78. Find unit vector perpendicular to the plane of $\underline{a}$ and $\underline{b}$ if $\underline{a} = -i - j - \underline{k}, \underline{b} = 2\underline{i} - 3\underline{j} + 4\underline{k}$.
79. Find vertices and equation of directrices of hyperbola $x^2 - y^2 = 9.17\mathrm{Grp}11,$
80. Find α so that $\underline{u} = \alpha\underline{i} + 2\alpha\underline{j} - \underline{k}$ and $\underline{v} = \underline{i} + \alpha\underline{j} + 3\underline{k}$ are perpendicular.
81. Find a, so that $|a\underline{i} + (a+1)\underline{j} + 2\underline{k}| = 3$.
82. Fine the value $3\underline{j} \cdot \underline{k} \times \underline{i}$.
83. If $\overrightarrow{AB} = \overline{CD}$, find coordinates of points A if B, C, D are $(1,2), (-2,5), (4,11)$
84. If $\underline{a} = 2\underline{i} + \underline{j} - \underline{k}$ and $\underline{b} = \underline{i} - \underline{j} + \underline{k}$ find the cross product $\underline{a} \times \underline{b}$
85. If $\underline{u} = 3\underline{i} + \underline{j} - \underline{k}$ and $\underline{v} = 2\underline{i} - \underline{j} + \underline{k}$, find the cosines of the angle θ between $\underline{u}$ and $\underline{v}$
86. If O is the origin and $\overrightarrow{OP} = \overrightarrow{AB}$, find the point P when A and B are $(-3,7)$ and $(1,0)$ respectivel
87. Prove that if $\underline{a} + \underline{b} + \underline{c} = 0$ then $\underline{a} \times \underline{b} = \underline{b} \times \underline{c} = \underline{c} \times \underline{a}$
88. Prove that $\underline{a} \times (\underline{b} + \underline{c}) + \underline{b} \times (\underline{c} + \underline{a}) + c \times (\underline{a} + \underline{b}) = 0$.
89. Prove that if the lines are perpendicular, then product of their slopes $= -1$
90. Show that the points $A(3,1), B(-2,-3)$ and $C(2,2)$ are vertices of an isosceles triangle.
91. Show that the points $A(-1,2), B(7,5)$ and $C(2,-6)$ are vertices of a right triangle.
92. Show that the triangle with vertices $A(1,1), B(4,5)$ and $C(12,-5)$ is right triangle.
93. Show that vectors $3\underline{i} - 2\underline{j} + \underline{k}, \underline{i} - 3\underline{j} + 5\underline{k}$ and $2\underline{i} + \underline{j} - 4\underline{k}$ from a right triangle.
94. Transform $5x - 12y + 39 = 0$ into two intercept form. 15 Grp II,
95. Two lines l_1 and l_2 with respective slopes m_1 and m_2 are parallel if $m_1 = m_2$.
96. Write and equation of parabola with focus $(-1,0)$, vertex $(-1,2)$.
97. Write direction cosine of $\overrightarrow{PQ}$, if $P(2,1,5), Q(1,3,1)$.
98. Write down the equation of straight line with x-intercept $(2,0)$ and y-intercept $(0,-4)$
99. Find the mid-point of line segment joining the points $A\left(-\sqrt{5}, -\frac{1}{3}\right)$ and $(-3\sqrt{5}, 5)$.
100. Find the slope and inclination of the line joining the points $(-2,4)$ and $(5,11)$.
101. Find equation of tangent to the circle $x^2 + y^2 = 25$ at $(4,3)$.
102. Find the vertex and directrix of parabola $x^2 = 4(y-1)$.
103. Find the centre and vertices of the ellipse $9x^2 + y^3 = 18$.
104. Find the sum of vectors $\overrightarrow{AB}$ and $\overrightarrow{CD}$, given the four points $A(1,-1), B(2,0), C\ (-1,3)$ and $D(-2,2)$.
105. Find a vector perpendicular to each of the vectors $\underline{a} = 2\underline{i} + \underline{j} + \underline{k}$ and $\underline{b} = 4\underline{i} + 2\underline{j} - \underline{k}$.
106. Prove that the vectors $\underline{i} - 2\underline{j} + 3\underline{k} - 2\underline{i} + 3\underline{j} - 4\underline{k}$ and $\underline{i} - 3\underline{j} + 5\underline{k}$ are co-planar.
107. Find equation of a line through (–4 , 7) and parallel to the line $2x - 7y + 4 = 0$.
108. Find equation of a line through (–6 , 5) having slope = 7
109. Find distance from the point P (6 , –1) to the line $6x - 14y + 9 = 0$
110. Find area of triangular region whose vertices are A (5 , 3), B (–2 , 2), C (4 , 2).
111. Find the equation of tangent to the circle $x2 + y3 = 25$ at (4 , 3). 14 Grp I,
112. Find the equation of parabola whose focus is (2 , 5) and directrix is $y = 1$
113. Find foci and eccentricity of ellipse
114. Find vector from A to origin whose $AB = 4i - 2j$ and B (–2 , 5).
115. Find a vector whose magnitude is 2 and is parallel to $i + j + k$. .
116. Find α so that the vectors $2i + \alpha j + 5k$ and $3i + j + \alpha k$ are perpendicular.
117. 129. Find α so that $\alpha i + j$, $i + j + 3k$, $2i + j - 2k$ are co-planar

Long Questions

1. Chapter No. 1 (Functions and Limits)

1. Evaluate $\lim_{x\to 0} \frac{1-\cos x}{\sin^2 x}$ 17GrpI,
2. Evaluate $\lim_{x\to 0} \frac{\sin x}{x} = 1$

3. Evaluate $\lim_{\theta \to 0} \left(\frac{1-\cos p\theta}{1-\cos q\theta}\right)$
4. Evaluate $\lim_{\theta \to 0} \frac{\tan\theta - \sin\theta}{\sin^3\theta}$
5. Find the values of m and n, so that given function f is continuous at $x = 3$.
6. If $f(x) = \begin{cases} mx & \text{if } x < 3 \\ n & \text{if } x = 3 \\ -2x + 9 & \text{if } x > 3 \end{cases}$
7. Discuss the continuity of $f(x)$ at $x = 2$ and $x = -2$.
8. If $f(x) = \begin{cases} 3x & \text{if } x \le -2 \\ x^2 & \text{if } -2 < x < 2 \\ 3 & \text{if } x \ge 2 \end{cases}$
9. If $f(x) = \begin{cases} \frac{\sqrt{2x+5} - \sqrt{x+7}}{x-2}, & x \ne 2 \\ k & x = 2 \end{cases}$
10. Find the value of k so that f is continuous at $x = 2$.
11. Let $f(x) = \frac{2x+1}{x-1}$; $x \ne 1$, find $f^{-1}(x)$ and verify $fof^{-1}(x) = x$
12. Prove $\lim_{x \to \infty} \left(1 + \frac{1}{n}\right)^n = e$14 Grp II, 10. Prove that $\lim_{x \to 0} \left(\frac{a^x - 1}{x}\right) = \log_e a$
13. Prove that $\lim_{x \to 0} \frac{\sin x}{x} = 1$

Chapter No. 2 (Differentiation)

1. Differentiate $\frac{x^2+1}{x^2-1}$ w.r.t. $\frac{x-1}{x+1}$
2. Differentiate $x^2 + \frac{1}{x^2}$ w.r.t. $x - \frac{1}{x}$
3. Differentiate $\cos\sqrt{x}$ from the first principle.
4. Differentiate $\sin\sqrt{\frac{1+2x}{1+x}}$ w.r.t x
5. Find $\frac{dy}{dx}$ if $x = a(\cos t + \sin t), y = a(\sin t - t\cos t)$
6. Find two positive integers whose sum is 9 and the product of one with the square of the other will be maximum.
7. If $x = \sin\theta, y = \sin m\theta$, Show that $(1 - x^2)y_2 - xy_1 + m^2 y = 0$
8. If $y = (\cos^{-1} x)^2$, prove that $(1 - x^2)y_2 - xy_1 - 2 = 0$
9. If $y = e^x \cdot \sin x$, then prove that $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = 0$
10. Prove that $y\frac{dy}{dx} + x = 0$ if $x = \frac{1-t^2}{1+t^2}, y = \frac{2t}{1+t^2}$.
11. Show that $\cos(x + h) = \cos x - h\sin x - \frac{h^2}{\underline{|2}}\cos x + \frac{h^3}{\underline{|3}}\sin x + \cdots$ And evaluate $\cos 61^\circ$
12. Show that $\frac{dy}{dx} = \frac{y}{x}$ if $\frac{y}{x} = \text{Tan}^{-1}\frac{y}{x}$
13. Show that $y = \frac{\ln x}{x}$ has maximum value at $x = e$.
14. Show that $y = x^x$ has a maximum value at $= \frac{1}{e}$

Chapter No. 3 (Integration)

1. Evaluate $\int \left(\frac{1-\sin x}{1-\cos x}\right) e^x dx$
2. Evaluate $\int \left(\frac{1-\sin x}{1-\cos x}\right) e^x dx$
3. Evaluate $\int \frac{\sqrt{2}}{\sin x + \cos x} dx$

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4. Evaluate $\int \frac{e^x(1+\sin x)}{(1+\cos x)}dx$
5. Evaluate $\int \frac{1}{x(x^3-1)}dx$
6. Evaluate $\int \cos^3 x\sqrt{\sin x}dx, (\sin x > 0)$
7. Evaluate $\int \text{cosec}^3 xdx$
8. Evaluate $\int \frac{\cos x}{\sin x \ln \sin x}dx$
9. Evaluate $\int \frac{dx}{\frac{1}{2}\sin x+\frac{\sqrt{3}}{2}\cos x}$
10. Evaluate $\int e^{2x}\cos 3xdx$
11. Evaluate $\int \tan^3 x\sec xdx$
12. Evaluate $\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \frac{\cos x}{\sin x(2+\sin x)}dx$
13. Evaluate $\int_0^{\frac{\pi}{4}} \cos^4 tdt$
14. Evaluate $\int_0^{\frac{\pi}{6}} \cos^3 \theta d\theta$
15. Evaluate $\int_0^{\pi/4} \frac{\sin x-1}{\cos^2 x}dx$
16. Evaluate $\int_0^{\pi/4} \frac{\sec\theta}{\sec\theta+\cos\theta}d\theta$
17. Evaluate $\int_{-1}^{2} (x+|x|)dx$
18. Evaluate $\int_2^3 \frac{3x^2-2x+1}{(x-1)(x^2+1)}dx$
19. 19. Evaluate $\int_2^3 \left(x-\frac{1}{x}\right)^2 dx$
20. Evaluate the indefinite integral $\int \sqrt{a^2-x^2}dx$
21. Find the area between the x-axis and the curve $y=\sqrt{2ax-x^2}; a>0$
22. Find the area bounded by the curve $y=x^3-4x$ and x-axis
23. Show that $\int \frac{dx}{\sqrt{x^2-a^2}} = \ln\left(x+\sqrt{x^2-a^2}\right)+c$
24. Solve the differential equation $\left(x^2-yx^2\right)\frac{dy}{dx}+y^2+xy^2=0$
25. Solve the following differential equation $\left(x^2-yx^2\right)\frac{dy}{dx}+y^2+xy^2=0$
26. Solve the following differential equation $1+\cos x\tan y\frac{dy}{dx}=0$
27. Solve the following differential equation $xdy+y(x-1)dx$
28. Use differentials to approximate the values of $(31)^{1/5}$
29. $y=\sqrt{2ax-x^2}$ when $a>0$.

Chapter No. 4 (Intro. to Analytic Geometry)

1. Find a joint equation of the straight lines through the origin perpendicular to the lines represented by $x^2+xy-6y^2=0$
2. Find an equation of the perpendicular bisector joining the points $A(3,5)$ and $B\ (9,8)$
3. Find an equation of the perpendicular bisector of the segment joining the points $A\ (3,5)$ and B $(9,8)$
4. Find equations of the sides, altitudes and medians of the triangle whose vertices are A $(-3,2)$, $\text{B}(5,4)$ and C $(3,-8)$.
5. Find equations of two parallel lines perpendicular to $2x-y+3=0$ such that the product of the x-intercept and y-intercept of each is 3.
6. Find h such that the points A $(\sqrt{3},-1)$, $\text{B}(0,2)$, $\text{C}(h,-2)$ are the vertices of a right triangle with right angle at the vertex A.
7. Find interior angles of a triangle whose vertices are $A(6,1)$, $B(2,7)$ and $C\ (-6,7)$.
8. Find the condition that the line $y=mx+c$ touches the circle $x^2+y^2=a^2$ at a single point.
9. Find the condition that the lines $y=m_1x+c_1; m_2x+c_2; y=m_3x+c_3$ are concurrent.
10. Find the distance between the given parallel lines. Also find equation of parallel lying midway between them. $3x-4y+3=0$ and $3x-4y+7=0$

11. **Find the equations of altitudes of $\triangle ABC$ whose vertices are $A(-3,2), B(5,4)$ and C $(3,-8)$**
12. **Find the interior angles of a triangle whose vertices are $A(6,1), B(2,7), C(-6,-7)$.**
13. **Find the length of the chord cut off from the line $2x+3y=13$ by the circle $x^2+y^2=26$.**
14. **14. Find the lines represented by each of the following and also find measure of the angle between them $x^2+2xy\sec\alpha+y^2=0$**
15. **Prove that the line segment joining the midpoints of two sides of a triangle is parallel to the third side and half as long.**
16. **Prove that the line segments joining the mid-points of sides of quadrilateral taken in order form a parallelogram.**
17. **Prove that the midpoint of the hypotenuse of a right triangle is the circumcenter of the triangle. 11 Grp II,**
18. **The points $A(-1,2), B(6,3)$ and $C(2,-4)$ are vertices of a triangle. Show the line joining the midpoint D of AB and the midpoing E of AC is parallel to BC and $DE=\frac{1}{2}$**
19. **The three points $A(7,-1), B(-2,2)$ and $C(1,4)$ are consecutive vertices of a parallelogram, find the fourth vertex.**
20. **The vertices of a triangle are $A(-2,3), B(-4,1)$ and $C(3,5)$. Find the circumcircle of the triangle.**

Chapter No. 5 (Linear Inequalities and Linear Programming)

1. Graph the feasible region of system of linear inequalities and find the corner points.
2. $2x+3y\le 18$, $x+4y\le 12$, $3x+y\le 12$ $x\ge 0, y\ge 0$
3. Graph the feasible region of system of linear inequalities and find the corner points.
4. $3x+7y\le 21$, $2x-y\le -3$, $y\ge 0$
5. Shade the feasible region and also find the corner points of: $2x-3y\le 6$, $2x+3y\le 12$, $x\ge 0, y\ge 0$
6. Minimize $z=2x+y$ subject to the constraints. $x+y\ge 3$; $7x+5y\le 35$; $x\ge 0$; $y\ge 0$
7. Graph the feasible region of system of linear inequalities and find the corner points.
8. $x+y\le 5$; $-2x+y\le 2$; $y\ge 0$
9. Graph the feasible region of system of linear inequalities and find the corner points.
10. $2x-3y\le 6$; $2x+y\ge 2$; $y\ge 0, y\ge 0$
11. Minimize $f(x,y)=x+3y$ subject to constraint.
12. $2x+5y\le 30$; $5x+4y\le 20$; $x\ge 0, y\ge 0$
13. Minimize $f(x,y)=2x+3y$ subject to constraint.
14. $2x+y\le 8$; $x+2y\le 14$; $x\ge 0, y\ge 0$
15. Find the minimum value of $\phi(x,y)=4x+6y$ under the constrains:, $2x-3y\le 6$, $2x+y\ge 2$, $2x+3y\le 12$ $x\ge 0, y\ge 0$
16. Minimize the function $z=3x+y$ subject to the constrains: $3x+5y\ge 6$, $x+6y\ge 9$, $x\ge 0, y\ge 0$

Chapter No. 6 (Conic Sections)

1. **Find an equation of parabola having its focus at the origin and directrix parallel to y-axis.**
2. **Find the centre, foci, eccentricity, vertices and equation of directices of $\frac{y^2}{4}-x^2=1$.**
3. **Find x so that points $A(1,-1,0)$. $B(-2,2,1)$ and $C(0,2,x)$ from triangle with right angle at C.**
4. **Find the coordinates of the points of intersection of the line $2x+y+5=0$ and the circle $x^2+y^2+2x-9=0$. Also find the length of intercepted chord.**
5. **Find equation of parabola with elements directrix : $x=-2$, focus $(2,2)$.**
6. **Find an equation of parabola whose focus is $F(-3,4)$, directrix line is $3x-44y+5=0$.**
7. **Find the focus, vertex and the directrix of the parabola $x^2-4x-8y+4=0$.**
8. **Write an equation of the parabola with axis $y=0$ and passing through $(2,1)$ and $(11,-2)$.**
9. **Show that the line $3x-2y=0$ and $2x+3y-13=0$ are tangents to the circle $x^2+y^2+6x-4y=0.17$**
10. **Show that the equation $9x^2-18x+4y^2+8y-23=0$ represent an ellipse. Find its elements (foci, vertices and directrices)**

11. Show that the equation $x^2+16x+4y^2-16y+76=0$ represent an ellipse. Find its foci eccentricity, vertices and directrices.
12. Write equations of tangent lines to the circle $x^2+y^2+4x+2y=0$ down from the point $P(-1,2)$. Also find the tangential distance.
13. Prove that in any triangle ABC by vector method $a^2=b^2+c^2-2bc\cos A$
14. Find equation of ellipse having vertices $(0,\pm5)$ and eccentricity $\frac{3}{5}$
15. Find an equation of the circle passing through the point $(-2,-5)$ and touching the line $3x+4y-24=0$ at the point $(4,3)$
16. Find the foci, vertex and directrix of the parabola $y=6x^2-1$.,
17. Find equations of the tangents to the circle $x^2+y^2=2$
18. Find an equation of an ellipse with Foci $(-3\sqrt{3},0)$ and vertices $(\pm6,0)$
19. Find equation of the circle passing through $A(a,0)$, $B(0,b)$ and $C(0,0)$
20. Find an equation of the parabola with focus $(1,2)$ and vertex $(3,2)$,
21. Write an equation of the circle that passes through the point $A(a,0), B(0,b), C\ (0,0)$,
22. Write an equation of the circle that passes through the points $A(4,5), B(-4,-3)$, and $C(8,-3)$.

Chapter No. 7 (Vectors)

1. Find the value of α, in the coplanar vectors $\alpha\underline{i}+\underline{j}, \underline{i}+\underline{j}+3\underline{k}$, and $2\underline{i}+\underline{j}-2\underline{k}$.
2. If $\underline{a}=3\underline{i}-\underline{j}-4\underline{k}$; $\underline{b}=-2\underline{i}-4\underline{j}-3\underline{k}$ and $\underline{c}=\underline{i}+2\underline{j}-\underline{k}$, then find a unit vector parallel to $-3\underline{a}-2\underline{b}+4\underline{c}, 16$
3. (Example) Find the volume of the tetrahedron whose vertices are $A(2,1,8), B\ (3,2,9), C(2,1,4)$ and D $(3,3,10)$.
4. Prove that $\sin(\alpha-\beta)=\sin\alpha\cdot\cos\beta-\cos\alpha\sin\beta$ by method of vectors.
5. Find the volume of the tetrahedron with the vertices of $A(0,1,2), B(3,2,1), C\ (1,2,1)$ and D $(5,5,6)$
6. Find the constant a such that the vectors are coplanar $\underline{i}-\underline{j}+\underline{k}, \underline{i}-2\underline{j}-3\underline{k}$, and $3\underline{i}-a\underline{j}+5\underline{k}\cdot$
7. The position vectors of the points A, B, C and D are $2\underline{i}-\underline{j}+\underline{k}, 3\underline{i}+\underline{j}, 2\underline{i}+4\underline{j}-2\underline{k}$ and $-\underline{i}+2\underline{j}+\underline{k}$ respecetively. Show that AB is parallel to CD.
8. A force of magnitude 6 units acting parallel to $2\underline{i}-2\underline{j}+\underline{k}$ displaces the point of application from $(1,2,3)$ to $(5,3,7)$. Find the work done.
9. Prove by using vectors that the line segment joining the mid-points of two sides of a triangle is parallel to the third side and half as long.
10. If $\underline{a}+\underline{b}+\underline{c}=0$ then prove that $\underline{a}\times\underline{b}=\underline{b}\times\underline{c}=\underline{c}\times\underline{a}$
11. A force $\underline{F}=4\underline{i}-3\underline{k}$ passes through the point $A(2,-2,5)$. Find the moment of the force about the point $B(1,-3,1)$
12. Find a unit vector perpendicular to both vectors $\underline{a}$ and $\underline{b}$ where $\underline{a}=-\underline{i}-j-k$ and $\underline{b}=2\underline{i}-3\underline{j}+4\underline{k}$,
13. If $\underline{a}=3\underline{i}-\underline{j}-4\underline{k}$, $\underline{b}=-2\underline{i}-4\underline{j}-3\underline{k}$ and $\underline{c}=\underline{i}+2\underline{j}-\underline{k}$ find a unit vector parallel to $3\underline{a}-2\underline{b}+4\underline{c}$.
24. Find equation of the circle of radius 2 and tangent to the line $x-y-4=0$ at $A\ (1,-3)$