

**Mech. Engg. Deptt.**  
**INDIAN INSTITUTE OF TECHNOLOGY DELHI**  
**Major Test - IInd Semester 2008-09**  
**MEL 742: OPTIMUM DESIGN OF MECHANICAL SYSTEMS**  
**on 2 May 2009 (Saturday) at 13:00-15:00 hrs in III 342**  
**Course Coordinator/Faculty : Prof. T.K.Kundra**

**Max. Marks 120**

**Notes:** *“Materials Selection in Mechanical Design” by M.F.Ashby and “Engg Optimization” by S.S.Rao are permitted for reference. All questions carry equal marks. Suitable data, if need be, may be assumed.*

**I. [a] How optimum selection of material, shape and process of a mechanical component helps in its optimum design?**

**[b] Illustrating your decisions with material selection algorithms select the material for the following: i) High power and high precision screw for a heavy duty lifting equipment, and ii) Forks for a motorbike.**

**II. Explain the meaning of evolution, selection, reproduction, crossover and mutation in genetic algorithms {GA}. What are the unique advantages of GA based optimization? Show GA algorithm on a flowchart. Illustrate GA implementation on an SDOF model of vibrating equipment.**

**III When would you like to use fuzzy logic based controllers? Why? Give examples. Explain the meaning of universe discourse, membership function, complement, intersection and union in the context of fuzzy logic. How fuzzification and defuzzification can be achieved in the case of an inverted pendulum being balanced/ controlled on a moving platform?**

**IV. For what type of engineering optimization problem you would choose each of the following optimization algorithms? Also show Matlab program outline for one of the following optimization algorithms:**

**Geometric Programming, Dynamic Programming, Rosenbrock method, Quadratic interpolation, Hooks and Jeeves method, Powell method, Linear Programming, Fibonacci method, Stochastic Programming, Random Walk method, Newton Method, Steepest descent, Davidson Fletcher Powell, Rosens Gradient, Sequential Quadratic Programming, Sequential Linear Programming, Convex Programming, Exterior Penalty, Integer Polynomial Programming, and Goal Programming.**