Assignment I	Optimization Techniques in Engineering
Department of Mechanical Engineering	ME 6003/2004

1. Match the following terms and descriptions.

(a) Free feasible point	g_j (X) = 0
(b) Free infeasible point	Some g_j (X) = 0 and other g_j (X) < 0
(c) Bound feasible point	Some g_j (X) = 0 and other g_j (X) > 0
(d) Bound infeasible point	Some g_j (X) > 0 and other g_j (X) < 0
(e) Active constraints	All g_j (X) < 0

2. Define the following terms with example.
   (a) Design Variable, (b) Side Constraint, (c) Behavior constraint
   (d) Objective Function (e) Inequality and Equality constraints
   (f) Graphical method of solving the two variables non-linear problem.
3. Define an Optimization Constrained problem and give an engineering example.
4. What is the difference between linear and nonlinear programming problems?
5. What is the difference between design variables and preassigned parameters?
6. What is a design space? What is the difference between a bound point and a free point in the design space? What are objective function contours?
7. State five engineering applications of optimization.
8. Give detail of the classifications of the optimization problems.
9. Consider the slider-crank mechanism shown in Fig. 1.16 with the crank rotating at a constant angular velocity ω. Use a graphical procedure to find the lengths of the crank and the connecting rod to maximize the velocity of the slider at a crank angle of $\theta = 30°$ for $\omega = 100$ rad/s. The mechanism has to satisfy Groshof's criterion $l \geq 2.5r$ to ensure 360° rotation of the crank. Additional constraints on the mechanism are given by $0.5 \leq r \leq 10$, $2.5 \leq l \leq 25$, and $10 \leq x \leq 20$.

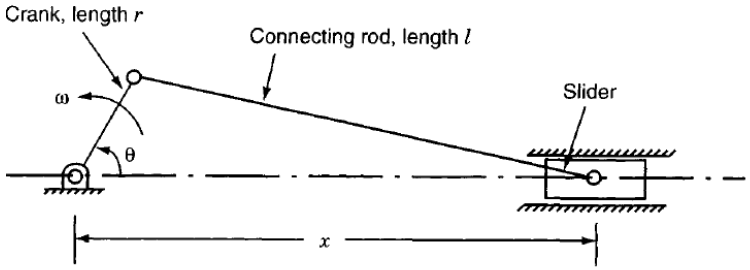

Figure 1.16 Slider-crank mechanism.

10. What is single variable unconstrained optimization problem.
11. Provide the list of different optimization methods that are available to solve the single variable optimization problem.
12. Explain the Direct search method for solving the OUC problem with its algorithm.
13. What are the methods available to eliminate the region of the uncertainty interval. Write down their algorithms for eliminating the region.
14. Write down the necessary and sufficient conditions to find the maximum and minimum of the objective function.
15. Explain the concept of local maxima, local minima, global maxima and global minima.
16. Solve the problem for minimization using exhaustive search method. $F(x)= x^2 + 54 /x$ in the interval [0,5].
17. Solve the above objective function with bounding phase method and dichotomous method.