

(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 2762**

Roll No.

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**B.Tech.**

(SEM. VII) ODD SEMESTER THEORY

EXAMINATION 2013-14

**MECHANICAL SYSTEM DESIGN**

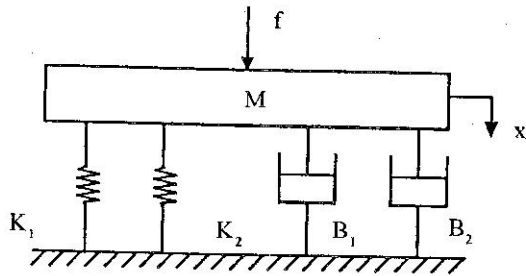
*Time : 3 Hours*

*Total Marks : 100*

**Note :-** Attempt all the questions. All questions carry equal marks.

1. Attempt any **four** parts : (5×4=20)
  - (a) Explain the role of engineer in Mechanical System Design. Briefly explain application of systems concepts engineering.
  - (b) Explain the difference between 'statement of need' and 'definition of the problem'. Explain with the help of an example.
  - (c) Explain the role of concurrent engineering and its influence on product development and design.
  - (d) What is meant by morphology of design ? What are ideation techniques ?
  - (e) What is meant by entity, attributes and activities for a system ? Write entity attributes and activities for a manufacturing system, bank and supermarket.
  - (f) Give suitable example to explain an activity for carrying out the need analysis of the design of a product.

2. Attempt any **two** parts : (10×2=20)
- (a) Explain the statement 'Model building is essence of system design'. Explain in brief iconic, analogue and mathematical models.
  - (b) Explain giving suitable example the methodology of system analysis based on Black-box approach. Illustrate your answer with reference to a production system.
  - (c) For a mechanical system shown in figure, determine the differential equation relating  $f$  and  $x$ .



3. Attempt any **two** parts : (10×2=20)
- (a) Explain with examples analytical, combinatorial and subjective methods of optimization.
  - (b) Consider a function of two variables  $x_1$  and  $x_2$  given as :

$$f(x_1, x_2) = x_1^2 - 8x_2 + 2x_2^2 - 6x_1 + 30$$

Find the optimum values of  $x_1$  and  $x_2$  and verify the values obtained for maxima and minima.

- (c) The project activities, precedence relationships and duration are described in the table given below. Find the critical path of the project :

Activity	Precedence	Duration (days)
P	—	4
Q	—	5
R	P	6
S	Q	6
T	R, S	8
U	R, S	6
V	T	3
W	U	11

4. Attempt any two parts : (10×2=20)

- (a) Write a note on time value of money. Suppose Rs. 20,000/- equipment investment is expected to last 5 years and then result in Rs. 4,000/- salvage value. If  $i = 15\%$ , find the equivalent annual cost.
- (b) A small company makes curtain rods of standard sizes of 2 m in length. There are three materials A, B and C which can be used. Each material calls for a different process and machines for manufacturing and their cost data may be summarized as below :

Item	Materials		
	A	B	C
Raw material cost (Rs./m)	2.20	2.50	2.60
Equipment cost (Rs.)	5,000	3,000	4,000
Labour cost (Rs./rod)	0.50	0.60	0.20

Draw the total cost versus the yearly production volume curve for each of the three materials. If a sales volume of Rs. 10,000 rods per year is anticipated which material should be used ?

- (c) What is the significance of feasibility study and planning horizon in system design ?

5. Attempt any **two** parts : (10×2=20)

- (a) (i) Write the Baye's theorem for conditional probability. What is meant by prior and posterior probability ?  
 (ii) Explain the concept of utility and law of Diminishing returns.

(b) ABC company is faced with four decision alternatives relating to investments in a capital expansion programme. Since these investments are made in future, company foresees different market conditions as expressed in the form of states of nature. The following table summarizes the decision alternatives, the various states of nature and rate of return associated with each state of nature. If the company has no information regarding probability of the occurrence of 3 states, give the recommended decision for the decision criteria listed below :

- (i) Maximax (ii) Maximin  
 (iii) Minimax regret (iv) Laplace criteria

Decision	State of Nature		
	P	Q	R
A	17	15	8
B	18	16	9
C	21	14	9
D	19	12	10

(c) An automobile company manufactures around 150 bikes daily. The daily production varies from 146 to 154 depending upon the availability of raw materials and other working conditions.

Production per day	146	147	148	149	150	151	152	153	154
Probability	0.04	0.09	0.12	0.14	0.11	0.10	0.20	0.12	0.08

The finished bikes are transported in a specially arranged lorry accommodating 150 bikes. Using the following random numbers 80, 81, 76, 75, 64, 43, 18, 26, 10, 12, 65, 68, 69, 61, 57. Simulate the process to find out :

- (i) What will be the average number of bikes waiting in the factory ?  
 (ii) What will be the average number of empty spaces on the lorry ?