1. Find the order of the differential equation of the family of circles of radius 3 units.

2. Find the angle between the line $\overrightarrow{r} = \left(2\hat{i} - \hat{j} + 3\hat{k}\right) + \lambda\left(3\hat{i} - \hat{j} + 2\hat{k}\right)$ and the plane $\overrightarrow{r}.\left(\hat{i} + \hat{j} + \hat{k}\right) = 3$.

3. Find the co-ordinates of the point, where the line $\frac{x+2}{1} = \frac{y-5}{3} = \frac{z+1}{5}$ cuts the yz-plane.

4. If $A = \begin{bmatrix} 8 & 2 \\ 3 & 2 \end{bmatrix}$, then find $\left|adj A\right|$.

5. If $y = 2\sqrt{sec\left(e^{2x}\right)}$, then find $\frac{dy}{dx}$.

6. Four cards are drawn one by one with replacement from a well-shuffled deck of playing cards. Find the porbability that at least three cards are of diamonds.

7. The probability of two students A and B coming to school on time are $\frac{2}{7}$ and $\frac{4}{7}$, respectively. Assuming that the events 'A coming on time' and 'B coming on time' are independent, find the probability of only one of them coming to school on time.

8. Using vectors, prove that the points $(2, -1, 3), (3, -5, 1)$ and $(-1, 11, 9)$ are collinear.

9. For any two vectors $\overrightarrow{a}$ and $\overrightarrow{b}$, prove that
$\left(\overrightarrow{a} \times \overrightarrow{b}\right)^2 = \overrightarrow{a}^2\overrightarrow{b}^2 - \left(\overrightarrow{a}\ .\ \overrightarrow{b}\right)^2$

10. Find :
$\int \frac{x-1}{(x-2)(x-3)}dx$

11. Integrate :
$\frac{e^x}{5-4e^x-e^{2x}}$ with respect to x.

12. If $P(A) = 0.6, P(B) = 0.5 \text{and} P(B|A) = 0.4$, find$P(A \bigcup B)$ and$P(A|B)$.

13. Find the value of $(x-y)$ from matrix equation
$2\begin{bmatrix} x & 5 \\ 7 & y-3 \end{bmatrix} + \begin{bmatrix} -3 & -4 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 7 & 6 \\ 15 & 14 \end{bmatrix}$

14. Find:

    $\int e^x (\cos x - \sin x)\ \text{cosec}^2 x dx$

15. Find the differetial equation of the family of curves represented by $y^2 = a(b^2 - x^2)$.

16. Let an operation $*$ on the set of natural numbers N be defined by $a * b = a^b$. Find (i) whether $*$ is a binary or not, and (ii) if it is a binary, then is it commutative or not.

17. Find the particular solution of the differential equation :

    $(1 + e^{2x})\, dy + (1 + y^2)\, e^x dx = 0$, given that $y(0) = 1$.

18. Find the particular solution of the differential equation :

    $x\frac{dy}{dx} \sin\left(\frac{y}{x}\right) + x - y \sin\left(\frac{y}{x}\right) = 0$, given that $y(1) = \frac{\pi}{2}$.

19. Prove that the relation R in the set A $= \{1, 2, 3, 4, 5, 6, 7\}$ given by $R = \Big\{(a, b) : \big|a - b\big| \text{ is even}\Big\}$ is an equivalence relation.

20. Show that the funtion f in $A = R - \left\{\frac{2}{3}\right\}$ defined as $f(x) = \frac{4x+3}{6x-4}$ is one-one and onto. Hence, find f^{-1}.

21. Find whether the functin $f(x) = \cos\left(2x + \frac{\pi}{4}\right)$; is increasing or decreasing in the interval $\frac{3\pi}{8} < x < \frac{5\pi}{8}$.

22. Using vectors, find the value of x such that the four points A$(x, 5, -1)$, B$(3, 2, 1)$, C$(4, 5, 5)$ and D$(4, 2, -2)$ are coplanar.

23. Prove that :

    $\sin^{-1} \frac{4}{5} + \tan^{-1} \frac{5}{12} + \cos^{-1} \frac{63}{65} = \frac{\pi}{2}$

24. If $x^p y^q = (x + y)^{p+q}$, prove that $\frac{dx}{dy} = \frac{y}{x}$ and $\frac{d^2y}{dx^2} = 0$.

25. Find :

    $\int (\sin x . \sin 2x . \sin 3x)\, dx$

26. Differentiate $\tan^{-1} \frac{3x-x^3}{1-3x^2}, \big|x\big| < \frac{1}{\sqrt{3}}$ w.r.t. $\tan^{-1} \frac{x}{\sqrt{1-x^2}}$.

27. If $\sqrt{1 - x^2} + \sqrt{1 - y^2} = a(x - y), \big|x\big| < 1, \big|y\big| < 1$, show that $\frac{dy}{dx} = \sqrt{\frac{1-y^2}{1-x^2}}$.

28. Using properties of determinents, prove the following :

$$\begin{vmatrix} a^2 & bc & ac+c^2 \\ a^2+ab & b^2 & ac \\ ab & b^2+bc & c^2 \end{vmatrix} = 4a^2b^2c^2$$

29. Evaluate :

$\int_{-1}^{2} \left|x^3 - x\right| dx$

30. Find the equation of planes passing through the intersection of planes $\vec{r}.\left(2\hat{i}+6\hat{j}\right)+12=0$ and $\vec{r}.\left(3\hat{i}-\hat{j}+4\hat{k}\right)=0$ and are at a unit distance from origin.

31. A company manufactures two types of novelty souvenirs made of plywood. Souvenirs of type A require 5 minutes each for cutting and 10 minutes each for assembling. Souvenirs of type B require 8 minutes each for cutting and 8 minutes each for assembling. There are 3 hours 20 minutes available for cutting and 4 hours for assembling. The profit for type A souvenirs is ₹ 100 each and for type B souvenirs, profit is ₹ 120 each. How many souvenirs of each type should the company manufacture in order to maximise the profit ? Formulate the problem as a LLP and then solve it graphically.

32. Using integration, find the area of the following region :

$$\left\{(x,y) : x^2+y^2 \leq 16a^2 \text{ and } y^2 \leq 6ax\right\}$$

33. Using integration, find the area of triangle ABC bounded by the lines $4x-y+5=0, x+y-5=0$ and $x-4y+5=0$.

34. Find the vector equation of the line passing through $(2,1,-1)$ and parallel to the line $\vec{r}=\left(\hat{i}+\hat{j}\right)+\lambda\left(2\hat{i}-\hat{j}+\hat{k}\right)$. Also, find the distance between these two line Also, find the distance between these two lin Also, find the distance between these two lines.

35. Find the coordinates of the foot Q of the perpendicular drawn from the point $P(1,3,4)$ to the plane $2x-y+z+3=0$.Find the distance PQ and the image of P treating the plane as a mirror.

36. Using elementary row transformations, find the inverse of the matrix $\begin{bmatrix} 3 & 0 & -1 \\ 2 & 3 & 0 \\ 0 & 4 & 1 \end{bmatrix}$.

37. Using matrices, solve the following system of linear equations :

$$\begin{aligned} 2x + 3y + 10z &= 4 \\ 4x - 6y + 5z &= 1 \\ 6x + 9y - 20z &= 2 \end{aligned}$$

38. The sum of the perimeters of circle and a square is K, where K is some constant. Prove that the sum of their areas is least when the side of the square is twice the radius of the circle.

39. A bag contains 5 red and 3 black balls and another bag contains 2 red and 6 black balls. Two balls are drawnat random ($without replacement$) from one of the bags and both are found to be red. Find the probability that balls are drawn from the first bag.