

Code: 9A03701

B.TECH IV Year I Semester (R09) Regular Examinations, November 2012

OPERATIONS RESEARCH

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 Solve the following Linear programming problem using Big-M method

Maximize  $Z = x_1 + 2x_2 + 3x_3 - x_4$

Subjected to the constraints

$x_1 + 2x_2 + 3x_3 = 15$

$2x_1 + x_2 + 5x_3 = 20$

$x_1 + 2x_2 + x_3 + x_4 = 10$

$x_1, x_2, x_3, x_4 \geq 0$

- 2 A Salesman has to visit five cities A,B,C,D,E. The distances (in hundred kilometers) between the five cities are as follows:

		To city				
		A	B	C	D	E
To city	A	-	1	6	8	4
	B	7	-	8	5	6
	C	6	8	-	9	7
	D	8	5	9	-	8
	E	4	6	7	8	-

If the salesman starts from city A and has to come back to city A, which route should he select so that total distance travelled is minimum.

- 3 A computer has a large number of electronic tubes. They are subject to mortality as given below:

Period	Age of failure (Hrs.)	Probability of failure
1	0-200	0.10
2	201-400	0.26
3	401-600	0.35
4	601-800	0.22
5	801-1000	0.07

If the tubes are group replaced, the cost of replacement is Rs 15 per tube. Replacement of individual tubes which fail in service costs Rs 60 per tube. How

frequently should the tubes be replaced?

- 4 Use graphical method to solve the following game and find the value of the game.

Player A	Player B			
	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>
A <sub>1</sub>	2	2	3	-2
A <sub>2</sub>	4	3	2	6

- 5 Consider a self-service store with one cashier. Assume Poisson arrivals and exponential service times. Suppose that nine customers arrive on the average every 5 minutes and the cashier can serve 10 in 5 minutes. Find
- Average number of customers queuing for service,
  - Probability of having more than 10 customers in the system and
  - Probability that a customer has to queue for more than 2 minutes if the service can speed up to 12 in 5 minutes by using a different cash register. What will be the effect on the quantities (a),(b) and (c)?

- 6 Annual demand for a particular item of inventory is 10,000 units. Inventory carrying costs per unit per year is 20 percent and ordering cost is Rs 40 per order. The price quoted by the supplier is Rs 4 per unit. However the supplier is willing to give discount of 5 percent for orders of 1500 or more. Is it worthwhile to avail of the discount offer?

- 7 Solve the following linear programming problem using dynamic programming method.

$$\begin{aligned}
 &\text{Maximize } Z = 3x_1 + 5x_2 \\
 &\text{Subjected to } x_1 \leq 4 \\
 &\quad \quad \quad x_2 \leq 6 \\
 &\quad \quad \quad 3x_1 + 2x_2 \leq 18 \\
 &\quad \quad \quad x_1, x_2 \geq 0
 \end{aligned}$$

- 8 What is simulation? What is its importance? Explain utility of simulation to solve inventory problems.

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- 1 (a) Explain the various types of OR models.  
(b) Use the graphical method to solve the following linear programming problem:

$$\begin{aligned} \text{Minimize } Z &= -x_1 + 2x_2 \\ \text{Subject to the constraints} \\ &-x_1 + 3x_2 \leq 10 \\ &x_1 + x_2 \leq 6 \\ &x_1 - x_2 \leq 2 \\ &\text{and } x_1, x_2 \geq 0 \end{aligned}$$

- 2 A department has five employees with five Jobs to be performed. The time in hours each man will take to perform each Job is given in the effectiveness matrix. How should the Jobs be allocated one per employee so as to minimize the total man-hours?

		Employees				
		I	II	III	IV	V
Jobs	A	10	5	13	15	16
	B	3	9	18	13	6
	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

- 3 Machine A costs Rs 45,000 and the operating costs are estimated at Rs 1,000 for the first year increasing by Rs 10,000 per year in the second and subsequent years. Machine B Costs Rs 50,000 and operating costs are Rs 2,000 for the first year, increasing by Rs 4,000 in the second and subsequent years. If we now have a machine of type A, should we replace it with B? If so when? Assume that both machines have no resale value and future costs are not discounted.
- 4 Explain the principle of dominance in game theory and solve the following game:

Player A	Player B		
	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
A <sub>1</sub>	1	7	2
A <sub>2</sub>	6	2	7
A <sub>3</sub>	5	2	6

Contd. in page 2

- 5 Consider a self-service store with one cashier. Assume poisson arrivals and exponential service times. Suppose that 9 customers arrive on the average every 5 minutes and the cashier can serve 10 in 5 minutes. Find.
- (a) Average number of customers queing for service.
  - (b) Probability of having more than 10 customers in the system.
  - (c) Probability that a customer has to queue for more than 2 minutes.
- 6 The production department for a company requires 3,600 Kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is Rs 36 and the cost of carrying inventory is 25 percent of the investment in the inventories. The price is Rs 10 per Kg. Find the optimum run size and the minimum yearly cost (average).
- 7 State Bellman's "principle of optimality" and giving suitable examples discuss the applications of dynamic programming.
- 8 Define simulation. Discuss about the various simulation models with their advantages and limitations.

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- 1 Use the simplex method to solve the following linear programming problem:

$$\begin{aligned} &\text{Maximize } Z = 10x_1 + 5x_2 \\ &\text{Subject to } 4x_1 + 5x_2 \leq 100 \\ &\quad 5x_1 + 2x_2 \leq 80 \\ &\quad \text{and } x_1, x_2 \geq 0 \end{aligned}$$

- 2 Five Jobs are performed first on machine x and then on machine y. The time taken, in hours by each job on each machine is given below:

Job	A	B	C	D	E
Time on Machine x :	12	4	20	14	22
Time on Machine y :	6	14	16	18	10

Determine the optimum sequence of jobs that minimizes the total elapsed time to complete the jobs.

- 3 The cost of a machine is Rs 6,100 and its scrap value is Rs 100. The maintenance costs found from experience are as follows:

Year	1	2	3	4	5	6	7	8
Maintenance Cost (Rs) :	100	250	400	600	900	1200	1600	2000

When should the machine be replaced?

- 4 Solve the game whose payoff matrix is given below:

Player A	Player B			
	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>
A <sub>1</sub>	3	2	4	0
A <sub>2</sub>	3	4	2	4
A <sub>3</sub>	4	2	4	0
A <sub>4</sub>	0	4	0	8

- 5 In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the interarrival time follows an exponential distribution and the service time distribution is also exponential with an average of 36 minutes. Calculate
- Expected queue size
  - Probability that the queue size exceeds 10
- If the input of trains increases to an average of 33 per day what will be the change in (a) and (b)
- 6 (a) Derive the optimal economic lot size formula in the usual notations when the rate of replenishment is finite. Also find the optimal value of total variable cost.
- (b) A manufacturer has to supply his customer with 600 units of his product per year. Shortages are not allowed and the storage cost amounts to Rs 0.60 per unit per year. The set-up cost per run is Rs 80. Find the optimum run size and the minimum average yearly cost.
- 7 Use dynamic programming to solve the following linear programming problem.
- $$\begin{aligned} &\text{Maximize } Z = 3x_1 + 5x_2 \\ &\text{Subject to constrain } x_1 \leq 4 \\ & \quad \quad \quad \quad \quad x_2 \leq 6 \\ & \quad \quad \quad \quad \quad 3x_1 + 2x_2 \leq 18 \\ & \quad \quad \quad \quad \quad x_1, x_2 \geq 0 \end{aligned}$$
- 8 (a) What are the various types of simulation models? Explain.
- (b) Discuss about the applications of simulation and various simulation languages used.

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## OPERATIONS RESEARCH

(Mechanical Engineering)

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\*\*\*\*\*

- 1 Use the simplex method to solve the following linear programming problem:  
 Maximize  $Z = 3x_1 + 5x_2 + 4x_3$   
 Subject to the constraints  $2x_1 + 3x_2 \leq 8$   
 $2x_2 + 5x_3 \leq 10$   
 $3x_1 + 2x_2 + 4x_3 \leq 15$   
 and  $x_1, x_2, x_3 \geq 0$
- 2 Determine an initial basic feasible solution to the following transportation problem using (a) Least cost method and (b) Vogel's approximation method.

	Destination				Supply
	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	
Source	21	16	15	3	11
	17	18	14	23	13
	32	27	18	41	19
Demand	6	10	12	15	

- 3 A truck owner finds from his past records that the maintenance costs per year of a truck whose purchase price is Rs 8000 are as given below:  
 Year : 1 2 3 4 5 6 7 8  
 Maintenance cost (Rs) : 1000 1300 1700 2000 2900 3800 4800 6000  
 Resale price (Rs) : 4000 2000 1200 600 500 400 400 400
- 4 (a) Define: (i) saddle point (ii) pure and mixed strategies (iii) optimal strategies (iv) rectangular game.  
 (b) Solve the following games by using maximum (minimum) principle whose payoff are given below:

Player A	Player B			
	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>
A <sub>1</sub>	1	7	3	4
A <sub>2</sub>	5	6	4	5
A <sub>3</sub>	7	2	0	3

- 5 A super market has two sales girls at the sales counters. If the service time for each customer is exponential with a mean of 4 minutes, and if people arrive in a poisson fashion at the rate of 10 an hour then calculate the
- (a) Probability that a customer has to wait for service
  - (b) Expected percentage of idle time for each sales girl.
  - (c) If a customer has to wait, what is the expected length of his waiting time.
- 6 Find the optimum order quantity for a product for which price breaks are as follows:
- | Quantity (units) | Price per unit (Rs) |
|------------------|---------------------|
| $0 < Q_1 < 500$  | 10                  |
| $500 \leq Q_2$   | 9                   |
- 7 (a) Define the following dynamic programming terms:  
(i) Stage (ii) State variable (iii) Decision variable (iv) State transformation function
- (b) If which areas of an organization can dynamic programming be applied successfully. Discuss.
- 8 Define simulation. Explain the phases and applications of simulation in practice.



Code: 9A03702

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B.Tech IV Year I Semester (R09) Regular Examinations, November 2012

**AUTOMATION AND ROBOTICS**

(Mechanical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 State advantages and disadvantages of automation. Explain direct and indirect role of computer in manufacturing.
- 2 (a) Explain about automated flow lines.  
(b) Explain analysis of two stage transfer line with storage buffers.
- 3 Explain the following terms related to line balancing:  
(a) Station time.  
(b) Cycle time.  
(c) Line efficiency.  
(d) Balance delay.
- 4 Explain the following grippers with a neat sketch.  
(a) Linkage actuation.  
(b) Gear and rack actuation.  
(c) Cam actuation.  
(d) Screen actuation.
- 5 Calculate the velocity of the trip of the two jointed planar RR manipulator, where first link of the robot is making an angle  $V_0$  w. r. t  $X_0$  and the second link of the robot is making an angle of  $\theta_1$  w.r.t  $x_1$  which is coincident with the first link. Assume the length of each link is one unit.
- 6 Explain the advantages and disadvantages of off-line programming for robot.
- 7 What are the advantages of using pneumatic drives in the robots? Discuss the different types of pneumatic drives used in the robots with the help of neat sketches.
- 8 What type of robot manipulator is best suited for:  
(a) Machine loading and unloading.  
(b) Assembly operations.

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Code: 9A03702

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B.Tech IV Year I Semester (R09) Regular Examinations, November 2012

**AUTOMATION AND ROBOTICS**

(Mechanical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE questions  
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- 1 What is automation? Explain various types of automation.
- 2 Explain analysis of two stage transfer lines with storage buffers.
- 3 Explain the following:
  - (a) Flexible assembly lines.
  - (b) Implementation of automated flow lines.
- 4 Mention any four types of grippers to hold an object with sketches.
- 5 Discuss with an illustrative example for any one type of robot, solution for inverse kinematics problem of robot. Discuss algorithm to be developed for solving multiple solutions.
- 6 A one degree of freedom manipulator with rotary joint is to move from  $113^0$  to  $210^0$  m 7 seconds. Find the coefficients for the cubic polynomial to interpolate a smooth trajectory, plot the position, velocity and acceleration variation as a function of time.
- 7 Explain the principle used in the following sensors.
  - (a) Acoustic sensors.
  - (b) Optical sensors.
  - (c) Pneumatic sensors.
  - (d) Force/Torque sensors.
- 8 Explain the importance of robots in:
  - (a) Spot welding.
  - (b) Spray painting.
  - (c) Arc welding.
  - (d) Assembly.

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B.Tech IV Year I Semester (R09) Regular Examinations, November 2012

**AUTOMATION AND ROBOTICS**

(Mechanical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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- 1 (a) Differentiate between fixed, programmable and flexible automation.  
(b) What are the various technologies used for automation?
- 2 Explain transfer lines with more than two stages with storage buffer.
- 3 (a) Explain the concept of assembly process.  
(b) Define line balancing problem and explain the terminology involved.
- 4 (a) Explain 3 laws of Asimov on robots.  
(b) Show with a neat sketch a 3-degree of freedom robot and also explain its parts.
- 5 Derive the Jacobian matrix for a cylindrical robot with 3 degrees of freedom.
- 6 (a) A joint of a manipulator is required to move from  $\theta = 30^\circ$  to  $150^\circ$  in 5 seconds. Find the cubic polynomial to generate the smooth trajectory for the joint. What is the maximum velocity and acceleration for the trajectory?  
(b) Explain 4 - 3 - 4 trajectory.
- 7 Mention the major advantages and disadvantages of hydraulic actuators over pneumatic actuators.
- 8 (a) Explain the applications robots in an industrial use.  
(b) Explain the following:  
(i) Accuracy. (ii) Precision.

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B.Tech IV Year I Semester (R09) Regular Examinations, November 2012

**AUTOMATION AND ROBOTICS**

(Mechanical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 Discuss the strategies in automation that can be employed to improve productivity in manufacturing operations.
- 2 (a) List objectives of automated storage & retrieval system.  
(b) Explain work in process storage.
- 3 (a) Explain the model variations in manual assembly lines.  
(b) Write a note on flexible assembly lines.
- 4 (a) What is a robot? Describe the function of the basic components of a robot?  
(b) Discuss the reasons for using a robot instead of a human being to perform a specific task.
- 5 What is forward kinematics explain Denavit - Hartenberg conventions for any one type of robot?
- 6 (a) Explain point to point trajectory.  
(b) Explain continuous trajectory.
- 7 (a) Distinguish between tactile and non-tactile sensors sketch and explain the working of an acoustic sensor.  
(b) Distinguish between shunt wound motor and series wound motor sketch and explain the principle of operation of stepper motor.
- 8 (a) What is meant by a robot cell? Explain the different robot cell layouts?  
(b) What is spot welding? Describe briefly the operations involved in robotic spot welding. What are the advantages of robotic welding over manual welding?

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**Code: 9A03703**

B.TECH IV Year I Semester (R09) Regular Examinations, November 2012

**FINITE ELEMENT METHODS**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions  
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- 1 (a) Derive strain-displacement relations for a 3-D elastic body.  
(b) State various application of finite element methods in different field of engineering.
- 2 (a) State properties of global stiffness matrix.  
(b) An aluminum rod tapers uniformly from 50 mm diameter to 25 mm in length of 0.5 m fixed at one end. Find the stress in the bar if it is subjected to an axial tensile load 10 kN at free end. Idealize the rod in to two bar elements.
- 3 A girder 10 m long with the cross-section shown in figure is simply supported over a span of 6 m and carries a uniformly distributed load of 85 N/m. Determine max stress and max deflection in the girder  $E = 206 \text{ GPa}$ .

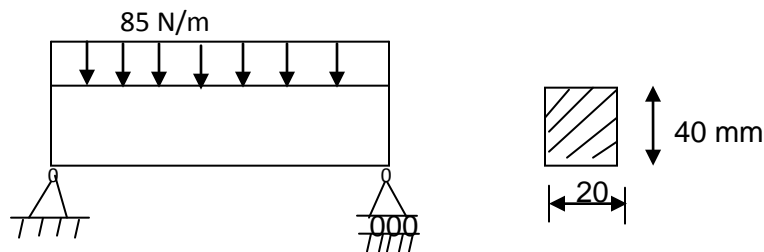


Figure for problem no:3

c/s of beam

- 4 (a) Derive strain-displacement matrix in case CST element.  
(b) Obtain load vector for the following CST element.

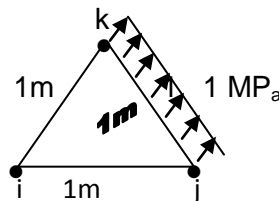


Figure for problem 4(b)

- 5 A set circular plate of diameter 100 mm and thickness 7.5 mm is subjected to a uniformly distributed press of  $345 \text{ KN/m}^2$ . With the axysymmetric approach determine distribution of radial stresses. Take  $E = 200 \text{ GP}_a, \nu = 0.25$ .

Contd. in page 2

- 6 Determine the temperature distribution in stepped circular fin shown in the following figure.

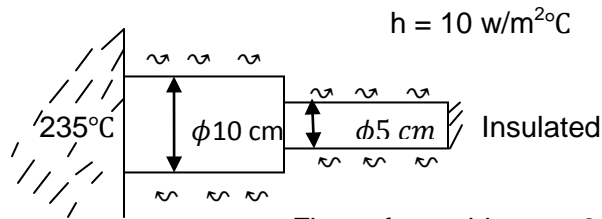


Figure for problem no.6

The thermal conductivity of fin is  $360 \text{ W/m } ^\circ\text{C}$ . Tip is insulated and base (other end) is maintained  $235^\circ\text{C}$ .

- 7 Find the velocity distribution of an in viscid fluid flowing through the tube shown in figure.

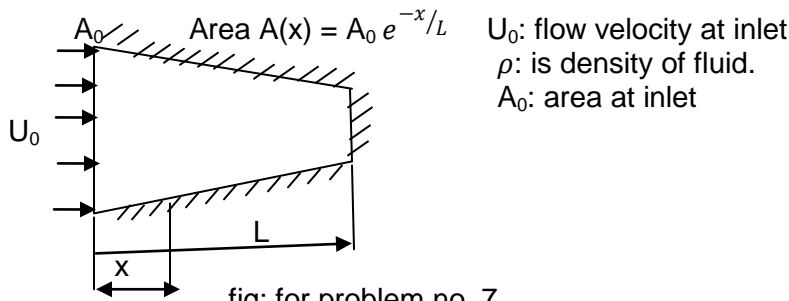


fig: for problem no. 7

- 8 Two ends of axial bar is fixed. Complete the natural frequencies of the bar taking two bar elements, length of axial bar 'L', mass is 'm', young's modulus is 'E', see the following figure.

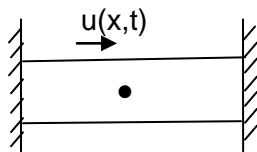


Figure for problem no. 8

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Code: 9A03703

B.TECH IV Year I Semester (R09) Regular Examinations, November 2012

**FINITE ELEMENT METHODS**

(Mechanical Engineering)

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- 1 (a) Derive stress-equilibrium relations for a 3D elastic body, mention assumptions made. Develop governing differential equation of 1D axial bar using stress-equilibrium conditions.  
(b) Compare FEM with FDM (Finite difference method).
- 2 (a) Derive finite element equation for a truss element using transformation matrix.  
(b) A axial bar is subjected to a temperature rise  $30^{\circ}\text{C}$ . Its linear expansion coefficient is  $1.6 \times 10^{-6}/^{\circ}\text{C}$  and young's modulus is 200 GPa. Find temperature stresses in the bar if its two ends are fixed. The cross area of bar is  $100 \text{ mm}^2$  and length is 0.5 m. Use two bar elements to idealise axial bar.
- 3 The beam shown below is subjected to a distributed load  $12 \text{ KN/m}$  and a point load  $5 \text{ KN}$ . The beam cross section is  $0.25 \text{ m} \times 0.1 \text{ m}$ . With the help of suitable beam elements, find deflection at 'D'.

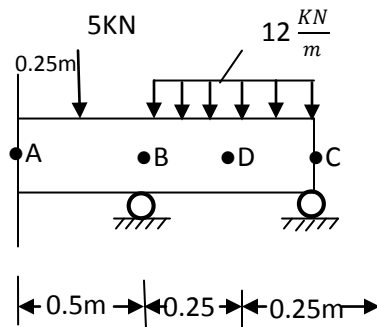


Figure for problem no: 3

- 4 The  $(x, y)$  coordinates of the nodes of a triangular element of thickness 0.2cm are  $(1,4)$ ,  $(5,2)$ ,  $(3,6)$  cms. Its young's modulus is 200 GPa. Poisson ratio 0.3. The edge of element formed by points  $(1,4)$  and  $(5,2)$  is fixed and a load 5 KN is acting at point  $(3,6)$ . Find the nodal displacements.
- 5 A long hollow cylinder of inside diameter 100 mm and outside diameter 140 mm is subjected to an internal pressure of 4 MPa. By using two triangular axisymmetric elements, calculate displacements at the inner radius. Take  $E = 200 \text{ GPa}$   $\nu = 0.25$ .

**Contd. in page 2**

Code: 9A03703

- 6 A vertical wall has three layers having thickness 0.25 m, 0.5 m and 0.25 m respectively. The surface of layer 1 is exposed to  $68^\circ\text{C}$  and surface layer 3 is exposed to  $28^\circ\text{C}$ . The thermal conductivities of these three layers respectively are given by 20, 60 and  $80 \frac{\text{W}}{\text{m}\cdot^\circ\text{C}}$ . Find the nodal temperatures by taking each layer 1D linear element.

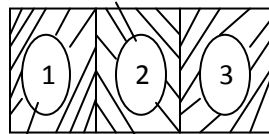


Fig. for problem : 6

- 7 Consider the uniform (ideal flow) flow shown in fig. Use two triangular elements shown to compute the stream function and derive the velocity components.  
U is inlet velocity of stream.

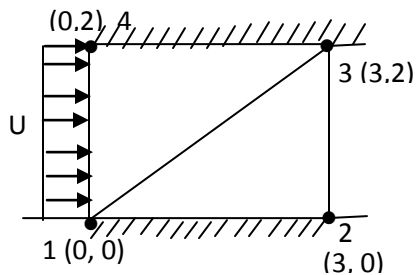


Figure for problem: 7

- 8 Find fundamental frequencies in the beam shown in the following figure using two beam elements as shown.

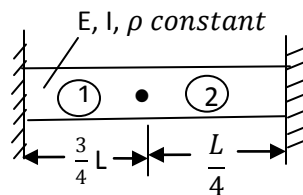


Figure for problem no: 8

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- 1 Find natural frequencies of a fixed beam of length 'L' mass 'M' and moment of inertia 'I'. Young's modulus E. Idealise beam into two elements. Also sketch mode shapes.
- 2 (a) Explain the conditions for plane stress and plane strain problems. Modify 3-D elastic stress-strain relations in to plane stress and plane strain conditions.  
(b) Elaborate advantageous finite element methods as compared to other numerical method.
- 3 (a) Explain with neat mathematical steps to derive beam stiffness matrix.  
(b) Verify the deflection of free end of cantilever beam with a single beam element. Take tip vertical load 'W', length of beam 'L', moment of inertia 'I', and young's modulus 'E'.
- 4 Idealise the following rectangular plate into two triangular CST elements and determine deflection at nodes.

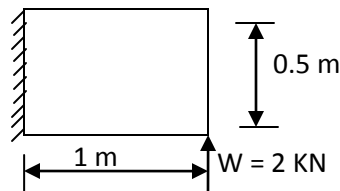


Figure for problem. 4

Take thickness 1mm, young's modulus : 120MPa,  $\gamma = 0.25$ .

- 5 A vertical member is under vertical load of 1 kN and gravity load ' $\rho g$ ' where ' $\rho$ ' mass density  $7200 \frac{kg}{m^3}$  and 'g' is gravity ( $9.81 \frac{m}{sec^2}$ ). The length of member is 1 m and has a square cross-section 0.1x0.1 m. Take young's modulus  $E = 210 \cdot 10^9 \frac{N}{m^2}$  and idealise member into two bar elements. Find stresses in each element by assuming one of its ends rested on the ground.
- 6 (a) Derive shape functions in case of iso parametric quadrilateral element.  
(b) Write down various strain-displacement relations in case a axisymmetric 2D elastic member. Take 'E' young's modulus,  $\gamma$  is poison ratio.

Contd. in page 2

Code: 9A03703

- 7 Consider a circular fin of length 8 cm and diameter 2 cm. Its one of ends subjected to a base temperature  $100^{\circ}\text{C}$  and its lateral surface undergoes convection to a fluid having coefficient  $2500 \text{ W/m}^2\text{C}^{\circ}$  and temperature  $30^{\circ}\text{C}$ . Fin thermal conductivity  $380 \text{ W/mC}^{\circ}$ . With the help of two 1D linear elements of equal length, determine the nodal temperatures and the heat removal rate from the fin.
- 8 Given the three node triangular element shown in following figure, compute the nodal forces corresponding to the flow conditions shown, assuming unit depth into the plane. 'U' flow velocity.

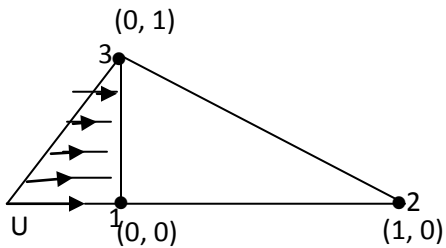


Figure for problem 8

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Code: 9A03703

B.TECH IV Year I Semester (R09) Regular Examinations, November 2012

**FINITE ELEMENT METHODS**

(Mechanical Engineering)

Time: 3 hours

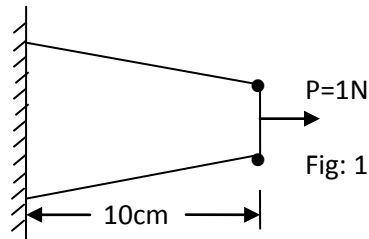
Max. Marks: 70

Answer any FIVE questions &amp; Assume suitable data wherever necessary.

All questions carry equal marks

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- 1 (a) Find the stress distribution in the tapered bar shown in figure 1 using two finite elements under an axial load of  $P = 1\text{N}$ .



Cross sectional area at root and at end are respectively given by  $2\text{ cm}^2$  and  $1\text{ cm}^2$ . Young's modulus is  $2 \times 10^7\text{ N/cm}^2$ .

- (b) Derive transformation matrix for a truss element.
- 2 Find the stress distribution in the beam shown in figure: 2 using two beam elements.

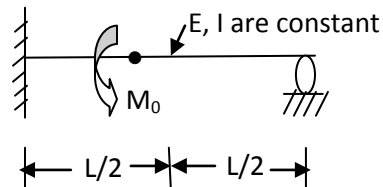
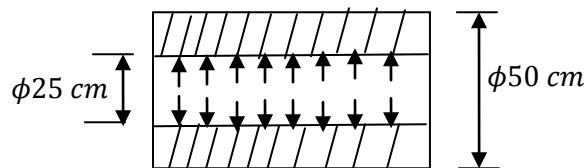


Figure:2

- 3 A thick-walled pressure vessel is subjected to an internal pressure  $p = 5\text{ MPa}$  as shown in figure 3. Model the cross-section of the pressure vessel by taking the advantages of the symmetry of the geometry and load condition. Determine deflection of inner surface.



Take young's modulus  $2 \times 10^5\text{ N/mm}^2$ , poisson ratio: 0.25.

Contd. in page 2

Code: 9A03703

- 4 Triangular element has node coordinates as  $i(20,20)$ ,  $j(40,20)$  and  $k(40,40)$ cm. The components of displacements at nodes  $i,j$  and  $k$  are found to be  $(-0.001, 0.01)$ cm  $(-0.002, 0.01)$  cm and  $(-0.002, 0.02)$  cm respectively. Find
- The distribution displacement components inside the element.
  - The components of displacements of the point  $(30,25)$  cm.
- 5 (a) Consider the following state of stress in 2D problem  
 $\sigma_x = x^2$ ,  $\sigma_y = y^2$ ,  $\tau = xy$ .  
 Assume body forces are zero. Determine whether the stress equilibrium equations are satisfied or not.
- (b) Explain the general steps in F.E.M.
- 6 Find the natural frequencies and mode shapes for the following cases.
- One element axial bar, one of its end is fixed.
  - One element of cantilever beam.
- Use usual notations for material and geometry properties.
- 7 A wall consists of 4 cm thick wood, 10 cm thick glass fiber insulation and 1 cm thick plaster. If the temperatures on the wood and plaster faces are  $20^\circ\text{C}$  and  $-20^\circ\text{C}$ , respectively. Determine the temperature distribution in the wall with 1D linear element approach. Assume thermal conductivities of wood, glass fiber and plaster as 0.17, 0.035 and 0.5  $\text{W/m}\cdot^\circ\text{C}$ , respectively. The convective heat transfer coefficient on the colder side of the wall as  $25 \text{ W/m}^2\cdot^\circ\text{C}$ .
- 8 Given the uniform (ideal) flow, use two triangular elements as shown in figure and compute the stream function and derive the velocity components at 'B' which has coordinates  $(1.5, 1)$ .

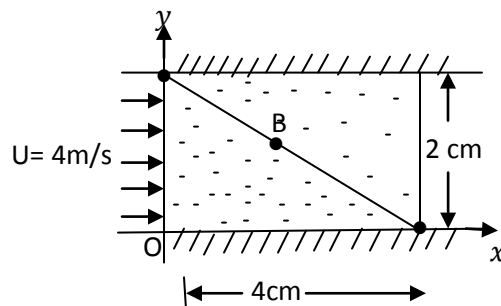


Figure for problem:8

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**Code: 9A03704**

B.TECH IV Year I Semester (R09) Regular Examinations, November 2012

**INSTRUMENTATION & CONTROL SYSTEMS**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 Explain the function of various elements in a generalized measuring system through a block diagram.
- 2 (a) Explain the operating principle of an LVDT with a diagram.  
(b) Describe, with a sketch, the working principle of the inductive transducer.
- 3 (a) Describe, with neat sketch any one method of low pressure measurement.  
(b) What is diaphragm pressure gauge? Explain its operation.
- 4 (a) Explain the working principle of rotometer with a neat diagram.  
(b) What are bubbler level indicators? Describe their working.
- 5 (a) Explain the working principle of a vibrometer with a neat sketch.  
(b) Describe the working principle of stroboscope with a neat sketch.
- 6 (a) Explain the procedure to measure axial strain using strain gauges.  
(b) Explain the procedure to measure strain due to bending, using strain gauges.
- 7 (a) Explain the working principle of a sling psychrometer with a neat sketch.  
(b) Describe how the torque and power are measured by using a prony brake dynamometer.
- 8 (a) Explain the temperature control system with a neat sketch.  
(b) Explain the speed control system with neat sketch.

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Code: 9A03704

B.TECH IV Year I Semester (R09) Regular Examinations, November 2012

**INSTRUMENTATION & CONTROL SYSTEMS**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 (a) What are the different measurement methods? Explain briefly.  
(b) What are the different types of errors in the measurement? Explain briefly.
- 2 (a) Explain with a sketch, the working principle of the ionization transducer.  
(b) Describe the working principle of an electrical resistance thermometer.
- 3 (a) Explain the concept of pressure measurement using diaphragm gauges.  
(b) Describe the working of McLeod gauge with a neat sketch.
- 4 (a) Describe the working principle of a turbine flow meter with a neat diagram.  
(b) What are cryogenic fuel level indicators? Describe their working.
- 5 (a) Explain the principle of operation of any one non-contact type tachometer.  
(b) Describe the working principle of a piezo-electric accelerometer.
- 6 (a) What is temperature compensation in strain gauge? How is it achieved?  
(b) Distinguish between two-gauge bridge system and far-gauge bridge system for strain measurement.
- 7 (a) How is a hydraulic cell used for force measurement? Explain.  
(b) Describe the working principles of a dew point meter with a neat sketch.
- 8 (a) What is a servo mechanism? Where it is used.  
(b) Distinguish between open loop and closed loop control system.

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Code: 9A03704

B.TECH IV Year I Semester (R09) Regular Examinations, November 2012

**INSTRUMENTATION & CONTROL SYSTEMS**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 (a) What do you mean by instrumentation?  
(b) State and explain the desirable static characteristics of an instrument?
- 2 (a) Explain the operating principle of a piezo-electric transducer with diagram.  
(b) Describe the working principle of a radiation pyrometer with a diagram.
- 3 (a) Define the following terms:  
(i) Absolute pressure (ii) Gauge pressure (iii) Vacuum pressure.  
(b) Describe the working principle of pirani gauge with neat sketch.
- 4 (a) With a neat sketch, explain the operation of a magnetic flow meter.  
(b) Explain the working principle of an ultrasonic fluid level detector.
- 5 (a) Sketch and explain the working principle of eddy current tachometer.  
(b) Explain how a vibrometer is calibrated to measure acceleration.
- 6 (a) How do you use a resistance strain gauge to measure compressive strain? Explain.  
(b) What is strain gauge rosette? Explain its importance.
- 7 (a) Describe how the torque and power are measured by using a rope brake dynamometer.  
(b) Explain the working principle of dew point meter with neat sketch.
- 8 (a) What are the different types of control system? Explain them with block diagrams.  
(b) Explain the position control system with a neat sketch.

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**Code: 9A03704**

B.TECH IV Year I Semester (R09) Regular Examinations, November 2012

**INSTRUMENTATION & CONTROL SYSTEMS**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 (a) What is measurement system and explain its elements?  
(b) Explain its dynamic characteristics of measuring systems.
- 2 (a) Explain with a sketch, the working principle of the capacitive transducers.  
(b) Explain with a sketch, the working principle of the inductive transducer.
- 3 (a) Explain the working of a bellows pressure gauge.  
(b) What is a differential manometer? Explain its principle of operation.
- 4 (a) Describe, with a neat sketch, the principle of operation of a laser Doppler anemometer.  
(b) Explain the working principle of a capacitance type fluid level detector.
- 5 Explain the following:  
(i) Stroboscope (ii) Accelerometer
- 6 (a) Name the various types of strain gauges for different application.  
(b) Distinguish between bonded and unbonded type of strain gauge.
- 7 (a) Describe the working principle of a absorption pychrometer with a neat sketch.  
(b) Describe how the torque and power are measured by using eddy current dynamometer.
- 8 (a) Explain any one control system with a neat sketch.  
(b) Difference between open loop and closed loop control system.

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Code: 9A03707

1

B.Tech IV Year I Semester (R09) Regular Examinations, November 2012

**MECHATRONICS**  
(Mechanical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 (a) Explain the steps that might be present in the sequential control of a dish masher.  
(b) Name any two PC based control systems and explain them briefly.
- 2 (a) With the help of simple sketches, explain low pass passive filter and low pass active filter.  
(b) Explain the importance of using signal conditioning.
- 3 (a) Explain the applications of hydraulic actuator systems.  
(b) Explain with a suitable illustration, how a linear motion is used to produce rotary movement.
- 4 (a) What is CMOS? Explain its function.  
(b) Explain the various protection schemes used in mechatronic systems.
- 5 What are the basic components of a relay? Explain the basic function of each relay.
- 6 Compare and contrast between analog to digital converters (ADC) and digital to analog convertors (DAC).
- 7 (a) Describe the procedure for solving a rung of logic.  
(b) What are the two steps which a PLC must perform during its operation?
- 8 Discuss the control system performance for the proportional, integral and derivative controllers in corporate in a transfer function.

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Code: 9A03707

2

B.Tech IV Year I Semester (R09) Regular Examinations, November 2012

**MECHATRONICS**  
(Mechanical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 (a) What is simulation? Explain its use in CNL machine tools.  
(b) Discuss the important applications of mechatronic systems.
- 2 Explain the following:  
(a) Signal conditioning forces.  
(b) Applications of amplifiers.
- 3 (a) Explain the following precision mechanical systems:  
(i) Ball screw and nut. (ii) Linear motion guides.  
(b) Discuss the factors that have to be considered in the drive selection.
- 4 Discuss in detail about the operating principles and common base characteristics of bipolar junction transistor.
- 5 Describe the construction and working principle of variable reluctance stepper motor and also write about its application.
- 6 Explain the interrupt handling mechanisms in 8051 microcontroller.
- 7 Explain with the help of ladder rungs the simple jump control mechanism in a programmable logic controller.
- 8 Explain the principle of operation of capacitive proximity sensor with a neat diagram.

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Code: 9A03707

3

B.Tech IV Year I Semester (R09) Regular Examinations, November 2012

**MECHATRONICS**  
(Mechanical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 What are the different control methods used in mechatronics? Discuss them with suitable examples.
- 2 (a) Explain the functions of signal conditioning equipment.  
(b) Explain the AC signal conditioning systems.
- 3 (a) What are the various complements used in pneumatic systems? Explain them briefly.  
(b) Discuss the factors that have to be considered in a motor selection.
- 4 What do you mean by MOSFET? Explain the MOSFET instruction and symbols. Discuss also about the depletion mode and enhancement mode of MOSFET.
- 5 Explain the construction and principle of operation of DC servomotor with a neat sketch.
- 6 (a) What is a microcontroller? What are the components of microcontroller? Explain.  
(b) What is the input of microcontroller on society?
- 7 Explain how a data is handled by timers, counters, relays and registers with example.
- 8 Discuss the advantages and disadvantages of P, P1, PD and PID controllers.

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Code: 9A03707

4

B.Tech IV Year I Semester (R09) Regular Examinations, November 2012

**MECHATRONICS**  
(Mechanical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 (a) Compare the open loop and closed loop control systems.  
(b) What are the functions of a PC based real time control system? Discuss its applications in robots.
- 2 (a) What are the desirable characteristics of electronic amplifiers?  
(b) Explain the classification of filters based on passing and attenuating of frequencies.
- 3 Describe the following systems:  
(a) Timing belts.  
(b) Linear bearing.  
(c) Electro pneumatic
- 4 Discuss about the following types of electronic interface subsystems.  
(a) CMOS interfacing.  
(b) Sensor interfacing.  
(c) Actuator interfacing.
- 5 Discuss the advantages and disadvantages of variable frequency drives.
- 6 Explain in detail about microprocessor structure.
- 7 What is a PLC? How it is different form a microcontroller? What are the advantages of PLC compared to a microcontroller?
- 8 (a) Explain the working of following types of position sensors:  
(i) Potentiometer. (ii) Resolver.  
(b) Explain the proportional mode control.

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B.Tech IV Year I Semester (R09) Regular Examinations November 2012

**MODERN MANUFACTURING METHODS**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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1. Explain the need for the use of non-traditional machining processes compared to the traditional ones.
2. (a) Discuss the effects of the following parameters on MRR as applied to usm process:
  - (i) Amplitude and frequency of vibrations.
  - (ii) Grain size.
  - (iii) Applied static load.
  - (iv) Effect of slurry.(b) Discuss briefly the advantages and disadvantages of ultrasonic machining.
3. (a) With a neat sketch explain the working principle of abrasive jet machining.  
(b) Mention the advantages and applications of water jet machining.
4. Explain the principle, working and advantages of electro chemical machining process.
5. (a) Explain the mechanics of material removal in electrical discharge machining.  
(b) What are the functions served by the dielectric fluid in EDM?
6. Explain the process of laser beam machining highlighting the applications, advantages and disadvantages of the process.
7. (a) What is the principle involved in chemical machining? Explain with suitable sketches.  
(b) What is the role of Maskants and Etchants in chemical machinery? Name few.
8. What is rapid prototyping? Explain the process of stereo lithography for manufacturing prototypes.

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Code: 9A03708

2

B.Tech IV Year I Semester (R09) Regular Examinations November 2012

**MODERN MANUFACTURING METHODS**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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1. Give a comparison of the non-traditional processes in terms of process, material removal rate and applications.
2. (a) Explain how material is removed in ultrasonic machining.  
(b) Briefly explain the functions of transducer and tool cone in usm.
3. With a neat sketch explain the principle of working of water jet machining highlighting the advantages and limitations of the process.
4. What are the various Electro chemical processes used for material removal? Enumerate the principle differences in working in these processes.
5. (a) Explain the principle of EDM with a neat sketch.  
(b) What are the characteristics required for a good electrode material in electrical discharge machining?
6. Explain the principle, applications, merits and demerits of electron beam machining of process.
7. (a) Explain plasma Arc machining process with a neat sketch.  
(b) Mention advantages, disadvantages and applications of plasma Arc machining process.
8. How are rapid prototyping techniques different than conventional techniques? Explain the process of selective laser sintering in producing prototypes?

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Code: 9A03708

3

B.Tech IV Year I Semester (R09) Regular Examinations November 2012

**MODERN MANUFACTURING METHODS**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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1. (a) Explain the reasons, why the non-traditional machining processes are used.  
(b) Explain the basic differences between traditional and non-traditional machining process.
2. Explain the principle and working of ultrasonic machining process. List out the advantages and applications of the process.
3. What is abrasive water jet machining? Explain its principle of operation.
4. (a) Explain the process parameters that affect the material removal rate and surface quality in electro chemical machining.  
(b) Explain the principle of Electro chemical grinding.
5. (a) What are the important parameters that control the material removal rate in electrical discharge machining? Briefly explain any two factors.  
(b) Write a short note on wire electric discharge machining process.
6. What is electron beam machining? Sketch its set up and indicate its main elements on it? What are the advantages and disadvantages of the process?
7. Explain the steps involved in chemical machining with sketch. What are the advantages and applications of the process?
8. (a) Explain the principle of operation of magnetic abrasive finishing process.  
(b) Explain the principle applications of electro stream drilling process.

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Code: 9A03708

4

B.Tech IV Year I Semester (R09) Regular Examinations November 2012

**MODERN MANUFACTURING METHODS**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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1. (a) What do you understand by the term non-traditional machining methods? What is their importance?  
(b) Classify the common non-traditional methods. Give a list of such operations.
2. With a neat sketch explain the elements involved in the ultrasonic machining process.
3. (a) What is abrasive jet machining process? Explain its principle of operation.  
(b) What are the main advantages, disadvantages and industrial applications of abrasive jet machining?
4. (a) What are the principle features of ECM process? Briefly explain the working of an electro chemical machine.  
(b) What are the functions served by the Electrolyte in electro chemical machining?
5. (a) Explain the generation and control of Electron beam in electron beam machining process.  
(b) Explain the advantages and industrial applications of electron beam machining process.
6. Explain the process parameters that effect the material removal rate and surface quality in plasma machining.
7. (a) Explain why the tool shape in EDM should be complimentary to the final form.  
(b) Draw a typical relaxation circuit used for the EDM power supply and derive the expression for the material removal rate.
8. What are the various rapid prototyping techniques available commercially? Explain the difference between selective laser sintering and stereo lithography in terms of principle of working.

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