

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

PAPER ID : 0481

Roll No.

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**B. Tech.**

(SEM. VIII) THEORY EXAMINATION 2010-11

**MECHANICAL SYSTEM DESIGN**

*Time : 3 Hours*

*Total Marks : 100*

- Note :**
- (i) Attempt **all** questions.
  - (ii) All questions carry equal marks.
  - (iii) Be precise in your answer.
  - (iv) Assume missing data, if any.

1. Attempt any **two** parts of the following : **(2×10=20)**
- (a) Define the Systems. Describe various processes involved in systems engineering with suitable examples.
  - (b) Explain the various phases and interactions involved in the design process.
  - (c) What is the difference between 'statement of need' and 'definition of the problem' ? Explain it with the help of example.
2. Attempt any **two** parts of the following : **(2×10=20)**
- (a) Explain state theory approach in system analysis.

- (b) What is the need of system modelling in mechanical systems ? How it is used in the above system ?
- (c) A steel tube 2.4 cm external diameter and 1.8 cm internal diameter encloses a copper rod 1.5 cm diameter to which it is rigidly joined at each end. If at a temperature of 10°C there is no longitudinal stress. Calculate the stresses in the rod and tube when the temperature is raised to 200°C.  $E_s = 210 \text{ GPa}$ ,  $E_c = 100 \text{ GPa}$  Coefficient of linear expansion :

$$\lambda_s = 11 \times 10^{-6}/^\circ\text{C}, \lambda_c = 18 \times 10^{-6}/^\circ\text{C}.$$

3. Attempt any two parts of the following :  $(2 \times 10 = 20)$

- (a) What are different types of graphs ? Write an algorithm to solve the shortest path problem.
- (b) With the help of an example, explain how an optimization problem is formulated.
- (c) Differentiate between the following with suitable examples :
- (i) Design variables and preassigned parameters.
  - (ii) Functional Constraints and Side Constraints.
  - (iii) Bound point and free point in the design space.

4. Attempt any two parts of the following :  $(2 \times 10 = 20)$

- (a) What kind of questions you are going to ask while evaluating a mechanical system ? Give an example.
- (b) Find the dimensions of a cylindrical tin (with top and bottom) made up of sheet metal to maximize its volume such that the total surface area is equal to  $A_0 = 24\pi$ .

- (c) If a crank is at an angle  $\theta$  from dead centre  $\theta = \omega t$ , where  $\omega$  is the angular velocity and  $t$  is time, the distance of the piston from the end of its stroke ( $x$ ) is given by

$$x = r(1 - \cos\theta) + \frac{r^2}{4\ell}(1 - \cos 2\theta)$$

Where  $r$  is the length of the crank and  $\ell$  is the length of the connecting rod. For  $r = 1$  and  $\ell = 5$ , find (i) the angular position of the crank at which the piston moves with maximum velocity, and (ii) the distance of the piston from the end of its stroke at that instant.

5. Attempt any two parts of the following : (2×10=20)

- (a) Define Simulation. Describe different types of the computer simulation.
- (b) Describe different elements of decision problem. What is the role of conflict probability in decision making ?
- (c) An inspector working for a manufacturing company has a 99% chance of correctly identifying defective items and a 0.5% chance of incorrectly classifying a good item as defective. The company has evidence that the line produces 0.9% of nonconforming items.
- (i) What is the probability that an item selected for inspection is classified as defective ?
- (ii) If an item selected at random is classified as nondefective, what is the probability that it is indeed good ?