1. All questions are **compulsory**.
2. All **questions** carry **equal** marks.
3. Draw **neat, labeled diagrams** wherever necessary.

### 1. Attempt the following (Any three)   (15 M)

a. Find $fog, gof, fof$ and $gog$ of the functions $f(x) = x^2, g(x) = x + 1$
b. Find the inverse of the function $f(x) = \frac{3-4x}{8x-1}$
c. A quadratic function $f(x) = 2x^2 + 12x + 10$ is given. (i) Express f in standard form. (ii) Sketch a graph of f. (iii) Find the maximum or minimum value of f.
d. Express the polynomial $f(x) = x^4 - 3x^3 + 2x^2$ into factor form and also find all its zeroes
e. Find an equation of the circle that has the points P(1, 8) and Q(5, -6) as the endpoints of a diameter
f. Solve : $(x - 4)(x + 2)^2 < 0$

### 2. Attempt the following (Any three)   (15 M)

a. Solve : $\log_3(x + 15) - \log_3(x - 1) = 2$
b. A certain culture of the bacterium Rhodo-bactersphaeroides initially has 25 bacteria and is observed to double every 5 hours.(a) Find an exponential model for the number of bacteria in the culture after t hours. (b) Estimate the number of bacteria after 18 hours. (c) After how many hours will the bacteria count reach 1 million?
c. Find the exact value of the following:
   i) $\cos\frac{19\pi}{6}$    ii) $\tan\frac{5\pi}{3}$
d. Find the values of all the trigonometric functions of t from $\tan t = \frac{1}{4}$, terminal point of t is in Quadrant III
e. Find the value of the following: i) $\tan^{-1}(-\sqrt{3})$   ii) $\cos(\tan^{-1}\frac{4}{3})$
f. Find the area of the triangle having sides of length 7 and 9 and included angle72°

### 3. Attempt the following (Any three)   (15 M)

a. Verify the identity: $\frac{1+\tan^2 x}{1-\tan^2 x} = \frac{1}{\cos^2 x - \sin^2 x}$
b. Prove the identity: $\frac{1-\sin x}{1+\sin x} = (\sec x - \tan x)^2$
c. Find $\tan 2\theta$ if $\cos\theta = \frac{3}{5}$ where $\theta$ is in quadrant I.
d. Find the value of the following: i) $\cos 75°$   ii) $\tan\frac{\pi}{12}$
e. Solve the equation: $2\sin^2\theta - 7\sin\theta + 3 = 0$
f. Find all the solution of $2\sin 3\theta - 1 = 0$

### 4. Attempt the following (Any three)   (15 M)

a. Express complex number $2\sqrt{3} - 2i$ into polar form
b. Find the fifth root of $Z = 1 + i$

c. Solve the following system of equation by using Gaussian Elimination method
$$\begin{cases} x - 2y + z = 1 \\ y + 2z = 5 \\ x + y + 3z = 8 \end{cases}$$

d. Solve the following system of equation by using Cramer's rule
$$\begin{cases} 2x - 5y = 4 \\ x + y - z = 8 \\ 3x + 5z = 0 \end{cases}$$

e. If $u = 2i + j, v = 3i - 2j$ find $u.v$ and the angle between the vectors u and v

f. If $u = -j + 3k, v = 2i - k$, find a unit vector that is orthogonal to the plane containing the vectors u and v.

## 5. Attempt the following (Any three)          (15 M)

a. Find the equation of the parabola that has its vertex at the origin and directrix $x = -5$. And sketch its graph.

b. Find the vertices, foci, asymptotes, length of transverse axis of the hyperbola $25y^2 - 9x^2 = 225$ and sketch its graph.

c. The 3rd term of a geometric sequence is 63/4 and the 6th term is 1701/32 . Find the fifth term.

d. Use Mathematical induction prove that $1^2 + 2^2 + \cdots \ldots + n^2 = \dfrac{n(n+1)(2n+1)}{6}$ for all natural number 'n'

e. Find the limit if it exist: i) $\lim_{x \to -2} \dfrac{4x^3 + 2x^2 - 1}{5 - 3x}$      ii)    $\lim_{x \to 0} \dfrac{|x|}{x}$

f. Find the derivative of $f(x) = \sqrt{x}$ at $x = a$

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