USN | | | | | | | | | | |

06ME61

Sixth Semester B.E. Degree Examination, June 2012
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions, selecting at least TWO from each part A and B.***
2. Use of data hand book permitted.
3. Missing data, if any, may be suitably assumed.

PART – A

1 a. Compare the stresses due to a bending moment applied on a straight beam and a curved beam. **(05 Marks)**

b. The parallel sides of a trapezoidal cross section of a crane hook of capacity 50 kN are 100 mm and 60 mm. the depth of the section being 120 mm. The radius of curvature of the inner fibre is 150 mm as shown is the Fig.Q1(b). Determine the stresses at the extreme fibres of the cross section of the crane hook. **(15 Marks)**

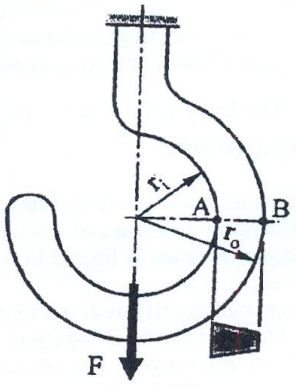


Fig.Q1(b)

2 a. In an air operated press, the piston rod of the operating cylinder must exert a force of 4000 N. The air pressure in the cylinder is 0.7 MPa. Calculate the bore of the cylinder, assuming that overall friction due to stuffing box and piston packing is equivalent to 8% of the maximum force exerted by the piston rod. Determine the thickness of the cylinder assuming that it is a seamless tubing with an allowable stress of 21 MPa. **(06 Marks)**

b. A steel hub 440 mm out side diameter, 250 mm inside diameter and 300 mm length has an interference fit with a shaft of 250 mm diameter. The torque to be transmitted is 30×10^4 N-m. The permissible stress for the material of the shaft and hub is 120 MPa. The coefficient of friction is 0.18. Determine:

i) The contact pressure
ii) Interference required
iii) The tangential stress at the inner and outer surface of the hub.
iv) Force required to assemble
v) Radial stress at the outer and inner diameter of the hub. **(14 Marks)**

3 a. Derive an expression for the stress induced is a helical spring, with usual notations. **(06 Marks)**

b. A carriage weighing 25000 N is moving on track with a linear velocity of 3.6 km/hour. If is brought to rest by two helical compression springs is the from of a bumper by under going a compression of 180 mm. The springs may be assumed to have a spring index of 6 and a permissible shear strength of 450 MPa. Design the spring and determine the diameter of the wire, mean coil diameter and the length of the spring. Assume the modulus of rigidity of the spring material as 81.4 GPa. **(14 Marks)**

4 a. Sketch and explain the different forms of involute gear tooth. **(05 Marks)**

b. A cast steel pinion with an allowable stress of 103 MPa rotating at 900 r/min is to drive a cast iron gear at 1440 r/min. The teeth are 20° stub involute and the maximum power to be transmitted is 25 kW. The allowable stress for cast iron gear is 56 MPa. Determine the module, number of teeth on the gears and face-width from the stand point of strength, dynamic load and wear. **(15 Marks)**

PART – B

5 a. Explain the advantages of worm drive. Write a note on materials used for worm and worm wheel. **(05 Marks)**

b. A speed reduced unit is to be designed for an input power of 0.75 kW with a transmission ratio of 27. The speed of the hardened worm is 1750 r/min. The worm wheel is made of phosphor bronze. The tooth form is to be $14\frac{1}{2}^{\circ}$ involute. The allowable stress for the wheel may be taken as 80 MPa. **(15 Marks)**

6 a. A multiplate clutch consists of five steel plates and four bronze plates. The inner and outer diameter of friction disks are 75 mm and 150 mm respectively. The coefficient of friction is 0.1 and the intensity of pressure is limited to 0.3 N/mm^2. Assuming uniform wear theory. Calculate:
i) The required operating force ii) Power transmitting capacity at 750 r/min. **(10 Marks)**

b. A differential band brake is shown is Fig.Q6(b). The width and thickness of the steel band are 100 mm and 3 mm respectively. The permissible tensile stress is the band is limited to 50 MPa. The coefficient of friction between the friction lining and the drum is 0.25. Calculate:
i) Tensions is the band ii) The actuating force iii) Torque capacity of the brake. **(10 Marks)**

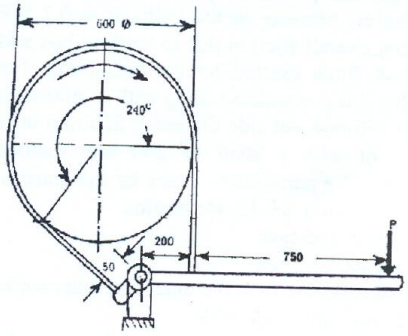


Fig.Q6(b)

7 a. Explain the properties a good bearing material should posses. List the different types of bearing materials. **(06 Marks)**

b. The following data are given for a full journal bearing:
Radial load: 25 kN
L/d ratio: 1:1
Unit bearing pressure: 2.5 MPa.
Viscosity of the lubricant: 20 Cp.
Class of fit: H7 e7.
Calculate:
i) Dimensions of the bearing
ii) Minimum oil film thickness.
iii) Requirement of oil flow.
Assume that the process to clearance is centered. **(14 Marks)**

8 a. Explain the advantages and applications of chain drives. **(05 Marks)**

b. The layout of the leather belt drive transmitting 15 kW power is shown in Fig.Q8(b). The centre distance between the pulleys is twice the diameter of the big pulley. The belt should operate at a velocity of 20 m/sec and the stresses in the belt should not exceed 2.25 MPa. The density of the leather belt is 0.95 g/cc and the coefficient of friction is 0.35. The thickness of the belt is 5 mm.
Calculate:
i) Diameter of the pulleys
ii) The length and width belts.
iii) Belt tensions.

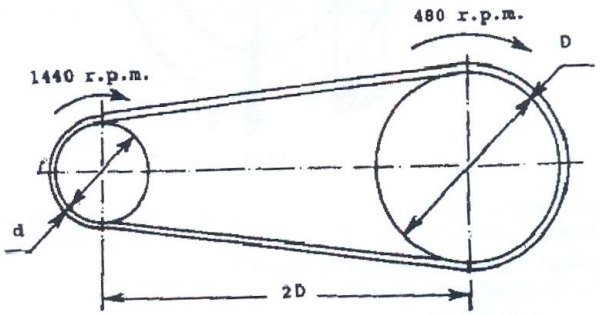


Fig.Q8(b) **(15 Marks)**

* * * * *

USN | | | | | | | | | | |

06ME62

Sixth Semester B.E. Degree Examination, June 2012
Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following terms:
i) Resonance
ii) Simple harmonic motion.
iii) Time period. **(06 Marks)**

b. Add the following motions analytically:
$X_1 = 2 \cos (wt + 0.5)$; $x_2 = 5 \sin (wt + 1.0)$. **(04 Marks)**

c. Periodic motion in time domain is given by $x(t) = -20t + 2$ for $0 \le t \le 2$.
Obtain Fourier's series equation in frequency domain. **(10 Marks)**

2 a. A spring mass system has a stiffness of k N/m and a mass of M kg. It has natural frequency of vibration of 12 cps. An extra 2 kg mass is coupled to M and its net frequency becomes 10 cps. Find k and M. **(10 Marks)**

b. Determine the natural frequency of the system shown in Fig.Q2(b). The pulleys are mass-less and there is no slippage between pulley and rope.

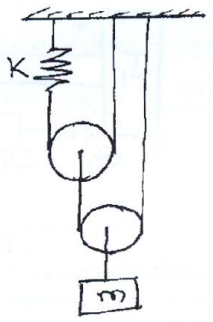


Fig.Q2(b) **(10 Marks)**

3 a. Define logarithmic decrement. Show that logarithmic decreement can be expressed as $\delta = \frac{1}{n} \log_e \frac{x_o}{x_n}$ (Derive the expression), where, x_o is amplitude at particular maximum and x_n is amplitude after 'n' cycles. **(10 Marks)**

b. A torsional pendulum has a natural frequency of 200 cpm when vibrating in vaccum (no damping). The mass moment of inertia of the disc is 2.5 kg cm^2. It is then immersed in oil and is observed that its damped natural frequency is 180 cpm. Determine the damping torque per radian per second. If the disc is displaced 3° when in oil, find its displacement at the end of first complete cycle. **(10 Marks)**

4 a. A mass of 100 kg is suspended on a spring having a stiffness of 19600 N/m and is acted upon by a harmonic force of 39.2 N at the undamped natural frequency. The damping coefficient is 98 N-s/m.
Determine:
i) Undamped natural frequency
ii) Amplitude of vibration of mass.
iii) Phase difference between force and displacement. **(10 Marks)**

b. The springs of an automobile trailer are compressed 0.1 under its own weight. Find the critical speed when the automobile is traveling over a road with a profile approximated by a sine wave of amplitude 0.08 m and a wavelength of 14 m. What will be the amplitude of vibration at 60 Km/hr. **(10 Marks)**

PART – B

5 a. A commercial vibration pick-up has a natural frequency of 5.75 cps and a damping factor of 0.65. What is the lowest frequency beyond which the amplitude can be measured within ± 1% error? **(10 Marks)**

b. A rotor having a mass of 5 kg is mounted midway on a 1 cm diameter shaft supported at ends by bearings. Bearings span is 40 cm. Eccentricity is 0.02 mm. If the system rotates at 3000 rpm find the amplitude of steady state vibrations and dynamic force transmitted to bearings. $E = 1.96 \times 10^{11}$ N/m^2. Neglect damping. **(10 Marks)**

6 a. Determine the natural frequencies and mode shapes for a system shown in Fig.Q6(a). J_1 and J_2 are mass moment inertias of the discs. K_t is torsional stiffness of shaft. **(10 Marks)**

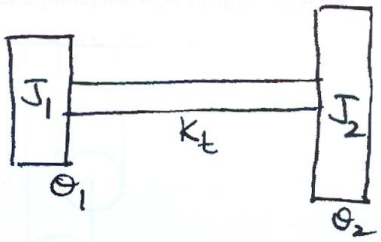


Fig.Q6(a)

b. A string is tightly stretched between two supports as shown in Fig.Q6(b). The tension T in the string may be assumed to be constant for small displacement. Obtain the two natural frequencies for the system.

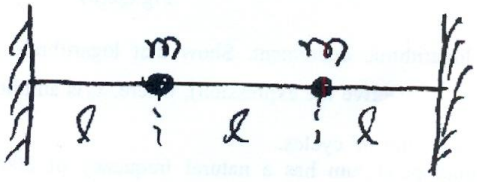


Fig.Q6(b) **(10 Marks)**

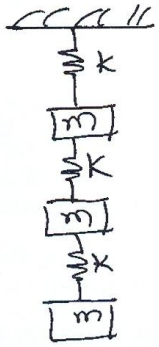
7 From the first principles show that the general solution for torsional vibration of circular shaft can be obtained as:

$$\theta = \sum_{i=1,2,3}^{\infty} \left(A_i \sin \frac{W_i x}{c} + B_i \cos \frac{W_i x}{c} \right) \left(C_i \sin W_i t + D_i \cos W_i t \right).$$

where, $C = \sqrt{\frac{G}{\rho}}$ = velocity of wave propagation G is modulus of rigidity and ρ is density.

(20 Marks)

8 a. Using stodola method find the fundamental natural frequency and mode shape of the system shown in Fig.Q8(a).



Assume k = 1 N/m
And m = 1kg.

Fig.Q8(a) **(10 Marks)**

b. Obtain influence coefficients for the system shown in Fig.Q8(b).

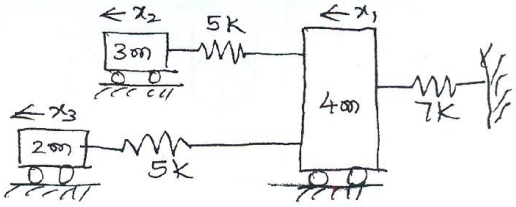


Fig.Q8(b) **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

06ME63

Sixth Semester B.E. Degree Examination, June 2012
Modelling and Finite Element Analysis

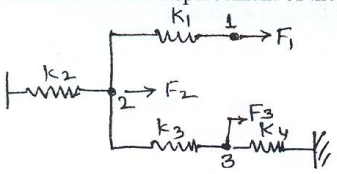
Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Differentiate between plane stress and plane strain problems. Also state the stress-strain relations for both. **(05 Marks)**

b. State the principle of minimum (stationary) potential energy and apply the same to determine nodal displacement of the spring system shown in Fig.Q1(b). **(10 Marks)**



$k_1 = 50$ N/mm
$k_2 = k_3 = 60$ N/mm
$k_4 = 80$ N/mm
$F_1 = 100$ N, $F_2 = 150$ N, $F_3 = 200$ N,

Fig.Q1(b)

c. Evaluate the following integral using two point Gauss quadrature formula.

$$I = \int_1^3 \left(\frac{1}{x}\right) dx$$ **(05 Marks)**

2 a. What is FEM? What are the advantages and limitations of the method? **(08 Marks)**

b. Derive the element stiffness matrix of linear bar element and list the properties of stiffness matrix. **(12 Marks)**

3 a. What do you understand by C° and C^1 shape functions? State the properties of C° shape functions. Derive shape functions of a 3-noded bar element in natural coordinates. Show the variation of each shape function over the element. **(12 Marks)**

b. Discuss the various convergence criteria and geometric isotropy as regards to finite element models. **(08 Marks)**

4 a. What do you understand by Hermitian shape functions? Derive Hermite shape functions of a beam element and show the variation of the shape functions over the element. **(10 Marks)**

b. Explain the sub-super and isoparametric finite elements. **(05 Marks)**

c. Write a note on higher order elements used in FEM. **(05 Marks)**

PART – B

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

b. Derive strain-displacement [B] matrix for a 3-noded CST element. **(10 Marks)**

6 a. Write a note on application of FEM in solving scalar field problems. **(04 Marks)**

b. Write the governing differential equations for one dimensional heat transfer and discuss the various types of boundary conditions used in solving heat transfer problems. **(06 Marks)**

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

7 a. Determine the nodal displacement at node 2, the stresses in the elements at support reactions for the stepped bar shown in Fig.Q7(a). **(10 Marks)**

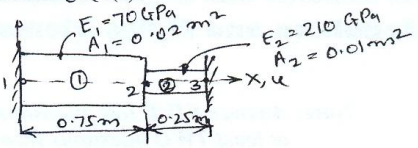


Fig.Q7(a)

b. For the truss element shown in Fig.Q7(b), (x, y) co-ordinates of the element are indicated near nodes 1, 2. The element displacement dof vector is given by $\{u\} = \lfloor 1.5 \;\; 1.0 \;\; 2.1 \;\; 4.3 \rfloor^T \times 10^{-2}$ mm. Take $E = 300\times10^3$ N/mm^2, A = 100 mm^2, determine the following:

i) Element displacement dof in local coordinates (u_1^1 & u_2^1)

ii) Stress in the element

iii) Stiffness-matrix of the element. **(10 Marks)**

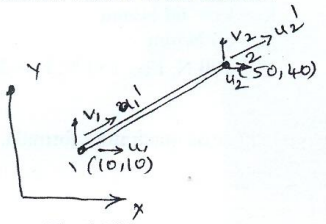


Fig.Q7(b)

$E = 300\times10^3$ N/mm^2

A = 100 mm^2

$$\begin{Bmatrix} u_1 \\ v_1 \\ u_2 \\ v_2 \end{Bmatrix} = \begin{Bmatrix} 1.5 \\ 1.0 \\ 2.1 \\ 4.3 \end{Bmatrix} \times 10^{-2} \text{ mm}$$

8 a. For the brick wall shown in Fig.Q8(a), the inner surface temperature is 28°C and outer surface is exposed to cold air at –15°C. Determine the temperature distribution in steady state, within the wall, by considering 2 elements, one dimensional heat flow elements. What is heat flux through the wall? **(10 Marks)**

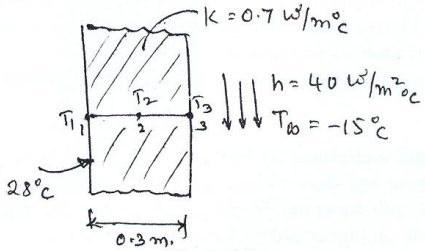


Fig.Q8(a)

b. For the beam fixed at both ends and loaded as shown in Fig.Q8(b), determine the displacement and slopes at node 2, and reaction force at node 1 only. **(10 Marks)**

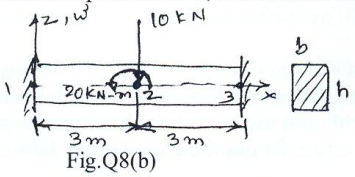


Fig.Q8(b)

E = 210 GPa

b = 0.2 m

h = 0.4 m

* * * * *

USN | | | | | | | | | | |

06ME64

Sixth Semester B.E. Degree Examination, June 2012
Mechatronics and Microprocessors

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 meaning of the term "Mechatronics" with respect to multi-disciplinary scenario. Briefly discuss the origin and evolution of Mechatronics. **(07 Marks)**

b. Briefly explain the concept of system development in Mechatronics and functions of main elements in Mechatronics system (closed loop control system) with figure. **(07 Marks)**

c. What are micro-processor based controllers? Briefly explain the principle of working of any one of the following with figure: i) Automatic camera ii) Engine management system. **(06 Marks)**

2 a. What is a sensor and how are they classified? What are the different types of sensors? **(06 Marks)**

b. Briefly explain the various static and dynamic characteristics of sensors. **(06 Marks)**

c. Briefly explain the principle of working and applications of any two of the following sensors:
i) Light sensors ii) Pronimity sensors iii) Hall effect sensor **(08 Marks)**

3 a. Briefly explain the working principle of a stepper motor. Draw the T-θ characteristic curve of a 3ϕ variable – reluctance (VR) type of a stepper motor and then predict stable and unstable position of the rotor. **(10 Marks)**

b. Explain the basic construction of DC motors. Explain field and armature speed control of DC motors. **(10 Marks)**

4 a. Draw the circuit diagram of op-amp integrator, differentiator and derive an expression of an output voltage. **(06 Marks)**

b. Explain balance mode of wheat stone bridge and hence deduce the expression for change in output voltage. **(08 Marks)**

c. With bock diagram, explain digital data acquisition system. **(06 Marks)**

PART – B

5 a. Implement a NOT, OR and AND gates using NOR gates. Also mention their truth tables. **(08 Marks)**

b. Convert the following: i) $(754.534)_{10} = (\_\_\_\_\_)_{16}$ ii) $(110.10101)_2 = (\_\_\_\_\_)_{10}$
iii) $(327.45)_8 = (\_\_\_\_\_)_{10}$ **(06 Marks)**

c. State Demorgan's theorems. Also draw the logic circuits for the same. **(06 Marks)**

6 a. Explain the following terminologies of a 8085 microprocessor:
i) Program counter ii) Assembler iii) ALU iv) Fetch cycle
v) BUS **(10 Marks)**

b. State any five differences between a microprocessor and a microcontroller. **(05 Marks)**

c. Give the classification of microcontrollers. **(05 Marks)**

7 a. Explain the architecture of 8085 microprocessor with neat block diagram. **(10 Marks)**

b. Write a program to find the largest of a byte in the array of numbers. **(10 Marks)**

8 a. Explain the flow of instruction and data in the 8085 microprocessor. **(07 Marks)**

b. Draw and explain the timing diagram of opcode fetch machine cycle. **(10 Marks)**

c. List the differences of 4004 and 8085 microprocessors register organization. **(03 Marks)**

* * * * *

USN | | | | | | | | | | |

06ME661

Sixth Semester B.E. Degree Examination, June 2012
Theory of Elasticity

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Derive 3 – dimensional equilibrium equation in Cartesian co-ordinate system. **(10 Marks)**

b. The state – of – stress at a point is given by the following matrix :

$$\begin{bmatrix} 9 & 6 & 3 \\ 6 & 5 & 2 \\ 3 & 2 & 4 \end{bmatrix} \text{MPa.}$$

Determine the principal stresses and principal directors. **(10 Marks)**

2 a. What is the significance of compatibility conditions in theory of elasticity? Given the following system of strains :

$\varepsilon_x = 5 + x^2 + y^2 + x^4 + y^4$

$\varepsilon_y = 6 + 3x^2 + 3y^2 + x^4 + y^4$

$\gamma_{xy} = 10 + 4xy(x^2 + y^2 + 2)$

$\sum_z = \gamma_{yz} = \gamma_{zx} = 0$

Determine whether the above strain field possible. **(10 Marks)**

b. If the displacement field in a body is specified as $u = (x^2 + 3) \times 10^{-3}$, $v = 3y^2z \times 10^{-3}$ and $w = (x + 3z) \times 10^{-3}$, determine the strain components at a point whose coordinate are (1, 2, 3). **(10 Marks)**

3 a. Investigate what problem of plane stress is satisfied by the stress function.

$$\phi = \frac{3F}{4h}\left(xy - \frac{xy^3}{3h^2}\right) + \frac{P}{2}y^2.$$ **(10 Marks)**

b. What is a stress function? Show that the stress function ϕ which satisfy the equation :

$$\frac{\partial^4\phi}{\partial x^4} + 2\frac{\partial^4\phi}{\partial x^2\partial y^2} + \frac{\partial^4\phi}{\partial y^4} = 0$$, for two–dimensional rectangular coordinates. **(10 Marks)**

4 a. Derive the biharmonic equation in polar coordinates, and its general solution for the analysis of 2D plane elasticity problems. **(10 Marks)**

b. A steel cylinder which has an inside diameter of 1 metre is subjected to an internal pressure of 8 MPa. Calculate the wall thickness of the maximum sharing stress is not to exceed 35 MPa. **(10 Marks)**

PART – B

5 a. Derive the expressions for radial and tangential stresses in a rotating disc of uniform thickness. **(10 Marks)**

b. A flat steel turbine disc of 750 mm outside diameter and 150 mm inside diameter rotates at 3000 rpm. At which speed the blades and shrouding causes a tensile rim stressing of 4.4 N/mm^2. The maximum stress at this speed is to be 116 N/mm^2. Find the maximum shrinkage allowable on the diameter when the disc and the shaft are rotating. **(10 Marks)**

6 a. Discuss the torsion of a solid circular cross section bar. **(10 Marks)**

b. A two – cell tube as shown in Fig. Q6(b) is subjected to a torque of 10 kN-m. Determine the shear stress in each port and angle of twist per meter length. Take modulus of rigiding of the material as 83 kN/mm^2. **(10 Marks)**

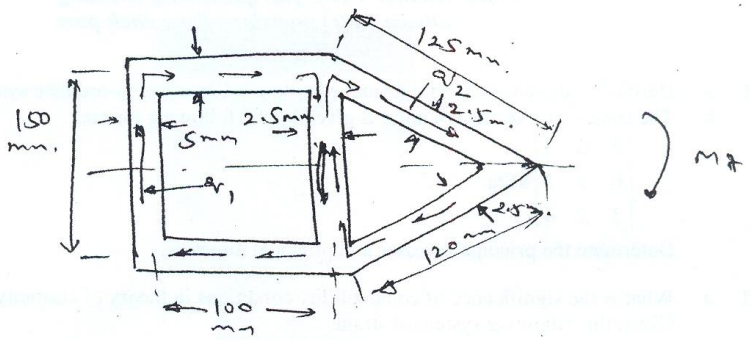


Fig. Q6(b)

7 a. Determine the radial and tangential stress distribution in a long solid cylindrical conductor subjected to a temperature distribute. **(10 Marks)**

b. The temperature distribution in a long cylindrical conductor due to a passage of current is given by $T = \lambda(\delta^2 - r^2)$ where λ is constant. Determine the stresses due to thermal loading. **(10 Marks)**

8 Write notes on the following :

a. Uniquenessds of a solution

b. Principle of super position

c. Reciprocal theorem

d. St. Venout's principle. **(20 Marks)**

* * * * *

USN | | | | | | | | | | |

06ME665

Sixth Semester B.E. Degree Examination, June 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. Give the broad classification of non-traditional machining processes. **(06 Marks)**
b. What are the advantages of non-traditional machining processes? **(06 Marks)**
c. With a neat sketch, explain the working principle of ultrasonic machining process. **(08 Marks)**

2 a. Explain the effect of different process parameters on machining performance in USM process. **(10 Marks)**
b. What are the advantages, disadvantages and applications of USM process? **(10 Marks)**

3 a. Sketch and explain AJM process. **(10 Marks)**
b. During AJM process the mixing ratio is 0.2. Calculate the mass ratio if the ratio of density of abrasive and density of carrier gas is 20. **(04 Marks)**
c. What are the process variables that affect the performance of water-jet machining process. **(06 Marks)**

4 a. With a neat sketch, explain the working principle of ECM process. **(08 Marks)**
b. Sketch and explain different types of tools used in ECM process. **(06 Marks)**
c. List the advantages, limitations and applications of ECM process. **(06 Marks)**

PART – B

5 a. What are Maskants used in chemical machining? Explain the different types of it. **(10 Marks)**
b. What are the factors to be considered in the selection of etchant? **(04 Marks)**
c. List the commonly used dielectric fluids in EDM process. What properties should they posses? **(06 Marks)**

6 a. Derive the relationship for breakdown voltage, V_b in EDM process, ($V_b \approx 0.72\ V_o$), where V_o is the supply voltage. **(12 Marks)**
b. Sketch and explain ECG process. **(08 Marks)**

7 a. Sketch and explain transferred and non-transferred plasma arc system. **(10 Marks)**
b. Write a note on process performance in plasma arc cutting process. **(04 Marks)**
c. Write a note on different types of lasers used in LBM process. **(06 Marks)**

8 a. What are the advantages and applications of laser beam machining? **(08 Marks)**
b. Sketch and explain electro beam machining process. **(08 Marks)**
c. What are the process parameters affect on the machining process in EBM? **(04 Marks)**

* * * * *