 a. Explain the physical significance of i) Nusselt number; ii) Groshoff number. **(04 Marks)**

b. Air at 2 atm and 200°C is heated as it flows at a velocity of 12 m/sec through a tube with a diameter of 3cm. A constant heat flux condition is maintained at the wall and the wall temperature is 20°C above the air temperature all along the length of the tube. Calculate:

i) The heat transfer per unit length of tube.

ii) The increase in bulk temperature of air over a 4m length of the tube.

Take the following properties for air Pr = 0.681, $\mu = 2.57 \times 10^{-5}$ kg/ms, K = 0.0386 W/mK and $C_p = 1.025$ kJ/kg K. **(10 Marks)**

c. Obtain a relationship between drag coefficient, c_m and heat transfer coefficient, h_m for the flow over a flat plate. ***(06 Marks)***

6 a. Derive an expression for LMTD of a counter flow heat exchanger. State the assumptions made. **(08 Marks)**

b. What is meant by the term fouling factor? How do you determine it? **(04 Marks)**

c. Engine oil is to be coded from 80°C to 50°C by using a single pass counter flow, concentric tube heat exchanger with cooling water available at 20°C. Water flows inside a tube with inner diameter of 2.5cm and at a rate of 0.08 kg/sec and oil flows through the annulus at the rate of 0.16 kg/sec. The heat transfer coefficient for the water side and oil side are respectively $h_w = 1000$ $W/m^2°C$ and $h_{oil} = 80$ $W/m^2°C$. The fouling factors is $F_w = 0.00018 m^2°C/W$ on both the sides and the tube wall resistance is negligible. Calculate the tube length required. **(08 Marks)**

7 a. Sketch a pool boiling curve for water and explain briefly the various regimes in boiling heat transfer. **(06 Marks)**

b. Define mass transfer coefficient. **(02 Marks)**

c. A 12cm outside diameter and 2m long tube is used in a big condenser to condense the steam at 0.4 bar. Estimate the unit surface conductance i) in vertical position; ii) in horizontal position. Also find the amount of condensate formed per hour in both the cases.

The saturation temperature of the steam = 74.5°C.

Average wall temperature = 50°C.

The properties of water film at average temperature of $\frac{75.4+50}{2} = 62.7°C$ are given below

$\rho = 982.2$ kg/m^3, $h_{fg} = 2480$ kJ/kg, K = 0.65 W/mK, $\mu = 0.47 \times 10^{-3}$ kg/ms. **(12 Marks)**

8 a. State and prove Wiens displacement law of radiation. **(06 Marks)**

b. The temperature of a black surface $0.2m^2$ in area is 540°C. Calculate:

i) The total rate of energy emission.

ii) The intensity of normal radiation.

iii) The wavelength of maximum monochromatic emissive power. **(06 Marks)**

c. Derive an expression for a radiation shape factor and show that it is a function of geometry only. **(08 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME64

Sixth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Finite Element Methods

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Differentiate between plane stress and plain strain problems with examples. Write the stress-strain relations for both. **(08 Marks)**

b. Explain the node numbering scheme and its effect on the half band-width. **(06 Marks)**

c. List down the basic steps involved in FEM for stress analysis of elastic solid bodies. **(06 Marks)**

2 a. State the principle of minimum potential energy. Determine the displacements at nodes for the spring system shown in the Fig.Q.2(a). **(08 Marks)**

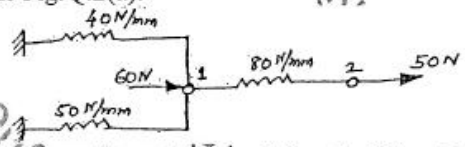
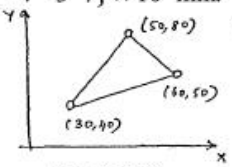


Fig.Q.2(a)

b. Determine the deflection of a cantilever beam of length 'L' subjected to uniformly distributed load (UDL) of P_o/unit length, using the trail function $y = a \sin\left(\frac{\pi x}{2L}\right)$. Compare the results with analytical solution and comment on accuracy. **(12 Marks)**

3 a. Derive an expression for Jacobian matrix for a four-noded quadrilateral element. **(10 Marks)**

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



Note: All dimensions in mm. Fig.Q.3(b)

4 a. An axial load $P = 300 \times 10^3$ N is applied at 20°C to the rod as shown in the Fig Q 4(a) The temperature is then raised to 60°C.

i) Assemble the global stiffness matrix (K) and global load vector (F).

ii) Determine the nodal displacements and element stresses.

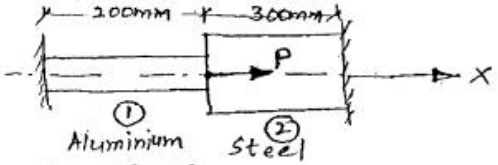


Fig.Q.4(a)

$E_1 = 70 \times 10^9$ N/m^2, $E_2 = 200 \times 10^9$N/m^2

$A_1 = 900$mm^2, $A_2 = 1200$mm^2

$\alpha_1 = 23 \times 10^{-6}$/°C, $\alpha_2 = 11.7 \times 10^{-6}$/°C. **(12 Marks)**

b. Solve the following system of equations by Gaussian-Elimination method:

$x_1 - 2x_2 + 6x_3 = 0$

$2x_1 + 2x_2 + 3x_3 = 3$

$-x_1 + 3x_2 = 2.$ **(08 Marks)**

PART – B

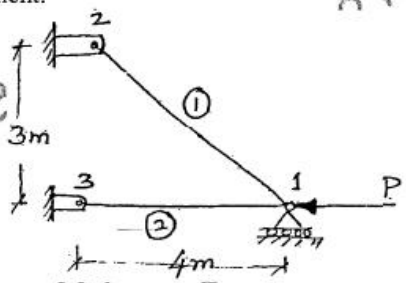
5 a. Using Lagrangian method, derive the shape function of a three-noded one-dimensional (1D) element [quadratic element]. **(06 Marks)**

b. Evaluate $I = \int_{-1}^{+1}\left[3e^x + x^2 + \frac{1}{(x+2)}\right].dx$ using one-point and two-point Gauss quadrature. **(06 Marks)**

c. Write short notes on higher order elements used in FEM. **(08 Marks)**

6 a. For the two-bar truss shown in the Fig.Q.6(a). Determine the nodal displacements and element stresses. A force of P = 1000 kN is applied at node 1. Take E = 210 GPa and A = 600mm^2 for each element. **(12 Marks)**

Fig.Q.6(a)

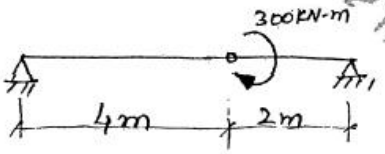


b. Derive an expression for stiffness matrix for a 2-D truss element. **(08 Marks)**

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

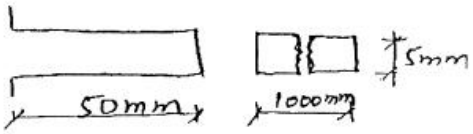
b. A simply supported beam of span 6m and uniform flexural rigidity EI = 40000 kN-m^2 is subjected to clockwise couple of 300 kN-m at a distance of 4m from the left end as shown in the Fig.Q.7(b). Find the deflection at the point of application of the couple and internal loads. **(12 Marks)**

Fig.Q.7(b)



8 a. Find the temperature distribution and heat transfer through an iron fin of thickness 5mm, height 50mm and width 1000mm. The heat transfer coefficient around the fin is 10 W/m^2. K and ambient temperature is 28°C. The base of fin is at 108°C. Take K = 50 W/m.K. Use two elements. **(10 Marks)**

Fig.Q.8(a)



b. Derive element matrices for heat conduction in one-dimensional element using Galerkin's approach. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

10ME65

Sixth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Mechatronics and Microprocessor

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What are primary objectives of mechatronics? Explain with a block diagram the key components in a typical mechatronics system. **(10 Marks)**

b. Explain with a block diagram, the working of automatic camera. **(10 Marks)**

2 a. Distinguish between sensor and transducer. Explain detail the classification of transducers. **(10 Marks)**

b. Write short notes on the following: i) Proximity sensors. ii) Hall effect sensors. **(10 Marks)**

3 a. Write brief notes on silicon controlled rectifier and junction field effect transistors. **(10 Marks)**

b. Explain with neat circuit diagrams, various types of D.C. rotors with respect to field coils. **(10 Marks)**

4 a. What is data acquisition? Explain with block diagram DAQ system. **(08 Marks)**

b. Write short notes on the following:
   i) Multiplexer. **(06 Marks)**
   ii) Explain analog to digital conversion process. **(06 Marks)**

PART – B

5 a. What is a microprocessor? Draw the block diagram of a micro computer and explain briefly the three segments (ALU, register and control unit) of a microprocessor. **(10 Marks)**

b. Define logic gates. Draw the symbols of AND, OR, EXOR and NOT gates and corresponding truth tables. **(10 Marks)**

6 a. Explain Intel 8085 microprocessor with the help of block diagram. **(10 Marks)**

b. Explain briefly a microcontroller, with a simplified block diagram. **(06 Marks)**

c. Compare microprocessors and microcontrollers. **(04 Marks)**

7 a. Briefly explain the various forms of memory unit: i) ROM; ii) PFROM; iii) EPROM; iv) EEPROM; v) RAM. **(10 Marks)**

b. Write short notes on the following:
   i) Data and address bus.
   ii) Instruction register and temporary register. **(10 Marks)**

8 *Write short notes on the following:*

a. Elements of closed loop control system.

b. Bimetallic thermostat.

c. Laws of Boolean algebra.

d. Classification of micro controllers. **(20 Marks)**

* * * * *