Code No: **R4203B** **R10** **Set No. 1**

IV B.Tech II Semester Regular/Supplementary Examinations, April - 2015

ADVANCED OPTIMIZATION TECHNIQUES

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. Write the classification of optimization problems.

2. The efficiency of a screw jack is given by $\eta=\tan\alpha/(\tan(\alpha+\phi)$ where α is the lead angle and ϕ is a constant. Prove that the efficiency of the screw jack will be maximum when $\alpha=45^0-\phi/2$ with $\eta_{max}= (1-\sin\phi) / (1+\sin\phi)$

3. a) What is the difference between elimination and interpolation methods?
   b) Find the minimum of the function $f=\lambda^5-5\lambda^3-20\lambda+5$ by the following methods:
      i) Dichotomous search in the interval (0,5) with $\delta=0.0001$
      ii) Fibonacci search in the interval (0,5)

4. a) What is the role of one dimensional minimization methods in solving an unconstrained minimization problem?
   b) Explain Fletcher- Reeves method in detail.

5. a) Write about the Interior penalty function method in detail.
   b) Explain Rosen's gradient projection method.

6. a) How is the degree of difficulty is defined for a constrained geometric programming problem?
   b) An open cylindrical vessel is to be constructed to transport 80 m^3 of grain from a warehouse to a factory. The sheet metal used for the bottom and the sides cost Rs. 80 and Rs. 10 per square meter, respectively. If it costs Rs. 1 for each round trip of the vessel, find the dimensions of the vessel for minimizing the transportation cost. Assume that the vessel has no salvage upon completion of the operation.

7. Solve the following problem by dynamic programming.

   $$Maximize \sum_{i=1}^{3} d_i^2 , where\ d_i \geq 0$$

   Subject to $d_i = x_{i+1}- x_i$, $i=1,2,3$; $x_i = 0,1,2,\ldots,5$; $i=1,2$; $x_3=5$, $x_4=0$;

8. a) Give two engineering systems for which zero-one programming is applicable.
   b) Find the solution for the following problem using graphical procedure.
   Minimize $f=4x_1+5x_2$
   Subject to $3x_1+x_2 \geq 2$;
   $x_1+4x_2 \geq 5$;
   $3x_1+2x_2 \geq 7$
   $x_1, x_2 \geq 0$, integers

Code No: **R4203B** **R10** **Set No. 2**

IV B.Tech II Semester Regular/Supplementary Examinations, April - 2015

ADVANCED OPTIMIZATION TECHNIQUES

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) What is graphical optimization, and what are its limitations?
   b) What is the difference between a constraint surface and a composite constraint surface?

2. 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 $A_0=24\Pi$.

3. a) Suggest a method of finding the minimum of a multimodal function.
   b) Minimize $f(x)=100(x_2- x_1^2)^2+(1- x_1)^2$ and the starting point $X_1=[-1\ \ 1]^T$. Find the minimum of f(x) along the direction $S=[4\ \ 0]^T$ using the direct root method. Use a maximum of two refits.

4. Minimize $f(x_1, x_2)=x_1-x_2+2x_1^2+2x_1x_2+x_2^2$. Take the points defining the initial simplex as $X_1= [4.0\ \ 4.0]^T$ $X_2= [5.0\ \ 4.0]^T$ and $X3= [4.0\ \ 5.0]^T$ and $\alpha=1.0$, $ß=0.5$ and $ỿ=2.0$. For convergence, take the value of ε as 0.2.

5. a) Explain Exterior penalty function method in detail.
   b) Write a short note on convex programming problem.

6. a) Write the applications of geometric programming.
   b) Explain complementary geometric programming.

7. Maximize $f(x_1, x_2) =50x_1+100x_2$
   Subject to $10x_1+5x_2 \leq 2500$
   $4x_1+10x_2 \leq 2000$
   $x_1+1.5x_2 \leq 450$
   $x_1 \geq 0, x_2 \geq 0$

8. a) Explain Bala's Algorithm for Zero- one programming problem.
   b) Explain Gomory's cutting plane method in detail.

Code No: **R4203B** **R10** **Set No. 3**

IV B.Tech II Semester Regular/Supplementary Examinations, April - 2015

ADVANCED OPTIMIZATION TECHNIQUES

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) Write the typical applications of optimization in mechanical engineering.
   b) How do you solve a maximization problem as a minimization problem?

2. State and explain the various methods available for solving a multi variable optimization problem with equality constraints.

3. a) What are the limitations of classical methods in solving a one dimensional minimization problem?
   b) Minimize the function $f(x)=x_1-x_2+2x_1^2+2x_1x_2+x_2^2$ starting from the point $X_1=[0 \quad 0]^T$ along the direction $S=[-1 \quad 0]^T$ using the quadratic interpolation method with an initial step length of 0.1

4. a) Why is Rosenbrock method called the method of rotating coordinates?
   b) Perform two iterations of the Davidon Fletcher Powell method to minimize the function given, $f(x_1, x_2) =100(x_2-x_1^2)^2+ (1-x_1)^2$ from the starting point $[-1.2 \quad 1.0]^T$

5. a) Write the characteristics of a constrained problem.
   b) Find the dimensions of a rectangular prism type box that has the largest volume when the sum of its length, width and height is limited to a maximum value of 36in.

6. Minimize x_1
   Subject to $-4x_1^2+4x_2 \leq 1$; $x_1+ x_2 \geq 1$; $x_1 > 0, x_2 > 0$

7. Solve the following LP problem by dynamic programming.
   Maximize $f(x_1, x_2)=10x_1+8x_2$
   Subject to $2x_1+x_2 \leq 25$; $3x_1+2x_2 \leq 45$; $x_2 \leq 10$; $x_1 \geq 0, x_2 \geq 0$
   Verify your solution by solving it graphically.

8. Solve the following problem using Gomory's cutting plane method:
   Maximize $f=x_1+2x_2$ subject to $x_1+x_2 \leq 7$, $2x_1 \leq 11$, $2x_2 \leq 7$ $x_i \geq 0$ and integer, i=1,2

Code No: **R4203B** **R10** **Set No. 4**

IV B.Tech II Semester Regular/Supplementary Examinations, April - 2015

ADVANCED OPTIMIZATION TECHNIQUES

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. Explain optimization techniques in detail.

2. Minimize $f(x) = 1/2(x_1^2+x_2^2+x_3^2)$ subject to $g_1(x) = x_1-x_2=0$, $g_2(x) = x_1+x_2+x_3-1=0$ by a) Direct substitution b) constrained variation and c) Lagrange multiplier method.

3. a) Prove that a convex function is unimodal.
   b) Minimize the function $f(x)=0.65-[0.75/(1+x^2)]-0.65x \tan^{-1}(1/x)$ using the golden section method with n=6.

4. a) What are the characteristics of the direct search method?
   b) Minimize $f(x_1, x_2)=x_1-x_2+2x_1^2+2x_1x_2+x_2^2$ with the starting point (0, 0).

5. a) What are the differences between the interior and extended interior penalty function methods?
   b) Write the algorithm of ZOUTENDIJK'S method of feasible directions.

6. Minimize $f(X)=20x_2x_3x_4^4+20x_1^2x_3^{-1}+5x_2x_3^2$
   Subject to $5x_2^{-5}x_3^{-1} \leq 1$
   $10x_1^{-1}x_2^3x_4^{-1} \leq 1$
   $x_i > 0$, i=1 to 4

7. a) What is meant by curse of dimensionality? Explain.
   b) What are the characteristics of a dynamic programming problem? Explain.

8. a) Find the solution for the following problem using graphical procedure.
   Maximize $f=3x_1-x_2$
   Subject to $3x_1-2x_2 \leq 3$; $-5x_1-4x_2 \leq -10$; $x_1, x_2 \geq 0$, integers.
   b) How can you solve an integer non linear programming problem?