

Roll No. ....

**24002**

**B.Tech. 1st Semester  
Examination – December, 2013**

**MATHEMATICS-I**

(‘F’ Scheme)

Paper : Math-101-F

*Time : Three hours ]*

*[ Maximum Marks : 100*

*Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.*

*Note : Question 1st is compulsory. Attempt total five questions with selecting one question from each Unit. All questions carry equal marks.*

1. (a) What will be the product of Eigen values of singular matrix ?

(b) Using cayley-Hamilton theorem, find  $A^4$  if

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

(c) Discuss the behavior of series

$$\frac{\sqrt{2}-1}{3^3-1} + \frac{\sqrt{3}-1}{4^3-1} + \frac{\sqrt{4}-1}{5^3-1} + \frac{\sqrt{5}-1}{6^3-1} + \dots$$

(d) Find asymptotes parallel to co-ordinate axis of the curve

$$x^2y^2 - x^2y - xy^2 + x + y + 1 = 0$$

(e) Expand  $a^x$  by using maclaurin's series

(f) If  $u = \tan^{-1}\left(\frac{x^3 + y^3}{x - y}\right)$  then prove

$$x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \sin 2u.$$

(g) Write the formula of finding the volume of the solid generated by revolving about both the co-ordinate axis.

(h) State p-Test for convergence of series.

### UNIT - I

2. (a) Discuss the convergence of the series :

$$1 + \frac{\alpha+1}{\beta+1} + \frac{(\alpha+1)(2\alpha+1)}{(\beta+1)(2\beta+1)} + \frac{(\alpha+1)(2\alpha+1)(3\alpha+1)}{(\beta+1)(2\beta+1)(3\beta+1)} + \dots \infty$$

(b)  $x + \frac{(2x)^2}{2!} + \frac{(3x)^3}{3!} + \frac{(4x)^4}{4!} + \dots$

3. (a) Test for absolute/conditionally convergence of the series.

$$\frac{1}{6}x^2 - \frac{2}{11}x^3 + \frac{3}{16}x^4 - \frac{4}{21}x^5 + \frac{5}{26}x^6 \dots$$

(b) Discuss the convergence of the series

$$\frac{1}{2} + \frac{2}{3}x + \left(\frac{3}{4}\right)^2 x^2 + \left(\frac{4}{5}\right)^3 x^3 + \dots \infty,$$

## UNIT - II

4. (a) Find the characteristic roots and characteristic vectors of the matrix.

$$A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$$

- (b) Find non-singular matrices P and Q such that PAQ is in the normal form for the matrices

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \\ 1 & 3 & 2 \\ 2 & 1 & 3 \end{bmatrix} \quad \text{Also find the rank of matrix A}$$

5. (a) Find the characteristic equation of the matrix

$$A = \begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix} \quad \text{Hence obtain the inverse of the}$$

given matrix.

(b) Are the following vectors are linearly dependent ?

If so, find the relation between them.

$$x_1 = (1,2,1), x_2 = (2,1,4), x_3 = (4,5,6), x_4 = (1,8,-3)$$

### UNIT - III

6. (a) If  $u = \sin^{-1}\left(\frac{x+y}{\sqrt{x}-\sqrt{y}}\right)$

then prove that

$$x^2 \frac{\partial^2 u}{\partial x^2} + y^2 \frac{\partial^2 u}{\partial y^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} = \frac{-\cos 2u \sin u}{4 \cos^3 u}$$

(b) Discuss the maxima and minima of

$$\sin x + \sin y + \sin (x + y)$$

(c) By using Taylor's series prove that

$$\sin (x + y) = \sin x \cos y + \cos x \sin y$$

Hence find the value of  $\sin 46^\circ$  correct to four places of decimals.

8,6,6

7. (a) If  $\rho_1$  &  $\rho_2$  be the radii of curvature at the extremities of a focal chord of a parabola whose latus rectum is '4a' then prove that

$$\rho_1^{-2/3} + \rho_2^{-2/3} = 2a^{-2/3}$$

(b) Prove that  $\int_0^{\infty} \frac{\tan^{-1} ax}{x(1+x^2)} dx = \frac{\pi}{2} \log(1+a)$ , where

$$a > 0.$$

#### UNIT - IV

8. (a) Evaluate by changing the order of integration

$$\int_0^1 \int_x^{\sqrt{2-x^2}} \frac{xy dx}{\sqrt{x^2+y^2}}$$

(b) Find the double integration, the area lying inside the circle  $r = a \sin \theta$  and outside the cardioid  $r = a(1 - \cos \theta)$ .

9. (a) Find the volume of the ellipsoid

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$$

(b) Prove that :

$$\beta(m, n) = \frac{\Gamma m \Gamma n}{\Gamma m + n}, \text{ hence evaluate } \Gamma 1/2.$$