

SUBJECTIVE

Note: Section I is compulsory. Attempt any three (3) questions from Section II.

SECTION I

2. Write short answers to any EIGHT questions:

(2 x 8 = 16)

- i- Define implicit function.
- ii- If $f(x) = 2x + 1$ and $g(x) = \frac{3}{x-1}$, $x \neq 1$, find $\text{fog}(x)$.
- iii- Evaluate $\lim_{x \rightarrow -1} \frac{x^3 - x}{x+1}$ by using algebraic technique.
- iv- Find $\frac{dy}{dx}$ if $y = (x-5)(3-x)$
- v- Find $\frac{dy}{dx}$ if $xy + y^2 = 2$
- vi- Differentiate $\sin x$ w. r. t. $\cot x$
- vii- Find $\frac{dy}{dx}$ if $y = \frac{x}{\ln x}$
- viii- Define the stationary point.
- ix- Find $\frac{dy}{dx}$ if $y = e^{-2x} \sin 2x$
- x- Differentiate $\cot^{-1} \frac{x}{a}$ w. r. t. x
- xi- Find y_2 if $y = \sqrt{x} + \frac{1}{\sqrt{x}}$
- xii- Find the extreme values for $f(x) = 5x^2 - 6x + 2$

3. Write short answers to any EIGHT questions:

(2 x 8 = 16)

- i- Using differentials find $\frac{dx}{dy}$ if $x^2 + 2y^2 = 16$
- ii- Define first order differential equation.
- iii- Evaluate $\int \tan^2 x \, dx$
- iv- Evaluate $\int \frac{\sqrt{2}}{\sin x + \cos x} \, dx$
- v- Evaluate $\int \sin^{-1} x \, dx$
- vi- Evaluate $\int \frac{e^x(1+x)}{(2+x)^2} \, dx$
- vii- Evaluate $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \cos t \, dt$
- viii- Find the area between x-axis and curve $y = \sin 2x$ from $x = 0$ to $x = \frac{\pi}{3}$
- ix- Solve the differential equation $\frac{x^2+1}{y+1} = \frac{x}{y} \frac{dy}{dx}$ ($x, y > 0$)
- x- Evaluate $\int x^2 \ln x \, dx$
- xi- Define problem constraints.
- xii- Graph the solution set of linear inequality $3y - 4 \leq 0$ in xy -plane.

(Turn over)

4. Write short answers to any NINE questions:

- i- Find the point that divides the join of A(-6, 3) and B(5, -2) in the ratio 2 : 3 internally.
- ii- A point P(5, 3) is in xy-coordinates system. Axes are rotated through angle 45° . Find the new point P(X, Y)
- iii- Find an equation of line passing through (2, 3), having slope -1.
- iv- Find the point of intersection of the lines $x + 4y - 12 = 0$ and $x - 3y + 3 = 0$
- v- Find the centre and radius of the circle $4x^2 + 4y^2 - 8x + 12y - 25 = 0$
- vi- Determine the length of tangent drawn from point (-5, 4) to the circle $5x^2 + 5y^2 - 10x + 15y - 131 = 0$
- vii- Find the focus and directrix of the parabola $x^2 = 4(y - 1)$
- viii- Find the centre and eccentricity of the ellipse $\frac{(2x-1)^2}{16} + \frac{(y+2)^2}{16} = 1$
- ix- Define scalar product of two vectors.
- x- Find a vector of length 5 in the direction opposite to that of $\underline{v} = \hat{i} - 2\hat{j} + 3\hat{k}$
- xi- Find a vector perpendicular to the plane containing vectors $\underline{a} = 2\hat{i} - 6\hat{j} - 3\hat{k}$, $\underline{b} = 4\hat{i} + 3\hat{j} - \hat{k}$
- xii- A force $\underline{F} = 2\hat{i} + \hat{j} - 3\hat{k}$ is acting at a point A(1, -2, 1). Find the moment of $\underline{F}$ about point B(2, 0, -2)
- xiii- What are direction angles of a vector?

SECTION II

- 5- (a) If $f(x) = \begin{cases} \frac{\sqrt{2x+5} - \sqrt{x+7}}{x-2}, & x \neq 2 \\ K, & x = 2 \end{cases}$ Find value of K so that f(x) is continuous at $x = 2$ 5
- (b) Find $\frac{dy}{dx}$ if $y = \frac{\sqrt{a+x} + \sqrt{a-x}}{\sqrt{a+x} - \sqrt{a-x}}$, $x \neq 0$ 5
- 6- (a) Evaluate $\int \frac{1+4x}{(x-3)(x^2+4)} dx$ 5
- (b) If (4, -2), (-2, 4) and (5, 5) are vertices of a triangle, find the co-ordinates of its 'Incentre'. 5
- 7- (a) Evaluate $\int_0^{\frac{\pi}{4}} \frac{\cos\theta + \sin\theta}{2\cos^2\theta} d\theta$ 5
- (b) Graph the solution region and find the corner points of $3x + 2y \geq 6$; $x + y \leq 4$; $x \geq 0$, $y \geq 0$ 5
- 8- (a) Show that the line $2x + 3y - 13 = 0$ is tangent to the circle $x^2 + y^2 + 6x - 4y = 0$ 5
- (b) Prove that the angle in a semi-circle is a right angle. 5
- 9- (a) Show that an equation of parabola with focus at $(a \cos \alpha, a \sin \alpha)$ and directrix at $x \cos \alpha + y \sin \alpha + a = 0$ is $(x \sin \alpha - y \cos \alpha)^2 = 4a(x \cos \alpha + y \sin \alpha)$ 5
- (b) Find the volume of the tetrahedron whose vertices are A(2, 1, 8), B(3, 2, 9), C(2, 1, 4), D(3, 3, 10) 5