Q. P. Code: 20945

(Time: 2½ hours)

Total Marks: 75

N. B.:
(1) **All** questions are **compulsory**.
(2) Make **suitable assumptions** wherever necessary and **state the assumptions** made.
(3) Answers to the **same question** must be **written together**.
(4) Numbers to the **right** indicate **marks**.
(5) Draw **neat labeled diagrams** wherever **necessary**.
(6) Use of **Non-programmable** calculators is **allowed**.

15

1. **Attempt _any three_ of the following:**
   a. Find the Adjoint of the given matrix and hence find Inverse if exist

   $$\begin{bmatrix} 2 & -1 & 3 \\ 4 & 6 & -2 \\ 5 & 1 & 8 \end{bmatrix}$$

   b. Find the Characteristic values and characteristic vectors of the given matrix.

   $$\begin{vmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{vmatrix}$$

   c. Verify Caley-Hamilton theorem for the given matrix, also find inverse if exists.

   $$\begin{vmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{vmatrix}$$

   d. Expand $(1 + \cos x + i\sin x)^n$
   e. Evaluate $(1 + i\sqrt{3})^{16} / (\sqrt{3} - i)^{17}$
   f. Express $\sec(x + iy)$ in $a + ib$ form

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2. **Attempt _any three_ of the following:**
   a. Solve the Differential Equation $(x - 4xy - 2y^2) dx + (y^2 - 4xy - 2x^2) dy = 0$
   b. Solve the Differential Equation $dy/dx + x^2y = x^5$
   c. Solve the following Equation $x^2p^2 - 2xpy + (2y^2 - x^2) = 0$
   d. Solve the following Equation $p(p + y) = x(x + y)$
   e. Find the Complementary and Particular Solution of the equation $(D^3 + D^2 + D + 1)y = \sin 2x$
   f. Find the General Solution of the equation $(D^2 + 4)y = \sin 3x + e^x + x^2$

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3. **Attempt _any three_ of the following:**
   a. Evaluate $\int_0^\infty e^{-2t} \sin^2 t \, dt$
   b. Find the inverse Laplace transform for the function

   $$F(s) = \frac{21 - s^2}{s(s^2 + 4s + 13)}$$

   c. Find Laplace transformation of the function

   $$f(t) = te^{2t} \cos 3t$$

[TURN OVER]

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d. Obtain the Inverse Laplace transform of each of the given function
$$\frac{(s+1)}{s^3(s-3)^2}$$

e. Find Inverse Laplace Transformation by convolution theorem for
$$F(s) = \frac{s}{(s^2+1)(s^2+4)}$$

f. By using fundamental definition, find laplace transform of f(t)
F(t) = t, 0 < t < 4
= 5, t > 4

4. Attempt *any three* of the following: 15

a. Evaluate $\int_0^1 \int_0^2 e^{x+y} dxdy$

b. Evaluate $\int_0^3 \int_0^{\sqrt{4-y}} \frac{dxdy}{(1+x^2+y^2)}$

c. Evaluate $\int_0^{log2} \int_0^x \int_0^{x+logy} e^{x+y+z} dxdydz$

d. Evaluate $\int_0^1 \int_0^{1-x} \int_0^{x+y} e^z dxdydz$

e. Change the order of integration and evaluate $\int_0^2 \int_0^{x^2/4} xydxdy$

f. Solve $\iint r^3 drd\theta$ over the area included between the circles r = 2sinθ and r = 4 sinθ

5. Attempt *any three* of the following: 15

a. Evaluate $\int_0^{\pi/2} sin^6x \, cos^7x \, dx$

b. Evaluate i) erfc(-x) + erfc(x)
ii) erfc(x) + erf(x)

c. Evaluate $\int_0^{2a} x(2ax - x^2)^{1/2}dx$

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d.   Evaluate $\int_0^{\pi/2} \sin^5 2x\, dx$

e.
     Evaluate $\int_0^1 \frac{x^7}{(1-x^4)^{1/2}}\, dx$

f.
     Evaluate $\int_0^1 \frac{(x^a - x^b)}{\log x}\, dx$

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