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10ME62

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016

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 permitted.***
3. ***Missing data, if any, may be suitably assumed.***

PART – A

1 a. A ring is made from a 75mm diameter bar. The inside diameter of the ring is 100mm. For the load shown in figure Q1(a), Calculate the maximum shear stress in the bar and specify its location. **(10 Marks)**

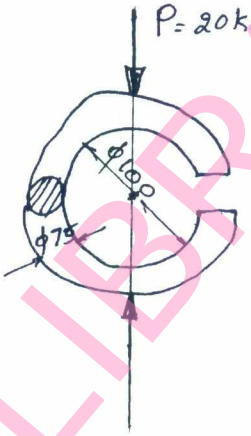

Fig Q1 (a)

b. An engine's chest is covered by a flat rectangular head of 200mm × 300mm dimensions. The plate is made of grey cast iron FG150 with ultimate stress of the material is 150N/mm^2, supported at the edges and subjected to a uniform pressure of 1.5N/mm^2. Determine the thickness of the head for a factor of safety 5. **(10 Marks)**

2 a. A 'V' belt is to be arranged between two shafts whose centers are 3000mm. The driving pulley is of 850mm effective diameter and is to be supplied with 75kW at 960 rpm. The follower pulley is to run at 480rpm. Determine the number of belts required for the following particulars :
Area of belt section – 400mm^2
Weight of belt – 0.01 N/cm^3
Safe working tensile stress – 2.1 N/mm^2
Coefficient of friction – 0.27
Groove angle of pulley - 40°
Also find the initial tension required in each belt. **(12 Marks)**

b. A 20mm 8 × 19 steel wire rope is used with a hoisting drum of 1m diameter to lift a load of 20kN. The depth of mine is 800m and the acceleration is 3m/sec^2. Determine the number of ropes required using a factor of safety 5. Neglect weight of skip. **(08 Marks)**

3 a. Design a valve spring of a petrol engine for the following operating conditions.
Spring load when the valve is open – 400N
Spring load when the valve is closed – 250N
Maximum inside dia of spring – 25mm
Length of spring when the valve is open – 40mm
Length of spring when the valve is closed – 50mm
Maximum permissible shear stress – 400MPa **(10 Marks)**

b. i) Define nipping in the leave springs. **(02 Marks)**
ii) A locomotive spring has an overall length of 1100mm and sustain a load of 75kN at its centre. The spring has 3 full length leaves and 15 graduated leaves with a central band of 100mm. All the leaves are stressed at 0.4 GPa when fully loaded. The ratio of total spring depth to width is 2. Determine
i) Width and thickness of leaves ii) nipping
iii) What load is exerted on the band after the spring is assembled? **(08 Marks)**

4 a. Derive the Lewis equation for the beam strength of a spur gear tooth. Also list the assumptions. **(03 Marks)**

b. A 55kW motor running at 450rpm is geared to a pump by means of a double helical gearing. The forged steel pinion on motor shaft has a PCD of around 200mm and it drives a good grade C.I gear over the pump shaft at 120rpm. The allowable stress for both pinion and gear material should be taken as 224 N/mm^2 and 56 N/mm^2 respectively. Assuming $14\frac{1}{2}^\circ$ form teeth with $\beta = 20^\circ$ and $Z_1 = 24$. Design the gears. **(17 Marks)**

PART – B

5 a. Explain with a sketch, the formative number of teeth of bevel gear. **(06 Marks)**

b. A two teeth right hand worm transmits 2kW at 1500rpm to a 36 teeth wheel. The module of the wheel is 5mm and the pitch diameter of the worm is 60mm. 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. **(14 Marks)**

6 a. A multiple clutch with steel and bronze is to transmit 8kW at 1440rpm. The inner diameter of the contact is 80mm and the outer diameter of contact is 140mm. The clutch plate operates in oil with expected coefficient of friction of 0.1 and allowable pressure of 0.35MPa. Assume uniform wear theory. Determine the number of steel and bronze plates, axial force required, average pressure, actual maximum pressure. **(10 Marks)**

b. A 400mm radius brake drum contacts a single shoe as shown in Fig.Q6(b) and sustains 200N – m toque at 500rpm. For a coefficient of friction 0.25, determine
i) Normal force on the shoe.
ii) Required force F to apply the brake for clockwise rotation.
iii) Required force F to apply the brake for counterclockwise rotation.
iv) The dimension 'C' required to make the brake self locking, assuming the other dimensions remains the same.
v) Heat generated. **(10 Marks)**

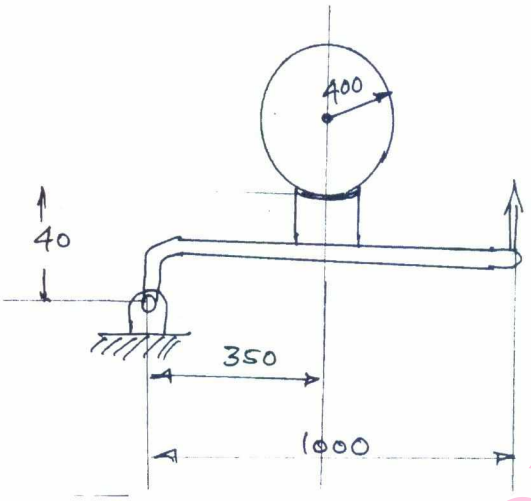

Fig. Q6 (b)

7 a. Explain the following :
   i) Hydrodynamic theory of lubrication.
   ii) Bearing characteristics number and bearing modulus.
   iii) Sommerfield number. **(08 Marks)**

b. A 75mm long full journal bearing of diameter 75mm supports a radial load of 12kN at the shaft speed of 1800 rev/min. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of oil is 0.01 Pas at operating temperature. Determine the following:
   i) Sommerfield number
   ii) The coefficient of friction based on Mckee's equation
   iii) Amount of heat generated
   iv) Power loss due to friction. **(12 Marks)**

8 a. The following data is given for the piston of a four stroke diesel engine:
Cylinder bore – 250mm
Maximum pressure – 4MPa
Bearing pressure at small end of connecting rod = 15MPa
Length of piston pin in bush of small end = 0.45D
Ratio of inner to outer dia of piston pin = 0.6
Mean diameter of piston boss = 1.4 × outer dia of pin
Allowable bending stress for piston pin = 84N/mm^2.
Calculate
   i) Outer dia of the piston pin
   ii) Inner dia of piston pin
   iii) Mean dia of piston boss
   iv) Check for bending stress **(10 Marks)**

b. Determine the dimensions of cross section of the connecting rod for a diesel engine with the following data :
Cylinder bore = 100mm
Length of connecting rod = 350mm
Maximum gas pressure = 4MPa
Factor of safety = 6. **(10 Marks)**

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10ME63

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Heat and Mass Transfer

Time: 3 hrs. Max. Marks:100

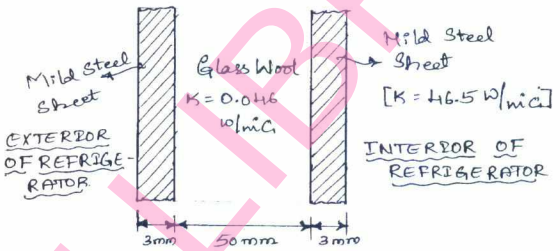
Note: 1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. ***Use of heat transfer data hand book and steam tables are permitted.***

PART - A

1 a. Derive the general 3 – D Heat conduction equation in Cartesian coordinate system and hence obtain Laplace and Poisson equations. **(10 Marks)**

b. The Interior of a Refrigerator having inside dimensions of 0.5 × 0.5m base area and 01 mtr height is to be maintained at 6^0C. The walls of the Refrigerator are constructed of 2 mild steel sheets, three (3mm) thick. [K = 46.5 W/m ^{0}C] with a 50mm of glass wool insulation [K = 0.046W/m ^{0}C] between them. If the Average Heat transfer coefficients at the inner and outer surfaces are 11.6W/m^2 ^{0}C and 14.5W/m^2 ^{0}C respectively.
Calculate : i) The rate at which the heat must be removed from the Interior to maintain the specified temperature in the kitchen at 25^0C and ii) The temperature on the outer surface of the metal sheet. **(10 Marks)**

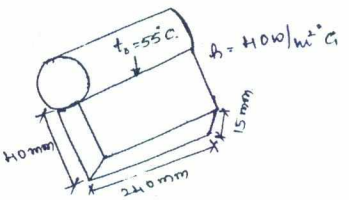
Fig.Q1(b)



2 a. Derive an expression for critical thickness of insulation for a sphere. **(08 Marks)**

b. A motor body is 360mm in diameter (OD) and 240mm long. It's surface temperature should not exceed 55^0C when dissipating 340 watts. Longitudinal fins of 15mm thickness and 40mm height are produced. The convection coefficient is 40W/m^2 ^{0}C. Determine the number of fins required. Assume, the atmospheric temperature is 30^0C for a finite fin. [Fig.Q2(a)]. **(12 Marks)**

Fig.Q2(b)



3 a. Show that the temperature distribution under Lumped analysis is given by,
$\frac{T - T_a}{T_i - T_a} = e^{-B_i F_o}$, where T_i = Initial temperature , T_a = Ambient temperature. **(10 Marks)**

b. A 15mm diameter Mild Steel Sphere (K = 42W/m ^{0}C) is exposed to cooling air flow at 20^0C resulting in the convective coefficient 'h' = 120 W/m^2 ^{0}C. Determine the following :
i) Time required to cool the sphere from 550^0C to 90^0C.
ii) Instantaneous heat transfer rate 2 minutes after start of cooling.
iii) Total energy transferred from the sphere during the first 2 minutes.
For Mild steel take : ρ = 7850 kg/m^3, C_p = 475 J/kg ^{0}C and α = 0.045 m^2/hr. **(10 Marks)**

4 a. Using Buckingham's π – theorem, obtain the relationship between various dimensionless numbers ($N_u = \phi (P_r) (G_r)$ for free convection heat transfer. **(08 Marks)**

b. Air at 20^0C and at a pressure of 1 bar is flowing over a flat plate at a velocity of 3m/sec if the plate is 280 mm wide and 56^0C. Calculate the following quantities at x = 280mm, given that the properties of air at bulk mean temperature = 38^0C are : $\rho = 1.1374$ kg/m^3, $K = 0.02732$ W/m ^{0}C , $C_p = 1.005$ kJ/kg ^{0}K, $\gamma = 16.768 \times 10^{-6}$ m^2/sec , $P_r = 0.7$.
i) Boundary layer thickness ii) Thickness of boundary layer iii) Local convective heat transfer coefficient iv) Average convective heat transfer coefficient v) Rate of heat transfer by convection vi) Total drag force on the plate. **(12 Marks)**

PART - B

5 a. Explain the significance of i) Reynold's number ii) Prandtl number iii) Nusselt number iv) Stanton number. **(10 Marks)**

b. A refrigerated truck is moving on a highway at 90km/hr in a desert area, where the ambient air temperature is 50^0C. The body of the truck is a rectangular box measuring 10mtr (length) × 4m(width) × 3m(height). Assume that the boundary layer on the four walls is turbulent. The heat transfer takes place only from the four surfaces and the wall surfaces of the truck is maintained at 10^0C. Neglecting heat transfer from front and back and assuming flow to be parallel to 10m long side, calculate : i) A heat lost from the four surfaces ii) The power required to overcome the resistance acting on the four surfaces. The properties of air (at $t_f = 30^0$C) are: $\rho = 1.165$kg/m^3 , $C_p = 1.005$ kJ/kg ^{0}C , $K = 0.02673$W/m ^{0}C , $\gamma = 16 \times 10^{-6}$ m^2/S , $P_r = 0.701$. **(10 Marks)**

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

b. 8000 kg/hr of air at 100^0C is cooled by passing it through a single pass cross flow heat exchanger. To what temperature is the air cooled, if water entering a 15^0C flows through the tubes unmixed at the rate of 7500 kg/hr. Take , U = 500kJ/hr – m^2 ^{0}C , A = 20m^2 , C_p of air = 1kJ/kg ^{0}C , C_p of water = 4.2 kJ/kg ^{0}C. [Fig.Q6(a)] **(10 Marks)**

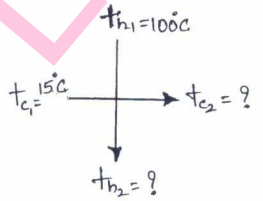


Fig.Q6(a)

7 a. Define i) Pool boiling ii) Forced convection boiling iii) Sub cooled iv) Local boiling iv) Saturated boiling. **(08 Marks)**

b. Explain Fick's law of diffusion. **(04 Marks)**

c. A vertical tube (Taking Experimental value) of 60mm OD and 1.2mtr long is exposed to steam at atmospheric pressure. The outer surface of the tube is maintained at a temperature of 50^0C by circulating cold water through the tubes. Calculate i) Rate of heat transfer to the coolant ii) The rate of condensation of steam. Assuming the condensation film is Laminor and TPP of water at 75^0C are: $\rho_L = 975$ kg/m^3, $\mu_L = 375 \times 10^{-6}$ N-S/m^2 , $K = 0.67$W/m^0 C. The properties of saturated vapor $t_{sat} = 100^0$C , $\rho_v = 0.596$ kg/m^3, $h_{fg} = 2257$kJ/kg. **(08 Marks)**

8 a. For a Black body enclosed in a hemispherical space, show that emissive power of Black body is π times the Intensity of Radiation. **(08 Marks)**

b. State and explain i) Kirchoff's law ii) Planck's law iii) Wein's displacement law iv) Lambert's cosine law. **(08 Marks)**

c. Explain briefly the concept of a Blackbody. **(04 Marks)**

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10ME64

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Finite Element Method

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What is Finite Element Method (FEM)? Explain the steps involved in FEM. **(10 Marks)**

b. Differentiate between plane stress and plane strain problems. Also state the stress strain relations for both. **(10 Marks)**

2 a. State the principle of minimum potential energy and apply the same to determine nodal displacement of a spring system shown in Fig Q.2(a) **(10 Marks)**

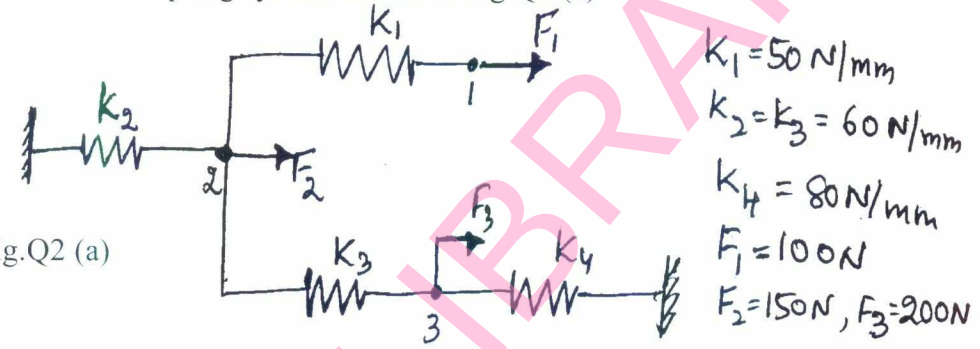

Fig.Q2 (a)

b. Using Rayleigh's – Ritz method, derive an expression for maximum deflection of the simply supported beam with point load 'p' at centre. **(10 Marks)**

3 a. Derive the shape function for triangular element (CST Element) in natural co-ordinate system. **(10 Marks)**

b. Derive an expression for Jacobean matrix for a four noded quadrilateral element. **(10 Marks)**

4 a. A stepped bar is shown in Fig. 4(a).
Determine i) The nodal displacement and nodal forces
ii) The stresses in each element
iii) The principal and shear stress in each element. **(10 Marks)**

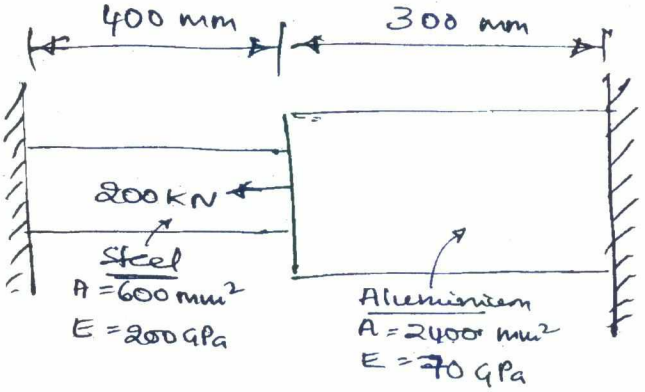

Fig.Q4 (a)

b. Solve the following system of equations by Gauss Elimination method.

$x_1 + x_2 + x_3 = 6$

$x_1 - x_2 + 2x_3 = 5$

$x_1 + 2x_2 - x_3 = 2$ **(10 Marks)**

PART – B

5 a. Derive the shape function for a quadratic bar element using Lagrange's interpolation. **(10 Marks)**

b. Evaluate $\int_{-1}^{+1} \left[3e^x + x^2 + \frac{1}{(x+2)} \right] dx$

Using one – point and two – point Gauss quadrature. **(10 Marks)**

6 a. Derive the stiffness matrix for truss element. **(10 Marks)**

b. For the two bar truss shown in Fig.6 (b), determine the nodal displacements. Assume E = 200GPa, A = $6 \times 10^{-4} m^2$ **(10 Marks)**

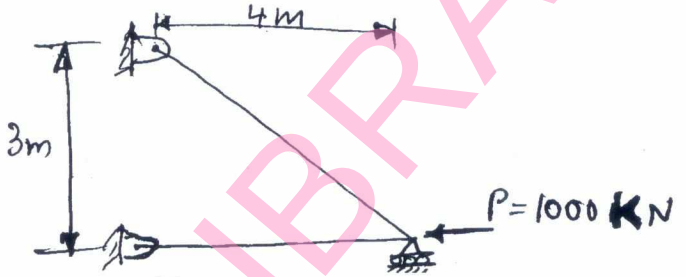

Fig.Q6 (b)

7 a. Derive the Hermite shape functions for a beam element. **(10 Marks)**

b. For the beam fixed at both ends and loaded as shown in Fig.Q7(b). Determine the displacement and shapes at node 2, and reaction forces at node 1 only. **(10 Marks)**

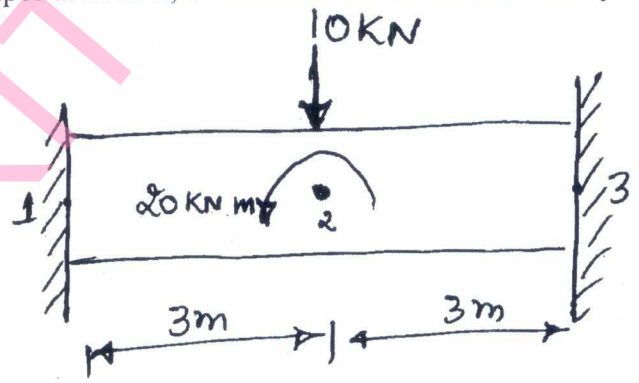

Fig.Q7 (b)

8 a. Derive element conductivity matrix for one dimensional heat flow element. **(10 Marks)**

b. 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 = 50W/m K. Use two elements. **(10 Marks)**

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10ME65

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.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. Define mechatronics. What are the advantages and disadvantages of mechatronics? **(05 Marks)**
b. Explain with a block diagram the working of a digital camera. **(10 Marks)**
c. Discuss basic elements of a closed-loop system. **(05 Marks)**

2 a. Explain static and dynamic characteristics of sensors. **(08 Marks)**
b. Explain working principle of Hall effect sensor. **(06 Marks)**
c. Define following terms:
i) Hysteresis error
ii) Repeatability
iii) Non-linearity error **(06 Marks)**

3 a. Discuss any four solid state switches. **(10 Marks)**
b. What is stepper motor? Explain various types of stepper motor. **(10 Marks)**

4 a. Explain inverting and non-inverting op-amps with a neat sketch. **(10 Marks)**
b. With a neat sketch, discuss basic elements used in analog to digital converter. **(10 Marks)**

PART – B

5 a. State and prove De-Morgan's theorem. Also draw the logic circuit for the same. **(08 Marks)**
b. Explain any six laws of Boolean algebra. **(06 Marks)**
c. With the help of symbols and truth table, explain XOR and NAND gate. **(06 Marks)**

6 a. What are the differences between microprocessors and microcontrollers? **(04 Marks)**
b. Explain with a neat sketch of architecture 8085 microprocessor. **(10 Marks)**
c. Explain the following terminology related to microprocessor:
i) Interrupts
ii) RAM
iii) Assembler **(06 Marks)**

7 a. Discuss classification of instruction sets of 8085 microprocessor. **(10 Marks)**
b. What are buses? Explain types of buses. **(08 Marks)**
c. List any four applications of microprocessor. **(02 Marks)**

8 a. Explain with a neat diagram of the flow of data word and instrumentation word. **(10 Marks)**
b. Draw and explain timing diagram for memory write operation. **(10 Marks)**

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10ME665

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Non – Traditional Machining

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain the basic needs of modern machining process. **(04 Marks)**

b. Compare the conventional machining with non – traditional machining process. **(06 Marks)**

c. With the aid of a neat sketch, explain briefly the principle of ultrasonic machining. **(10 Marks)**

2 a. Explain different feed mechanisms used in USM. **(08 Marks)**

b. A drill is required to be made in 5mm thick tungsten carbide sheet. The slurry is made of 1 part of 320 grit (15 micron radius) boron carbide mixed with 1¼ part of H_2O. The static stress is 1.4 kg/cm^2 and the amplitude of tool oscillation is 0.025mm. The machine operates at 25000 cycles/sec. The compression fracture strength of tungsten carbide is 225kg/mm^2. Calculate the time required to perform drilling. Assume that only one pulse out of 10 pulses are effective. **(08 Marks)**

c. Write a note on Abrasive slurry in USM. **(04 Marks)**

3 a. Briefly explain the Abrasive jet machining, with a neat schematic sketch. **(06 Marks)**

b. List and explain the parameters that influence in Abrasive jet machining. **(10 Marks)**

c. Define mixing ratio in AJM. Explain its effect on MRR. **(04 Marks)**

4 a. Give the classification of Electro – chemical machining methods. **(04 Marks)**

b. Describe the working principle of Electro – chemical grinding. **(08 Marks)**

c. In ECM process machining of iron using copper tool and saturated solution of NaCℓ in H_2O as Electrolyte, the Electrode area is 2cm × 2cm. The initial gap for Electrolyte to pass is 0.02cm. For Electrolyte specific heat is 0.997 cal/gram ^{0}C, density is 1gm/cm^3 and specific resistance is 3 ohm – cm.

i) Calculate the permissible fluid flow velocity if the maximum permissible temperature of Electrolyte is 95^{0}C at boiling. The ambient temperature is 25^{0}C and applied voltage is 10V.

ii) Calculate maximum MRR if the permissible current density has been 150 amp/cm^2. **(08 Marks)**

PART – B

5 a. What are the factors that influence in the selection of maskants? Explain the various types of maskants used in chemical milling. **(10 Marks)**

b. Differentiate between chemical milling and chemical blanking. **(04 Marks)**

c. Write a note on 'Etchants' in chemical milling. **(06 Marks)**

6 a. With neat sketch, explain the mechanism of metal removal in EDM. **(07 Marks)**

b. What is dielectric fluids? Enlist the basic requirements of an dielectric fluids in EDM. **(07 Marks)**

c. Explain flushing and explain any two methods of flushing in EDM process. **(06 Marks)**

7 a. Briefly explain plasma arc machining, with neat schematic sketch. **(06 Marks)**

b. Explain the parameters that govern the performance of PAM and discuss the guidelines for designing the torch. **(10 Marks)**

c. Mention the advantages and disadvantages of PAM process. **(04 Marks)**

8 a. With a neat sketch, explain the mechanism of metal removal in laser beam machining. **(10 Marks)**

b. With a neat sketch, explain electron beam machining and enlist its process parameters. **(10 Marks)**

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