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# INSTITUTE OF AERONAUTICAL ENGINEERING (Autonomous)

B.Tech I Semester End Examinations (Supplementary) - February, 2018

Regulation: IARE-R16

## LINEAR ALGEBRA AND ORDINARY DIFFERENTIAL EQUATIONS (Common for all branches)

**Time: 3 Hours**

**Max Marks: 70**

**Answer ONE Question from each Unit**

**All Questions Carry Equal Marks**

**All parts of the question must be answered in one place only**

### UNIT – I

1. (a) Prove that the matrix  $A = \begin{bmatrix} \frac{1+i}{2} & \frac{-1+i}{2} \\ \frac{1+i}{2} & \frac{1-i}{2} \end{bmatrix}$  is Unitary and find  $A^{-1}$ . [7M]

(b) Solve the following equations by LU decomposition method  $x - 3y + 4z = 12$ ,  $-x + 5y - 3z = -12$ ,  $4x - 8y + 23z = 58$ . [7M]

2. (a) Find the rank of the matrix  $A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 2 & -1 & 2 & -1 \\ 3 & 2 & 3 & 4 \\ 1 & -2 & -3 & 2 \end{bmatrix}$  by reducing to Echelon form. [7M]

(b) Express the matrix  $A = \begin{bmatrix} 1 & 5 & 7 \\ -1 & -2 & -4 \\ 8 & 2 & 13 \end{bmatrix}$  as sum of Symmetric and Skew Symmetric matrix. [7M]

### UNIT – II

3. (a) Show that Eigen values of a matrix and its transpose are same. [7M]

(b) Diagonalize the matrix  $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ . [7M]

4. (a) Examine whether  $X_1 = [1, 2, 3]^T$ ,  $X_2 = [3, -2, 1]^T$ ,  $X_3 = [1, -6, 5]^T$  are linearly independent or dependent. [7M]

(b) Find all the Eigen Values and Eigen Vectors of  $\begin{bmatrix} 1 & 2 & 2 \\ 0 & 2 & 1 \\ -1 & 2 & 2 \end{bmatrix}$  [7M]

### UNIT – III

5. (a) Solve  $\frac{dy}{dx} = -\frac{(x+y \cos x)}{1+\sin x}$ . [7M]  
(b) Solve  $\frac{dy}{dx} = y \tan x - y^2 \sec x$ . [7M]
6. (a) Find the orthogonal trajectories of  $\frac{x^2}{a^2} + \frac{y^2}{a-b} = 1$ , where a and b are parameters. [7M]  
(b) If the temperature of the air is 40°C and the substance cools from 80°C to 60°C in 20 minutes, what will be the temperature of the substance after 40 minutes? [7M]

### UNIT – IV

7. (a) Solve  $(D^3 - 3D^2 + 4D - 2)y = e^x + \cos x$ . [7M]  
(b) Solve  $(D^2 - 2D + 2)y = e^x \tan x$  by the method of variation of parameters. [7M]
8. (a) If  $D^4x = a^4t$  then show that  $x = C_1 \cos at + C_2 \sin at + C_3 \cosh at + C_4 \sinh at$ . [7M]  
(b) Solve  $y'' + 5y' - 6y = \sin 4x \sin x$ . [7M]

### UNIT – V

9. (a) Verify Cauchy mean value theorem for  $\log x$  and  $1/x$  in  $[1, e]$ . [7M]  
(b) A rectangular box open at the top is to have a volume of 32 cc. Find the dimensions of the box requiring least material for its construction.
10. (a) If  $U = \tan^{-1} \left[ \frac{x^3 + y^3}{x - y} \right]$  then show that [7M]  
i.  $xU_x + yU_y = \sin 2U$   
ii.  $x^2U_{xx} + y^2U_{yy} + 2xyU_{xy} = \sin 4U - \sin 2U$
- (b) Find the minimum and maximum values of the function  $x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$ . [7M]