

Roll No. 2021218211

Total Pages : 03

BT-3/D-22

43142

MATHEMATICS-III

BS-205A, Option II

Time : Three Hours]

[Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit.

Unit I

1. (a) Define the following : 2.5×3=7.5

(i) D'Alembert's ratio test

(ii) Cauchy root test

(iii) Raabe's test.

(b) Test for convergence of the series : 7.5

$$\left(\frac{1}{3}\right)^2 + \left(\frac{1}{3} \cdot \frac{2}{5}\right)^2 + \left(\frac{1}{3} \cdot \frac{2}{5} \cdot \frac{3}{7}\right)^2 + \dots$$

2. (a) Find the Fourier series of the function

$$f(x) = x + x^2, \text{ in } -\pi < x < \pi. \quad 7.5$$

(b) Express $f(x) = e^x$ as half-range sine series in

$$0 < x < 1. \quad 7.5$$

Unit II

3. (a) Solve the DE : 7.5

$$(3x^2y^4 + 2xy)dx + (2x^3y^3 - x^2)dy = 0$$

(b) Solve : 7.5

$$x - yp = ap^2.$$

4. (a) Solve the ODE : 7.5

$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xe^x \sin x.$$

(b) Solve : 7.5

$$x^2 \frac{d^2y}{dx^2} + 2x \frac{dy}{dx} - 12y = x^3 \log x.$$

Unit III

5. (a) Evaluate $\iint xy(x+y)dx dy$ over the area between 7.5

$$y = x^2 \text{ and } y = x.$$

(b) Change order of integration and solve : 7.5

$$\int_0^4 \int_y^4 \frac{x}{x^2 + y^2} dx dy.$$

6. (a) Evaluate : 7.5

$$\int_0^{\log 2} \int_0^x \int_0^{x+\log y} e^{x+y+z} dz dy dx.$$

(b) Find, by triple integration, the volume of the sphere 7.5

$$x^2 + y^2 + z^2 = a^2.$$

L-43142

2

Unit IV

7. (a) Find the directional derivative of the function

$f = x^2 - y^2 + 2z^2$ at the point P(1, 2, 3) in the direction of the line PQ, where Q is the point (5, 0, 4). 7.5

(b) Prove that : 7.5

$$\text{div}(r^n \vec{r}) = (n+3)r^n.$$

8. (a) Evaluate $\iint_S \vec{F} \cdot \hat{n} dS$, where $\vec{F} = y\hat{i} + 2x\hat{j} - z\hat{k}$, and S

is the surface of the plane $2x + y = 6$ in the first octant cut-off by the plane $z = 4$. 7.5

(b)

Evaluate $\oint_C (e^x dx + 2y dy - dz)$; by Stokes' theorem, where C is the curve $x^2 + y^2 = 4$, $z = 2$. 7.5

(3-40/8) L-43142

3

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