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10ME61

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Computer Integrated Manufacturing

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What is automation? Explain different types of automation. **(08 Marks)**

b. Explain the following terms:
i) Manufacturing lead time ii) Production rate iii) Production capacity **(06 Marks)**

c. In a manufacturing plant a part is produced in a batch size of 60 units. The batch must be routed through 8 operations to complete it. Average set up time 5 hr/operation. Average operation time is 10 min. Average non-operation time is 7 hrs/operation. Determine:
i) Manufacturing lead time in number of days of the plant runs 8 hrs shift/day.
ii) Production rate of the plant. **(06 Marks)**

2 a. Explain the various methods of work part transport in an automated flow line. **(09 Marks)**

b. What are the symbols used in an automated flow line? **(05 Marks)**

c. Sketch and explain the linear walking beam mechanism. **(06 Marks)**

3 a. Explain the upper bound approach and lower bound approach in analyzing transfer lines, without storage buffer. **(08 Marks)**

b. Discuss the starving and blocking of stations with respect to an automated flow line. **(04 Marks)**

c. The ideal cycle time of an 16 station transfer line is 1.4 min. The average down time per line will be 6 min and the probability of breakdowns per cycle is equal for all cycles and is equal to 0.004. Determine production rate and line efficiency by considering both upper bound and lower bound approaches. **(08 Marks)**

4 a. Explain the following terms with respect to line balancing:
i) Cycle time ii) Precedence constraints
iii) Precedence diagram iv) Balance delay **(08 Marks)**

b. What are the objectives of line balancing? **(06 Marks)**

c. Explain with an example, the largest candidate rule method of line balancing. **(06 Marks)**

PART – B

5 a. Discuss the principles used in product design to facilitate automated assembly. **(06 Marks)**

b. With neat figures, explain the elements of part delivery system. **(06 Marks)**

c. Discuss the functions that are performed while operating AGVS. **(08 Marks)**

6 a. With the help of a block diagram, explain retrieval CAPP systems. **(08 Marks)**

b. Explain the structure of MRP system. **(08 Marks)**

c. Briefly explain the capacity planning. **(04 Marks)**

7 a. Describe salient features of CNC systems. **(10 Marks)**

b. Discuss the advantages and disadvantages of CNC systems. **(10 Marks)**

8 a. With neat sketches, discuss the common robot configurations. **(12 Marks)**

b. Explain resolution, accuracy and repeatability, as applied to robot. **(08 Marks)**

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10ME62

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018

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. Missing data can be suitable assumed.

PART – A

1 a. A chain link is made up of 40 mm diameter rod is semicircle at each end. The mean diameter of which is 80 mm. The straight side of the link are also 80 mm. If the link carry a load of 90 kN, estimate the tensile and compressive stresses in the link along the section of load line. Also find the stresses at a selection 90° away from the load line. **(15 Marks)**

b. A cast steel cylinder of 300 mm internal diameter is to contain liquid at a pressure of 12.5 N/mm^2. It is closed at both ends by unstayed flat cover plates rigidly bolted to the shell flange. Determine the thickness of the cover plates if the allowable working stress for the cover material is 75 N/mm^2. **(05 Marks)**

2 a. A belt drive of two V-belt in parallel on ground pulleys of the same size. The angle of the groove is 30°. The cross section area of each belt is 750 mm^2 and $\mu = 0.12$. The density of the belt material is 1.2 g/cc and the mass safe stress in the material is 1.2 g/cc and the mass of safe stress in the material is 7 MPa. Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1500 rpm. Find the shaft speed at which power transmitted would be a maximum. **(15 Marks)**

b. Derive an expression for centrifugal tension in belt drive. **(05 Marks)**

3 a. Helical compression spring is subjected to 1960 N force, as to deflect by 50 mm. Under this load the outside diameter is not to exceed 70 mm and inside diameter not less than 20 mm. Take allowable shear stress is 430 MPa, spring index is 6. Design the spring. **(12 Marks)**

b. Derive an expression of deflection in helical spring. **(08 Marks)**

4 A pair of steel helical gear is to transmit 15 kW at 5000 rpm of the pinion both the gears are made of the same material, hardened steel with allowable bending stress of 120 MPa. The gears are to be operated at a centre distance of 200 mm, speed reduction ration is 4:1. The teeth are 20° FDI profile on transverse plane (diameter plane), helix angle is 45°. The gears are manufactured to class-3 accuracy (precision class). Face width can be taken as 16 times the normal module. The wear strength has to be more than the dynamic load. **(20 Marks)**

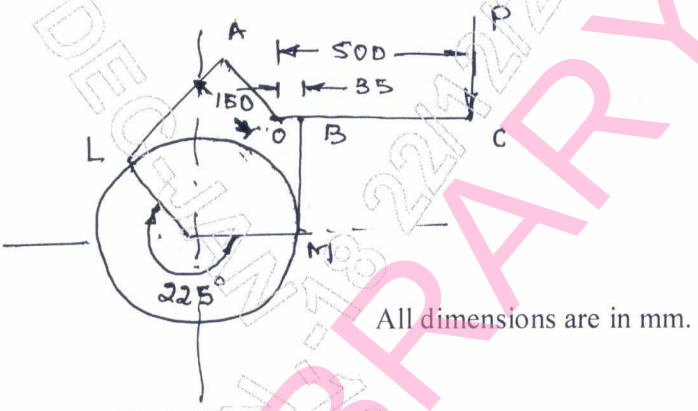
PART – B

5 a. Under what circumstances the bevel gears are used. Give a detailed classification of Bevel gears. **(05 Marks)**

b. Design a worn gear reducer unit which consists of a hardened steel worn and a phosphor bronze gear having 20° stub involute teeth. The centre distance is to be 200 mm and the transmission ratio is 10 and the worn speed is 2000 rpm. Assuming the temperature of gear and ambient temperature as 65° and 25° respectively. **(15 Marks)**

6 a. A cone clutch has a semi-cone angle of 12° to transmit 10 KW at 750 rpm. The width of the face is one fourth of the mean diameter of friction lining. If the normal intensity of pressure between the contacting surface is not to exceed 0.85 bar, assuming uniform wear criterion and taking $\mu = 0.2$, calculate dimensions of clutch. Also find the axial force while running. **(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 CI 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, F for the clockwise and anticlockwise rotation of the drum and (ii) The value of "OA" for the brake to be self locking, when the drum rotates clockwise.



All dimensions are in mm.

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

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

b. A bearing for an axial flow compressor is to carry a radial load of 4905 N and thrust load of 2452 N. The service imposes light shock and the bearing is used for 40 hr/week for 5 years. The speed of shaft is 300 rpm and diameter of shaft is 60 mm. Select a suitable bearing. **(15 Marks)**

8 a. The following data is given for the piston of a four-stroke diesel engine. Cylinder bore = 250 mm, maximum gas pressure = 4 MPa, bearing pressure at small end of connecting rod = 15 MPa, length of piston pin in bush of small end = 0.45D, ratio of inner of outer diameter of piston pin = 0.6, mean diameter of piston boss = 1.4 × outer diameter of piston pin, allowable bending stress for piston pin = 84 N/mm^2. Calculate:

i) Outer diameter of the piston pin
ii) Inner diameter of the piston pin
iii) Mean diameter of the piston boss
iv) Check the design for bending stress. **(16 Marks)**

b. List and explain the functions of parts of internal combustion engine. **(04 Marks)**

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10ME63

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Heat and Mass Transfer

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define Thermal Diffusivity. **(04 Marks)**

b. The inside temperature of a furnace wall with k = 1.35 N/m.K, 200 mm thick is 1400°C. The heat transfer coefficient at the outside surface is a function of temperature difference and is given by $(h = 7.85 + 0.08\Delta T)$ W/m².K. where ΔT is the temperature difference between outside wall surface and surroundings. Determine the rate of heat transfer per unit area, if the surrounding temperature is 40°C. **(08 Marks)**

c. The temperature distribution across a wall, 1 m thick at a certain instant of time is given as $T(x) = 900 - 300x - 50x^2$, where T is in degree Celsius and x in metre. The uniform heat generation of 1000 W/m³ is present in wall of area 10 m² having the properties $\rho = 1600$ kg/m³, k = 40 W/m.K and C = 4 kJ/kg.K. Determine

(i) The rate of heat transfer entering the wall at x = 0 and leaving the wall at x = 1 m.
(ii) The rate of change of internal energy of the wall
(iii) The time rate of temperature change at x = 0, 0.5 m. **(08 Marks)**

2 a. Define fin effectiveness. When the use of fins is not justified? **(03 Marks)**

b. A plane wall k = 45 W/m.K 10 cm thick, generated at a uniform rate of 8×10^6 W/m³. The two sides of the wall are maintained at 180°C and 120°C. Neglect end effects, calculate

(i) Temperature distribution across the plate
(ii) Position and magnitude of maximum temperature.
(iii) The heat flow rate from each surface of the plate. **(09 Marks)**

c. A very long rod, 25 mm in diameter, has one end maintained at 100°C. The surface of the rod is exposed to ambient air at 25°C with convection coefficient of 10 W/m².K. What are the heat losses from the rods, constructed of pure copper with K = 398 W/mK and stainless steel with K = 14 W/m.K ? Also, estimate how long the rods must be to be considered infinite. **(08 Marks)**

3 a. Define Biot number and Fourier number. **(03 Marks)**

b. An aluminium wire, 1 mm in diameter at 200°C is suddenly exposed to an environment at 30°C with h = 85.5 W/m²K. Estimate the time required to cool the wire to 90°C. If the same wire to place in air stream (h = 11.65 W/m²K), what would be time required to reach it to 90°C. Assume thermophysical properties C = 900 J/kg.K, ρ = 2700 kg/m³, k = 204 W/m.K. **(09 Marks)**

c. A long cylindrical shaft 20 cm in diameter is made of steel k = 14.9 W/m.k, ρ = 7900 kg/m³, C = 477 J/kg.K and $\alpha = 3.95 \times 10^{-6}$ m²/s. It comes out an oven at a uniform temperature of 600°C. The shaft is then allowed to cool slowly in an environment at 200°C with an average heat transfer coefficient of 80 W/m²K. Calculate the temperature at the centre of the shaft, 45 min after the start of cooling process. Also calculate the heat transferred per unit length of the shaft during this period. **(08 Marks)**

4 a. Explain velocity and thermal boundary layer. **(04 Marks)**

b. A fan provides air speed upto 50 m/s is used in low speed wind tunnel with atmospheric air at 27°C. If this wind tunnel is used to study the boundary layer behavior over a flat plate upto $R_c = 10^8$. What should be the minimum plate length? At what distance from the leading edge would transition occur, if critical Reynolds number $R_{c_{cr}} = 5 \times 10^5$? **(08 Marks)**

c. Calculate the approximate Reynolds numbers and state if the flow is laminar or turbulent for the following:

(i) A 10 m long yatch sailing at 13 km/h in sea water, $\rho = 1000$ kg/m^3 and $\mu = 1.3 \times 10^{-3}$ kg/m.S.

(ii) A compressor disc of radius 0.3 m rotating at 15000 rpm in air at 5 bar and 400°C and $\mu = \frac{1.46 \times 10^{-6} T^{\frac{3}{2}}}{(110 + T)}$ kg/m.S **(08 Marks)**

PART – B

5 a. Define Grashof number and Stanton number. **(04 Marks)**

b. Air at 27°C and 1 atmosphere pressure flows over a heated plate with a velocity of 2 m/s. The plate is at uniform temperature of 60°C. Calculate the heat transfer rate from first 0.2 m of the plate. **(08 Marks)**

c. Air at velocity of 3 m/s and at 20°C flows over a flat plate along its length. The length, width and thickness of the plate are 100 cm, 50 cm and 2 cm respectively. The top surface of the plate is maintained at 100°C. Calculate the heat lost by the plate and temperature of bottom surface of the plate for the steady state conditions. The thermal conductivity of the plate may taken as 23 W/mK. **(08 Marks)**

6 a. Classify heat exchange in three broad classes. **(04 Marks)**

b. Hot engine oil is to be cooled in a double pipe counter flow heat exchanger. The copper tube has a diameter of 2 cm with negligible thickness. The inner diameter of outer tube is 3 cm. The water flow through the inner tube at a rate of 0.5 kg/s and oil flows through the annular space at a rate of 0.8 kg/s. Taking the average temperature of water and oil as 47°C and 80°C respectively. Assume fully developed flow, calculate overall heat transfer coefficient of flow conditions of the heat exchanger. **(12 Marks)**

c. Calculate the overall heat transfer coefficient based on outer surface of a steel pipe K = 54 W/mK with inner and outer diameters as 25 mm and 35 mm respectively. The inside and outside heat transfer coefficients are 1200 W/m^{2}K and 2000 W/m^{2}K respectively. **(04 Marks)**

7 a. Discuss modes of condensation **(04 Marks)**

b. Saturated steam at 90°C and 70 kPa is condensed on outer surface of a 1.5 m long, 2.5 m diameter vertical tube maintained at uniform temperature of 70°C. Assuming film wise condensation, calculate the heat transfer rate on the tube surface. **(08 Marks)**

c. A tube 13 mm in outer diameter and 1.5 m long is used to condense the steam at 40 kPa $(T_{sat} = 76^0 C)$. Calculate the heat transfer coefficient for this tube in : (a) horizontal position (b) vertical position. Take average tube wall temperature as 52°C. **(08 Marks)**

8 a. State and explain Kirchoff's law of radiation. **(02 Marks)**

b. A pipe carrying steam runs in a large room and exposed to air at 30°C. The pipe surface temperature is 200°C. Diameter of the pipe is 20 cm. If the total heat loss per metre length of the pipe is 1.9193 kW/m, determine the emissivity to the pipe surface. **(08 Marks)**

c. In an isothermal enclosure at uniform temperature two small surfaces A and B are placed . The irradiation to the surface by the enclosure is 6200 W/m^2. The absorption rates by the surfaces A and B are 5500 W/m^2 and 620 W/m^2. When steady state is established, calculate the following:

(i) What are the heat fluxes to each surface? What are their temperatures?

(ii) Absorptivity of both surfaces.

(iii) Emissive power of each surface

(iv) Emissivity of each surface. **(10 Marks)**

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10ME64

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018

Finite Element Methods

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Describe the basic steps in the finite element method for engineering analysis in detail. **(06 Marks)**

b. For a 3-D elemental cube, obtain the differential equations of equilibrium subjected to a system of stresses in all the three directions. **(06 Marks)**

c. Distinguish clearly between plane stress and plane strain problems. Also give the constitutive equations (stress-strain equations) for both. **(08 Marks)**

2 a. A cantilever beam of span 'ℓ' is subjected to a uniformly distributed load P_0 over its entire length. The Young's modulus of elasticity of the beam material is 'E' and moment of inertia of the section is 'I'. Derive an equation for deflection by using the Rayleigh-Ritz method. **(12 Marks)**

b. Derive the element stiffness matrix for a two-node one-dimensional bar element using direct approach. **(08 Marks)**

3 a. Sketch and explain Pascal triangle for 2-D polynomials. **(04 Marks)**

b. Derive the strain displacement matrix [B] for a three noded constant strain triangle (CST) element. **(08 Marks)**

c. Derive the Jacobian matrix [J] for a four noded quadrilateral element. **(08 Marks)**

4 a. Explain in detail, 'Elimination approach' to handle boundary conditions. **(10 Marks)**

b. For the three stepped bar shown in Fig.Q4(b), find the nodal displacements, stress in the middle portion and left support reaction.

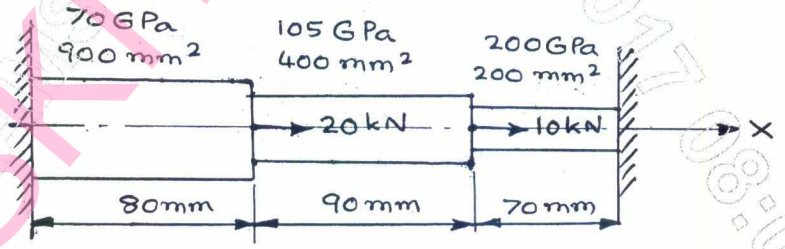


Fig.Q4(b) **(10 Marks)**

PART – B

5 a. Derive the shape functions for a four node 1-D cubic bar element and show the variations of them along the length of the element. **(10 Marks)**

b. Using two point Gaussian quadrature formula evaluate the following integrals:

i) $\int_{-1}^{+1}\int_{-1}^{+1}(r^2+2rs+s^2)dr.ds$ ii) $\int_{0}^{1}x^2.dx$ **(10 Marks)**

6 a. Derive the element stiffness matrix for the truss element. **(08 Marks)**

b. For the two-bar truss shown in Fig.Q6(b), determine the nodal displacement, stress in each element and reaction at the support.
Take $E = 2 \times 10^5$ N/mm^2, area of each bar = $A_e = 200$ mm^2.

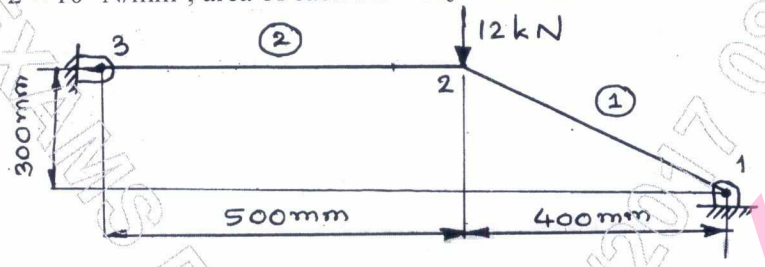


Fig.Q6(b) **(12 Marks)**

7 a. Obtain the shape functions for a 2-node beam element and plot them. **(10 Marks)**

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

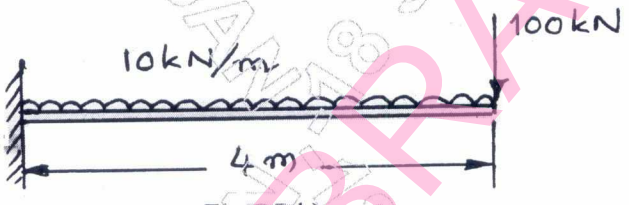
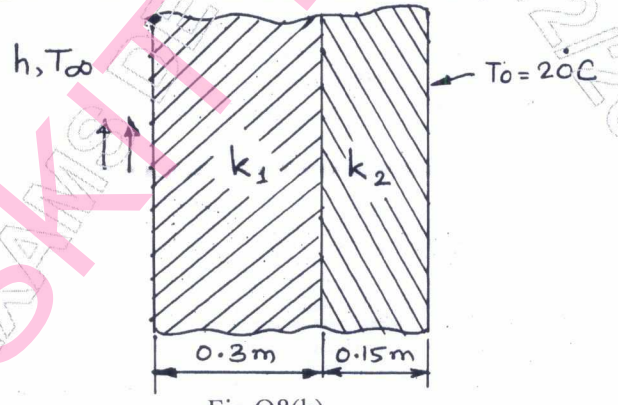


Fig.Q7(b) **(10 Marks)**

8 a. Explain the different types of boundary conditions in heat transfer problems. **(08 Marks)**

b. A composite wall consists of two materials is as shown in Fig.Q8(b). The outer temperature is $T_0 = 20°C$. Convection heat transfer takes place on the inner surface of the wall with $T_\infty = 800°C$ and $h = 25$ W/m^2-°C. Determine the temperature distribution in the wall.



$k_1 = 20$ W/m-°C
$k_2 = 30$ W/m-°C
$h = 25$ W/m^2-°C
$T_\infty = 800°C$

Fig.Q8(b) **(12 Marks)**

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10ME65

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018

Mechatronics and Microprocessor

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define mechatronics. State the major differences between conventional and mechatronic product design approach. **(08 Marks)**

b. What is sequential controller and explain with a block diagram the working of domestic washing machine. **(12 Marks)**

2 a. Explain how sensing is achieved by an incremental optical encoder. **(08 Marks)**

b. Explain the following performance terminologies of transducers:
i) Accuracy ii) Repeatability
iii) Drift iv) Speed of response **(06 Marks)**

c. Explain the principle of operation of Hall effect sensor. **(06 Marks)**

3 a. Differentiate between a diode, thyristor and transistor. **(06 Marks)**

b. Explain the working principle of a permanent magnet D.C. motor. How it is used for positive control drives? **(08 Marks)**

c. Sketch and explain the working of an stepper motor. **(08 Marks)**

4 a. What is the significance of operational amplifier? How it is used in an inverting amplifier circuit? **(10 Marks)**

b. What is multiplexer and de multiplexer? Where they are used? **(06 Marks)**

c. Write a note on digital signal processing. **(04 Marks)**

PART – B

5 a. With the help of a block diagram, explain briefly the general form of a microprocessor system. **(08 Marks)**

b. What are logic gates? Discuss AND and OR gates with their truth tables for two inputs. **(08 Marks)**

c. Write a note on representation of real numbers. **(04 Marks)**

6 a. Explain in detail with a block diagram, the architecture of Intel 8085 A microprocessor. **(10 Marks)**

b. What are micro controllers? Explain the general form of a micro controller. **(10 Marks)**

7 a. Explain the classification of instructions for the Intel's 8085 microprocessor. **(10 Marks)**

b. With a neat flow chart, discuss the programming process. **(10 Marks)**

8 a. Distinguish between instruction cycle, machine cycle and T-state. **(10 Marks)**

b. Draw and explain the timing diagram for opcode fetch operation. **(10 Marks)**

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10ME665

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
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. Distinguish between conventional and non-conventional machining processes. **(04 Marks)**

b. Discuss briefly, how the non-traditional machining processes are classified. **(06 Marks)**

c. Explain different parameters for selecting modern machining processes. **(10 Marks)**

2 a. Explain USM process with a neat diagram. **(08 Marks)**

b. List out advantages and limitations of USM process. **(06 Marks)**

c. Discuss the effects of the following parameters on the rate of material removal and surface finish obtainable in ultrasonic machining
   i) Amplitude and frequency of vibration
   ii) Abrasive grid size
   iii) Static load. **(06 Marks)**

3 a. Explain with a schematic diagram the abrasive jet machining process. **(06 Marks)**

b. Discuss the following variables that influence the metal removal in AJM.
   i) Carrier gas ii) Type of abrasive iii) Standoff distance
   iv) Work material v) Velocity of the abrasive jet. **(10 Marks)**

c. List out advantages of water jet machining process. **(04 Marks)**

4 a. List out different characteristics of an electrolyte to be effective and efficient in ECM process. **(04 Marks)**

b. Explain ECM process with a schematic diagram. **(06 Marks)**

c. Briefly discuss the economics of ECM process. **(05 Marks)**

d. Discuss different applications of ECM. **(05 Marks)**

PART – B

5 a. Explain the following parameters with respect to chemical machining
   i) Resists (Maskants) ii) Etchants. **(10 Marks)**

b. What are the specific advantages of using chemical machining over electro-chemical machining? **(05 Marks)**

c. Give some practical applications of chemical machining. **(05 Marks)**

6 a. Explain the mechanism of metal removal in EDM. **(10 Marks)**

b. Discuss the factors that influence the choice of electrode material in EDM. **(05 Marks)**

c. Discuss the advantages of EDM as compared to other non-traditional methods. **(05 Marks)**

7 a. Explain with a neat sketch the principle process of metal removal in PAM. **(10 Marks)**

b. List out different applications of PAM. **(05 Marks)**

c. Discuss advantages and limitations of PAM process. **(05 Marks)**

8 a. With a neat diagram, explain the process of metal removal by Laser Beam Machining (LBM). **(10 Marks)**

b. Discuss with a neat diagram, Electron Beam Machining (EBM). **(06 Marks)**

c. List out advantages and limitation of LBM process. **(04 Marks)**

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