

Registration No. :

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Total number of printed pages – 3

B. Tech
BS 1101

First Semester (Back/ Special) Examination – 2013

MATHEMATICS – I

QUESTION CODE : D 166

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which are compulsory and any **five** from the rest.
The figures in the right-hand margin indicate marks.

1. Answer the following questions :

2×10

(a) Find the order and degree of the following differential equation :

$$\left[1 + \left(\frac{dy}{dx} \right)^2 \right]^{5/2} = \frac{d^3y}{dx^3}$$

(b) Form a differential equation for a circuit with emf $E = 15$ V, resistance $R = 5 \Omega$ and $L = -0.5$ H.

(c) Define integrating factor. What is its importance?

(d) Find the Bessel's function of order 2.

(e) Find the inverse Laplace transform of $F(s) = \frac{3s}{s^2 + 2s + 5}$.

(f) What is the condition of existence of inverse Laplace transform?

(g) Define Hermitian matrix and orthogonal matrix.

(h) What kind of conic section is represented by the quadratic form $6x_1^2 + 16x_1x_2 - 6x_2^2 = 0$?

(i) Prove that eigenvalue of a Hermitian matrix is real.

(j) Prove that the determinant of an orthogonal matrix has the value +1 and -1.

P.T.O.

2. (a) Solve : $(2\cos y + 4x^2) dx = x \sin y dy$ 5
- (b) Solve : $y' + y \tan x = \sin 2x$ 5
3. (a) Solve the initial value problem $xy' + 4y = 8x^4, y(1) = 2$ 5
- (b) Find a general solution of the following using undetermined co-efficient : 5
- $$y'' + 2y' - 35y = e^{5x} + 37\sin x$$
4. (a) Solve : $x^2y'' - xy' + y = 0$ 5
- (b) Using variation of parameter solve the differential equation
- $$\frac{d^2y}{dx^2} + 9y = \sec 3x.$$
- 5



5. (a) Find all asymptotes of the curve $x^3 + 2x^2y - xy^2 - 2y^3 + xy - y^2 = 1$. 5
- (b) Find the radius of curvature of the curve $x^{2/3} + y^{2/3} = a^{2/3}$ at $(a\cos^3\theta, a\sin^3\theta)$. 5
6. (a) Find the power series solution of $y'' + 8xy' - 4y = 0$ 5
- (b) Using Bessel's function, solve the differential equation $y'' + x^2y = 0$ 5
7. (a) Solve the system of equations using Gauss elimination method 5
- $$10x + 4y - 2z = -4$$
- $$17x + y + 2z = 14$$
- $$13x + 5y - 3z = -8$$
- (b) Find the rank of the matrix 5

$$\begin{bmatrix} 9 & 3 & 1 \\ 3 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

8. (a) Find the eigenvalue and its corresponding eigen vector of the following matrix : 5

$$\begin{bmatrix} 10 & -3 & 5 \\ 0 & 1 & 0 \\ -15 & 9 & -10 \end{bmatrix}$$

- (b) Diagonalize the following matrix after finding the basis vectors : 5

$$A = \begin{bmatrix} 8 & -1 \\ 5 & 2 \end{bmatrix}$$

