



Reg. No. :

Name :

Third Semester B.Sc. Degree Examination, December 2017

First Degree Programme Under CBCSS

Complementary Course for Physics

MM 1331.1 - MATHEMATICS - III (Theory of Equations, Differential Equations and Theory of Matrices)
(2013 Admissions)

Time : 3 Hours

Max. Marks : 80

All the first 10 questions are compulsory. Each question carries 1 mark.

1. Form the rational cubic equation whose two roots are 1, 3, $-\sqrt{-2}$.
2. State fundamental theorem of algebra.
3. Give an example of a reciprocal equation.
4. The equation $3x^7 - x^4 + 10x^3 - 28 = 0$ has at least _____ number of imaginary roots.
5. Solve the differential equation $y' = 1 + y^2$.
6. Solve $y'' + 4y = 0$.
7. Solve $y'' + 8y' + 16y = 0$.
8. Which of the following matrix is in the reduced echelon form ?

$$\begin{bmatrix} 1 & 0 & 3 & 8 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 5 & -3 \end{bmatrix}; \begin{bmatrix} 1 & 0 & 0 & 3 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$



9. Find the rank of the matrix

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$$

10. The eigen values of the matrix
- $A = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 2 & 3 \\ 0 & 0 & 5 \end{bmatrix}$
- are _____ (10×1=10 Marks)

Answer **any 8** questions from among the questions **11 to 22**. These questions carry **2 marks each**.

11. Solve the polynomial equation
- $x^4 + 4x^3 + 5x^2 + 2x - 2 = 0$
- of which one root is
- $-1 - \sqrt{2}$
- .

12. Find the condition that the roots of
- $ax^2 + bx + c = 0$
- may be both positive.

13. Form an equation whose roots are four times those of the equation
- $4x^3 - 2x^2 + 8x + 5 = 0$
- .

14. Solve the equation
- $6x^5 - x^4 - 43x^3 + 43x^2 + x - 6 = 0$
- .

15. Solve the initial value problem
- $2xy' - 3y = 0$
- ;
- $y(1) = 4$
- .

16. Show that
- $(x^2 - 4xy - 2y^2) dx + (y^2 - 4xy - 2x^2) dy = 0$
- is exact and hence solve it.

17. Solve
- $\sin 2x \frac{dy}{dx} = y + \tan x$
- .

18. Solve the nonhomogeneous equation
- $y'' - 4y' + 3y = 10e^{-2x}$
- .

19. Find the index of the nilpotent matrix
- $A = \begin{bmatrix} 0 & 0 & 0 \\ 2 & 0 & 0 \\ 0 & -2 & 0 \end{bmatrix}$
- .

20. Find the row reduced Echelon form of the matrix

$$A = \begin{bmatrix} 1 & 2 & -1 & 4 \\ 2 & 4 & 3 & 5 \\ -1 & -2 & 6 & -7 \end{bmatrix}$$

21. If $A = \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix}$ show that $A^2 - 4A + 5I = 0$.

22. Show that the eigen values of a diagonal matrix are the same as its diagonal elements.

(8×2=16 Marks)

Answer **any 6** questions from the questions 23 to 31. These questions carry 4 marks each.

23. Find the equation whose roots are the roots of the equation $x^4 - 5x^3 + 7x^2 - 4x + 5 = 0$ diminished by 2.

24. If α , β and γ are the roots of the equation $x^3 + px^2 + qx + r = 0$, form the equation whose roots are $\alpha - \frac{1}{\beta\gamma}$, $\beta - \frac{1}{\gamma\alpha}$ and $\gamma - \frac{1}{\alpha\beta}$.

25. Find the orthogonal trajectory of the family of circles $(x - c)^2 + y^2 = c^2$.

26. Solve the differential equation $2x^2y \frac{dy}{dx} = \tan(x^2y^2) - 2xy^2$.

27. Solve the initial value problem $(D^2 + 4D + 1)y = 0$; $y(0) = 0$, $y'(0) = -3$.

28. Find the inverse of the matrix $\begin{bmatrix} 3 & 3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$.

29. Show that the following system of equations is consistent and hence solve the same.

$$x_1 + x_2 + x_3 = 4$$

$$2x_1 + 5x_2 - 2x_3 = 3$$

30. Show that the eigen values of the matrix kA are k times the eigen values of the matrix A where k is a scalar.

31. Find the eigen vector corresponding to the largest eigen value of the matrix

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

(6×4=24 Marks)



Answer any 2 questions from among the questions 32 to 35. These questions carry 15 marks each.

32. Using Ferrari's method, solve $x^4 - 3x^2 - 6x - 2 = 0$.

33. Solve the nonhomogeneous equation $y'' - 4y' + 3y = \sin 3x \cos 2x$.

34. Solve $(D^2 + 4D + 4)y = \frac{e^{-2x}}{x^2}$.

35. Diagonalize the matrix $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$. (2x15=30 Marks)