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06ME71

Seventh Semester B.E. Degree Examination, May/June 2010
Control Engineering

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What are the requirements of an ideal control system? **(05 Marks)**

b. Differentiate between open loop and closed loop control systems. **(05 Marks)**

c. What are the characteristics of an integral controller? **(05 Marks)**

d. Describe a controller which will improve the transient behavior of the system. **(05 Marks)**

2 a. Write the transfer functions for the mechanical system shown in Fig.2(a). **(10 Marks)**

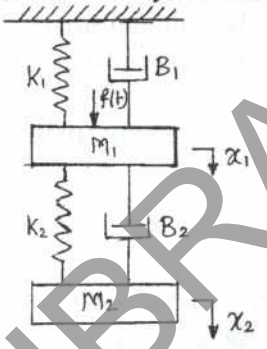

Fig.2(a)

b. Draw equivalent electrical circuits for the above mechanical system using voltage-force and current-force analogy. **(10 Marks)**

3 a. Use block diagram reduction to obtain the overall transfer function of the system shown in Fig.3(a). **(10 Marks)**

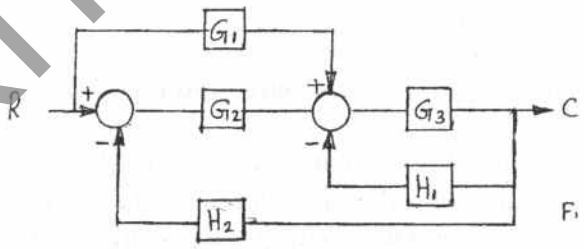

Fig.3(a)

b. Obtain the overall transfer function C/R from the signal flow graph shown in Fig.3(b). **(10 Marks)**

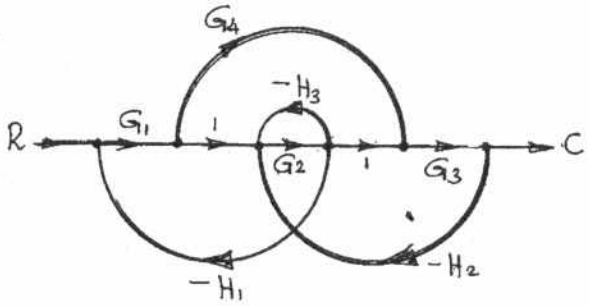

Fig.3(b)

4 a. Derive the response of a first order system, subjected to unit step function input. Explain the importance of time constant on speed of response. **(10 Marks)**

b. By applying Routh criterion, discuss the stability of the closed loop system whose characteristic equation is $S^6 + 3S^5 + 4S^4 + 6S^3 + 5S^2 + 3S + 2 = 0$. **(10 Marks)**

PART – B

5 The open loop transfer function of a unity feedback system is

$$G(S) = \frac{K}{S(1+S)(1+0.125S)}.$$

Draw the polar plot and determine :

i) The value of K so that the gain margin of the system is 32 db.

ii) The value of K so that the phase margin of the system is 60°. **(20 Marks)**

6 The open loop transfer function of a unity feedback system is

$$G(S) = \frac{K(1-0.1S)}{S(1+S)(1+0.1S)}.$$

By sketching the Bode asymptotic plot, determine:

i) Gain crossover frequency and phase crossover frequency when K = 1

ii) The value of K so that the gain margin as the system is 30 db

iii) The values of K so that the phase margin of the system is 60°. **(20 Marks)**

7 The open loop transfer function of a unity feedback system is

$$G(S) = \frac{K}{S(S+2)(S^2+2S+2)}.$$

Sketch the root locus plot and determine :

i) Limiting value of K for stability

ii) The values of K so that the damping ratio is 0.707. **(20 Marks)**

8 a. What is a compensator? How are compensators classified? **(05 Marks)**

b. Derive the transfer function of lag network and find the frequency at which the phase angle lag of a lag network is maximum. What are the characteristics of a lag compensator? **(15 Marks)**

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06ME72

Seventh Semester B.E. Degree Examination, May/June 2010
Computer Integrated Manufacturing

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What do you mean by automation? Explain different types of automation. **(10 Marks)**

b. Explain the following terms:
i) Manufacturing lead time ii) Production rate iii) Production capacity. **(10 Marks)**

2 a. With suitable examples, explain the methods for work-part transport on a flow line. **(10 Marks)**

b. Sketch and explain the following transfer mechanisms:
i) Roller chain drive mechanism ii) Geneva wheel mechanism. **(10 Marks)**

3 a. Explain the upper bound approach and lower bound approach in analyzing transfer lines, without storage buffer. **(08 Marks)**

b. Give your conclusion on the basis of cost calculations, whether the performance of 12 station transfer line having 4 manual and 8 automated stations can be improved by replacing bottleneck manual station with an automated station. Cost data for the existing line:
i) C_m – Rs.0.65/unit ii) T_c – 40 seconds iii) C_o – Rs. 0.25/min
iv) C_{as} – Rs.0.35/min ii) C_{at} – 0.30/min vi) C_t – Rs. 0.15/min
The proposed automated stations would allow the cycle time to be reduced to 32 seconds, with added cost of Rs.0.40/min. Probability of breakdown for 8 stations, p = 0.01 and estimated probability for new automated station p = 0.02 with downtime of 3 minutes, which is unaffected. **(12 Marks)**

4 a. Explain the following:
i) Work station process time ii) Cycle time iii) Precedence diagram iv) Balance delay. **(08 Marks)**

b. The following table defines the precedence relationship & element times in an assembly line.

Elements	T_e (min)	Immediate predecessors
1	0.2	-
2	0.4	-
3	0.7	1
4	0.1	1, 2
5	0.3	2
6	0.11	3
7	0.32	3
8	0.6	3, 4
9	0.27	6, 7, 8
10	0.38	5, 8
11	0.5	9, 10
12	0.12	11

i) Construct the precedence diagram ii) Use the largest candidate rule to assign work elements to stations. What is the balance efficiency for the solution? **(12 Marks)**

5 a. Explain with sketches, the elements of the parts delivery system for an automated assembly line. **(10 Marks)**

b. Explain the approach for the quantitative analysis of AGV systems. **(10 Marks)**

6 a. Briefly explain:
   i) Retrieval CAPP system.
   ii) Generative CAPP system **(10 Marks)**

b. Discuss the fundamental concepts and inputs of a MRP system. **(10 Marks)**

7 a. Define CNC. Explain with a neat sketch, the elements of CNC. **(10 Marks)**

b. What are the fundamental steps involved in the development of part programming for milling? **(10 Marks)**

8 a. What do you understand by robotics? Explain with a neat figure, the robot configuration. **(10 Marks)**

b. Briefly explain the different steps of robot programming. **(10 Marks)**

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06ME74

Seventh Semester B.E. Degree Examination, May/June 2010
Operations Research

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of statistical tables is permitted.***

PART – A

1 a. Briefly explain the scopes of operation research. **(05 Marks)**

b. A farmer has a 100 acre farm. He can sell all tomatoes, lettuce or radishes and can rise the price to obtain Rs.1.00 per kg for tomatoes, Rs.0.75 ahead for lettuce and Rs.2.00 per kg for radishes. The average yield per acre is 2000 kgs of tomatoes, 3000 heads of lettuce and 1000 kgs of radishes. Fertilizers are available at Rs.0.50 per kg and the amount required per acre is 100 kgs each for tomatoes and lettuce and 50 kgs for radishes. Labour required for sowing, cultivating and harvesting per acre is 5 man-days for tomatoes and radishes and 6 man-days for lettuce. A total of 400 man days of labour are available at Rs.20 per man-day. Formulate this problem as a linear programming model to maximize the farmer's total profit. **(15 Marks)**

2 a. Obtain the dual of the following LP problem:

Minimize, $Z = 2x_1 + 3x_2 + 4x_3$

Subject to, $2x_1 + 3x_2 + 5x_3 \geq 2$

$3x_1 + x_2 + 7x_3 = 3$

$x_1 + 4x_2 + 6x_3 \leq 5$

$x_1, x_2 \geq 0$ and x_3 is unrestricted. **(06 Marks)**

b. Solve the following LPP by using two phase simplex method:

Maximize, $Z = 3x_1 + 2x_2 + 2x_3$

Subject to, $5x_1 + 7x_2 + 4x_3 \leq 7$

$-4x_1 + 7x_2 + 5x_3 \geq -2$

$3x_1 + 4x_2 - 6x_3 \geq 29/7$

$x_1, x_2, x_3 \geq 0$ **(14 Marks)**

3 a. List out the differences between transportation and assignment problems. **(06 Marks)**

b. A product is produced by four factories A, B, C and D. The unit production costs in them are Rs 2.00, Rs 3.00, Rs 1.00 and Rs 5.00 respectively. Their production capacities are factory A = 50 units, B = 70 units, C = 30 units and D = 50 units. These factories supply the product to four stores, demands of which are 25, 35, 105 and 20 units respectively. Unit transport cost in rupees from each factory to each store is given in the table below:

	Stores			
Factories	1	2	3	4
A	02	04	06	11
B	10	08	07	05
C	13	03	09	12
D	04	06	08	03

Determine the extent of deliveries from each of the factories to each of the stores so that the total production and transportation cost is minimum. **(14 Marks)**

4 a. There are five jobs, each of which must go through machines A, B and C in the order ABC Processing times are given in the table below:

Job	Processing times (Hrs)		
	A	B	C
1	8	5	4
2	10	6	9
3	6	2	8
4	7	3	6
5	11	4	5

Determine a sequence for five jobs that will minimize the elapsed time T. **(10 Marks)**

b. The owner of a small machine shop has four machinists available to do jobs for the day. Five jobs are offered with expected profit for each machinist on each jobs as follows:

	1	2	3	4
A	32	41	57	18
B	48	54	62	34
C	20	31	81	57
D	71	43	41	47
E	52	29	51	50

Find by using assignment method, the assignment of machinist to jobs that will result in a maximum profit. **(10 Marks)**

PART – B

5 a. List out the differences between PERT and CPM. **(06 Marks)**

b. Arrival rate of telephone calls at a telephone booth are according to Poisson distribution, with an average time of 9 minutes between two consecutive arrivals. The length of telephone calls is assumed to be exponentially distributed with mean 3 minutes.

i) Determine the probability that a person arriving at the booth will have to wait.

ii) Find the average queue length.

iii) The telephone company will install a second booth when convinced that an arrival would expect to have to wait at least four minutes for the phone. Find the increase in flow arrivals which will justify a second booth.

iv) What is the probability that an arrival will have to wait for more than 10 minutes before the phone is free? **(14 Marks)**

6 a. Briefly explain queuing system and their characteristics. **(05 Marks)**

b. The below table shows the jobs of a network along with their time estimates. The time estimates are in days :

Jobs	1 – 2	1 – 6	2 – 3	2 – 4	3 – 5	4 – 5	5 – 8	6 – 7	7 - 8
a	3	2	6	2	5	3	1	3	4
m	6	5	12	5	11	6	4	9	19
b	15	14	30	8	17	15	7	27	27

i) Draw the project network ii) Find the critical path

iii) Find the probability that the project is completed in 31 days. **(15 Marks)**

7 a. Explain clearly the following terms : **(06 Marks)**

i) Pay off matrix ii) Saddle point iii) Two person zero sum game

b. In a game of matching coins with two players suppose "A" wins one unit of value when there are two heads, wins nothing when there are two tails and losses half unit of value when there are one head and one tail. Determine the payoff matrix, the best strategies for each player and the value of game to "A". **(14 Marks)**

8 a. Explain the importance of integer programming. **(05 Marks)**

b. Find the optimum integer solution to the following LPP:

Maximum, $Z = x_1 + x_2$; subject to $3x_1 + 2x_2 \leq 5$; $x_2 \leq 2$; $x_1, x_2 \geq 0$, are integers. **(15 Marks)**

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06ME754

Seventh Semester B.E. Degree Examination, May/June 2010
Solar Energy

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What are the advantages and limitations of renewable energy sources? **(10 Marks)**

b. What is solar constant? Discuss spectral distribution of extraterrestrial solar radiation. **(10 Marks)**

2 a. Explain beam, diffuse and global radiation. **(06 Marks)**

b. Sketch and explain the working principle of equipments used to measure the beam radiation flux and number of sunshine hours in a day at any given location. **(14 Marks)**

3 a. Calculate the length of the shadow cast on the ground by a 1 m long vertical stick for the following situation:

Location : Mumbai (19°07′N,72°51′E)

Date: February 13, 1980

Time : 10:00 AM (IST)

Take equation of time correction, E = −12′10″ **(10 Marks)**

b. Define the following: i) Declination ii) Lattitude angle iii) Hour angle and iv) Solar azimuth angle **(04 Marks)**

c. Calculate the hour angle at sunrise and sunset on June 21 and December 21 for a surface inclined at an angle of 10° and facing due south ($\gamma = 0°$). The surface is located in Mumbai (19°07′N, 72°51′E). **(06 Marks)**

4 a. Sketch and explain the principle of working of a simple flat plate collector and list its advantages. **(10 Marks)**

b. Sketch and explain the construction and working principle of a salt concentration gradient solar pond. **(10 Marks)**

PART – B

5 a. What is the principle of solar photovoltaic power generation? What are the main elements of a PV system? **(10 Marks)**

b. Describe any three types of solar cells commercially available. **(10 Marks)**

6 a. State the energy balance equation for a simple flat plate collector under state condition and discuss the terms in the equation. **(06 Marks)**

b. Define instantaneous efficiency and stagnation temperature with reference to flat plate collector. **(04 Marks)**

6 c. Calculate the reflectance of one surface of glass for an angle of 75°. The average index of refraction of glass for the solar spectrum is 1.526. Also calculate the reflectance for normal incidence and transmittance for the same single glass neglecting any absorption.

[Correlation for reflectance, $\rho = \frac{1}{2}\left[\frac{\sin^2(\theta_2-\theta_1)}{\sin^2(\theta_2+\theta_1)} + \frac{\tan^2(\theta_2-\theta_1)}{\tan^2(\theta_2+\theta_1)}\right]$, for normal incidence $\rho = \left[\frac{(n_1-n_2)}{(n_1+n_2)}\right]^2$] **(10 Marks)**

7 a. Discuss the effect of following parameters on the performance of a flat plate collector:
i) Number of covers ii) Effect of shading
iii) Incident solar flux iv) Fluid inlet temperature and
v) Dust on the top cover. **(10 Marks)**

b. Explain the following with reference to solar concentrator:
i) Aperture area ii) Acceptance angle
iii) Geometrical concentration ratio iv) Brightness concentration ratio and
v) Optical efficiency. **(05 Marks)**

c. Write a note on selective surfaces. **(05 Marks)**

8 a. A cylindrical parabolic concentrator with width 2.0 m and length 8 m has an absorbed radiation, per unit area aperture, of 400 W/m^2. The receiver is a cylinder painted flat black and surrounded by an evacuated glass cylindrical envelope. The absorber has a diameter of 55 mm and the transparent envelope has a diameter of 85 mm. The collector is designed to heat a fluid entering the absorber at 220°C at a flow rate of 0.04 kg/s. The value of C_p for the fluid is 3.26 KJ/kg°C. The heat transfer coefficient inside the tube is 280 W/m^2°C and the overall loss coefficient is 12 W/m^2°C. The tube is made of stainless steel (K = 16 W/m°C) with a wall thickness of 5 mm. If the ambient temperature is 22°C, calculate the useful gain and exit fluid temperature. Correlations given

$$F' = \frac{1/v_2}{\frac{1}{v_2} + \frac{D_o}{hf_iD_i} + \left(\frac{D_o}{2K}\ln\frac{D_o}{D_i}\right)}; F_R = \frac{niC_p}{v_2}\left[1-\exp\left(-\frac{v_2F'}{niC_p}\right)\right]; Q_u = A_aF_R\left[S - \frac{A_rv_2}{A_a}(T_{fi}-T_a)\right]$$

(10 Marks)

b. Write a note on tracking methods for two and three dimensional concentrators. **(10 Marks)**

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06ME762

Seventh Semester B.E. Degree Examination, May/June 2010
Engineering System Design

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. "Designing includes the transformation of all ideas into reality." Is this statement true? Discuss with examples. **(06 Marks)**

b. Explain in brief, with neat sketches, the significant developments indicating evolution of the bicycle to the present form. **(08 Marks)**

c. Explain in brief, 'convergence phase' of the design process. **(06 Marks)**

2 a. State the goals of design in the following situations:
i) Air-conditioning of public buildings, which are used by a large number of persons, carrying luggage, possibly both their hands. ii) Grain being destroyed by mice. **(06 Marks)**

b. Consider a dining hall, where 400 persons take their meals everyday, everyone washing and drying the hands before and after meals. It is required to design a system for the purpose of drying the hands. For this problem state i) the need statement and ii) specifications and standards of performance. **(08 Marks)**

c. Explain in brief, "specifications" of a design problem. **(06 Marks)**

3 a. "One of the greatest hindrances to design effort is the tendency of most people to get into a mental rut". Explain this statement with examples. **(06 Marks)**

b. Explain the use of AIDA technique for fresh design ideas for a garden chair. **(08 Marks)**

c. Write a brief note on 'Brain writing'. **(06 Marks)**

4 a. What is a model? State the difference between descriptive model and predictive model, giving an example for each. **(06 Marks)**

b. Explain in brief, the characteristics of a 'mathematical model.' **(08 Marks)**

c. Explain in brief, the concept of sensitivity. **(06 Marks)**

PART – B

5 a. Explain how 'Design tree' can be used to measure the physical realizability of various design concepts. **(10 Marks)**

b. Two design concepts A and B are to be evaluated on the basis of four quality dimensions. The table below shows the estimates of preference on a scale of 0 to 10, for each dimension.

Quality dimension	Preferences for design concept	
	A	B
Protection	6	9
Reliability	9	5
Adaptability	4	9
Cost	9.5	4

Determine the overall utility of design concepts A & B if
i) Preferences satisfy the property 'indifference'. ii) The weights for quality dimensions are protection 0.45; Reliability 0.15; Adaptability 0.1 and Cost 0.30. **(10 Marks)**

6 a. If a device has a constant failure rate of 2×10^{-6} failure/hour, what is its reliability in an operating period of 500 hours? If there are 4000 items in the test, how many failures are expected in 500 hours? **(06 Marks)**

b. What is reliability? Sketch typical forms of failure curve for
i) an electric equipment ii) a mechanical equipment. **(08 Marks)**

c. Determine the reliability of the system shown in Fig.Q6(c).

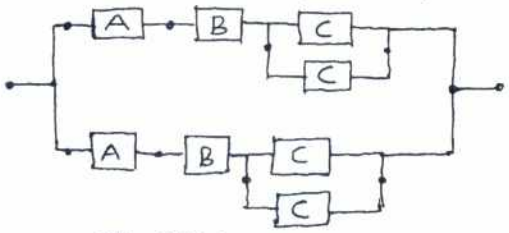

Fig.Q6(c)

Reliability of
A = 0.9
B = 0.8
C = 0.7

(06 Marks)

7 a. A small company makes curtain rods of standard sizes 2 m in length. There are 3 materials A, B and C which can be used for this. Each material calls for a different process and machine for manufacturing. Their cost data is shown below:

Item	Material 'A'	Material 'B'	Material 'C'
Raw material (Rs./m)	2.2	2.5	2.6
Equipment cost (Rs./year)	5000	3000	4000
Labour cost (Rs./rod)	0.50	0.60	0.20

Draw the total cost verses the yearly production volume curve for each of the three materials. If a sales volume of 10,000 rods per year is anticipated, which material should be used? What should be the selling price of each rod for break-even? **(10 Marks)**

b. A small shop makes two types of tumbler locks, having the following requirements:

Lock type	Turning (min)	Grinding (min)	Assembly (min)	Cost of material (Rs.)	Sales price (Rs.)
A	5	5	5	1.2	5
B	4	8	6	1.3	15

The availability of turning is 40 hrs. per day at Rs.10 per hour, of grinding is 50 hours at Rs.15 per hour and of assembly is 50 hrs at Rs. 5 per hour. Formulate the problem as LPP for maximization of profit. (No need to solve). **(10 Marks)**

8 a. Explain in brief, the man-machine cycle. **(08 Marks)**

b. Sketch various displays and controls. State clearly their advantages & limitations. **(12 Marks)**

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