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06ME61

# Sixth Semester B.E. Degree Examination, December 2012
# 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 design data handbook is permitted.***
**3.** ***Missing data may be suitably assumed.***



## PART – A

1 a. Differentiate between a straight beam and a curved beam. **(04 Marks)**

b. Compute the combined stresses at the inner and outer fibres in the critical cross section of a crane hook which is required to lift loads upto 25 kN. The hook has trapezoidal cross section with parallel sides 60 mm and 30 mm, the distance between them being 90 mm. The inner radius of the hook is 100 mm. The load line is nearer to the inner surface of the hook by 25 mm than the centre of curvature at the critical section. What will be the stresses at the inner and outer fibre, if the beam is treated as straight beam for the given load? **(16 Marks)**

2 a. A cast iron cylindrical pipe of outside diameter 300 mm and inside diameter 200 mm is subjected to an internal fluid pressure of 20 $N/mm^2$ and external fluid pressure of 5 $N/mm^2$. Determine the tangential and radial stresses at the inner, middle and outer surface. Sketch the tangential and radial stress distribution across its thickness. **(10 Marks)**

b. A cylinder is provided with a heat of flat circular steel plate of 500 mm diameter and is supported around the edge. It is subjected to a uniform pressure of 5 $N/mm^2$. The allowable working stress for the material is 70 $N/mm^2$ and Poisson's ratio is 0.3. Determine the i) Thickness of thick cylinder wall and ii) Thickness of the circular flat cylinder head. **(10 Marks)**

3 a. Derive an expression for strain energy stored in a body when the load is applied gradually. **(05 Marks)**

b. A railway wagon weighing 40 kN and moving with a speed of 10 km/hour has to be stopped by 4 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 GPa. **(08 Marks)**

c. A truck spring has 12 leaves of which 2 are full length leaves. The spring supports are 1.05 m apart and the central band is 85 mm wide. The central load is to be 5400 N with a permissible stress of 0.28 GPa. The ratio of total depth to width of spring is 4. Assume E = 210 GPa. Determine the maximum deflection in the spring. **(07 Marks)**

4 a. Two spur gears are to be used for a rock crusher drive and are to be of minimum size. The gears are to be designed for the following requirements. Power to be transmitted is 20 kW; speed of pinion is 1200 rpm, velocity ratio is 3.5 : 1; tooth profile 20° stub involute. Determine module and face width for strength requirements only. **(10 Marks)**

b. A pair of mating helical gears have 20° pressure angle in the normal plane. The normal module is 5 mm and the module in the diametral plane is 5.7735 mm. The pitch diameter of the smaller gear is 115.47 mm. If the transmission ratio is 4:1, calculate i) Helix angle ii) Normal pitch iii) Transverse pitch iv) Number of teeth for each gear v) Addendum vi) Dedandum vii) Whole depth viii) Clearance ix) Tooth thickness x) Working depth xi) Outside diameters xii) Centre distance xiii) Root circle diameters xiv) Base circle diameters. **(10 Marks)**

## PART – B

5 a. A pair of mitre gears have pitch diameter 280 mm and face width of 36 mm and run at 250 rpm. The teeth are of $14\frac{1}{2}^{\circ}$ involute and accurately cut and transmit 6 kW. Neglecting friction angle, find the following: i) Outside diameter of gears ii) Resultant tooth load tangent to pitch cone. iii) Radial load on the pinion iv) Thrust on the pinion. Assume low carbon cast steel 0.2%C heat treated as the material for both the gears. **(10 Marks)**

b. The following data refer to a worm and worm gear drive: i) centre distance = 200 mm ii) pitch circle diameter of the worm = 80 mm iii) Number of start = 4 iv) Axial module = 8 mm v) transmission ratio = 20 vi) the worm gear is made of phosphor bronze with an allowable bending stress = 55 MPa vii) the worm is made of hardened and ground steel viii) tooth form is 20° full depth involute. Determine i) Number of teeth on the worm gear ii) lead angle iii) face width of worm gear to 15 kW of power at 1750 rpm of the worm based on beam strength of the worm gear. **(10 Marks)**

6 a. In a multiple disc clutch, the radial width of the friction material is to be 0.2 of the maximum radius. The coefficient of friction is 0.250. The clutch is to transmit 60 kW at 3000 rpm. Its maximum diameter is 250 mm and the axial force is limited to 600 N. Determine i) Number of driving and driven discs ii) Mean unit pressure on each contact surface. Assume uniform wear. **(10 Marks)**

b. In a band and block brake $\theta = 15°$ and effective diameter is 800 mm. P = 0.4, a = 100 mm, b = 25 mm. The power absorbed at 600 rpm is 450 kW when the force applied at the end of levels at a distance of 1.20 m from the fulcrum is 200 N. Find the number of blocks. **(10 Marks)**

7 a. Explain the meaning of, i) Oiliness ii) Flash point iii) Fire point iv) Pour point v) Cloud point. **(05 Marks)**

b. Write a note bearing modulus. **(05 Marks)**

c. A 75 mm journal bearing of diameters 75 mm supports a load of 15 kN. The ratio of $\frac{d}{c} = 1000$ and the viscosity of the oil is $25 \times 10^{-3}$ PaS. The heat generated in the bearing is 442 watts. Determine the maximum speed of the journal using Mckee's equation. **(10 Marks)**

8 a. A nylon core flat belt 200 mm wide weighing 20 N/m, connected 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/s : i) Calculate the belt length and the angles of wrap ii) Compute the belt tensions based on a coefficient of friction 0.38. **(10 Marks)**

b. A compressor is driven by a motor of 2.5 kW running at 1200 rpm to a 400 rpm compressor. Select a suitable V-belt. **(10 Marks)**

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06ME62

# Sixth Semester B.E. Degree Examination, December 2012

## Mechanical Vibration

Time: 3 hrs. Max. Marks:100

**Note: 1.** ***Answer FIVE full questions, selecting at least TWO questions from each part.***
**2.** ***Missing data may be suitably assumed.***



### PART – A

1 a. Add the following motions analytically:
$x_1 = 4\cos(\omega t + 10^\circ)$, $x_2 = 6\sin(\omega t + 60^\circ)$ **(10 Marks)**

b. Develop a periodic function in terms of sines and cosines of a Fourier series and determine $a_o$, $a_n$ and $b_n$. **(10 Marks)**

2 a. Determine the effect of the mass of the spring on the natural frequency of the spring-mass-system. **(10 Marks)**

b. A bifiliar suspension consists of thin cylindrical rod of mass m suspended symmetrically by two equal strings as shown in Fig.Q2(b). Find the frequency of oscillation of the rod about vertical axis Y-Y. **(10 Marks)**

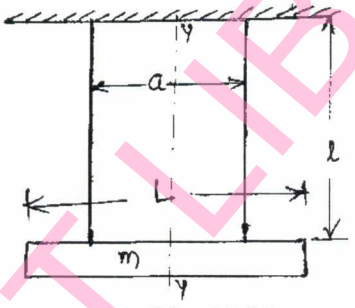

Fig.Q2(b)

3 a. Obtain the response of viscous damped system for underdamped case. **(10 Marks)**

b. Find the equation of motion for the system shown in Fig.Q3(b) when $\xi$ = 1, 0.3 and 2. If the mass m is displaced by a distance of 30 mm and released. **(10 Marks)**

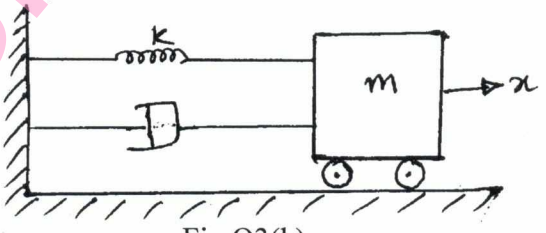

Fig.Q3(b)

4 a. Derive an expression for a steady state solution with viscous damping due to harmonic force. **(10 Marks)**

b. A vibrating body is supported by six isolators each having stiffness 32000 N/m and 6 dashpots each have 400 N-s/m. The vibrating body is to be isolated by a rotating device having an amplitude of 0.06 mm at 600 rpm. Take m = 30 kg. Determine the amplitude of vibration of the body and dynamic load on each isolator. **(10 Marks)**

## PART – B

5 a. Explain and discuss vibrometer and accelerometer devices with the help of relative amplitude ratio versus frequency ratio plot. **(10 Marks)**

b. Obtain an expression for whirling of shaft with air damping. **(10 Marks)**

6 a. Set up the differential equation of motion for the system shown in Fig.Q6(a) and hence derive the frequency equation and obtain the two natural frequencies of the system. Sketch the mode shapes for $m_1 = m_2 = m$, $k_1 = k_2 = k_3 = k$. **(10 Marks)**

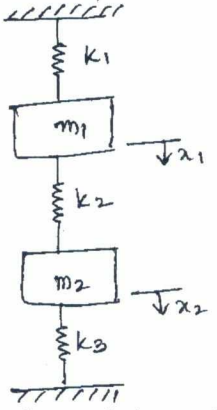


Fig.Q6(a)

b. Explain the principle of undamped dynamic vibration absorbers. Obtain an expression for $\frac{X_1}{X_{st}}$ for main mass and $\frac{X_2}{X_{st}}$ for absorber mass. **(10 Marks)**

7 a. Derive the general solution of a torsional vibration of rods. **(10 Marks)**

b. Derive suitable mathematical expression for longitudinal vibration of a rod of uniform c/s. **(10 Marks)**

8 a. Calculate the influence coefficients of 3-DOF spring mass system shown in Fig.Q8(a). Take $m_1 = m_2 = m_3 = m$ and $k_1 = k_2 = k_3 = k_4 = k_5 = k_6 = k$. **(10 Marks)**

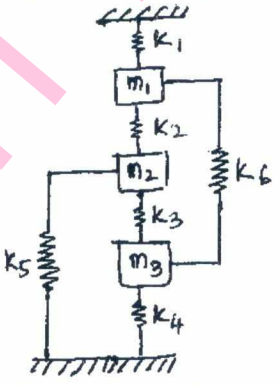


Fig.Q8(a)

b. Use the Stodola method to determine the lowest natural frequency of a 4-DOF spring mass system shown in Fig.Q8(b). **(10 Marks)**

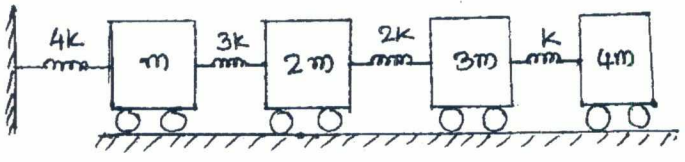


Fig.Q8(b)

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06ME63

# Sixth Semester B.E. Degree Examination, December 2012
# Modeling and Finite Element Analysis

Time: 3 hrs. Max. Marks:100

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



## PART – A

1 a. Using Rayleigh-Ritz method, derive an expression for maximum deflection of the simply
b. supported beam with point load P at centre. Use trigonometric function. **(08 Marks)**

Solve the following system of simultaneous equations by Gauss elimination method.

$$x + y + z = 9$$
$$x - 2y + 3z = 8$$
$$2x + y - z = 3$$

**(08 Marks)**

c. Explain the principle of minimum potential energy and principle of virtual work. **(04 Marks)**

2 a. Explain the basic steps involved is FEM. **(10 Marks)**
b. Explain the concepts of iso, sub and super parametric elements. **(05 Marks)**
c. Define a shape function. What are the properties that the shape functions should satisfy? **(05 Marks)**

3 a. What are the convergence requirements? Discuss three conditions of convergence requirements. **(05 Marks)**
b. What are the considerations for choosing the order of the polynomial functions? **(05 Marks)**
c. Derive the shape functions for CST element. **(10 Marks)**

4 a. Derive the Hermite shape function for a 2-noded beam element. **(10 Marks)**
b. Derive the shape functions for a four noded quadrilateral element in natural coordinates. **(10 Marks)**

## PART – B

5 a. Derive an expression for stiffness matrix for a 2-D truss element. **(10 Marks)**
b. Derive the strain displacement matrix for 1-D linear element and show that $\sigma = E[B]\{u\}$ **(10 Marks)**

6 a. Discuss the various steps involved in the finite element analysis of a one dimensional heat transfer problem with reference to a straight uniform fin. **(10 Marks)**
b. Derive the element matrices, using Galerkin for heat conduction in one dimensional element with heat generation Q. **(10 Marks)**

7 a. A bar is having uniform cross sectional area of 300 $mm^2$ and is subjected to a load P = 600kN as shown in Fig.Q7(a). Determine the displacement field, stress and support reaction in the bar. Consider two element and rise elimination method to handle boundary conditions. Take E = 200 GPa. **(10 Marks)**

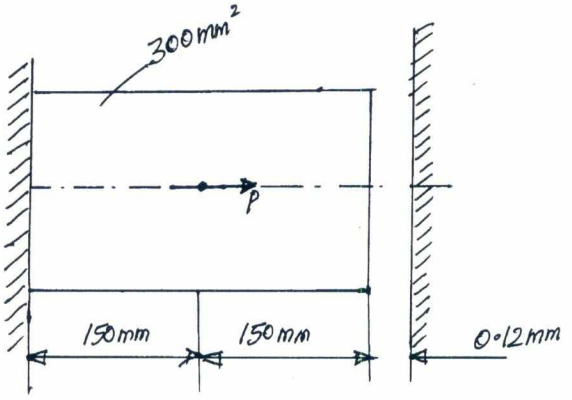


Fig.Q7(a)

b. For the two bar truss shown in Fig.Q7(b), determine the nodal displacements and stress in each number. Also find the support reaction. Take E = 200 GPa. **(10 Marks)**

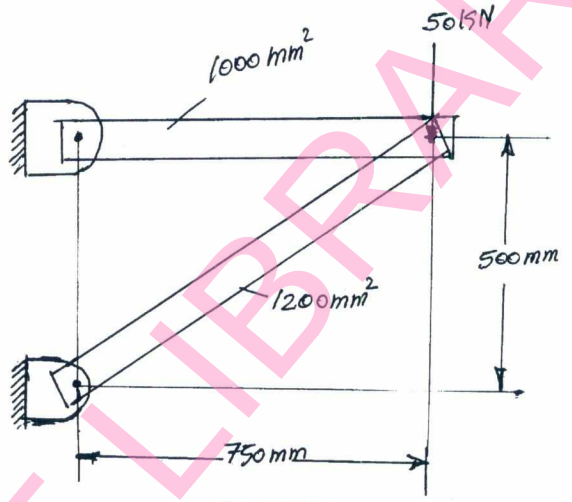


Fig.Q7(b)

**8** a. For the beam shown in Fig.Q8(a), determine the end reaction and deflection at mid span. Take E = 200 GPa, I = $4\times10^6$ mm$^4$. **(10 Marks)**

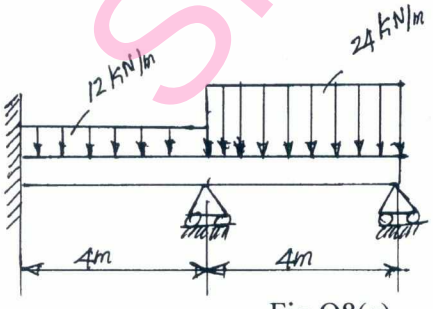


Fig.Q8(a)

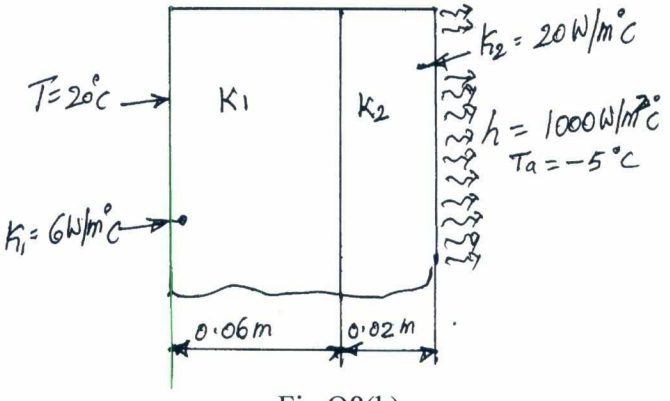


Fig.Q8(b)

b. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convection heat transfer coefficient shown in Fig.Q8(b). The ambient temperature is –5°C. **(10 Marks)**

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06ME64

# Sixth Semester B.E. Degree Examination, December 2012

## 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 is mechatronics? What are the objectives of mechatronics? **(05 Marks)**

b. Explain briefly the elements of a measuring system, with an example. **(05 Marks)**

c. Explain with the block diagram, how a microprocessor based control system is used to control the focusing and exposure of an automatic camera. **(10 Marks)**

2 a. What is the difference between a sensor and transducer? **(04 Marks)**

b. What is Hall effect? Explain with a neat sketch the principle of Hall effect sensor. **(06 Marks)**

c. What are light sensor? Explain briefly the following:
i) Photo emissive cell ii) Photo conductive cell iii) Photovoltaic cell **(10 Marks)**

3 a. What is an actuator? List the various types of actuators. **(04 Marks)**

b. Explain the terms bouncing and debouncing as applied to mechanical switches? Mention the various methods which can be to tackle the problem of bouncing in mechanical switches. **(08 Marks)**

c. What are stepper motors? State the advantages and applications. **(08 Marks)**

4 a. Define signal conditioning. What are the necessity for signal conditioning? **(05 Marks)**

b. What is an operational amplifier (op-amp)? Why it is called an operational amplifier? **(05 Marks)**

c. What do you mean by the term filtering and filter? How are filters classified? **(05 Marks)**

d. List the functions of signal conditioning equipment. Explain the function of these equipments. **(05 Marks)**

### PART – B

5 a. Explain briefly the evolution of microprocessor. **(06 Marks)**

b. Represent the real numbers +16.5 ad –16.5 in a 32 bit memory using floating point notation. **(06 Marks)**

c. Explain the concept of overflow and underflow with an example. **(08 Marks)**

6 a. Enumerate the difference between microprocessor and microcontroller. **(04 Marks)**

b. What is a clock? Why a clock is necessary in a microprocessor? Draw the ideal and non-ideal clock. **(06 Marks)**

c. What is meant by instruction set? Discuss the five group of instruction set with an example (for each group). **(10 Marks)**

7 a. Draw the functional block diagram of the Intel 8085 microprocessor. **(04 Marks)**

b. Explain with a block diagram the flow of instruction word and flow of data word in a microprocessor. **(12 Marks)**

c. What are the functions of CPU? **(04 Marks)**

8 Write short notes on the following:

a. Assembly language programming b. Fetch cycle and write cycle

c. System timing d. Character representation **(20 Marks)**

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06ME65

# Sixth Semester B.E. Degree Examination, December 2012
# 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 HMT data book is permitted.***



## PART – A

1 a. Starting from fundamental principles, derive the general, three-dimensional heat conduction equation in Cartesian co-ordinates. **(09 Marks)**

b. A liquid at 100°C flows through a pipe of 40 mm outer and 30 mm inner diameter. The thermal conductivity of pipe material is 0.5 W/mK. The pipe is exposed to air at 40°C. The inner and outer convective heat transfer coefficients are 300 $W/m^2K$ and 5 $W/m^2K$ respectively. Calculate the overall heat transfer coefficient and the heat loss per unit length of pipe. **(08 Marks)**

c. What is the technical need to under take a detailed study of heat transfer, having studied thermodynamics already? **(03 Marks)**

2 a. A tube with an outer diameter of 20 mm is covered with insulation. The thermal conductivity of insulating material is 0.18 W/mK. The outer surface losses heat by convection with a heat transfer coefficient of 12 $W/m^2K$. Determine the critical thickness of insulation. Also calculate the ratio of heat loss from the tube with critical thickness of insulation to that from the bare tube (without insulation). **(10 Marks)**

b. Derive the one-dimensional fin equation for a fin of uniform cross section. By integrating the fin equation, obtain the expression for the temperature variation in a long fin. **(10 Marks)**

3 a. Consider a solid, with an uniform initial temperature, suddenly immersed in a liquid. Derive the relevant governing differential equation, considering the system as lumped. By solving the differential equation, obtain the expression for the temperature variation with time. **(10 Marks)**

b. A 50 mm thick iron plate (K=60 W/mK, $C_p$=460 J/kg K, $\rho$=7800 $kg/m^3$, $\alpha = 1.6\times10^{-5}\ m^2/s$) is initially at 225°C. Suddenly both surfaces are exposed to a fluid at 25°C, with a heat transfer coefficient of 500 $W/m^2K$. Calculate the centre and the surface temperatures 2 minutes after the cooling begins using Heisler's charts. **(10 Marks)**

4 a. The velocity profile for boundary layer flow over a flat plate is given by, $\frac{u(x,y)}{u_\infty} = \frac{3}{2}\frac{y}{\delta(x)} - \frac{1}{2}\left\{\frac{y}{\delta(x)}\right\}^3$, where boundary layer thickness $\delta(x) = \sqrt{\frac{280\gamma x}{13u_\infty}}$. Develop an expression for local drag coefficient. Also develop an expression for average drag coefficient for a length of L. **(10 Marks)**

b. Consider a square plate of size 0.6 m in a room with stagnant air at 20°C. One side of plate is maintained at 100°C, while the other side is adiabatic. Determine the heat loss if the plate is, i) vertical and ii) horizontal with hot surface facing up. **(10 Marks)**

## PART – B

5 a. Air at 0°C and 20 m/s flows over a flat plate of length 1.5 m, that is maintained at 50°C. Calculate the average heat transfer coefficient over the region where flow is laminar. Find the average heat transfer coefficient and the heat loss for the entire plate per unit width. **(12 Marks)**

b. Air at -20°C and 30 m/s, flows over a sphere of diameter 25 mm, which is maintained at 80°C. Calculate the heat loss from sphere. **(08 Marks)**

6 a. Derive an expression for the logarithmic mean temperature difference (LMTD) for a parallel flow heat exchanger **(12 Marks)**

b. A cross flow heat exchanger, with both fluids unmixed, has an area of 8.4 $m^2$, is used to heat air (Cp = 1005 J/kgK) with water (Cp = 4180 J/kgK). Air enters at 15°C, at a rate of 2 kg/s, while water enters at 90°C at a rate of 0.25 kg/s. The overall heat transfer coefficient is 250 $W/m^2K$. Calculate exit temperatures of both fluids and the heat transfer, using effectiveness – NTU method. **(08 Marks)**

7 a. Saturated steam at 65°C condenses on a vertical tube with an outer diameter of 25 mm, which is maintained at 35°C. Determine the length of tube needed, if the condensate flow needed is $6 \times 10^{-3}$ kg/s. **(10 Marks)**

b. Water at atmospheric pressure and saturation temperature is boiled in a 250 mm diameter, polished stainless steel pan, which is maintained at 116°C. Calculate the heat flux and the evaporation rate. **(10 Marks)**

8 a. State and prove Kirchoff's law of radiation. **(06 Marks)**

b. Two large parallel plates with emissivities 0.5 and 0.8 are maintained at 800 K and 600 K respectively. A radiation shield having an emissivity of 0.1 on one side and 0.05 on the other side is placed in between. Calculate the heat transfer per unit area with and without the radiation shield. **(08 Marks)**

c. Determine the view factors from the base of a cube to each of its five surfaces. **(06 Marks)**

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06ME665

# Sixth Semester B.E. Degree Examination, December 2012
# 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. Explain the need to develop modern machining processes. **(04 Marks)**
b. Explain parameter to select to employ the new machining methods. **(06 Marks)**
c. Explain USM process with the required figure of the set up and a magnified view at tool tip/workpiece. **(10 Marks)**

2 a. Explain the methods to increase ultrasonic machining rates. **(10 Marks)**
b. Write a note on an abrasive slurry used in AJM indicating types of abrasive, and their properties, sizes used and liquid media with functions and characteristics. **(10 Marks)**

3 a. List variables in AJM. Explain any four variables. **(10 Marks)**
b. Explain advantages of water jet machining. **(10 Marks)**

4 a. Explain ECM with the schematic diagram. **(05 Marks)**
b. Explain functions of electrolytes used in ECM and name 3 electrolytes with their specialties. **(05 Marks)**
c. Explain chemistry of ECM with the circuit. **(05 Marks)**
d. Theoretically estimate metal removal rate and electrode feed rate of ECM. **(05 Marks)**

## PART – B

5 a. Explain the chemical blanking process stepwise with the flow chart. **(10 Marks)**
b. Write a note on etchants indicating factors to select. **(06 Marks)**
c. Write advantages of chemical machining. **(04 Marks)**

6 a. Define dielectric. Write a note on it indicating its functions and characteristics. **(10 Marks)**
b. Explain the mechanism of EDM showing the circuit and movements of ions. **(10 Marks)**

7 a. Explain advantages of EDM. **(05 Marks)**
b. Draw the diagram of electrode feed control of EDM and label it. **(05 Marks)**
c. Explain the non-thermal generation of plasma with the related diagram. **(10 Marks)**

8 a. Explain the generation of electron beam used in EBM with the help of the diagram of the equipment used. **(10 Marks)**
b. Describe the apparatus used to generate laser. **(05 Marks)**
c. Write the limitation of LBM. **(05 Marks)**

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