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EYS-308**B. Tech. (New Scheme) (IT) Examination, 2024****(Third Semester)****MATHEMATICS-II****IT-301****Time : 3 Hours]****[Maximum Marks : 60**

Note : Solve any *two* parts from each questions. All questions carry equal marks.

1. (a) Solve :

$$(D^2 - 2D + 1)y = xe^x \sin x$$

where $D \equiv \frac{d}{dx}$.

(b) Solve :

$$(2x+3)^2 y'' - (2x+3)y' - 12y = 6x$$

(c) Solve :

$$\frac{dy}{dx} \equiv \frac{2x+3y-4}{4x+y-3}$$

2. (a) Solve :

$$xy'' + (4x^2 - 1)y' + 4x^3y = 2x^3$$

- (b) Solve :

$$x^2y'' - (x^2 + 2x)y' + (x + 2)y = x^3e^x$$

- (c) Solve by the method of variation of parameters :

$$x^2y'' + xy' - y = x^2e^x$$

3. (a) Form the partial differential equation by eliminating the arbitrary function f from $f(xy + z^2, x + y + z) = 0$.

- (b) Apply Charpit's method to solve :

$$2xz - px^2 - 2qxy + pq = 0$$

- (c) Solve :

$$(D^2 - 6DD' + 9D'^2)z = 12x^2 + 36xy$$

where

$$D \equiv \frac{\partial}{\partial x}, D' \equiv \frac{\partial}{\partial y}$$

4. (a) If $f(z) = u + iv$ is an analytic function of $z = x + iy$ and $u - v = (x - y)(x^2 + 4xy + y^2)$, find $f(z)$.

- (b) Evaluate :

$$\int_C \frac{(z-3)dz}{z^2 + 2z + 5}$$

Where (i) $C: |z| = 1$

(ii) $C: |z + 1 + i| = 2$

- (c) Evaluate :

$$\int_0^\pi \frac{d\theta}{17 - 8\cos\theta}$$

5. (a) Find $\int \vec{F} \cdot d\vec{r}$ by Stoke's theorem where $\vec{F} = y^2\vec{i} + x^2\vec{j} - (x + z)y^2\vec{k}$ and C is the boundary of the triangle with vertices $(0, 0, 0)$, $(1, 0, 0)$ and $(1, 1, 0)$.

- (b) A vector field \vec{F} is given by $\vec{F} = (x^2 - y^2 + x)\vec{i} - (2xy + y)\vec{j}$. Show that the field is irrotational and find its scalar potential.

(c) Show that :

$$\operatorname{div}(\operatorname{grad} r^n) = n(n+1)r^{n-2}$$

where

$$r = \sqrt{x^2 + y^2 + z^2}$$