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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2018

Branch: **Electrical & Electronics Engineering**

(Common to all Streams)

01MA6021: ADVANCED MATHEMATICS AND OPTIMIZATION TECHNIQUES

Answer *any two full* questions from *each* part

Limit answers to the required points.

Max. Marks: 60 Duration: 3 hours

PART A

1. a. Determine whether or not $v=(2,-5,3)$ in $\mathbb{R}^3$ is a linear combination of the vectors $v_1=(1,-3,2)$, $v_2=(2,-4,-1)$, $v_3=(1,-5,7)$. (4)

   b. Find a basis of the null space and column space of $A=\begin{bmatrix}1&2&3&2&3\\3&6&9&2&3\\2&4&6&2&3\\1&2&3&2&3\end{bmatrix}$. (5)

2. a. Find an orthonormal basis for $\mathbb{R}^3$ from $u_1=(1,1,1)$, $u_2=(0,1,1)$ and $u_3=(0,0,1)$. (4)

   b. Find the singular value decomposition of $A=\begin{bmatrix}2&3\\0&2\end{bmatrix}$. (5)

3. a. Find the null space and nullity of the linear transformation $T:\mathbb{R}^3\to\mathbb{R}^3$ defined by $T(x,y,z)=(x-y,0,x+y)$. (4)

   b. Find a QR factorization of $A=\begin{bmatrix}5&9\\1&7\\-3&-5\\1&5\end{bmatrix}$. (5)

PART B

4. Use simplex method to solve the LPP: (9)
   Minimize $Z=x_1-3x_2+3x_3$
   Subject to $3x_1-x_2+2x_3\le 7$, $2x_1+4x_2\ge -12$, $-4x_1+3x_2+8x_3\le 10$, $x_1,x_2,x_3\ge 0$.

5. Solve the all integer programming problem by Gomory's cutting plane method: (9)
   Maximize $Z=4x_1+3x_2$
   Subject to $x_1+2x_2\le 4$, $2x_1+x_2\le 6$, $x_1,x_2\ge 0$ and are integers.

6. a. Write the dual of the following LPP: (4)

Maximize $Z = x_1 - x_2 + 3x_3$

Subject to $x_1 + x_2 + x_3 \le 10,\ 2x_1 - x_3 \le 2,\ 2x_1 - 2x_2 + 3x_3 \le 6,\ x_1, x_2, x_3 \ge 0.$

b. Solve the mixed integer programming problem graphically: (5)

Maximize $Z = x_1 + x_2$

Subject to $3x_1 + 2x_2 \le 5,\ x_2 \le 2,\ x_1, x_2 \ge 0$ and x_1 is an integer.

PART C

7. a. Minimize $f(x,y) = 2x^2 + y^2 + 2xy - y + x$ by using Fletcher-Reeves method. Take $(0,0)$ as the initial point. (6)

b. By applying steepest descent method, Minimize $f(x,y) = 4x^2 - 4xy + 2y^2$ with initial point $(2,3)$. Use two iterations. (6)

8. a. Describe Powell's method for solving the unconstrained minimization of a function of two variables. (6)

b. Use dynamic programming to solve the following problem: (6)

Minimize $Z = y_1^2 + y_2^2 + y_3^2$

Subject to $y_1 + y_2 + y_3 \ge 15,\ y_1, y_2, y_3 \ge 0.$

9. a. Solve the following nonlinear programming problem using Kuhn-Tucker conditions: (6)

Maximize $Z = 3x_1^2 + 14x_1x_2 - 8x_2^2$

Subject to $3x_1 + 6x_2 \le 72,\ x_1, x_2 \ge 0.$

b. Give the necessary conditions and the modified linear programming problem associated with the QPP: (6)

Maximize $f(x_1, x_2) = 8x_1 + 10x_2 - 2x_1^2 - x_2^2$

Subject to $3x_1 + 2x_2 \le 6,\ x_1 \ge 0,\ x_2 \ge 0.$