Reg. No.												

Question Paper Code	12655

M.E. / M.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

First Semester

M.E. - CAD/CAM

20PCDMA101 - OPTIMIZATION TECHNIQUES IN DESIGN

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Explain the necessary and sufficient conditions for the unconstrained minimum of a function.	2	K2	CO1
2.	When is the grid search method preferred in minimizing an unconstrained function?	2	K1	CO1
3.	How is a parametric constraint handled in the interior penalty function method?	2	K1	CO2
4.	How can you compute Lagrange multipliers during numerical optimization?	2	K1	CO2
5.	Explain the objective function to be used in GAs for a minimization problem with mixed equality and inequality constraints.	2	K2	CO3
6.	What is a neural network?	2	K1	CO3
7.	List out the types of transverse loading.	2	K2	CO4
8.	What are the factors considered in torsionally loaded shaft design?	2	K1	CO4
9.	List out the function of vibration absorber.	2	K2	CO5
10.	What is meant by degree of freedom? Give examples.	2	K1	CO5

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

			Marks	K – Level	CO
11.	a)	Derive an expression for Kuhn – Tucker conditions of nonlinear optimization problems.	13	K3	CO1
		ORe			
	b)	Given the function: $f(x) = 2 + (x_1^2 - x_2)^2 + x_2^2$. Using three iterations of the golden section search method, estimate the minimum point along the line joining the points $(-3, -4)^T$ and $(3, 2)^T$. Restrict the search between the above two points.	13	K3	CO1
12.	a)	Consider the constrained function: Minimize $(x_1^2 + x_2 - 11)^2 + (x_1 + x_2^2 - 7)^2$ subject to $(x_1 - 5)^2 + x_2^2 - 26 \geq 0, x_1, x_2 \geq 0.$	13	K3	CO2

OR

b) Explain in detail the relation between the Lagrangian function and sequential quadratic programming method. *13 K2 CO2*

13. a) Explain the working principles of Genetic Algorithms (GA) using an unconstrained optimization problem as an example. Compare GA with traditional methods. *13 K3 CO3*

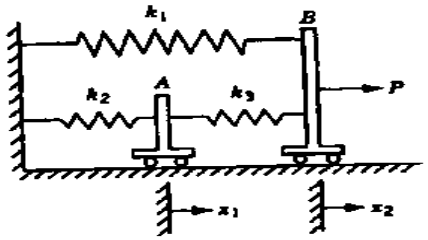
OR

b) Find the minimum of the following function using simulated annealing: *13 K3 CO3*

$$f(X) = 6x_1^2 - 6x_1x_2 + 2x_2^2 - x_1 - 2x_2$$

Assume suitable parameters and show detailed calculations for two iterations.

14. a) Figure below shows two frictionless rigid bodies (carts) A and B connected by three linear elastic springs having spring constants k_1, k_2 and k_3. The springs are at their natural positions when the applied force P is zero. Find the optimal solution of displacements x_1 and x_2 under the force P by using the principle of minimum potential energy. *13 K2 CO4*



OR

b) Explain in detail about the design optimization of shaft for minimum cost and weight. *13 K2 CO4*

15. a) With suitable example explain general procedure for optimization of path synthesis of a four bar mechanism. *13 K2 CO5*

OR

b) Consider the slider crank mechanism and explain its design methodology. Identify the parameters to be optimized and propose the techniques to solve the problem. *13 K2 CO5*

PART - C (1 × 15 = 15 Marks)

a) Derive the expression for torsional rigidity of shaft. *15 K3 CO4*

OR

b) A shaft is transmitting 95 kW at 164 rpm. Find a suitable diameter for the shaft, if the maximum torque transmitted exceeds the mean by 25%. Take maximum allowable shear stress as 72 MPa. *15 K3 CO4*