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06ME61

Sixth Semester B.E. Degree Examination, Dec.09/Jan.10
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.***

Important Note: 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8=50, will be treated as malpractice.

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Part – A

1 a. Determine the maximum stress induced in a ring cross section of 50 mm diameter rod subjected to a compressive load of 20 kN. The mean diameter of the ring is 100 mm. **(10 Marks)**

b. A cast iron cylinder of internal diameter 200 mm and thickness 50 mm is subjected to a pressure of 5 N/mm^2. Calculate the tangential and radial stresses at the inner, middle and outer surface. **(10 Marks)**

2 a. A railway wagon weighing 40 kN and moving with a speed of 10 km/hour has to be stopped by four buffer springs in which the maximum compression allowed is 200 mm. Find the number of turns in each spring of mean diameter 150 mm. The diameter of spring wire is 25 mm. Take $G = 82.7 \times 10^3$ MN/m^2. **(10 Marks)**

b. A multi-leaf spring with camber is fitted to the chasis of a automobile over a span of 1.2 meter to absorb shocks due to a maximum load of 20 kN. The spring material can sustain a maximum stress of 0.4 GPa. All the leaves of the spring were to receive the same stress. The spring should have at least 2 full length leaves out of 8 leaves. The leaves are assembled with bolts over a span of 150 mm width at the middle. Design the spring for a maximum deflection of 50 mm. **(10 Marks)**

3 Design a pair of spur gears to transmit 20 kW from a shaft rotating at 1000 rpm to a parallel shaft which is to rotate at 310 rpm. Assume number of teeth on pinion 31 and 20° full depth tooth form. **(20 Marks)**

4 Design a pair of helical gears to transmit power of 15 kW at 3200 rpm with speed reduction 4 : 1 pinion is made of cast steel 0.4% C-untreated. Gear made of high grade CI Helix angle is limited to 26° and not less than 20 teeth are to be used on either gear. Check the gears for dynamic and wear considerations. **(20 Marks)**

Part – B

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

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

i) Find the centre distance, the lead and the lead angle.

ii) Determine the forces. **(10 Marks)**

6 a. A single plate friction clutch of both sides effective has 0.3 m outer diameter and 0.16 m inside diameter. The co-efficient of friction is 0.2 and it runs at 1000 rpm. Find the power transmitted for uniform wear and uniform pressure distribution cases if the allowable maximum pressure is 0.08 MPa. **(10 Marks)**

b. In a simple band brake, the length of lever is 440 mm. The tight end of the band is attached to the fulcrum of the lever and the slack end to a pin 50 mm from the fulcrum. The diameter of the brake drum is 1 m and arc of contact is 300°. The co-efficient of friction between the band and the drum is 0.35. The brake drum is attached to a hoisting drum of diameter 0.65 m that sustains a load of 20 kN. Determine

i) Force required at the end of lever to just support the load.

ii) Width of steel band if the tensile stress is limited to 50 N/mm^2. **(10 Marks)**

7 a. Derive Petroff's equation, with usual notations. **(10 Marks)**

b. A lightly loaded bearing of 70 mm long and 70 mm in diameter is acted on by 1.5 kN radial load. The radial clearance is 0.07 mm and the journal is rotating at 25000 rpm. The viscosity of the oil is 3.45×10^{-3} pa.s. Determine frictional power loss using Petroff's equation. **(10 Marks)**

8 a. A compressor is driven by 900 rpm motor by means of 250 mm×10 mm flat belt. The motor pulley is 0.3 m in diameter and the compressor pulley is 1.5 m diameter. The distance between the centres of the pulleys is 2 m. A jockey pulley is used to make the angle of wrap on the smaller pulley 220° and the larger pulley 270°. The coefficient of friction between the belt and the smaller pulley is 0.3 and between the belt and the larger pulley is 0.22. The maximum allowable belt stress is 2 MN/m^2 and the specific weight of the belt material is 9.515 kN/m^3. Determine the power that can be transmitted by the belt drive. **(10 Marks)**

b. A compressor requiring 90 kW is to run at 250 rpm. The drive is by V-belt from an electric motor running at 750 rpm. The diameter of the pulley on the compressor shaft is 1 m, while the center distance between the pulleys is limited to 1.75 m. The belt speed should not exceed 1600 m/min. Determine the number of V-belts required to transmit the power if each belt has a cross sectional area of 375 mm^2 and density of 1 Mg/m^3 and has an allowable stress of 2.5 N/mm^2. The groove angle of the pulley is 35° and the coefficient of friction between the belt and the pulley is 0.25. **(10 Marks)**

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06ME62

Sixth Semester B.E. Degree Examination, Dec.09/Jan.10
Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions.*
2. Assume suitable data if necessary.

Important Note: 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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1 a. Define the following terms :
i) Simple harmonic motion ; ii) Resonance ; iii) Degree of freedom. **(06 Marks)**

b. Add the following motion analytically and find the amplitude and phase angle.
x1 = 2 Cos (wt + 0.5)
x2 = 5 Sin (wt + 1.0) **(06 Marks)**

c. Find the time period of vibration of a compound pendulum, shown in Fig.1(c). **(08 Marks)**

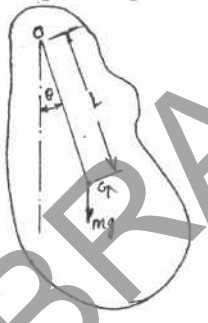


Fig.1(c)

2 a. Define "Logarithmic decrement" and show that it can be expressed as $\delta = \frac{1}{n} \ln \left(\frac{x_o}{x_n} \right)$ where
n is the number of cycles
x_o initial amplitude
x_n amplitude after 'n' cycles. **(08 Marks)**

b. A cylinder of mean 'M' and radius 'r' rolls without slipping on a cylindrical surface of radius 'R' as shown in Fig.2(b). Find the natural frequency for small oscillations about the lowest point. **(12 Marks)**

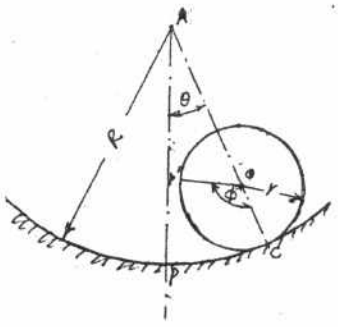


Fig.2(b)

3 a. Define the term "Transmissibility". Derive the expression for 'Motion transmissibility'. **(08 Marks)**

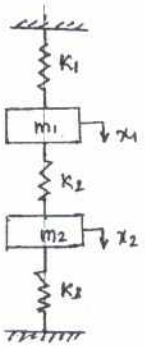
b. A 75 kg machine is mounted on springs of stiffness K = 11.76 x 10^5N/m with an assumed damping factor of $\xi = 0.2$. A 2kg piston within the machine has a reciprocating motion with a stroke of 0.08m and a speed of 300 c.p.m. Assuming the motion of the piston to the harmonic, determine the amplitude of vibration of the machine and the vibration force transmitted to the foundation. **(12 Marks)**

4 a. Discuss the basic principle on which vibration measuring instruments are designed. What are their practical limitations? **(08 Marks)**

b. A disc of mass 4kg is mounted midway between bearings which may be assumed to be simple supports. The bearing span is 480mm. The steel shaft, which is horizontal is 9mm in diameter. The CG of the disc is displaced 3mm form the geometric centre. The equivalent viscous damping at the centre of the disc-shaft may be taken as 49 N sec/m. If the shaft rotates at 760 rpm, find the maximum stress in the shaft and compare it with dead load stress in the shaft. Also, find the power required to drive the shaft at this speed. **(12 Marks)**

5 a. Set up the differential equation of motion for the system shown in Fig.5(a) and hence derive the frequency equation and obtain the two natural frequencies of the system. Sketch the mode shapes. **(12 Marks)**

Fig.5(a)



b. A section of pipe pertaining to a certain machine vibrates with large amplitude at a compressor speed of 220 rpm. For analyzing this system, a spring – mass system was suspended from the pipe to act as an absorber. A 1kg absorber mass tuned to 220 cpm resulted in two resonant frequencies of 188 and 258 cpm. What must be the mass and the spring stiffness of the absorber, if the resonant frequencies are to lie outside the range of 150 and 310 cpm? **(08 Marks)**

6 a. Show that the differential equation of motion for the transverse vibration for simply supported beam of uniform cross nation is given by $\frac{\partial^2 y}{\partial t^2} + a^2 \frac{\partial^4 y}{\partial x^4} = 0$. **(12 Marks)**

b. Write notes on:
i) Longitudinal vibration of bars ; ii) Torsional vibration of circular shaft. **(08 Marks)**

7 For a three degree of freedom system shown in Fig.7, find the lowest natural frequency by Stodola's method. **(20 Marks)**

8 Calculate all the natural frequencies of a three rotor system shown in Fig.8 by Holzer's method.
Take $J_1 = J_2 = J_3 = 1$ and
$Kt_1 = Kt_2 = 1$ **(20 Marks)**

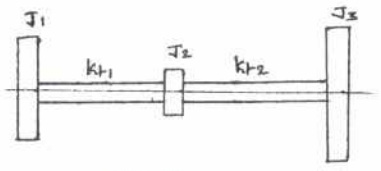


Fig.8

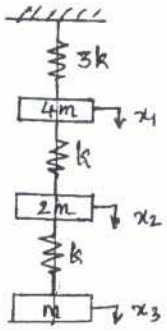


Fig.7

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06ME63

Sixth Semester BE Degree Examination, Dec.09-Jan.10
Modeling and Finite Element Analysis

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Solve the following system of simultaneous equations by Gaussian elimination method.
$x_1 - 2x_2 + 6x_3 = 0$
$2x_1 + 2x_2 + 3x_3 = 3$
$-x_1 + 3x_2 = 2$ **(10 Marks)**

b. Determine the deflection of a cantilever beam of length L and loaded with a vertical load P at the free end by Rayleigh – Ritz method. Use a trial function $y = a\left(1 - \text{Cos}\left(\frac{\pi x}{2L}\right)\right)$. **(10 Marks)**

2 a. Using Potential – energy approach, obtain the element stiffness matrix for a 1D bar element. **(10 Marks)**

b. i) What is symmetric banded matrix? **(05 Marks)**
ii) With an example, explain node numbering and element connectivity for a 1D bar. **(05 Marks)**

3 a. Explain simplex, complex and multiplex elements. **(10 Marks)**

b. What are interpolation functions? Explain 2D Pascal triangle. **(10 Marks)**

4 a. Derive the Hermit shape function for a 2 noded beam element. **(10 Marks)**

b. Derive the shape function for a 3 noded triangular element. **(10 Marks)**

PART – B

5 a. Derive an expression for stiffness matrix for a 2-D truss element. **(10 Marks)**

b. For a four noded quadrilateral element, derive an expression for Jacobian matrix. **(10 Marks)**

6 a. Derive $[B_T]$ for a two noded one dimensional heat element (conduction). **(10 Marks)**

b. For a one dimensional thin fin, when the base of the fin is held at T_o and the tip of the fin insulated (heat going out of the tip is negligible), obtain the element matrices by using Galerkin approach. **(10 Marks)**

7 Consider the bar shown in figure. An axial load $P = 200 \times 10^3$N is applied as shown. Using the penalty approach for handling boundary conditions, do the following:

a. Determine the nodal displacements.

b. Determine the stress in each material.

c. Determine the reaction forces.

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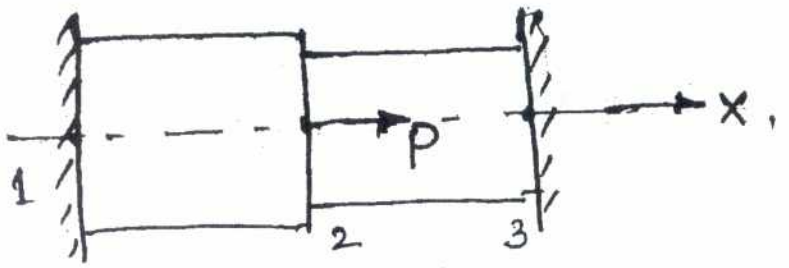

(i) Aluminum (ii) Steel

$A_1 = 2400mm^2$ $A_2 = 600mm^2$

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

Fig.7

(20 Marks)

8 For the beam and loading shown in figure 8, determine:

i) Slopes at 2 and 3.

ii) The vertical deflection at the midpoint of the distributed load.

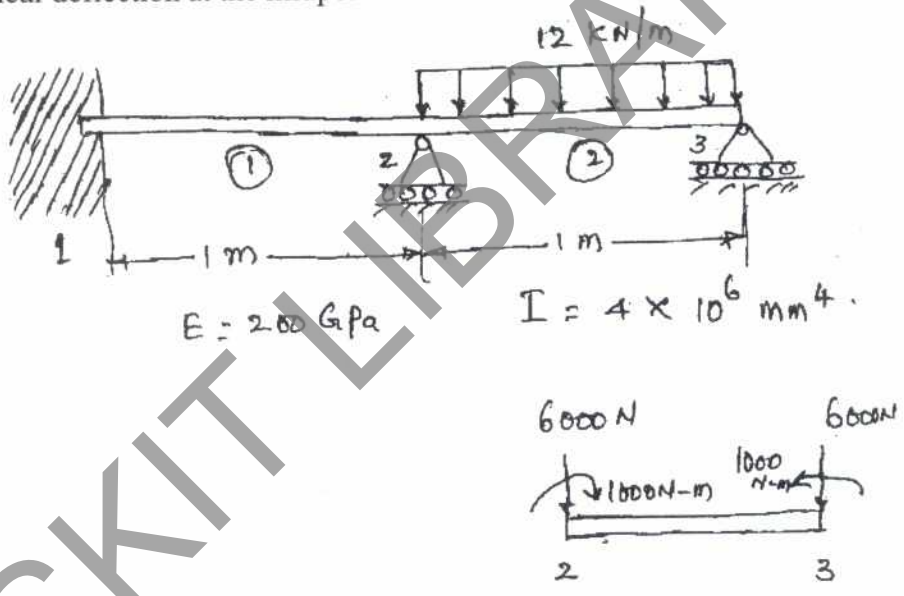

Fig.8

(20 Marks)

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06ME64

Sixth Semester B.E. Degree Examination, Dec.09/Jan.10
Mechatronics and Microprocessors

Time: 3 hrs. Max. Marks:100

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

Part – A

1 a. With a block diagram, briefly explain the generalized measurement system. **(05 Marks)**

b. State the functions of basic elements of a closed loop control system with a block diagram. **(08 Marks)**

c. Define microprocessor-based controllers. Explain with a block diagram, the working of an engine management system. **(07 Marks)**

2 a. Define : i) Sensor ii) Transducer and name three types of sensors and transducers each. **(05 Marks)**

b. State the principle of working and applications of hall effect sensor with a sketch. **(08 Marks)**

c. Explain light sensors and state six selection factors. **(07 Marks)**

3 a. With a sketch explain solenoid and state its uses. **(05 Marks)**

b. List the solid state switches and explain the two forms of a bipolar transistor. **(08 Marks)**

c. What are stepper motors? Explain with a neat sketch, the principle of working of a variable reluctance stepper motor. **(07 Marks)**

4 a. Briefly explain the different processes of signal conditioning. **(05 Marks)**

b. Explain ADC with signals. **(08 Marks)**

c. What is meant by data acquisition? Explain DAQ system. **(07 Marks)**

Part – B

5 a. Draw the formal structure of a microprocessor based system and state the functions of each element. **(05 Marks)**

b. With truth table, explain OR gate and AND gate. **(08 Marks)**

c. State in brief most widely used number system in computer. i) Convert the decimal number 45 to its binary equivalent. ii) Convert the binary system 10011 to its decimal number. **(07 Marks)**

6 a. What are microcontrollers? Distinguish between a microprocessor and a micro controller. **(05 Marks)**

b. List and explain the four forms of a memory unit. **(08 Marks)**

c. Define the following: i) Fetch cycle ii) ALU iii) BUS iv) Interrupt. **(07 Marks)**

7 a. Draw the functional block diagram of the intel 8085A microprocessor. **(05 Marks)**

b. Explain the following: i) Program counter register ii) Instruction register iii) Stack paint register iv) Status register **(08 Marks)**

c. Describe the instruction set of a 8085 microprocessor. **(07 Marks)**

8 a. Define CPU and state its functions. **(05 Marks)**

b. How the instructions and data flow occurs? **(08 Marks)**

c. Define the following: i) System clock ii) System clock frequency iii) Clock period iv) clock cycle v) Memory access time vi) System timing **(07 Marks)**

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06ME65

Sixth Semester BE Degree Examination, Dec.09-Jan.10
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 transfer data hand book permitted.

Important Note: 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8=50, will be treated as malpractice.

PART – A

1 a. State the assumptions and derive general 3 – dimensional heat conduction equation in Cartesian co-ordinates. **(08 Marks)**

b. Two bodies of thermal conductivity K_1 and K_2 are brought into thermal contact. Neglect the thermal contact resistance. Formulate this as steady – state, one – dimensional, no heat generation problem. **(04 Marks)**

c. A wall of a furnace is made up of inside layer of silica brick 120mm thick covered with a layer of magnesite brick 240 mm thick. The temperatures at the inside surface of silica brick wall and outside surface of magnesite brick wall are 725°C and 110°C respectively. The contact thermal resistance between the two walls at the interface is 0.0035°C/w per unit wall area. If thermal conductivities of silica and magnesite bricks are 1.7w/m°c and 5.8w/m°c, Calculate : i) The rate of heat loss unit area of walls and
ii) The temperature drop at the interface. **(08 Marks)**

2 a. Design critical thickness of insulation and derive an expression for critical thickness of insulation for a cylinder. **(10 Marks)**

b. A wire of 6.5 mm diameter at a temperature of 60°C is to be insulated by a material having K = 0.174 w/m°c. Convection heat transfer coefficient = 8.722 w/m^{2}°c. The ambient temperature is 20°C. For maximum heat loss, what is the minimum thickness of insulation and heat loss per metre length? Also find percentage increase in heat dissipation. **(10 Marks)**

3 a. What are Biot and Fourier numbers? Explain their physical significance. **(06 Marks)**

b. What are Heisler charts? Explain their significance in solving transient conduction problems. **(06 Marks)**

c. A 12cm diameter long bar initially at a uniform temperature of 40°C is placed in a medium at 650°C with a convective coefficient of 22 w/m^2k.Calculate the time required for the bar to reach 255°C
Take K = 20 w/mk, ρ = 580 kg/m^3 and c = 1050 J/kgk. **(08 Marks)**

4 a. Briefly explain:
i) Hydrodynamic boundary layer ii) Thermal boundary layer. **(06 Marks)**

b. Define:
i) Nusselt number ii) Prandtl number
iii) Stanton number iv) Grashof number. **(04 Marks)**

c. A square plate (0.5m x 0.5m) with one surface insulated and the other surface maintained at temperature of 385K is placed in ambient air at a temperature of 315K. Calculate the average heat transfer coefficient for free convection for the following orientations of the hot surface:
i) The plate is horizontal and hot surface faces up.
ii) The plate is horizontal and the hot surface faces down. **(10 Marks)**

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PART – B

5 a. Using dimensional analysis, obtain the dimensionless parameters in forced convection heat transfer. **(10 Marks)**

b. Water at a velocity of 1.5 m/s enters a 2cm diameter heat exchanger tube at 40°C. The heat exchanger tube wall is maintained at a temperature of 100°C. If the water is heated to a temperature of 80°C in the heat exchanger tube, find the length of the exchanger tube required. **(10 Marks)**

6 a. Define LMTD and obtain an expression for LMTD for parallel flow heat exchanger. **(10 Marks)**

b. The flow rate of hot and cold flux streams running through a parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficients on both sides are 650 w/m^{2}c, calculate the area of heat transfer. **(10 Marks)**

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

b. Saturated water at T_{sat} =100°C is boiled inside a copper pan having a heating surface area 5 x 10^{-2}m^2 which is maintained at uniform surface temperature T_s = 110°C. Calculate :

i) The surface heat flux (q)

ii) The rate of evaporation (m). **(08 Marks)**

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

8 a. State and explain the following:

i) Stefan – Boltzman law.

ii) Kirchoff's law.

iii) Planck's law

iv) Wien's displacement law

v) Lambert's cosine law. **(10 Marks)**

b. For a black body enclosed in a hemispherical space, prove that emissive power of the black body is π times the intensity of radiation. **(10 Marks)**

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06ME665

Sixth Semester B.E. Degree Examination, Dec.09/Jan.10
Non Traditional Machining

Time: 3 hrs. Max. Marks:100

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

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Part – A

1 a. Differentiate between conventional and non-conventional machining processes. **(07 Marks)**

b. Classify the non-conventional machining process on the basis of mechanism of metal removal, Transfer media, Type of energy and energy source. **(07 Marks)**

c. What are the advantages of non-conventional machining process over conventional machining process? **(06 Marks)**

2 a. What is ultrasonic machining? Explain the ultrasonic machining process with schematic diagram. **(07 Marks)**

b. Explain the effects of parameters of ultrasonic machining on metal removal rate. **(07 Marks)**

c. Explain some applications of ultrasonic machining. **(06 Marks)**

3 a. Explain the abrasive jet machining, with schematic diagram. **(07 Marks)**

b. Explain the variables that influence the rate of metal removal and accuracy of machining. **(07 Marks)**

c. What is mean number of abrasive grains per unit volume of the carrier gas? **(06 Marks)**

4 a. What is Michael Faraday's law? How is this law implemented for electrochemical machining process? Explain. **(07 Marks)**

b. What are the essential properties of electrolyte for electrochemical machining process? **(07 Marks)**

c. What is insulation to the ECM tool? Why is it required? Explain. **(06 Marks)**

Part – B

5 a. What are the elements of chemical machining process? Explain. **(07 Marks)**

b. What are the factors, which affect the selection of an etchant for a given component? **(07 Marks)**

c. Enumerate the advantages and applications of chemical machining. **(06 Marks)**

6 a. What is Electric Discharge Machining (EDM)? Explain the mechanism of metal removal. **(07 Marks)**

b. Explain the elementary relaxation circuit for EDM. **(07 Marks)**

c. Indicate and explain the parameters that govern the metal removal rate. **(06 Marks)**

7 a. What is PLASMA arc machining? Explain mechanism of metal removal. **(07 Marks)**

b. Explain the PAM parameters that govern the performance. **(07 Marks)**

c. Explain the applications of plasma jets. **(06 Marks)**

8 a. Explain the generation and control of electron beam with schematic diagram. **(07 Marks)**

b. What is Laser? Discuss thermal features of laser machining. **(07 Marks)**

c. What are the limitations of laser machining? **(06 Marks)**

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