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10ME61

Sixth Semester B.E. Degree Examination, June/July 2016
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. What are the different reasons for industrial automation? How do you classify automated manufacturing systems? List typical features of them. **(12 Marks)**

b. A part is produced in a batch size of 100 units. 5 operations are required to complete the processing of the part. Average setup time is 3 hours/operation, average operation time is 0.1 hour. Delay, inspection time & others account to 7 hours for each operation. Determine how many days are required to complete the batch, assuming the plant runs 8 hours shift per day. **(05 Marks)**

c. Define MLT, utilization and availability. **(03 Marks)**

2 a. With a neat sketch, explain the configuration of an automated flow line. What are the different symbols and notations practiced in production systems? **(08 Marks)**

b. Explain with neat diagram the working principle of walking beam system. **(08 Marks)**

c. What are the different controlling functions of an automated flow line? Explain. **(04 Marks)**

3 a. Explain the following :
i) Upper bound approach and lower bound approach
ii) Starting and Blocking of stations **(08 Marks)**

b. A line has 10 workstations, each with a probability of breakdown 0.02. The cycle time of line is 60 seconds and each time breakdown occurs, it takes 5 minutes to repair. The line is divided into two stages by a buffer storage. Each stage consists of 5 stations. Compute efficiency of the line with no buffer storage capacity and efficiency for two stage flow lines. **(10 Marks)**

c. What are the factors affecting line balancing? **(02 Marks)**

4 a. Write a short note on the following :
i) Precedence constraints & precedence diagram ii) Line efficiency iii) Balance delay. **(08 Marks)**

b. The demand of the assembly line with its elemental time and precedence is as given below. Construct the precedence diagram and find balance delay by Kilbridge and Wester's method. (Cycle time = 1.5 minute) **(12 Marks)**

Elements	Time (Minutes)	Immediate Predecessor
1	1	-
2	0.5	-
3	0.8	1, 2
4	0.3	2
5	1.2	3
6	0.2	3, 4
7	0.5	5
8	1.5	5, 6, 7

PART – B

5 a. With neat sketch, explain part feeding and delivery systems. **(10 Marks)**
b. Briefly explain different types of vehicle guiding systems used for AGVs. **(10 Marks)**

6 a. With a neat diagram, explain generative and retrieval CAPP systems. **(12 Marks)**
b. Define MRP process inputs and outputs. What do you mean by BOM? **(08 Marks)**

7 a. Give general configuration of a CNC system. List various advantages and disadvantages of CNC machining centers. **(08 Marks)**
b. Discuss various types of NC co-ordinate systems along with motion control systems. **(10 Marks)**
c. Describe the following codes:
i) G_{00} ii) G_{90} iii) G_{02} iv) G_{04} **(02 Marks)**

8 a. Define Industrial Robot. Enlist the different applications of Robot. **(06 Marks)**
b. How do you specify a robot? **(04 Marks)**
c. Explain with neat sketches different types of end-effectors, sensors used in robot. **(10 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, June/July 2016
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Use of Design hand book is permitted.
3. Missing data, is any may be suitably assumed.

PART – A

1 a. Determine the dimensions of the curved bar shown in Fig.Q1(a). Assume σ_{yt} = 400 MN/m^2 and FOS = 3.5. **(10 Marks)**

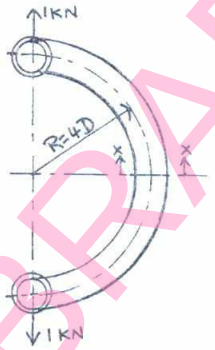

Fig.Q1(a)

b. A circular plate made of steel and of diameter 200 mm with thickness 10 mm is subjected to a load inducing a pressure of 4 MN/m^2. Taking E = 201 kN/mm^2, Poisson's ratio 0.3, determine (i) Maximum stress, its location and maximum deflection when the edges of the plate are supported. (ii) Maximum stress, its location and maximum deflection when the edges of the plate is fixed. **(10 Marks)**

2 a. A flat belt 200 mm wide weighing 20 N/m connecting a 300 mm diameter pulley to a 900 mm diameter driven pulley at a shaft spacing of 6 m, transmits 55.2 kW at a belt speed of 25 m/sec (i) Calculate the belt length and the a angles of wrap (ii) Compute the belt tensions based in a coefficient of friction 0.38. **(10 Marks)**

b. A V-belt drive is required to transmit 15 kW at 210 mm sheave running at 750 rpm to another pulley to run at 375 rpm. The belt used is 30 mm wide at top, 21 mm thick with V-angle 40°. The allowable stress for belt material is 2 MPa. Centre distance is 1.2 m. Specific weight of belt material is 1.1 gm/cc. Coefficient of friction of smaller pulley is 0.3 and for large pulley is 0.25. Find the number of bnelts of given cross-section required for this application. **(10 Marks)**

3 a. Derive an expression for the stress induced in a helical spring with usual notations. **(07 Marks)**

b. Write a note on Wahl stress correction factor. **(03 Marks)**

c. A semi-elliptical leaf spring has a span of 1.8 m. The spring carries a helical spring upon which is imposed an impact of 3 kN-m. The laminated spring has 8 graduated and 3 full length leaves each 60 mm wide and 6 mm thick. The coil spring has 9 coil of 12.5 mm wire diameter and a spring index of 7. Find the stresses induced in each spring. Take G = 80×10^3 MPa, E = 206×10^3 MPa. **(10 Marks)**

4 a. State any four advantages of gear drive over other types of drives. **(04 Marks)**

b. A pair of spur gears with 20° full depth involute teeth consists of a 20 teeth pinion meshing with a 41 teeth gear. The module is 3 mm while the face width is 40 mm. The material for the pinion as well as the gear is steel with an ultimate tensile strength of 600 MN/m^2. The gears are heat treated to a surface hardness of 400 BHN. The pinion rotates at 140 rpm and the service factor for the application is 1.75. Assume that the velocity factor accounts for the dynamic load and the factor of safety is 1.5. Determine the rated power that the gears can transmit. **(16 Marks)**

PART – B

5 a. A two teeth right hand worm transmits 2 kW at 1500 rpm to a 36 teeth wheel. The module is 5 mm and pitch diameter of worm is 60 mm. The pressure angle is 14.5°. The co-efficient of friction is found to be 0.06. Find :

i) The centre distance, lead and lead angle ii) The efficiency of the drive iii) The forces. **(10 Marks)**

b. A pair of bevel gear wheels with 20° pressure angle consists of 20 teeth pinion meshing with 30 teeth gear. The module is 4 mm while the face width is 20 mm. Surface hardness for both pinion and gear is 400 BHN. The pinion rotates at 500 rpm and receives power from an electric motor. The starting torque of the motor is 30% greater than the mean torque, Determine the safe power that can be transmitted. Considering dynamic load, wear strength and bending strength. The allowable bending stress may be taken as 240 MPa. **(10 Marks)**

6 a. Determine the dimensions of a simple cone clutch to transmit 20 kW at 1000 rpm. The minimum diameter is to be 300 mm and the cone angle 20°. Assume $\mu = 0.2$ and permissible pressure = 0.1 MN/m^2. Also determine the axial force required to engage the clutch. **(10 Marks)**

b. A differential band brake as shown in Fig.Q6(b), has an angle of contact of 225°. The band has a compressed woven lining and bears against a cast iron drum of 350 mm diameter. The brake is to sustain a torque of 350 N-m and the coefficient of friction between the band and the drum is 0.3. Find (i) the necessary force P for the clockwise and anticlockwise rotation of the drum. (ii) The value of 'OA' for the brake to be self locking when the drum rotates clockwise. **(10 Marks)**

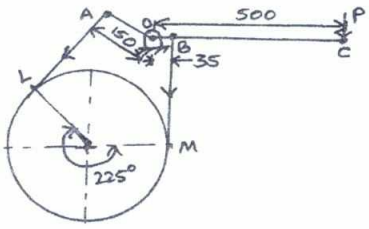

Fig.Q6(b)

7 a. Derive Petroff's equation for coefficient of friction for hydrodynamic bearing. **(08 Marks)**

b. The thrust of a propeller shaft in a ship engine is taken by a number of collars integral with the shaft which is 300 mm diameter. The thrust on the shaft is 200 kN and speed is 75 rpm. Bearing pressure is 0.3 MN/m^2. Find (i) the number of collar required if the outside diameter is 500 mm. (ii) Power lost in friction assuming uniform wear (iii) Heat generated in the bearing. **(12 Marks)**

8 Design a connecting rod for a petrol engine from the following data:

Cylinder bore or diameter of piston = 100 mm. Length of connecting rod = 350 mm
Maximum gas pressure = 3 N/mm^2 Length of stroke = 150 mm
Engine speed = 1500 rpm Weight of reciprocating parts = 25 N
Compression ratio = 4 : 1

Compression rod is made of steel and assume 'I' section. Assume any further data required for the design. **(20 Marks)**

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10ME63

Sixth Semester B.E. Degree Examination, June/July 2016
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.***

PART – A

1 a. What do you mean by boundary condition of I^{st}, 2^{nd} and 3^{rd} kind? **(06 Marks)**

b. Derive the general three dimensional heat conduction equation in cartesian co-ordinates and state the assumptions made. **(08 Marks)**

c. A pipe with outside diameter 20 mm is covered with two insulating materials. The thickness of each insulating layer is 10 mm. The conductivity of I^{st} insulating layer is 6 times that of the 2^{nd} insulating layer. Initially insulating layer is placed in the order of 1^{st} and 2^{nd} layer. Then it is placed in the order of 2^{nd} layer and 1^{st} layer. Calculate percentage change in heat transfer and increase or decrease. Assume a length of 1 m. In both the arrangement, there is no change in temperature. **(06 Marks)**

2 a. What is physical significance of critical thickness of insulation? Derive an expression for critical thickness of insulation for a cylinder. **(06 Marks)**

b. Derive an expression for the temperature distribution for a pinfin, when the tip of the fin is insulated. **(08 Marks)**

c. 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 at the tip of the fin assuming atmospheric temperature of 28°C and base temperature of fin = 108°C. Assume the following K = 50 W/mK, h = 10 W/m^{2}K. **(06 Marks)**

3 a. Write a note on Biot number and Fourier number. **(04 Marks)**

b. Obtain an expression for instantaneous heat transfer and total heat transfer for lumped heat analysis treatment of heat conduction problem. **(08 Marks)**

c. A hot mild steel sphere (K = 43 W/mK) having 10 mm diameter is planned to be cooled by an air flow at 25°. The convection heat transfer coefficient is 115 W/m^{2}K. Calculate the following (i) time required to cool the sphere from 600°C to 100°C (ii) Instantaneous heat transfer rate 1.5 min after the start of cooling (iii) total energy transferred from the sphere during the first 1.5 min. **(08 Marks)**

4 a. Explain the following: (i) Velocity boundary layer (ii) Thermal boundary layer. **(06 Marks)**

b. Using dimensional analysis derive an expression relating Nusselt number, Prandtl and Grashoff numbers for natural convection. **(08 Marks)**

c. Air at 20°C flows over thin plate with a velocity of 3 m/sec. The plate is 2 m long and 1 m wide. Estimate the boundary layer thickness at the trailing edge of the plate and the total drag force experienced by the plate. **(06 Marks)**

PART – B

5 a. Explain the physical significance of the following dimensionless numbers:
(i) Reynolds number (ii) Prandtl number (iii) Nusselt number
(iv) Stanton number. **(08 Marks)**

b. Air at 20°C flows past a 800 mm long plate at velocity of 45 m/sec. If the surface of the plate is maintained at 300°C. Determine (i) The heat transferred from the entire plate length to air taking into consideration both laminar and turbulent portion of the boundary layer.
(ii) The percentage error if the boundary layer is assumed to be of turbulent nature from the very leading edge of the plate. Assume unit width of the plate and critical Reynolds number to be 5×10^5. **(12 Marks)**

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

b. A counter flow, concentric tube heat exchanger used to cool the lubricating oil for a large industrial gas turbine engine. The flow rate of cooling water through the inner tube. (d_i = 20 mm) is 0.18 kg/sec. While the flow rate of engine oil through the outer annulus (d_0 = 40 mm) is 0.12 kg/sec. The inlet and outlet temperature of oil are 95°C and 65°C respectively. The water enters at 30°C to the exchanger. Neglecting tube wall thermal resistance, fouling factors and heat loss to the surroundings, calculate the length of the tube. **(10 Marks)**

7 a. Clearly explain the regions of pool boiling with neat sketch. **(06 Marks)**

b. State and explain Ficks law of diffusion. **(06 Marks)**

c. Air free saturated steam at 85°C and pressure of 57.8 KPa condenses on the outer surface of 225 horizontal tubes of 1.27 cm outside diameter arranged in 15×15 array. Tube surfaces are maintained at a uniform temperature of 75°C. Calculate the total condensation rate/m length of the tube bundle. **(08 Marks)**

8 a. Explain : (i) Stefan Boltzmann law. (ii) Kirchoff's law (iii) Plank's law
(iv) Wein's displacement law. (v) Radiation shield. **(10 Marks)**

b. Calculate the net radient heat exchange per m^2 area for two large parallel plates at temperatures of 427°C and 27°C respectively. Take emissivity of the hot plate and cold plates are 0.9 and 0.16 respectively. If the polished aluminium shield is placed between them, find the percentage reduction in the heat transfer. Take emissivity of shield as 0.4. **(10 Marks)**

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10ME64

Sixth Semester B.E. Degree Examination, June/July 2016
Finite element method

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.

PART – A

1 a. Derive the equilibrium equations of a three dimensional body subjected to a body force. **(08 Marks)**

b. Explain the general description (steps) of FEM. **(06 Marks)**

c. Briefly explain the types of elements based on geometry. **(06 Marks)**

2 a. State principle of virtual work and principle of minimum potential energy. **(04 Marks)**

b. Calculate an expression for deflection in a simply supported beam under uniformly distributed load P_o ever entire span of length L using Rayleigh Ritz method. **(10 Marks)**

c. What are the steps involved in Galerkin's method to find out deflection? **(06 Marks)**

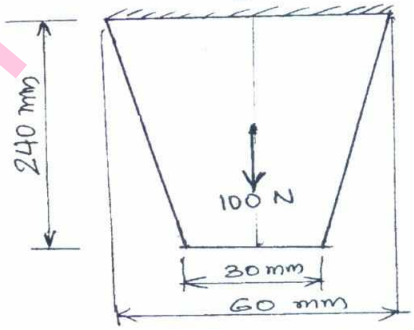
3 a. Explain two dimensional Pascal's triangle. **(05 Marks)**

b. Define interpolation polynomial, simplex, complex and multiplex elements and cubic element. **(05 Marks)**

c. Find the shape functions of a CST element and plot the same. **(10 Marks)**

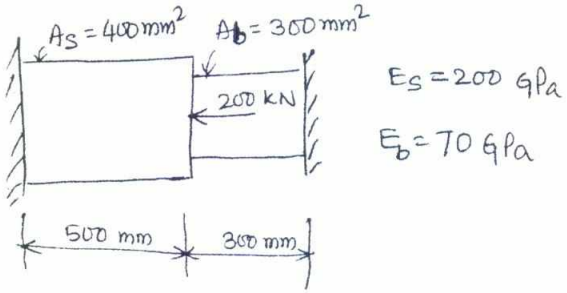
4 a. Fig Q4(a) shows a thin plate of uniform thickness of 1 mm, weight density = 76.6×10^{-6} N/mm^3 and subjected to point load of 1kN at its midpoint. Take E = 200 GPa. Evaluate nodal displacement, stresses, and reactions. Using elimination techniques. **(10 Marks)**

Fig Q4(a)



b. Find the nodal displacement, stresses and reactions of a Fig. Q4(b). Using penalty approach method. **(10 Marks)**

Fig Q4(b)



PART – B

5 a. Obtain the shape functions of quadratic bar element. **(10 Marks)**

b. Use two point Gauss quadrature to evaluate the integral $I = \int_0^3 (2^{\xi} - \xi) d\xi$. **(10 Marks)**

6 a. Derive an expression for stiffness matrix of a 2 noded truss element. **(10 Marks)**

b. Determine the nodal displacements in the truss segments subjected to concentrated load as shown in Fig Q6 (b). Take E = 70GPa A = 0.01 m^2. **(10 Marks)**

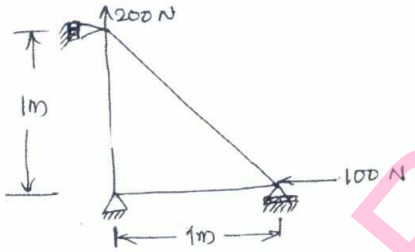


Fig Q6(b)

7 a. Obtain Hermite shape functions of a beam element. **(10 Marks)**

b. Find the deflection at the tip and the support reaction of a cantilever shown in Fig. 7(b).

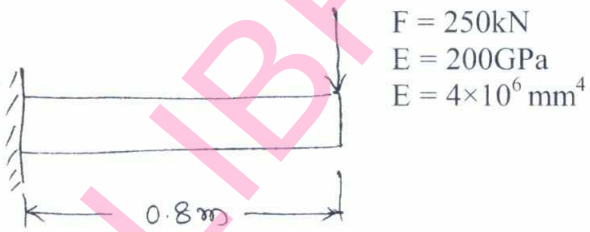


Fig. Q7(b)

(10 Marks)

8 a. Obtain the governing equation of a one dimension heat conduction. **(10 Marks)**

b. Calculate the temperature distribution in a one dimensional fin with the physical properties shown in Fig 8(b). There is a uniform generation of heat inside the wall of $\bar{Q} = 400\ W/m^3$.

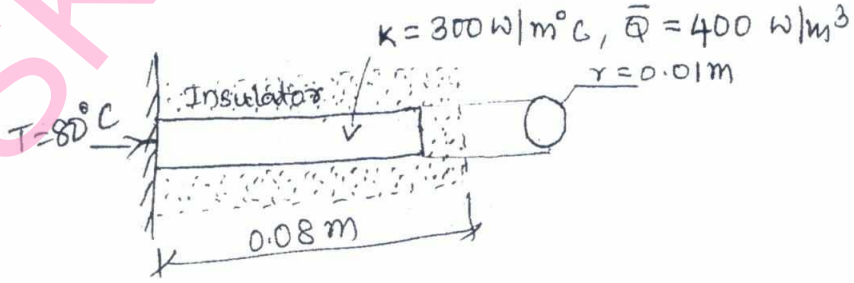


Fig. Q8(b)

(10 Marks)

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10ME65

Sixth Semester B.E. Degree Examination, June/July 2016
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 the basic functions of control system? Mention the requirement of it in detail. **(06 Marks)**

b. What are the benefits of mechatronics in industries? **(06 Marks)**

c. Draw the structure of a programmable logic controller and mention the functions of each block. **(08 Marks)**

2 a. A potentiometer resistance transducer has a total winding resistance of 8KΩ and a maximum displacement range of 5cm. The power dissipation at maximum displacement is not to exceed 50 mW. Determine the output voltage of the transducer when the input displacement is 2cm. **(06 Marks)**

b. What are position sensors? Explain the working of Hall effect sensors and mention the advantages of it. **(08 Marks)**

c. Explain the operation of a linear variable differential transducer. **(06 Marks)**

3 a. Draw the switching arrangement of break before make and make before break. Mention disadvantages of mechanical switches. **(06 Marks)**

b. What are solenoids? What are the parameters to be consider for selecting a solenoids for an application. **(06 Marks)**

c. What is stepper motor and explain the working of a two stack stepper motor. **(08 Marks)**

4 a. Explain the operation of a optical isolator. **(06 Marks)**

b. For the op-amp circuit shown in Fig.Q.4(b), find the output voltage. **(04 Marks)**

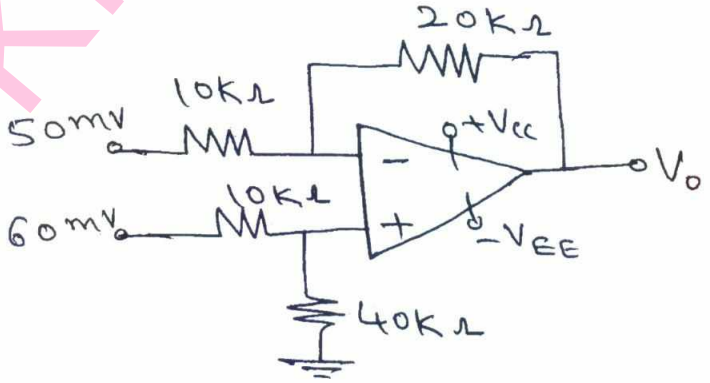

Fig.Q.4(b)

c. Illustrate a data acquisition system. **(07 Marks)**

d. What are the advantages of digital signal processing over analog signal processing? **(03 Marks)**

PART – B

5 a. Convert the following:
   i) $(ABC)_{16} = (\_\_\_\_\_)_{10}$
   ii) $(204.2)_8 = (\_\_\_\_\_)_{10}$
   iii) $(0.60)_{10} = (\_\_\_\_\_)_2$
   iv) $(101010.101)_2 = (\_\_\_\_\_)_{10}$. **(08 Marks)**

   b. Write a note on overflow and underflow. **(06 Marks)**

   c. Simplify the Boolean expression and realize using basic gates $Y = A\left(\overline{ABC} + A\overline{B}C\right)$. **(06 Marks)**

6 a. Define the following terms with respect to microprocessor:
   i) Fetch cycle
   ii) Accumulator
   iii) Interrupts
   iv) Stack pointer
   v) Write cycle. **(10 Marks)**

   b. Draw the block diagram of a micro controller and mention the functions of each block. **(10 Marks)**

7 a. Explain the different types of addressing modes of INTEL 8085 microprocessor with example. **(10 Marks)**

   b. Write a program to find the largest of N binary numbers that are stored at consecutive data memory locations starting at X. **(07 Marks)**

   c. What is the function of logical group of instructions and mention few of it. **(03 Marks)**

8 a. Draw the block diagram of a control unit and explain it. **(10 Marks)**

   b. Draw and explain the timing diagram of read operation. **(10 Marks)**

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10ME664

Sixth Semester B.E. Degree Examination, June/July 2016
Design of Heat Exchanger

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Classify the heat exchangers based on, (i) Transfer process (ii) Number of fluids (iii) Surface compactness (iv) Construction (v) Flow arrangements **(10 Marks)**

b. List possible reasons for Fouling of heat exchangers. **(06 Marks)**

c. Explain the LMTD correction factor. **(04 Marks)**

2 a. List the principal components of a shell and tube heat exchanger. **(06 Marks)**

b. Enumerate the design parameters to be considered for the thermal design of shell and tube heat exchanger. **(10 Marks)**

c. Explain the factors affecting pressure drop in shell and tube heat exchanger. **(04 Marks)**

3 Design a shell and tube heat exchanger to send cool condensate from a methanol condensor from 95°C to 40°C. Flow rate of methanol 100,000 kg/h. Brackish water is used as a coolant, with a temperature rise from 25°C to 40°C. Choose 20 mm OD, 16 mm ID, 4.88 m long tube CuPro-nickel and taking L = 4.83 m. Assume 1.25 triangular pitch as shell side fluid is relatively clean. Take properties of water and methanol at mean temperature as below. **(20 Marks)**

(a) Water	Properties	(b) Methonal
4.2	C_P (kJ/kg°C)	2.84
995	ρ (kg/m^3)	750
0.8	μ(N-S/m^2)	0.34
0.59	K(ω/m°C)	0.19

4 a. What is TEMA standard? Provide specification of a condenser as per TEMA. **(08 Marks)**

b. Estimate the heat transfer co-efficient for steam condensing on the outside and on the inside, of 25 mm OD, 21 mm ID and vertical tube of 3.66 m long. The steam condensate rate is 0.015 kg/s per tube and condensation takes place at 3 bar. The steam flows down the tube. Take physical properties from steam table at saturation temperature of 133.5°C
$\rho_L = 931$ kg/m^3, $\rho_V = 1.65$ kg/m^3, $K_L = 0.688$ W/m°C, $\mu_L = 0.21$ mNS/m^2, $P_r = 1.27$ **(12 Marks)**

PART – B

5 a. Describe a double pipe heat exchanger. Why it is used mostly in the form of hair pins? **(08 Marks)**

b. A counter flow double pipe heat exchanger is used to cool the lubricating oil for a large industrial gas turbine engine. The flow rate of cooling water through the inner tube having a diameter of 25 mm is 0.2 kg/s. While the flow rate of oil through the outer annulus of diameter 45 mm is 0.1 kg/s. The oil and water enter at a temperature of 100°C and 30°C respectively. How long must the tube be made if the outlet temperature of the oil is to be 60°C? **(12 Marks)**

6 a. What are the different types of compact heat exchangers? **(06 Marks)**

b. Air at 1 atm and 400 K with a velocity of 10 m/s flows across a compact heat exchanger having plate-finned circular tube matrix, calculate

i) Heat transfer coefficient.

ii) The ratio of the frictional pressure drop to inlet pressure drop for the flow of air across the exchanger.

Physical properties of atm. air at 400 K are

$\rho = 0.8826$ kg/m^3, $C_p = 1014$ J/kg°C, $\mu = 2.286 \times 10^{-5}$ kg/ms, $P_r = 0.689$. **(14 Marks)**

7 a. What are air heat exchanger? List its principal parts. **(06 Marks)**

b. List some of the applications of air-heat exchanger. **(04 Marks)**

c. An air cooled condenser has a fluid condensing at 50°C with air temperature rising by 8°C from 25°C. The capacity of the units is 10 kW. A variable speed fan is used for the air flow and the temperature is obtained at 2400 rpm. If the air mass flow varies directly as the fan speed N and if the over all heat transfer coefficient varies as $N^{0.7}$, determine the heat transfer at a fan speed of 1200 rpm. **(10 Marks)**

8 Write short notes on the following:

i) Process heaters.

ii) Mechanism of heat transfer in furnaces.

iii) Design method of Lobo and Evans of furnace design.

iv) Wallenberg simplified method of furnace design. **(20 Marks)**

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10ME665

Sixth Semester B.E. Degree Examination, June/July 2016
Non-Traditional Machining

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. How modern machining processes are classified? **(06 Marks)**

b. What is the difference between conventional and non conventional machining processes. **(05 Marks)**

c. What are the essential physical process parameters for an efficient use of modern machining process? **(05 Marks)**

d. Why NTM processes are selected for manufacturing? **(04 Marks)**

2 a. Explain with neat diagram construction and working of USM processes. **(10 Marks)**

b. Explain the following parameters with respect to USM:
i) Effect of amplitude and frequency of vibration.
ii) Effect of grain diameter.
iii) Effect of applied static load.
iv) Effect of slurry. **(10 Marks)**

3 a. Draw schematic diagram of Abrasive Jet Machining (AJM). Explain its construction and working. **(06 Marks)**

b. List and explain the variables used in AJM. **(12 Marks)**

c. List the application of water Jet machining. **(02 Marks)**

4 a. Draw schematic sketch of electro chemical machining and explain briefly the elements of ECM process. **(10 Marks)**

b. Explain with neat schematic diagram of electro chemical grinding and their advantages and application. **(10 Marks)**

PART – B

5 a. What are the factors on which the selection of a resist for all in chemical machining depend? **(03 Marks)**

b. Explain the elements of process (i) Maskants or resist (ii) etchants in CHM. **(08 Marks)**

c. Explain with sketch progressive stages of metal removal in chemical blanking. **(06 Marks)**

d. List the applications of chemical machining. **(03 Marks)**

6 a. Draw neat diagram of EDM (Electrical Discharge Machining). Explain its construction and working. **(10 Marks)**

b. Explain briefly EDM process characteristics. **(10 Marks)**

7 a. Explain the construction and working principle of Plasma Arc Machining (PAM) with neat sketch. **(08 Marks)**

b. List the general guideline for designing the torch. **(06 Marks)**

c. What are the application of PAM and also mention advantages and limitations? **(06 Marks)**

8 a. With neat sketch, explain working principle of Electron Beam Machining (EBM). **(08 Marks)**

b. Draw neat sketch of a typical set up for Laser Beam Machining (LBM) and explain briefly. **(08 Marks)**

c. What are the advantages and limitations of LBM? **(04 Marks)**

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