RADIANT P. U. COLLEGE, VIJAYAPUR
DEPARTMENT OF MATHEMATICS
CHAPTERWISE PREVIOUS YEAR BOARD EXAMINATION QUESTIONS

1. RELATIONS AND FUNCTIONS:

ONE MARK QUESTIONS :

1. A relation R on a set A = {1,2,3} defined by R= {(1,1), (1,2) ,(3,3)} is not symmetric . why ? **(March-2014,Sept-2020)**
2. Let * be a binary operation defined on the rational number Q defined by a*b= ab+1 ,prove that * is commutative .**(July -2014)**
3. Let * be a binary operation on the set of rational numbers by a*b= $\frac{ab}{4}$, find the identity element **(March-2015, July -2017)**
4. Let * be binary operation on the set of natural numbers given by a*b=L.C.M. of a and b , find 5*7. **(July-2015, July-2019)**
5. An operation * on Z^+ is defined as a*b = a-b , ∀ a,b ∈ Z^+ . Is * is a binary operation on Z^+ ? **(March-2016)**
6. An operation * on Z^+ is defined as a*b = |a-b| , ∀ a , b ∈ Z^+ . Is * is a binary operation on Z^+ **(July-2016, Model paper -02)**
7. Let * be a binary operation on the set of natural numbers given by , a*b= L.C.M. of a and b , find 20*16.**(March-2017)**
8. Define bijective function . **(March -2018)**
9. The relation R on a set A ={1,2,3} is defined as R={(1,1), (2,2), (3,3), (1,2), (2,3)} is not transitive why ? **(July -2018)**
10. Define binary operation **(March 2019, Model paper 2022)**
11. Let * be a binary operation on the set of natural numbers given by a*b = L.C.M. of a and b, find 5*7. **(March – 2020)**
12. Define empty relation . **(Model paper -1)**
13. Give an example of a relation which is symmetric and transitive but not reflexive **(Model paper -2022)**

TWO MARKS QUESTIONS :

1. Verify whether the operation * defined on Q by a*b = $\frac{ab}{2}$ is associative or not . **(March -2014, March -2018, Sept-2020, Model paper -01)**
2. On R^+ is defined by a*b = $\frac{a+b}{2}$, verify whether * is associative **(Model paper -01)**
3. Show that the function f: N → N , given by f(1) = f(2) =1 and f(x) = x -1 , for every x >2 , is onto , but not one-one **(July -2014)**
4. If f : R → R defined by f(x) = 1+ x^2 , then show that f is neither one-one nor onto . **(March -2017)**
5. Define binary operation on a set . Verify whether the operation * defined on Q by a*b = ab+1 a, b ∈ Q is binary or not . **(July -2018)**
6. Show that the function f : N → N given by f(x) =2 x is one-one but not onto . **(March -2019)**
7. Prove that the greatest integer function f : R → R , given by f(x) = $\begin{cases} 1 & if\ x > 0 \\ 0 & if\ x = 0 \\ -1 & if\ x < 0 \end{cases}$, is neither one – one nor onto . Where [x] denotes greatest integer less than or equal to x . **(Model paper 2022)**
8. Show that if f : A → B and g : B → C are one-one , then g0f : A → C is also one –one **(March 2015)**
9. If f : R → R is given by f(x) = $(3-x)^{\frac{1}{3}}$ then find $(fof)(x)$. **(July -2015)**
10. If the function f : R → R and g : R → R are given by $f(x) = |x|$ and $g(x) = [x]$, where $[x]$ is greatest integer function find $fog(-\frac{1}{2})$ and $gof(-\frac{1}{2})$ **(March -2016)**
11. Show that if f : A → B and g : B → C are onto , then gof : A → C is also onto . **(July -2017)**
12. Find of : and fog , if f(x) = 8 x^3 and $g(x) = x^{\frac{1}{3}}$ **(July- 2019)** .

THREE MARKS QUESTIONS :

1. Show that the relation R in the set Z of integers given by R = { (a,b) : 2 divides a – b } is an equivalence relation. **(July 2014)**
2. Define whether the relation R in the set A = { 1,2,3 ,……… 13,14 } is defined as R ={(x, y) : $3x - y = 0$} is reflexive , symmetric and transitive **(March 2015, July 2019)**
3. Prove that the relation R in the set of integers Z defined by R = {(x, y) : $x - y$ is an integer } is an equivalence relation . **(July 2015 , Sept 2020)**
4. Show that the relation R in the set a = { $x : x \in Z , 0 \leq x \leq 12$ } is given by R = {(a,b) : |a – b| is a multiple of 4 } is an equivalence relation . **(March 2016)**
5. Show that the relation R in set A = { 1,2,3,4,5} given by R = { (a,b) : |a – b| is even } is an equivalence relation . **(July 2016, March 2018)**
6. Show that the relation R in the set R defined as R = { (a,b) : a ≤ b} is reflexive , transitive but not symmetric . **(March 2017)**
7. Check whether the relation R defined in the set {1,2,3,4,5 } as R = { (a,b) : b = a + 1 } is reflexive or symmetric . **(July 2017)**
8. Check whether the relation R in the set R = { (a,b) : a ≤ b^3 } is reflexive , symmetric or transitive **(March 2019)**
9. Show that the relation R defined in the set A of all triangles as R = { (T_1 , T_2) : T_1 is similar to T_2 } is an equivalence relation . **(March 2020 , Model Paper- 01)**
10. Show that the relation R in the set of all integers Z defined by R = {(a,b) : 2 divides a - b } is an equivalence relation **(Model Paper -02)**
11. Find gof and fog if f : R → R and g : R → R are given by $f(x) = \cos x$ and $g(x) = 3x^2$. Show that $gof \neq fog$ **(March 2014, July 2016 , July 2018 , March 2020)**
12. Show that the relation R on a set A = { 1,2,3} is defined as R = { (1,1) , (2,2) , (3,3), (1,2) , (2,3)} is reflexive but neither symmetric nor transitive . **(Model Paper 2022)**

FIVE MARKS QUESTIONS :

1. Verify whether the function f : N → N defined by $f(x) = x^2$ is one-one , onto and bijective **(Model Paper -02)**
2. Check the injectivity and surjectivity of the function f : R → R by $f(x) = 3 - 4x$. Is it a bijective function ? **(Model Paper -01)**
3. Verify whether the function f : A → B , given by $f(x) = \frac{x-2}{x-3}$, where A = R – {3} and B = R- {1} is one – one , onto and bijective ? **(Model Paper 2022)**
4. Check the injectivity and surjectivity of the function f : R → R , given by $f(x)$ 1+ x^2 . Is it bijective ? **(Expected)**
5. Show that the function $f : R^+ \rightarrow R^+$, defined by $f(x) = \frac{1}{x}$ is both one-one and onto , where R^+ is the set of all nonzero real numbers . **(Expected)**
6. Prove that the modulus function f : R → R , given by $f(x) = |x|$, is neither one –one nor onto **(Expected)**
7. Prove that the function , f : N → Y defined by $f(x) = 4x + 3$, where Y = { y : y = $4x + 3$, $x \in$ N } is invertible and also find the inverse of $f(x)$. **(March 2014, March -2019)**
8. Prove that the function , f : R → R , given by $f(x) = 4x + 3$, is invertible , also find the inverse of $f(x)$ **(July 2015 , July 2017 , July 2019 , March 2019)**
9. Prove that the function f : N → Y defined by $f(x) = x^2$, where Y = { y : y = x^2 , $x \in$ N } is invertible . Also find the inverse of f **(July 2014)**
10. Let R_+ be the set of all non –negative real numbers . Show that the function $f : R_+ \rightarrow [4, \infty)$ defined by $f(x) = x^2 + 4$ is invertible . Also write the inverse of f **(March 2015, July 2016, March 2018 , July 2018)**
11. Let f : N → R be defined by $f(x) = 4x^2 + 12x + 15$. Show that f : N → S where S is the range of the function f is invertible . Also find the inverse of f **(March 2016 , March 2017 , Model Paper 2022)**

2. INVERSE TRIGONOMETRIC FUNCTION

ONE MARK QUESTIONS :

1. Write the domain of the function $f(x) = \cos^{-1} x$ **(March 2014, March 2018 , July 2018)**
2. Find the principal value of $\cos^{-1}\left(-\frac{1}{2}\right)$ **(July 2014 , March 2019 , Sept 2020 , Model Paper 2022)**
3. Write the domain of $f(x) = \sin^{-1} x$ **(July 2016, Model Paper 02)**
4. Find the principal value of $\text{cosec}^{-1}(-\sqrt{2})$ **(March -2017)**
5. Find the principal value of $\cot^{-1}\left(-\frac{1}{\sqrt{3}}\right)$ **(July 2019)**
6. Write the range of $y = \sec^{-1} x$ **(March 2020 , Model Paper -01)**
7. Write the values of x for which $2\tan^{-1} x = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ holds **(March 2015)**
8. Write the values of x for which $\tan^{-1}\left(\frac{1}{x}\right) = \cot^{-1} x$ holds **(July 2017)**
9. Find the value of $\sin^{-1}\left(\sin\left(\frac{2\pi}{3}\right)\right)$ **(July 2015, July 2016)**
10. Find the value of $\cos(\sec^{-1} x + \text{cosec}^{-1} x)$, $|x| \geq 1$ **(March 2016)**

TWO MARKS QUESTIONS :

1. Write the domain and range of $\tan^{-1} x$ **(Model Paper -2022)**
2. Evaluate $\sin\left[\frac{\pi}{3} - \sin^{-1}\left(-\frac{1}{2}\right)\right]$. **(March 2014)**
3. Find the principal value of $\cot^{-1}\left(-\frac{1}{\sqrt{3}}\right)$ **(Model paper -01)**
4. Evaluate $\cos^{-1}\left(\frac{1}{2}\right) + 2\sin^{-1}\left(\frac{1}{2}\right)$ **(Model Paper -02)**
5. Find the value of $\tan^{-1}\sqrt{3}$ - $\sec^{-1}(-2)$ **(Model Paper -2022)**
6. Prove that $\sin^{-1}(2x\sqrt{1-x^2}) = 2\sin^{-1} x$ for which $-\frac{1}{\sqrt{2}} \leq x \leq \frac{1}{\sqrt{2}}$ **(March 2015)**
7. Prove that $\sin^{-1}(2x\sqrt{1-x^2}) = 2\cos^{-1} x$ for which $\frac{1}{\sqrt{2}} \leq x \leq 1$ **(March 2016 , March 2017)**
8. Find the principal value of $\cot^{-1}(-\sqrt{3})$.
9. Prove that $\tan^{-1}\left(\frac{2}{11}\right) + \tan^{-1}\left(\frac{7}{24}\right) = \tan^{-1}\left(\frac{1}{2}\right)$ **(July – 2014)**
10. Write $\tan^{-1}\left(\frac{\cos x - \sin x}{\cos x + \sin x}\right)$, $0 < x < \pi$ in the simplest form . **(July 2015 , March 2018)**
11. Prove that $\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$, $x \in [-1,1]$ **(July 2015, March 2019)**
12. Prove that $\tan^{-1} x + \cot^{-1} x = \frac{\pi}{2}$, $x \in R$ **(July 2014)**
13. Write the simplest form of $\tan^{-1}\left[\frac{3\cos x - 4\sin x}{4\cos x + 3\sin x}\right]$, if $\frac{3}{4}\tan x > -1$ **(March 2016)**
14. Write the simplest form of $\tan^{-1}\left[\sqrt{\frac{1-\cos x}{1+\cos x}}\right]$, $0 < x < \pi$ **(March 2014 , July 2014 , July 2018)**
15. Write the simplest form of $\cot^{-1}\left[\frac{1}{\sqrt{x^2-1}}\right]$, $x > 1$ **(March 2019 , July 2019)**
16. Prove that $3\sin^{-1} x = \sin^{-1}(3x - 4x^3)$, $x \in \left[-\frac{1}{2}, \frac{1}{2}\right]$ **(July 2016)**
17. Prove that $\cot^{-1}(-x) = \pi - \cot^{-1} x$, $\forall x \in R$ **(March 2020)**
18. Solve the equation $\tan^{-1}\left(\frac{1-x}{1+x}\right) = \frac{1}{2}\tan^{-1} x$, $x > 0$ **(March 2017)**
19. Show that $2\tan^{-1} x = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$, $x \geq 0$ **(July 2017)**
20. Find the value of $\sin^{-1}\left(\sin\left(\frac{3\pi}{5}\right)\right)$ **(July 2017 , March 2020)**
21. Find the value of $\cos^{-1}\left(\cos\frac{13\pi}{6}\right)$ **(July 2018)**
22. If $\sin\left(\sin^{-1}\frac{1}{2} + \cos^{-1} x\right) = 1$, then find the value of x **(March 2028 , Model Paper 2022)**

THREE MARKE QUESTIONS :

1. Prove that $3\cos^{-1}x = \cos^{-1}(4x^3 - 3x)$, $x \in [\frac{1}{2}, 1]$ **(March 2014)**
2. Prove that $2\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{1}{7}\right) = \tan^{-1}\left(\frac{31}{17}\right)$ **(March 2015 , March 2018, March 2020 , Model Paper - 2022)**
3. Prove that $\tan^{-1}x + \tan^{-1}\left(\frac{2x}{1-x^2}\right) = \tan^{-1}\left(\frac{3x-x^3}{1-3x^2}\right)$, $|x| < \frac{1}{\sqrt{3}}$ **(July 2014)**
4. Find the value of x , if $\tan^{-1}\left(\frac{x-1}{x-2}\right) + \tan^{-1}\left(\frac{x+1}{x+2}\right) = \frac{\pi}{4}$ **(March 2015)**
5. Solve : $\tan^{-1}2x + \tan^{-1}3x = \frac{\pi}{4}$ **(July 2015 , July 2016 , July 2017 , July 2018 , July 2019)**
6. Show that $\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{2}{11}\right) + \tan^{-1}\left(\frac{3}{4}\right) = \frac{\pi}{2}$ **(March 2016)**
7. Write $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$, $x \neq 0$ in the simplest form **(March 2017)**
8. Prove that $\cos^{-1}\left(\frac{4}{5}\right) + \cos^{-1}\left(\frac{12}{13}\right) = \cos^{-1}\left(\frac{33}{65}\right)$ **(March 2019)**

3. MATRICES

ONE MARK QUESTIONS :

1. Define scalar matrix (March 2014 , July 2015 ,July 2016 , March 2019)
2. Define diagonal matrix (July 2014)
3. Define row matrix (Model Paper 2022)
4. Construct a 2x2 matrix A = $[a_{ij}]$ whose elements are given by $\frac{1}{2}|-3i + j|$ (March 2015, July 2019)
5. If $\begin{bmatrix} x+2 & y-3 \\ 0 & 4 \end{bmatrix}$ is a scalar matrix , find x and y . (March 2016)
6. Construct a 2x2 matrix A = $[a_{ij}]$ whose elements are given by $a_{ij} = \frac{i}{j}$ (March 2017 , July 2017 , March 2018 , Sept 2020)
7. Construct a 2x2 matrix whose elements are given by $a_{ij} = \frac{(i+j)^2}{2}$ (Model paper -02)
8. If a matrix has 5 elements , what are the possible orders it can have ? (July 2018 , March 2020 , Model Paper -01)
9. Find the values of x, y and z if $\begin{bmatrix} 4 & 3 \\ x & 5 \end{bmatrix} = \begin{bmatrix} y & z \\ 1 & 5 \end{bmatrix}$ **(Model Paper 2022)**

THREE MARKS QUESTIONS :

1. For any square matrix a with real entries , prove that A + A¹ is a symmetric matrix and A – A¹ is skew symmetric matrix . **(July 2014)**
2. Express A = $\begin{bmatrix} 3 & 5 \\ 1 & -1 \end{bmatrix}$ as a sum of a symmetric and skew –symmetric matrix (July 2015)
3. If A and B are symmetric matrices of same order , then show that AB is symmetric if and only if AB =BA **(March 2017 , Model Paper 02)**
4. If F(x) = $\begin{bmatrix} cosx & -sinx & 0 \\ sinx & cosx & 0 \\ 0 & 0 & 1 \end{bmatrix}$ then show that $F(x)F(y) = F(x+y)$ **(March 2020)**
5. For a matrix A = $\begin{bmatrix} 1 & 5 \\ 6 & 7 \end{bmatrix}$, verify that (i) A+ A¹ is a symmetric matrix (ii) A – A ¹ is a skew symmetric matrix **(Model Paper -01)**
6. If A and B are invertible matrices of the same order , then prove that $(AB)^{-1} = B^{-1}A^{-1}$ **(March 2015)**
7. By using elementary transformation , find the inverse of the matrix A = $\begin{bmatrix} 1 & -2 \\ 2 & 1 \end{bmatrix}$ **(March 2015)**
8. By using elementary transformation , find the inverse of the matrix A = $\begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$ **(March 2016)**
9. By using elementary transformation , find the inverse of the matrix A = $\begin{bmatrix} 1 & 3 \\ 2 & 7 \end{bmatrix}$ **(July 2016, March 2018)**

10. By using elementary transformation, find the inverse of the matrix $A = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$ **(July -2017, March 2019, July 2019)**

11. By using elementary transformation, find the inverse of the matrix $A = \begin{bmatrix} 3 & -1 \\ -4 & 2 \end{bmatrix}$ **(July -2018)**

12. By using elementary transformation, find the inverse of the matrix $A = \begin{bmatrix} 2 & 3 \\ 5 & 7 \end{bmatrix}$ **(Model Paper 2022)**

FIVE MARKS QUESTIONS :

1. If $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 0 \\ 1 & 3 \end{bmatrix}$ and $C = \begin{bmatrix} 1 & 1 \\ 2 & 3 \end{bmatrix}$. Calculate AC, BC and (A+B)C. Also verify that (A+B)C= AC+BC **(March 2014)**

2. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & -2 & 1 \\ 4 & 2 & 1 \end{bmatrix}$ then prove that A^3 - 23 A – 40 $I = O$ **(July 2014, March 2015, March 2019)**

3. If $A = \begin{bmatrix} 1 & 2 & -3 \\ 5 & 0 & 2 \\ 1 & -1 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 3 & -1 & 2 \\ 4 & 2 & 5 \\ 2 & 0 & 3 \end{bmatrix}$ and $C = \begin{bmatrix} 4 & 1 & 2 \\ 0 & 3 & 2 \\ 1 & -2 & 3 \end{bmatrix}$ then compute A+B and B – C. Also verify that A+(B –C) = (A+B)-C **(July 2015, March 2020, Model Paper –o1)**

4. If $A = \begin{bmatrix} -2 \\ 4 \\ 5 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 3 & -6 \end{bmatrix}$. Verify that $(AB)' = B'A'$ **(March 2016)**

5. If $A = \begin{bmatrix} 1 \\ -4 \\ 3 \end{bmatrix}$, $B = \begin{bmatrix} -1 & 2 & 1 \end{bmatrix}$ verify that $(AB)' = B'A'$ **((July 2018)**

6. If $A = \begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 5 & 7 \end{bmatrix}$. Verify that $(AB)' = B'A'$ **(Model Paper -02)**

7. If $A = \begin{bmatrix} 0 & 6 & 7 \\ -6 & 0 & 8 \\ 7 & -8 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 0 \end{bmatrix}$ and $C = \begin{bmatrix} 2 \\ -2 \\ 3 \end{bmatrix}$. Calculate AC, BC and (A+B)C. Also verify that (A+B)C = AC+BC **(July 2016, July 2017, March 2018, July 2019, Sept 2020)**

8. If $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$ then prove that A^3 - $6A^2$ + $7A$ +$2I = O$ **(March 2017)**

9. If $a = \begin{bmatrix} -1 & 2 & 3 \\ 5 & 7 & 9 \\ -2 & 1 & 1 \end{bmatrix}$ and $B = \begin{vmatrix} -4 & 1 & -5 \\ 1 & 2 & 0 \\ 1 & 3 & 1 \end{vmatrix}$ then verify that $(A-B)^1 = A^1$ - B^1 and $(A+B)^1 = A^1 + B^1$ **(Model Paper -2022)**

4. DETERMINANTS

ONE MARK QUESTIONS :

1. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then find $|2A|$ **(March 2014, July 2014)**

2. Find the value of x if $\begin{vmatrix} 3 & x \\ x & 1 \end{vmatrix} = \begin{vmatrix} 3 & 2 \\ 4 & 1 \end{vmatrix}$ **(March 2015, July 2017, March 2019, July 2019)**

3. Find $|3A|$, if $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 4 \end{bmatrix}$ **(July 2015)**

4. Find the value of x if $\begin{vmatrix} x & 2 \\ 18 & x \end{vmatrix} = \begin{vmatrix} 6 & 2 \\ 18 & 6 \end{vmatrix}$ **(March 2015, July 2018, March 2020, Model Paper -01, Model Paper 2022)**

5. Find the value of x if $\begin{vmatrix} 2 & 3 \\ 4 & 5 \end{vmatrix} = \begin{vmatrix} x & 3 \\ 2x & 5 \end{vmatrix}$ **(July 2016)**

6. If $|A| = 8$ then find $|AA^1|$ **(March 2017, Sept 2020)**

7. If A is an invertible matrix of order 2x2 then find $|A^{-1}|$ **(March 2018)**

8. If A is a square matrix and adj(A) = $\begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix}$ then find $|A|$. **(Model Paper -02)**

TWO MARKS QUESTIONS :

1. Using determinants find the equation of the line passing through the points (1,2) and (3,6) **(March 2014, Model Paper 02 , M0del Paper 2022)**
2. Using determinants find the equation of the line passing through the points (3,1) and (9,3) **(July 2014)**
3. Find the value of k if area of the triangle is 4 sq. units and vertices are (-2,0) , (0,4) , (0,k) **(March 2015, July 2015 , Sept 2020)**
4. Show that the points (a, b+c) , (b , c+a) and (c, a+b) are collinear by using determinant **(March 2016)**
5. Using determinants find the area of the triangle whose vertices are (3,8) , (-4,2) and (5,1) . **(July 2016, March 2019)**
6. Find the value of k if area of the triangle is 4 sq . units and vertices are (k,0) , (4,0) , (0,2) **(March 2017)**
7. Using determinants find the area of the triangle whose vertices are (1,0), (6,0) , (4,3) **(July 2017)**
8. Using determinants find the area of the triangle whose vertices are (-2,-3) , (3,2) , (-1,-8) **(March 2018 , March 2020 ,Model Paper 01)**
9. If the area of the triangle with vertices (2,-6) and (5,4) and (k,4) is 35 sq. units . Find the value of k using determinant method **(July 2018)**
10. Using determinant find the area of triangle whose vertices are (2,7) , (1,1) (10,8) . **(March 2019)**

FOUR MARKS QUESTIONS :

1. If A = $\begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$ satisfies the equation A^2 - 5 A +7 $I = O$, then find the inverse of A using this equation , where I is the identity matrix of order 2 **(Model Paper -01)**
2. If A = $\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$, satisfying the equation A^2 - 4 $A + I = 0$, where $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $O = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$. Find A^{-1} **(Model Paper 02 , Model Paper 2022)**
3. Prove that $\begin{vmatrix} b+c & a & a \\ b & c+a & b \\ c & c & a+b \end{vmatrix} = 4\,abc$ **(March 2014)**
4. Prove that $\begin{vmatrix} x+y+2z & x & y \\ z & y+z+2x & y \\ z & x & z+x+2y \end{vmatrix} = 2\,(x+y+z)^3$ **(July 2014 , March 2018, July 2018)**
5. Show that $\begin{vmatrix} a^2+1 & ab & ac \\ ab & b^2+1 & bc \\ ca & cb & c^2+1 \end{vmatrix} = 1+a^2+b^2+c^2$ **(March 2015, July 2015)**
6. Prove that $\begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^3 & b^3 & c^3 \end{vmatrix} = (a-b)(b-c)(c-a)(a+b+c)$ **(March 2016)**
7. Prove that $\begin{vmatrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{vmatrix} = (a+b+c)^3$ **(July 2016, Model Paper 2022)**
8. Prove that $\begin{vmatrix} x & x^2 & yz \\ y & y^2 & zx \\ z & z^2 & xy \end{vmatrix} = (x-y)(y-z)(z-x)(xy+yz+zx)$ **(March 2017)**
9. Prove that $\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} = (a-b)(b-c)(c-a)$ **(July 2017)**
10. Show that $\begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{vmatrix} = abc\left(1+\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)$ **(March 2019)**
11. Prove that $\begin{vmatrix} 1 & x & x^2 \\ x^2 & 1 & x \\ x & x^2 & 1 \end{vmatrix} = (1-x^3)^2$ **(July -2019)**
12. Prove that $\begin{vmatrix} x+4 & 2x & 2x \\ 2x & x+4 & 2x \\ 2x & 2x & x+4 \end{vmatrix} = (5x+4)(4-x)^2$ **(March 2020)**

FIVE MARKS QUESTIONS :

1. Solve the following system of linear equations by Matrix method
   $x - y + z = 4$, $2x + y - 3z = 0$ and $x + y + z = 2$ **(March 2014)**
2. Solve the following system of linear equations by Matrix method
   $x - y + 2z = 7$, $3x + 4y - 5z = -5$ and $2x - y + 3z = 12$ **(July 2014 , March 2018)**
3. Solve the following system of linear equations by Matrix method
   $2x + 3y + 3z = 5$, $x - 2y + z = -4$ and $3x - y - 2z = 3$
   (March 2015, July 2015, March 2020 , Model Paper -01 , Model Paper 2022)
4. Solve $4x + 3y + 2z = 60$, $2x + 4y + 6z = 90$ and $6x + 2y + 3z = 70$ by a matrix method
   (July 2018, Model Paper -02)
5. Solve the following system of linear equations by Matrix method
   $2x - 3y + 5z = 11$, $3x + 2y - 4z = -5$ and $x + y - 2z = -3$ **(March 2016)**
6. Solve the following system of linear equations by Matrix method
   $3x - 2y + 3z = 8$, $2x + y - z = 1$ and $4x - 3y + 2z = 4$
   (July 2016 , March 2019 , July 2019 , Sept 2020)
7. Solve the following system of linear equations by Matrix method
   $x - y + 2z = 1$, $2y - 3z = 1$ and $3x - 2y + 4z = 2$ **(March 2017)**
8. Solve the following system of linear equations by Matrix method
   $x + y + z = 6$, $y + 3z = 11$ and $x - 2y + z = 0$ **(July 2017)**

5. CONTINUITY AND DIFFERENTIABILITY

ONE MARK QUESTIONS :

1. If $y = \log(\sin x)$, find $\frac{dy}{dx}$ **(March 2014)**
2. Find $\frac{dy}{dx}$, if $y = \cos(1 - x)$ **(July 2014)**
3. Find $\frac{dy}{dx}$, if $y = \sin(x^2 + 5)$ **(March 2015 , Model Paper 2022)**
4. Find $\frac{dy}{dx}$, if $y = \cos(\sqrt{x})$ **(July 2015, March 2017 , Model Paper -02)**
5. If $y = a^{\frac{1}{2}\log(\cos x)}$, find $\frac{dy}{dx}$ **(March 2016)**
6. If $y = \tan(2x + 3)$, find $\frac{dy}{dx}$ **(July 2016)**
7. Find $\frac{dy}{dx}$, if $y = \sin(x^2)$ **(July 2017 , Sept 2020)**
8. If $y = e^{x^3}$, find $\frac{dy}{dx}$ **(March 2018)**
9. Find $\frac{dy}{dx}$, if $y = \sin(ax + b)$ **(July 2018)**
10. If $y = \sin(x^2 + 5)$, then find $\frac{dy}{dx}$ **(March 2019)**
11. If $y = \cos^{-1}(e^x)$, find $\frac{dy}{dx}$ **(July – 2019)**
12. If $y = \tan\sqrt{x}$, find $\frac{dy}{dx}$ **(March 2020 , Model Paper -01)**
13. If $y = e^{\cos x}$, find $\frac{dy}{dx}$ **(Model Paper 2022)**

TWO MARKS QUESTIONS

1. If $y + \sin y = \cos x$, find $\frac{dy}{dx}$ **(March 2014)**
2. If $y = x^x$ find $\frac{dy}{dx}$ **(March 2014 , March 2020)**
3. If $\sqrt{x} + \sqrt{y} = \sqrt{10}$, show that $\frac{dy}{dx} + \sqrt{\frac{y}{x}} = 0$ **(July 2015)**
4. Find $\frac{dy}{dx} = (\log x)^{\cos x}$ **(July 2014, March 2019)**
5. Differentiate $\left(x + \frac{1}{x}\right)^x$ w.r.t. x **(March 2015)**
6. Find $\frac{dy}{dx}$, if $x^2 + xy + y^2 = 100$ **(March 2015, March 2018, July 2019, Model Paper 2022)**
7. Find $\frac{dy}{dx}$, if $\log_7(\log x)$ **(July 2015)**
8. If $x^y = a^x$, prove that $\frac{dy}{dx} = \frac{x\, loga - y}{x\, logx}$ **(March 2016)**
9. Find $\frac{dy}{dx}$, if $y = x^{sinx}$, $x > 0$ **(July 2016, March 2018, Sept 2020, Model Paper -02)**
10. Find $\frac{dy}{dx}$, if $ax + by^2 = cosy$ **(March 2017, March 2019 , Sept 2020 , Model Paper -02)**
11. Differentiate $(sinx)^x$ w.r.t. x **(July 2017)**
12. Find $\frac{dy}{dx}$, if $2x + 3y = \sin y$ **(July 2017)**
13. Differentiate $(sinx)^{cosx}$ w.r.t. x **(July 2018)**
14. Find $\frac{dy}{dx}$, if $sin^2 x + cos^2 y = 1$ **, (March 2020, Model Paper -01)**
15. Find $\frac{dy}{dx}$, if $y = \cos(logx + e^x)$ **(Model Paper -01)**
16. If $y = x^3 + \tan x$, then find $\frac{d^2y}{dx^2}$ **(Model Paper -01)**
17. Differentiate $\cos^{-1}(\sin x)$ w.r.t. x **(Model Paper -02)**
18. Find $\frac{dy}{dx}$, if $y = \sec^{-1}\left(\frac{1}{2x^2-1}\right)$, $0 < x < \frac{1}{\sqrt{2}}$ **(July 2015, March 2016 , July 2018)**
19. Find $\frac{dy}{dx}$, if $y = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$, $0 < x < 1$ **(July 2016)**
20. If $x = at^2$ and $y = 2at$ then find $\frac{dy}{dx}$ **(Model Paper 2022)**
21. Differentiate $\cos(\cos(x^2))$ w.r.t. x **(Model Paper -2022)**

THREE MARKS QUESTIONS

1. If $x = a(\cos\theta + \theta\sin\theta)$ and $y = a(\sin\theta - \theta\cos\theta)$ then prove that $\frac{dy}{dx} = \tan\theta$ **(March 2014, Model Paper 2022)**
2. If $x = a(\theta + \sin\theta)$ and $y = a(1 - \cos\theta)$, prove that $\frac{dy}{dx} = \tan\left(\frac{\theta}{2}\right)$ **(July 2014, March 2019 , July -2019, Model Paper -02)**
3. If $x = \sqrt{a^{\sin^{-1}t}}$ and $y = \sqrt{a^{\cos^{-1}t}}$ show that $\frac{dy}{dx} = -\frac{y}{x}$ **(March 2015)**
4. If $x = a\left(cost + \log\tan\frac{t}{2}\right)$, $y = a\sin t$, find $\frac{dy}{dx}$ **(July 2015, July 2017)**

5. If $x = acos^3\theta$ and $y = asin^3\theta$, prove that $\frac{dy}{dx}$ = - $\sqrt[3]{\frac{y}{x}}$ **(March 2016)**
6. If $x = a(\theta - \sin\theta)$, $y = a(1 + \cos\theta)$ then prove that $\frac{dy}{dx}$ = - $\cot\left(\frac{\theta}{2}\right)$ **(July 2016 , July 2018)**
7. Find $\frac{dy}{dx}$, if $y = (logx)^{cosx}$ **(March 2017)**
8. Differentiate sin^2x w.r.t. e^{cosx} **(March 2017)**
9. If $x = \sin t$, $y = \cos 2t$ then prove that $\frac{dy}{dx}$ = - 4 $\sin t$ **(March 2018)**
10. If x =2 at^2 , $y = at^4$ then find $\frac{dy}{dx}$ **(March 2020 , Model Paper -01)**
11. Find $\frac{dy}{dx}$, if $xy = e^{x-y}$ **(Sept 2020, Model Paper -2022)**
12. Find $\frac{dy}{dx}$, if $x^y = y^x$ (Model Paper -01)
13. If $x\sqrt{1+y} + y\sqrt{1+x}$ =0 , for - 1 < x <1 and $x \neq y$, prove that $\frac{dy}{dx}$ = - $\frac{1}{(1+x)^2}$ **(Model Paper -02)**
14. Verify Rolle's theorem for the function $y = x^2 + 2$, [-2,2] **(March 2014 , March 2018)**
15. Verify Rolle's theorem for the function $f(x) = x^2 + 2x - 8$, $x \in [-4,2]$
(March 2015, March 2017 , March 2019)
16. Verify Mean Value Theorem , if $f(x) = x^2 - 4x - 3$ in the interval [a , b] , where a = 1 and b = 4
(July 2014 , July 2015, July 2018 , July 2019 , March 2020 , Model Paper 2022)
17. Verify Mean Value Theorem , if $f(x) = x^3 - 5x^2 - 3x$ in the interval [1 , 3] **(March 2016)**
18. Verify Mean Value Theorem , if $f(x) = x^2$ in the interval [2 , 4] **(July 2016, July 2017)**

FIVE MARKS QUESTIONS

1. If $y = 3e^{2x} + 2e^{3x}$ then prove that $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$ **(March 2014)**
2. If $y = 3\cos(\log x) + 4\sin(\log x)$ then prove that $x^2y_2 + xy_1 + y$ =0
(July 2014, July 2016, July 2017 , July 2019 , Model Paper 2022)
3. If $y = Ae^{mx} + Be^{nx}$ then prove that $\frac{d^2y}{dx^2} - (m+n)\frac{dy}{dx} + mny$ =0 **(March 2015, July 2018 , Sept 2020)**
4. If $y = (\tan^{-1}x)^2$ then prove that $(x^2+1)^2y_2 + 2x(x^2+1)y_1 = 2$
(July 2015 , March 2017 , March 2018 , March 2020 , Model Paper -01)
5. If $y = (\sin^{-1}x)^2$ then prove that $(1-x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} = 2$ **(March 2016)**
6. If $y = \sin^{-1}x$ then prove that $(1-x^2)y_2 - xy_1 = 0$ **(March 2019)**
7. If $y = e^{a\cos^{-1}x}$, $-1 \leq x \leq 1$, then prove that $(1-x^2)y_2 - xy_1 - a^2y$ =0 **(Model Paper -02)**

FOUR MARKS QUESTIONS :

1. Find k, $f(x) = \begin{cases} \frac{k\cos x}{\pi - 2x} & if\ x \neq \frac{\pi}{2} \\ 3 & if\ x = \frac{\pi}{2} \end{cases}$ is continuous at $x = \frac{\pi}{2}$
(March 2014 , July 2014 , March 2017 , July 2019 , Sept 2020)
2. Find k , if $f(x) = \begin{cases} kx+1 & if\ x \leq 5 \\ 3x-5 & if\ x > 5 \end{cases}$ is continuous at $x = 5$
(March 2015 , March 2019 , Model Paper 2022)
3. Find the value of 'a ' and ' b' such that the function $f(x) = \begin{cases} 5 & if\ x \geq 2 \\ ax+b & if\ 2 < x < 10 \\ 21 & if\ x \geq 10 \end{cases}$ is continuous function **(July 2015 , Model Paper -02) .**

4. Find k , if $f(x) = \begin{cases} \frac{1-\cos 2x}{1-\cos x}, & x \neq 0 \\ k, & x = 0 \end{cases}$ is continuous at $x = 0$ **(March 2016)**
5. Find k , if $f(x) = \begin{cases} kx^2 & if\ x \leq 2 \\ 3 & if\ x > 2 \end{cases}$ is continuous at $x = 2$ **(July 2016 , July 2018)**
6. For what value of λ is the function defined by $f(x) = \begin{cases} \lambda(x^2 - 2x) & if\ x \leq 0 \\ 4x + 1 & if\ x < 0 \end{cases}$ continuous at $x = 0$? **(July 2017)**
7. Find the relation between 'a' and 'b' so that the function f defined by $f(x) = \begin{cases} ax + 1 & , if\ x \leq 3 \\ bx + 1 & , if\ x > 3 \end{cases}$ is continuous at $x = 3$ **(March - 2018)**
8. Find k , if $f(x) = \begin{cases} kx + 1 & if\ x \leq \pi \\ \cos x & if\ x > \pi \end{cases}$ is continuous at $x = \pi$ **(March 2020 , Model Paper -01)**

6. APPLICATION OF DERIVATIVE :

1. Find the approximate change in the volume V of a cube of side x meters caused by increasing the side by 2 % **(March 2014 , March 2019)**
2. Approximate $\sqrt{36.6}$ by using differential **(July 2014 , March 2020)**
3. Using differentials , find the approximate value of $\sqrt{49.5}$ (July 2015)
4. Using differentials find the approximate value of $(25)^{\frac{1}{3}}$ **(March 2016 , July 2016)**
5. Find the approximate chage in the volume of a cube of side x meters caused by increasing the side by 3 % **(March 2017)**
6. If the radius of a sphere is measured as 7 cm with an error of 0.02 m , then find the approximate error in calculating its volume . **(July 2018)**
7. Find the slope of the tangent to the curve $y = \frac{x-1}{x-2}$, $x \neq 2$ at $x = 10$ **(March 2015)**
8. Find the interval in which the function is given by $f(x) = 2x^2 - 3x$ is strictly increasing **(July 2016 , July 2019)**
9. Find the points on the curve $\frac{x^2}{4} + \frac{y^2}{25} = 1$ at which the tangents are parallel to x -axis (July 2017)
10. Find the slope of the tangent to the curve $y = x^3 - x$ at $x = 2$ **(March 2018 , Model Paper -01)**
11. Find the slope of the tangent to the curve $y = x^3 - x + 1$ at the point x co-ordinate is 2 **(Model Paper 2022)**
12. Find the interval in which the function f given by $f(x) = x^2 - 4x + 6$ is strictly decreasing **(March 2020)**
13. Find the local maximum value of the function $g(x) = x^2 - 3x$ **(Model Paper -02)**

THREE MARKS QUESTIONS :

1. Find the intervals in which the function f given by $f(x) = x^2 - 4x + 6$ is i) strictly increasing ii) strictly decreasing **(March 2014 , Model Paper -01)**
2. Find two positive numbers x and y such that $x + y = 60$ and xy^3 is maximum **(July 2014 , March 2017)**
3. Find two positive numbers whose sum is 15 and the sum of whose squares is minimum . **(March 2015 , July 2017 , July 2018)**
4. Find two numbers whose sum is 24 and whose product is as large as possible **(July 2015 ,March 2018 , Sept 2020)**
5. Find two numbers whose product is 100 and whose sum is minimum **(March 2016)**
6. Find the intervals in which the function f given by $f(x) = 2x^3 - 3x^2 - 36x + 7$ is strictly increasing and strictly decreasing . **(March 2019 , Model Paper 2022)**
7. Find a point at which the tangent to the curve $y = \sqrt{4x - 3} - 1$ has its slope $\frac{2}{3}$ **(July 2019 , Model paper -02)**

FIVE MARKS QUESTIONS :

1. A ladder 24 ft long is leaning against a wall . The bottom of the ladder is pulled along the ground away from the wall , at the rate of 3ft/s . How fast is its height on the wall decreasing when the foot of the ladder is 8ft away from the wall ? **(March 2014)**
2. A ladder 5m long is leaning against a wall . The bottom of the ladder is pulled along the ground , away from the wall , at the rate of 2cm/ s . How fast is its height on the wall decreasing when the foot of the ladder is 4 m away from the wall ? **(July 2016)**
3. The length x of a rectangle is decreasing at the rate of 5cm /minute and the width y is increasing at the rate of 4 cm/minute . When $x = 8$cm and $y = 6$ cm , find the rates of change of (a) the perimeter , and (b) the area of the rectangle **(July 2014, March 2017 , Model Paper -2022)**
4. The length x of a rectangle is decreasing at the rate of 3 cm /minute and the width y is increasing at the rate of 2 cm/minute . When $x = 10$ cm and $y = 6$ cm , find the rates of change of (a) the perimeter , and (b) the area of the rectangle **(March 2019, March 2016 , Sept 2020, Model Paper -01)**
5. A particle moves along the curve $6y = x^3 + 2$. Find the points on the curve at which y - coordinate is changing 8 times as fast as x - coordinate . **(March 2015 , July 2018 , Model Paper -02)**
6. Sand is pouring from a pipe at the rate of 12 cm^3/s . The falling sand forms a cone on the ground in such a way that the height of the cone is always one –sixth of the radius of the base . How fast is the height of the sand cone increasing when the height is 4 cm ?
(July 2015 , July 2017 , March 2018 , July 2019 , March 2020)

7. INTEGRAATION

ONE MARK QUESTIONS :

1. Evaluate : $\int (sinx + cosx)\ dx$ **(March 2014)**
2. Evaluate : $\int (2x - 3\cos x + e^x)dx$ **(July 2014)**
3. Evaluate : $\int e^x \left(\frac{x-1}{x^2}\right) dx$ **(March 2015)**
4. Evaluate : $\int secx\,(secx + tanx)\ dx$ **(July 2015 , July 2018)**
5. Evaluate : $\int cosec\,x(cosecx + \cot x)\ dx$ **(March 2016)**
6. Evaluate : $\int (2x^2 + e^x)\ dx$ **(July 2016 , March 2020 , Model Paper -01 , Model Paper 2022)**
7. Find $\int \left(\sqrt{x} + \frac{1}{\sqrt{x}}\right) dx$ **(March 2017 , Sept 2020)**
8. Find $\int \cos 3x\ dx$ **(July 2017)**
9. Find $\int \left(\frac{x^3-1}{x^2}\right) dx$ **(March 2018)**
10. Find $\int (1-x)\sqrt{x}\ dx$ **(March 2019)**
11. Find $\int sec^2(7-4x)\ dx$ **(July 2019)**
12. Evaluate : $\int \sqrt{ax+b}\ dx$ **(Model Paper -02)**
13. Evaluate : $\int_2^3 \frac{1}{x} dx$ **(Model Paper -2022)**

TWO MARKS QUESTIONS

1. Evaluate : $\int \frac{sin^2x}{1+cosx}\,dx$ **(March 2014)**
2. Evaluate : $\int_1^e \frac{1}{x}\,dx$ (March 2014)
3. Integrate $\sin x \sin(\cos x)$ with respect to x **(July 2014)**
4. Evaluate : $\int_0^1 \frac{1}{1+x^2}\,dx$ **(July 2014)**
5. Evaluate : $\int \frac{\cos 2x - \cos 2\alpha}{\cos x - \cos\alpha}\,dx$ **(March 2015)**
6. Evaluate : $\int \left(\frac{1}{x-\sqrt{x}}\right) dx$ **(March 2015 , Sept 2020)**
7. Evaluate : $\int \frac{x^2}{1-x^6}\,dx$ **(July 2015)**
8. Evaluate : $\int e^x \left(\frac{1}{x}-\frac{1}{x^2}\right) dx$ **(July 2015)**
9. Evaluate : $\int \left(\frac{1}{\sin x\, cos^3 x}\right) dx$ **(March 2016)**
10. Evaluate : $\int_0^\pi \left[sin^2\left(\frac{x}{2}\right) - cos^2\left(\frac{x}{2}\right)\right] dx$ **(March 2016 , Model Paper -01)**
11. Find $\int x^2 \log x\, dx$ **(July 2016)**
12. Evaluate : $\int_0^1 \frac{1}{\sqrt{1-x^2}}\,dx$ **(July 2016)**
13. Integrate $\frac{tan^4\sqrt{x}\ sec^2\sqrt{x}}{\sqrt{x}}$ with respect to x (March 2017)
14. Evaluate : $\int_0^{\frac{3}{2}} \frac{1}{4+9x^2}\,dx$ **(March 2017)**
15. Evaluate : $\int \frac{\sqrt{tanx}}{\sin x\ cosx}\,dx$ **(July 2017)**
16. Evaluate : $\int \left(\frac{x-3}{x-1}\right) e^x\,dx$ (July 2017)
17. Integrate $\frac{e^{\tan^{-1}x}}{1+x^2}$ with respect to x **(March 2018)**
18. Evaluate : $\int_2^3 \frac{x}{1+x^2}\,dx$ **(March 2018)**
19. Evaluate : $\int cos6x\sqrt{1+sin6x}\,dx$ **(July 2018)**
20. Evaluate : $\int \left(\frac{xe^x}{(x+1)^2}\right) dx$ **(July 2018)**
21. Find $\int \frac{1}{cos^2x\,(1-tanx)^2}\,dx$ **(March 2019)**
22. Find $\int sin2x\ .cos3x\,dx$ **(March 2019)**
23. Integrate $x\,sec^2x$ with respect to x **(July 2019 , March 2020 ,Model Paper -1)**
24. Find $\int \frac{(x^4-x)^{\frac{1}{4}}}{x^5}\,dx$ **(July 2019)**
25. Find $\int \cot x\, logsinx\,dx$ **(March 2020)**
26. Find $\int e^x \sec x\,(1+\tan x)\,dx$ **(Sept 2020)**
27. Evaluate : $\int \frac{sin^2 x - cos^2 x}{sin^2 x\, cos^2 x}\,dx$ **(Model Paper -02 , Model Paper 2022)**
28. Evaluate : $\int \log_e x\,dx$ **(Model Paper -02)**
29. Evaluate : $\int \left(\frac{(logx)^2}{x}\right) dx$ **(Model Paper -2022)**

THREE MARKS QUESTIONS :

1. Evaluate : $\int \left(\frac{x^2+1}{(x+1)^2}\right) e^x \ dx$ **(March 2014)**
2. Find $\int \frac{xe^x}{(1+x)^2} dx$ **(Model Paper 2022)**
3. Evaluate : $\int \tan^{-1} x \ dx$ **(March 2014)**
4. Evaluate : $\int \sin 3x \ .\cos 4x \ dx$ **(July 2014 Sept 2020)**
5. Integrate x^2e^x with respect to x **(July 2014)**
6. Evaluate : $\int x \ \tan^{-1} x \ dx$ **(March 2015)**
7. Evaluate : $\int \frac{x}{(x+1)(x+2)} dx$ **(July 2015 , July 2016 , July 2017 , March 2018 , July 2019 , Model Paper -02)**
8. Evaluate : $\int \frac{dx}{(x+1)(x+2)}$ **(Model Paper -01, Model Paper 2022)**
9. Evaluate : $\int \frac{x}{(x-1)(x-2)} dx$ **(March 2016)**
10. Integrate $\frac{2x}{(x^2+1)(x^2+2)}$ with respect to x **(March 2016)**
11. Find $\int e^x \left(\frac{1+sinx}{1+cosx}\right) dx$ **(July 2016)**
12. Evaluate : $\int \frac{2x}{x^2+3x+2} dx$ **(March 2017)**
13. Evaluate : $\int e^x \ sinx \ dx$ **(March 2017 , March 2018)**
14. Evaluate : $\int \frac{x \ \cos^{-1} x}{\sqrt{1-x^2}} dx$ **(July 2017)**
15. Evaluate : $\int_0^1 \frac{\tan^{-1} x}{1+x^2} dx$ **(July 2018)**
16. Find $\int \frac{dx}{x(x^2+1)}$ **(July 2018)**
17. Find $\int x \ logx \ dx$ **(March 2019 , Sept 2020)**
18. Evaluate : $\int_0^{\frac{\pi}{2}} \frac{sinx}{1+cos^2x} dx$ **(March 2019)**
19. Find $\int \frac{x-3}{(x-1)^3} dx$ **(March 2020 , Model Paper -01)**
20. Evaluate : $\int_0^{\frac{\pi}{2}} cos^2x \ dx$ **(March 2020 , Model Paper -2022)**
21. Evaluate : $\int \frac{sin^3x+cos^3x}{sin^2x cos^2x} dx$ **(Model Paper -01)**
22. Evaluate : $\int tan^4x \ dx$ **(Model Paper -01)**
23. Evaluate : $\int_0^{\frac{\pi}{4}} \sin 2x \ dx$ **(Model Paper -02)**
24. Evaluate : $\int_0^2 e^x \ dx$ as the limit of a sum **(March 2015 , July 2015 , Model Paper -2022)**
25. Evaluate : $\int_0^2 (x^2+1) \ dx$ as a limit of a sum **(July 2019)**

FIVE MARKS QUESTIONS :

1. Find $\int \frac{dx}{x^2-a^2}$ and hence evaluate $\int \frac{dx}{3x^2+13x-10}$, $\int \frac{dx}{4x^2-9}$ **(March 2014 , Model Paper -02)**
2. Find the integral of $\frac{1}{x^2-a^2}$ and hence evaluate $\int \frac{dx}{x^2-3^2}$ **(March 2019)**
3. Find $\int \frac{1}{\sqrt{x^2+a^2}} dx$ and hence evaluate $\int \frac{1}{\sqrt{x^2+7}} dx$ **(June 2014)**
4. Find the integral of $\frac{1}{\sqrt{x^2-a^2}}$ with respect to x and hence evaluate $\int \frac{1}{\sqrt{x^2+6x-7}} dx$ **(March 2015)**
5. Find the integral of $\frac{1}{x^2+a^2}$ w.r.t. x and hence evaluate $\int \frac{1}{3+2x+x^2} dx$
   (March 2016, March 2020 , Model Paper 2022)

6. Find the integral of $\frac{1}{x^2+a^2}$ w.r.t. x and hence evaluate $\int \frac{1}{x^2-6x+13}\,dx$ **(March 2018)**

7. Find the integral of $\frac{1}{\sqrt{a^2-x^2}}$ w.r.t. x and hence evaluate $\int \frac{dx}{\sqrt{5-4x-x^2}}$, $\int \frac{1}{\sqrt{9-25x^2}}\,dx$ **(July 2018 , Model Paper -01)**

8. Find the integral of $\sqrt{x^2+a^2}$ w.r.t. x and hence evaluate $\int \sqrt{x^2+4x+6}\,dx$, $\int \sqrt{1+x^2}\,dx$, $\int \sqrt{x^2+2x+5}\,dx$ **(July 2015, July 2017, July 2019)**

9. Find the integral of $\sqrt{a^2-x^2}$ w.r.t. x and hence evaluate $\int \sqrt{5-x^2+2x}\,dx$ **(July 2016)**

10. Find the integral of $\sqrt{x^2-a^2}$ w.r.t. x and hence evaluate $\int \sqrt{x^2-8x+7}\,dx$ **(March 2017)**

SIX MARKS QUESTIONS :

1. Prove that $\int_0^a f(x)\,dx = \int_0^a f(a-x)\,dx$ and hence evaluate (i) $\int_0^{\frac{\pi}{4}} \log(1+tanx)\,dx$ (ii) $\int_0^{\frac{\pi}{2}} \frac{\sqrt{sinx}}{\sqrt{sinx}+\sqrt{cosx}}\,dx$ (iii) $\int_0^a \frac{\sqrt{x}}{\sqrt{a-x}-\sqrt{x}}\,dx$ (iv) $\int_0^{\frac{\pi}{2}} \frac{cos^5x}{sin^5x+cos^5x}\,dx$ (v) $\int_0^{\frac{\pi}{2}} (2\log sinx - \log sin2x)\,dx$ **(March 2014, July 2016,March 2018, March 2019, Sept 2020, Model Paper -01 , Model Paper 2022)**

2. Prove that $\int_a^b f(x)\,dx = \int_a^b f(a+b-x)\,dx$ and hence evaluate $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{1}{1+\sqrt{tanx}}\,dx$ **(July 2014, July 2015 , March 2017 , July 2019 Model Paper -02)**

3. Prove that $\int_{-a}^a f(x)\,dx = \begin{cases} 2\int_0^a f(x)\,dx & if\ f(x) is\ even \\ 0 & if\ f(x) is\ odd \end{cases}$ and hence evaluate (i) $\int_{-1}^1 sin^5x\,cos^4x\,dx$ (ii) $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} tan^9x\,dx$ **(March 2015, July 2018, July 2017, March 2020)**

4. Prove that $\int_0^{2a} f(x)\,dx = \begin{cases} 2\int_0^a f(x)\,dx & if\ f(2a-x)=f(x) \\ 0 & if\ f(2a-x)=-f(x) \end{cases}$ and hence evaluate $\int_0^{2\pi} cos^5x\,dx$ **(March 2016)**

8. APPLICATION OF INTEGRATION :

THREE MARKS QUESTIONS

1. Find the area of the region bounded by the curve $y = x^2$ and the line y =4 **(March 2014 , March 2018 , Sept 2020)**
2. Find the area of the region by the curve $y = x^2$ and the line y =2 **(Model Paper -02)**
3. Find the area of the region bounded by the curve $y^2 = x$ and the line x =1 , x =4 and the x -axis in the first quadrant . **(July 2014)**
4. Find the area of the region bounded by the curve y^2 =4x and the line x =3 **(March 2015 , March 2019)**
5. Find the area of the region bounded by the curve $y^2 = 4x$ and the line $y = 2x$. **(July 2015 , March 2019)**
6. Find the area of the region bounded by $y^2 = 9\,x$, x =2 , x =4 and the x - axis in the first quadrant . **(July 2016 , July 2019 , Model Paper -2022)**
7. Find the area of the region bounded by the curve $y^2 = 4x$, y - axis and the line y =3 **(March 2017)**
8. Find the area of the region bounded by the curve $y = cosx$ between $x = 0$ and $x = 2\pi$ **(July 2017)**
9. Find the area of the parabola $y^2 = 4ax$ bounded by its latus rectum . **(July 2018)**
10. Find the area of the region bounded by the curve $x^2 = 4y$, $y = 2$, $y = 4$ and the y - axis in the first quadrant **(March 2020, Model Paper -01)**

FIVE MARKS QUESTIONS :

1. Find the area of the region bounded by two parabolas $y = x^2$ and $y^2 = x$. **(March 2014)**
2. Find the area of the region enclosed between two circles $x^2 + y^2 = 4$ and $(x-2)^2 + y^2 = 4$ **(July 2014)**
3. Using integration find the area of triangular region whose sides have the equations $y = 2x + 1$, $y = 3x + 1$ and $x = 4$ **(March 2015 , March 2017)**
4. Find the area of the region bounded by the curves $(x-1)^2 + y^2 = 1$ and $x^2 + y^2 = 1$ using integration method . **(July 2015)**
5. Using integration find the area of the region bounded by the triangle whose vertices are (1,0) , (2,2) and (3,1) . **(March 2016, March 2018)**
6. Find the smaller area enclosed by the circle $x^2 + y^2 = 4$ and the line $x + y = 2$ **(July 2017, March 2019)**
7. Using integration find the area of the region in the first quadrant enclosed by the x - axis , the line $y = x$ and the circle $x^2 + y^2 = 32$ **(July 2019)**
8. Using method of integration , find the area enclosed by the circle $x^2 + y^2 = a^2$ **(Model Paper -02 , Model Paper 2022)**
9. Find the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ (a>b) by method of integration and hence find the area of an ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ **(July 2016 , July 2018, Model Paper -02)**
10. Using the method of integration , find the area of the smaller region bounded by the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$ and the line $\frac{x}{3} + \frac{y}{2} = 1$ **(March 2020)**
11. Find the area enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ and the ordinates $x = 0$ and $x = ae$, where $b^2 = a^2(1 - e^2)$ and e <1 , using integration **(Expected)**
12. Find the area of the smaller part of the circle $x^2 + y^2 = a^2$ cut off by the line $x = \frac{a}{\sqrt{2}}$ **(Expected)**
13. Find the area of the region bounded by the parabola $y = x^2$ and $y = |x|$ **(Expected)**

9. DIFFERENTIAL EQUATIONS :

TWO MARKS QUESTIONS :

1. Find the order and degree of the differential equation $xy\left(\frac{d^2y}{dx^2}\right) + x\left(\frac{dy}{dx}\right)^2 - y\frac{dy}{dx} = 0$ **(March 2014)**
2. Find the order and degree of the differential equation $\left(\frac{d^3y}{dx^3}\right)^3 + \left(\frac{d^2y}{dx^2}\right)^3 + \frac{dy}{dx} + y = 0$ **(July 2014)**
3. Find the order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + \sin\left(\frac{dy}{dx}\right) + 1 = 0$ **(March 2015 , March 2020)**
4. Find the order and degree of the differential equation $\frac{d^2y}{dx^2} + \cos\left(\frac{dy}{dx}\right) = 0$ **(July 2015 , March 2019)**
5. Find the order and degree of the differential equation $\frac{d^4y}{dx^4} + \sin\left(\frac{d^3y}{dx^3}\right) = 0$ **(March 2016 , July 2017)**
6. Find the order and degree of the differential equation $\frac{d^3y}{dx^3} + 2\frac{d^2y}{dx^2} + \frac{dy}{dx} = 0$ **(July 2016)**
7. Find the order and degree of the differential equation $\left(\frac{dy}{dx}\right)^2 + \frac{dy}{dx} - \sin^2 y = 0$ **(March 2017)**
8. Find the order and degree of the differential equation $\left(\frac{d^3y}{dx^3}\right)^3 + \left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^4 + y^5 = 0$ **(March 2018)**
9. Find the order and degree of the differential equation $(y''')^2 + (y'')^3 + (y')^4 + y^5 = 0$ **(July 2018)**
10. Find the order and degree of the differential equation $y''' + y^2 + e^{y'} = 0$ **(July 2019)**
11. Find the order and degree of the differential equation $y''' + y'' + y' = 0$ **(Model Paper -01)**
12. Find the order and degree of the differential equation $y' + y = e^x$ **(Model Paper 2022)**

THREE MARKS QUESTIONS :

1. Form the differential equation representing the family of curves $y = mx$, where m is arbitrary constant . **(March 2014)**
2. Form the differential equation , if the family of circles touching the x - axis at the origin . **(July 2014)**
3. Form the differential equation representing the family of curves $y = a \sin(x + b)$, where a and b are arbitrary constants . **(July 2015 , March 2018 , July 2018 , Model Paper 2022)**
4. Form the differential equation of the family of curves $y = a\, e^{3x} + b\, e^{-2x}$ by eliminating arbitrary constants a *and* b . **(March 2019, July 2019)**
5. Form the differential equation representing the family of curves $\frac{x}{a} + \frac{y}{b} = 1$, where a *and* b are arbitrary constants . **(July 2016)**
6. Form the differential equation of the family of circles having the centre on y - axis and radius 3 units . **(March 2017)**
7. Find the equation of the curve passing through the point (1,1) , given that the slope of the tangent to the curve at any point is $\frac{x}{y}$ **(March 2017)**
8. Find the equation of the curve passing through the point (-2 ,3) , given that the slope of the tangent to the curve at any point is $\frac{2x}{y^2}$. **(July 2017, March 2020)**
9. Solve the differential equation $\frac{dy}{dx} = e^{x+y}$ **(Model Paper -01)**
10. Solve : $y \log y \, dx - x\, dy = 0$ **(Model Paper -02)**
11. Find the general solution of the differential equation $\frac{dy}{dx} = \frac{1+y^2}{1+x^2}$ **(Model Paper 2022)**

FIVE MARKS QUESTIONS :

1. Solve differential equations , $x \log x \frac{dy}{dx} + y = \frac{2}{x} \log x$ **(July 2014)**
2. Solve the differential equation , $\frac{dy}{dx} + (\sec x)y = \tan x$ **(March 2015 , March 2019)**
3. Find the general solution of differential equation , $x\frac{dy}{dx} + 2y = x^2$ **(July 2016 , July 2018 , Model Paper -01 , Model Paper 2022)**
4. Find the general solution of differential equation $\cos^2 x \frac{dy}{dx} + y = \tan x$ **(March 2017 , Sept 2020)**
5. Find the general solution of the differential equation , $x\frac{dy}{dx} + 2y = x^2 \log x$ **(March 2017, March 2020 , Model Paper -01)**
6. Find the general solution of the differential equation $e^x \tan y\, dx + (1 - e^x) \sec^2 y\, dy = 0$ **(March 2014)**
7. Solve the differential equation $y\, dx + (x - ye^y)\, dy = 0$ **(March 2017)**
8. Find the general solution of the differential equation $y\, dx - (x + 2y^2)\, dy = 0$ **(July 2017)**
9. Find the general solution of the differential equation $(x + y)\frac{dy}{dx} = 1$ **(July 2019)**

10. VECTOR ALGEBRA :

ONE MARK QUESTIONS

1. Find the direction cosines of the vector $\hat{\imath} + 2\hat{\jmath} + 3\hat{k}$ **(March 2014)**
2. Define unit vector **. (July 2014)**
3. Define negative of a vector **. (March 2015, July 2018 , March 2020 , Model Paper -01)**
4. Show that $\vec{a} = 2\hat{\imath} - 3\hat{\jmath} + 4\hat{k}$ and $\vec{b} = -4\hat{\imath} + 6\hat{\jmath} - 8\hat{k}$ are collinear **(July 2015)**
5. If vectors $\overrightarrow{AB} = 2\hat{\imath} - \hat{\jmath} + \hat{k}$ and $\overrightarrow{OB} = 3\hat{\imath} - 4\hat{\jmath} + 4\hat{k}$, find the position vector $\overrightarrow{OA}$ **(March 2016)**
6. Find a unit vector in the direction of vector $\vec{a} = 2\hat{\imath} + 3\hat{\jmath} + \hat{k}$ **(July 2016)**
7. Define collinear vectors . **(March 2017)**
8. Find a unit vector in the direction of vector $\vec{a} = \hat{\imath} + \hat{\jmath} + 2\hat{k}$ **(July 2017 , March 2018)**
9. Find a value of x for which $x(\hat{\imath} + \hat{\jmath} + \hat{k})$ is a unit vector . **(March 2019)**
10. If $\vec{a} = \frac{1}{\sqrt{14}}(2\hat{\imath} + 3\hat{\jmath} + \hat{k})$, then find the direction cosines of $\vec{a}$. **(July 2019)**
11. If the vectors $2\hat{\imath} + 3\hat{\jmath} - 6\hat{k}$ and $4\hat{\imath} - m\hat{\jmath} - 12\hat{k}$ are parallel , find the value of m . **(Sept 2020)**
12. Find the vector components of the vector with initial point (2,1) and terminal point (-5,7) . **(Model Paper -02)**
13. Find a unit vector in the direction of vector $\vec{a} = 2\hat{\imath} + 3\hat{\jmath} + 2\hat{k}$. **(Model Paper 2022)**
14. Write the two different vectors have same magnitude **. (Model Paper 2022)**

TWO MARKS QUESTIONS :

1. If $\vec{a}$ is a unit vector and $(\vec{x} - \vec{a}).(\vec{x} + \vec{a}) = 8$ then find $|\vec{x}|$ **. (March 2014, July 2017, July 2019)**
2. Find the area of the parallelogram whose adjacent sides are $\vec{a} = 3\hat{\imath} + \hat{\jmath} + 4\hat{k}$ and $\vec{b} = \hat{\imath} - \hat{\jmath} + \hat{k}$ (**March 2014, March 2018, July 2019 , Sept 2020)**
3. Find the area of the parallelogram whose adjacent sides are $\vec{a} = \hat{\imath} + \hat{\jmath} - \hat{k}$ and $\vec{b} = \hat{\imath} + \hat{\jmath} - \hat{k}$. **(July 2014 , July 2017)**
4. Obtain the projection of the vectors $\vec{a} = 2\hat{\imath} + 3\hat{\jmath} + 2\hat{k}$ on the vector $\vec{b} = \hat{\imath} + 2\hat{\jmath} + \hat{k}$ **(July 2014)**
5. Find $|\vec{a}|$ and $|\vec{b}|$, if $(\vec{x} + \vec{a}).(\vec{x} - \vec{a}) = 8$ and $|\vec{a}| = 8|\vec{b}|$ **(March 2015, March 2019, Sept 2020)**
6. Find the area of the parallelogram whose adjacent side are $\vec{a} = \hat{\imath} - \hat{\jmath} + 3\hat{k}$ and $\vec{b} = 2\hat{\imath} - 7\hat{\jmath} + \hat{k}$ **(March 2015, July 2016 , March 2017, July 2018 , March 2020 , Model Paper -01 , Model Paper 2020)**
7. **Find the projection of $\hat{\imath} + 3\hat{\jmath} + 7\hat{k}$ on $7\hat{\imath} - \hat{\jmath} + 8\hat{k}$ (July 2015, March 2018 , March 2020 , Model Paper -01)**
8. **Find the projection of $\vec{a} = \hat{\imath} - \hat{\jmath} + 3\hat{k}$ on $\vec{b} = 2\hat{\imath} + 3\hat{\jmath} + 2\hat{k}$ (July 2018 , Model Paper 2022)**
9. **If two vectors $\vec{a}$ and $\vec{b}$ such that $|\vec{a}| = 3$, $|\vec{b}| = \frac{\sqrt{2}}{3}$ and $|\vec{a} \times \vec{b}| = 1$. Find the angle between $\vec{a}$ and $\vec{b}$ (July 2015)**
10. **If $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$ then prove that $\vec{a}$ and $\vec{b}$ are perpendicular . (March 2016)**
11. **If two vectors $\vec{a}$ and $\vec{b}$ such that $|\vec{a}| = 2$, $|\vec{b}| = 3$ and $\vec{a}.\vec{b} = 4$ find $|\vec{a} - \vec{b}|$ (March 2016)**
12. **Find the angle between the following vectors $\vec{a} = \hat{\imath} + \hat{\jmath} - \hat{k}$ and $\vec{b} = \hat{\imath} + \hat{\jmath} + \hat{k}$.(July 2016)**
13. **Find the position vector of the point R which divides the join of the points P and Q with position vectors are $\hat{\imath} + 2\hat{\jmath} - \hat{k}$ and $-\hat{\imath} + \hat{\jmath} + \hat{k}$ in the ratio 2:1 internally and externally (March 2017)**
14. **Find a vector in the direction of a vector $\vec{a} = \hat{\imath} - 2\hat{\jmath}$ that has magnitude 7 units (Model Paper -02)**
15. **Show that the vector $\hat{\imath} + \hat{\jmath} + \hat{k}$ is equally inclined to the positive direction of the axes . (Model Paper -02)**

THREE MARKS QUESTIONS :

1. If $\vec{a} = 2\hat{\imath} + 2\hat{\jmath} + 3\hat{k}$, $\vec{b}$ = $-\hat{\imath} + 2\hat{\jmath} + \hat{k}$ and $\vec{c} = 3\hat{\imath} + \hat{\jmath}$ such that $\vec{a} + \lambda\vec{b}$ is perpendicular to $\vec{c}$ then find λ **(March 2014)**
2. If two vectors $\vec{a}$ and $\vec{b}$ such that $|\vec{a}|$ =2 , $|\vec{b}|$=3 and $\vec{a}.\vec{b}$ =4 find $|\vec{a} - \vec{b}|$ **(July 2014)**
3. Find a unit vector perpendicular to each of the vector $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ where $\vec{a} = \hat{\imath} + \hat{\jmath} + \hat{k}$ and $\vec{b} = \hat{\imath} + 2\hat{\jmath} + 3\hat{k}$ **(July 2014, July 2015, March 2019, Model Paper -02)**
4. Show that the position vector of a point P , which divides the line joining the points A and B having position vectors $\vec{a}$ and $\vec{b}$ internally in the ratio $m:n$ is $\frac{m\vec{b}+n\vec{a}}{m+n}$ **(March 2015, July 2016, July 2017, March 2018 , July 2019 , Sept 2019 , Sept 202 Model Paper –02)**
5. Find the sine of the angle between the vectors $\vec{a} = \hat{\imath} + 2\hat{\jmath} + 2\hat{k}$ and $\vec{b} = 2\hat{\imath} + 6\hat{\jmath} + 3\hat{k}$ **(March 2016)**
6. If three vectors $\vec{a}$, $\vec{b}, \vec{c}$ are such that $\vec{a} + \vec{b} + \vec{c} = \vec{o}$ then evaluate ▯= $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$ if $|\vec{a}|$ =1 , $|\vec{b}| = 4$, $|\vec{c}|$ =2 **(March 2017)**
7. If three vectors $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{o}$ then find $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$ **(Model Paper -2022)**
8. Find a unit vector perpendicular to each of the vector $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ where $\vec{a} = 3\hat{\imath} + 2\hat{\jmath} + 2\hat{k}$ and $\vec{b} = \hat{\imath} + 2\hat{\jmath} - 2\hat{k}$ **(July 2018, March 2020)**
9. If $\vec{a}, \vec{b}$ *and* $\vec{c}$ are three vectors such that $|\vec{a}|$ =3 , $|\vec{b}| = 4$, $|\vec{c}| = 5$and each vector is perpendicular to sum of the other two vectors then find $|\vec{a} + \vec{b} + \vec{c}|$ **.(Model Paper -01)**
10. Show that the points A$(-2\hat{\imath} + 3\hat{\jmath} + 5\hat{k})$, B$(\hat{\imath} + 2\hat{\jmath} + 3\hat{k})$ and C$(7\hat{\imath} - \hat{k})$ are collinear **(Model Paper -01)**
11. Prove that $[\vec{a}, \vec{b}, \vec{c} + \vec{d}] = [\vec{a}, \vec{b}, \vec{c}] + [\vec{a}, \vec{b}, \vec{d}]$ **(March 2014)**
12. Prove that $[\vec{a} + \vec{b}, \vec{b} + \vec{c}, \vec{c} + \vec{a}] = 2\,[\vec{a}\ \vec{b}\ \vec{c}]$ **(July 2016, July 2018)**
13. Show that the four points with position $4\hat{\imath} + 8\hat{\jmath} + 12\hat{k}$, $2\hat{\imath} + 4\hat{\jmath} + 6\hat{k}$,$3\hat{\imath} + 5\hat{\jmath} + 4\hat{k}$ and $5\hat{\imath} + 8\hat{\jmath} + 5\hat{k}$ are coplanar **(March 2015, March 2019 , July 2019)**
14. Find λ , if $\vec{a} = \hat{\imath} + 3\hat{\jmath} + \hat{k}$, $\vec{b}$ =$2\hat{\imath} - \hat{\jmath} - \hat{k}$ and $\vec{c}$ =$\lambda\hat{\imath} + 7\hat{\jmath} + 3\hat{k}$ are co planarity **(July 2015)**
15. Find x , such that the four points A(3,2,1), B(4, x ,5) , C(4,2,-2)and D(6,5,-1) are co planar . **(March 2017, July 2017, March 2018 , March 2020 , Model Paper 2022)**
16. For any three vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ prove that $\vec{a} - \vec{b}$, $\vec{b} - \vec{c}$ and $\vec{c} - \vec{a}$ are coplanar **(March 2016)**

11. THREE DIMENSIONAL GEOMETRY :

ONE MARK QUESTIONS :

1. Find the equation of the plane with intercept 4 on z - axis and parallel to XOY plane . **(March 2014)**
2. If a line makes angle 90^0 , 60^0 and 30^0 with positive direction of x , y *and* z axis respectively . Find its direction cosines . **(July 2014, March 2018, March 2020)**
3. Find the direction cosines of x -axis . **(March 2015, Model Paper 2022)**
4. Find the intercepts cut off by the plane $2x + y - z = 5$ **(July 2015 , July 2019)**
5. Find the distance of a point (-6,0, 0) to the plane $2x - 3y + 6z = 2$ **(March 2016)**
6. Find the direction cosines of z -axis . **(July 2016)**
7. Find the direction cosines of a line which makes equal angles with co- ordinate axes . **(March 2017)**
8. Find the direction cosines of y - axis **(July 2017)**
9. The Cartesian equation of a line is $\frac{x-5}{3} = \frac{y-4}{7} = \frac{z-6}{2}$. Write its vector form . **(July 2018)**
10. If a line makes angle 90^0 , 135^0 and 45^0 with positive direction of x, y and z -axis respectively . Find its direction cosines . **(March 2019 , Sept 2020)**
11. If a line has direction ratios 2 , -1 , -2 determine its direction cosines . **(March 2020, Model Paper -01)**
12. Find the distance of the plane $3x - 4y + 12z - 3 = 0$ from the origin . **(Model paper -02)**

TWO MARKS QUESTIONS :

1. Find the equation of the plane through the line of intersection of the planes $3x - y + 2z - 4 = 0$ and $x + y + z - 2 = 0$ and passing through (2,2,1) **(July 2014)**
2. Find the vector equation of the line , passing through the points (-1,0,2) and (3,4,6) .**(July 2015)**
3. Find the vector equation of the line passing through the points (3,-2,-5) and (3,-2,6) . **(March 2017)**
4. Find the vector equation of the line , passing through the points (3,-2,-5) and (3,-2,6) **(Model Paper -02)**
5. Find the Cartesian equation of the line parallel to y -axis and passing through the point (1,1,1) **(March 2016)**
6. Show that the lines $\frac{x-5}{7} = \frac{y+2}{-5} = \frac{z}{1}$ and $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ are perpendicular to each other . **(July 2016)**
7. Find the distance of a point (3,-2,1)to the plane $2x - y + 2z + 3 = 0$ **(March 2019)**
8. Find the distance of a point (-6,0,0) to the plane $2x - 3y + 6z - 2 = 0$ **(Model Paper 2022)**
9. Find the equation of a plane with intercepts 2,3 and 4 on x , y and z axis respectively **(March 2020, Model Paper - 01)**
10. Find the angle between pair of lines $\vec{r} = 3\hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda(\hat{\imath} + 2\hat{\jmath} + 2\hat{k})$ and $\vec{r} = \hat{\imath} - 2\hat{\jmath} + \square(3\hat{\imath} + 2\hat{\jmath} + 6\hat{k})$ **(March 2014 , March 2015)**
11. Find the angle between pair of lines $\vec{r} = 2\hat{\imath} - 5\hat{\jmath} + \hat{k} + \lambda(3\hat{\imath} + 2\hat{\jmath} + 6\hat{k})$ and $\vec{r} = 7\hat{\imath} - 6\hat{k} + \square(\hat{\imath} + 2\hat{\jmath} + \hat{k})$ **(July 2017)**
12. Find the angle between the planes whose vector equations are $\vec{r} . (2\hat{\imath} + 2\hat{\jmath} + 6\hat{k}) = 5$ and $\vec{r} . (3\hat{\imath} - 3\hat{\jmath} + 5\hat{k}) = 3$ **(March 2018)**
13. Find the angle between the line $\frac{x+1}{2} = \frac{y}{3} = \frac{z-3}{6}$ and the plane $10x + 2y - 11z = 3$ **(July 2018)**
14. Find the angle between the pair of lines $\frac{x+3}{3} = \frac{y-1}{5} = \frac{z+3}{4}$ and $\frac{x+1}{1} = \frac{y-4}{1} = \frac{z-5}{2}$ **(July 2019)**
15. Find the intercepts cut off by the plane $2x + y - z = 5$ **(Model Paper 2022)**

THREE MARKS QUESTIONS :

1. Find the distance of a point (2,5,-3) from the plane $\hat{r}.\left(6\hat{\imath} - 3\hat{\jmath} + 2\hat{k}\right) = 4$. **(March 2014)**
2. Find the shortest distance between the lines $\vec{r} = \hat{\imath} + \hat{\jmath} + \lambda\left(2\hat{\imath} - \hat{\jmath} + \hat{k}\right)$ and $\vec{r} = 2\hat{\imath} - \hat{\jmath} - \hat{k} + \square\left(3\hat{\imath} - 5\hat{\jmath} + 2\hat{k}\right)$.**(July 2014, July 2019)**
3. Find the equation of the plane through the line of intersection of the planes $3x - y + 2z - 4 = 0$ and $x + y + z - 2 = 0$ and passing through the point (2,2,1)
   (March 2015 , March 2018 , July 2018, March 2020, Model Paper -01)
4. Find the shortest distance between the lines $\frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1}$ and $\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$.
   (Model Paper 2022)
5. Find the distance between the lines whose vector equations are $\vec{r} = \hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda\left(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k}\right)$ and $\vec{r} = 3\hat{\imath} + 3\hat{\jmath} - 5\hat{k} + \square\left(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k}\right)$ **(July 2015, March 2016, Model Paper -02)**
6. Find the equation of the line , passing through the points (-1,0, 2) and (3,4,6) in both vector and Cartesian form . **(July 2016)**
7. Find the shortest distance between the lines $\vec{r} = \hat{\imath} + 2\hat{\jmath} + \hat{k} + \lambda\left(\hat{\imath} - \hat{\jmath} + \hat{k}\right)$ and $\vec{r} = 2\hat{\imath} - \hat{\jmath} - \hat{k} + \square\left(2\hat{\imath} + \hat{\jmath} + 2\hat{k}\right)$. **(March 2017, Sept 2020)**
8. Find the vector and Cartesian equations of the plane which passes through the point (5,2,-4) and perpendicular to the line with direction ratios 2,3,-1 . **(July 2017)**
9. Find the vector equation of the plane passing through the points R(2,5,-3) , S(-2,-3,5) and T(5,3,-3).
   (March 2019)

FIVE MARKS QUESTIONS :

1. Derive the equation of a plane in Normal form in both vector and Cartesian form .
   (March 2014, July 2016, July 2019, Model Paper -02)
2. Derive the equation of the line in space , passing through a point and parallel to a vector both in vector and Cartesian form. **(July 2014 , March 2015 , March 2019, March 2020, Model Paper -01)**
3. Derive the equation of a plane passing through a point and perpendicular to a vector in both vector and Cartesian form . **(July 2015 , March 2016, March 2017, Model Paper 2022)**
4. Derive the equation of the line in space , passing through two points both in vector and Cartesian forms **(July 2017, March 2018, July 2018 , Sept 2020)**

12. LINEAR PROGRAMMING PROBLEM :

ONE MARK QUESTIONS :

1. Define feasible region in a LPP
   (March 2014 , March 2015 , March 2016 , March 2017, July 2019 , Model Paper 2022)
2. Define linear objective function in LPP **(July 2014 , March 2019 , Model Paper -02)**
3. Define optimal solution in LPP
   (July 2015 , July 2016 , July 2017 , March 2018 , July 2018, March 2020 , Sept 2020, Model Paper -01)

SIX MARKS QUESTIONS :

1. Maximize and Minimize $Z = x + 2y$. Subject to the constraints : $x + 2y \geq 100$, $2x - y \leq 0$, $2x + y \leq 200$, $x, y \geq 0$ by graphical method . **(March 2014, July 2014, Model Paper -02)**
2. Maximize and Minimize $Z = 3x + 9y$, Subject to the constraints: $x + 3y \leq 60$, $x + y \geq 10$, $x \leq y$, $x, y \geq 0$ **(July 2016, March 2018)**
3. Maximize and Minimize $Z = 5x + 10y$, Subject to the constraints : $x + 2y \leq 120, x + y \geq 60$, $x - 2y \geq 0, x \geq 0$, $y \geq 0$ **(March 2016 , March 2019)**
4. Maximize and Minimize $Z = 600x + 400y$, Subject to the constraints , $x + 2y \leq 12, 4x + 5y \leq 12$, $4x + 5y \leq 20$ and $x \geq 0, y \geq 0$by graphically **(March 2017)**
5. Maximize and Minimize $Z = -3x + 4y$, subject to the constraints , $x + y \leq 8$, $3x + 2y \leq 12$, $x \geq 0, y \geq 0$ **(July 2017)**
6. Maximize and Minimize $Z = 10500x + 9000y$, subject to the constraints , $x + y \leq 50$, $20x + 10y \leq 800$, $x \geq 0, y \geq 0$ **(July 2018)**
7. Maximize and Minimize the following $Z = 4x + y$, Subject to the constraints : $x + y \leq 50$, $3x + y \leq 90$, $x \geq 0, y \geq 0$ **(March 2020, Model Paper -01)**
8. Maximize and Minimize the following : $Z = 3x + 2y$, subject to the constraints $x + 2y \leq 10$, $3x + y \leq 15$, $x \geq 0, y \geq 0$ **(Sept 2020, Model Paper -2022)**
9. A manufacturing company makes two models A and B of a product . Each piece of model A requires 9 labour hours for fabricating and 1 labour hour for finishing . Each piece of model B requires 12 labour hours for fabricating and 3 labour hour for finishing . For fabricating and finishing , the maximum labour hours available are 180 and 30 respectively . The company makes a profit of Rs 8000 on each piece of model A and Rs 12000 on each piece of model B . How many pieces of model A and model B should be manufactured per week to realize a maximum profit ? What is the maximum profit per week ? **(March 2015)**
10. One kind of cake requires 200g of flour and 25g of fat , and another kind of cake requires 100g of flour and 50g of fat . Find the maximum number of cakes which can made from 5 kg of flour and 1kg of fat assuming that there is no shortage of the other ingredients used in making the cakes . **(July 2015)**
11. A factory manufactures two types of screws , A and B . Each type of screw requires the use of two machines, an automatic and a hand operated . It takes 4 minutes on the automatic and 6 minutes on hand operated machines to manufacture a package of screws A , while it takes 6 minutes on automatic and 3 minutes on the hand operated machines to manufacture a package of screws B . Each machine is available for at the most 4 hours on any day . The manufacturer can sell a package of screws A at a profit of Rs 7 and screws B at a profit of Rs 10 . Assuming that he can sell all the screws he manufactures , how many packages of each type should the factory owner produce in a day in order to maximize his profit ? Determine the maximum profit **(July 2019)**

13. PROBABILITY

ONE MARK QUESTIONS :

1. If $P(A) = \frac{4}{5}$, $P(B/A) = \frac{2}{5}$, find $P(A \cap B)$ **(March 2014)**
2. If P(A) = 0.6 , P(B) =0.3 , $P(A \cap B)$ =0.2 , then find P(A/B) **(June 2014)**
3. If $P(A) = \frac{3}{5}$, $P(B) = \frac{1}{5}$ then find $P(A \cap B)$ if A and B are independent events .
   (March 2015 , March 2017, July 2019, March 2020)
4. If P(A) = 0.8 . P(B) =0.5 , P(B/A) =0.4 then find $P(A \cap B)$. **(June 2015 , March 2016, July 2017)**
5. If $P(A) = \frac{7}{13}$, $P(B) = \frac{9}{13}$ and $P(A \cap B) = \frac{4}{13}$ then find P(A/B)
   (July 2016 , March 2018 , Model Paper -01)
6. If P(B) =0.5 and $P(A \cap B)$ = 0.32 then find P(A/B) **(July 2018 , Model Paper -2022)**
7. If P(E) =0.6 , P(F) =0.3 and $P(E \cap F)$ =0.2 then find P(F/E) **(March 2019 , Sept 2020)**
8. If F is an event of a sample space S of an experiment then find P(S/F) . **(Model Paper -02)**

TWO MARKS QUESTIONS :

1. A die is thrown . If E is the event ' the number appearing is a multiple of 3 ' and F is the ' the number appearing is even ' , then find whether E and F are independent . **(July 2014)**
2. If A and B are two independent events then prove that the probability of occurrence of atleast one of A and B is given by 1 – $P(A')\,P(B')$. **(July 2017)**
3. Probability of solving a specific problem independently by A and B are $\frac{1}{2}$ and $\frac{1}{3}$ respectively . If both try to solve the problem independently , find the probability that exactly one of them solves the problem .**(March 2019)**
4. Two cards drawn at random and without replacement from a pack of 52 playing cards . Find the probability that both the cards are black . **(Model Paper -02)**
5. Find the probability distribution of number of heads in two tosses of a coin .
   (March 2014 , July 2016 , March 2017)
6. Find the probability distribution of the number of tails in simultaneous tosses of three coins .
   (July 2015)
7. Let X denotes the number of hours you study during a randomly selected school day . The probability that X can take the values of x , has the following form , where k is some constant .

$$P(X=x) \quad \begin{cases} 0.1 & \text{if } x = 0 \\ kx & \text{if } x = 1 \text{ or } x = 2 \\ k(5-x) & \text{if } x = 3 \text{ or } x = 4 \\ 0 & \text{otherwise} \end{cases}$$

   find the value of ' k ' **(March 2015)**

8. The random variable X has a probability distribution P(X) of the following form where k is some number :

$$P(X=x) \quad \begin{cases} k, & \text{if } x = 0 \\ 2k, & \text{if } x = 1 \\ 3k, & \text{if } x = 2 \\ 0, & \text{otherwise} \end{cases}$$

   Determine the value of ' k ' and $P(X \leq 2)$ **(March 2016, July 2018 , Model Paper 2022)**

9. A random variable X has the following probability distribution :

X	0	1	2	3	4
P(X)	0.1	k	2k	3k	5

Determine (i) k (ii) $P(X \geq 2)$ **(March 2018 , March 2020)**

10. The probability distribution of random variable X is as follows

X	0	1	2
P(X)	$\frac{188}{221}$	$\frac{32}{221}$	$\frac{1}{221}$

Find the expectation of X . **(July 2019)**

THREE MARKS QUESTIONS :

1. A die is tossed thrice . Find the probability of getting an odd number at least once . **(March 2014 , July 2016 ,)**
2. Bag I contains 3 red and 4 black balls and bag II contains 5 red and 6 black balls . One ball is drawn at random from one of the bag and it is found to be red . Find the probability that t was drawn from bag II **(July 2014 , July 2015 , July 2019 , Sept 2020 , Model Paper -02)**
3. An insurance company insured 2000 scooter drivers , 4000 car drivers and 6000 truck drivers . The probability of an accidents are 0.01 . 0.03 and 0.15 respectively . One of the insured persons meets with an accident . What is the probability that he is a scooter driver ? **(March 2015 , March 2019)**
4. Given three identical boxes , I, II and III , each containing two coins . In box I, both coins are gold coins , in box II , both are silver coins and in box III , ther is one gold coin and one silver coin . A person chooses a box at random and takes out a coin . If the coin is gold , what is the probability that the other coin in the box is also gold ? **(March 2016)**
5. Given that the two numbers appearing on throwing two dice are different . Find the probability of the event " the sum of numbers on the dice is 4" . **(March 2017)**
6. A man is known to speak truth 3 out of 4 times . He throws a die and reports that it is a six . Find the probability that it is actually a six . **(July 2017 , March 2020 ,Model Paper -01 , Model Paper 2022)**
7. A bag contains 4 red and 4 black balls , another bag contains 2 red and 6 black balls . One of the two bags is selected at random and a ball id drawn from the bag which is found to be red . Find the probability that it was drawn from first bag **.(March 2018)**
8. A man is known to speak truth 4 out of 5 times . He tossed a coin and reports that it is head . Find the probability that it is actually head . **(July 2018)**

FIVE MARKS QUESTIONS :

1. Probability of solving specific problem independently by A and B are $\frac{1}{2}$ and $\frac{1}{3}$ respectively . If both try to solve the problem independently , find the probability that (i) problem is solved (ii) exactly one of them is solves the problem . **(Model Paper -01 , Model Paper 2022)**
2. Two balls are drawn at random with replacement from a box containing 10 black and 8 red balls . Find the probability that (i) Both balls are red (ii) First ball is black and second is red (iii) One of them is black and other is red . **(Model Paper -02)**
3. A die is thrown . If E is the event ' the number appearing is a multiple of 3 ' and F be the event ' the number appearing is even' then find whether E and F are independent ? **(Expected)**
4. Given two independent events A and B such that P(A) =0.3 and P(B) =0.6 find (i) P(A and B) (ii) P(A or B) (iii) P(A and not B) . **(Expected)**

5. A fair coin and unbiased die are tossed . Let A be the event ' head appears on the coin ' and B be the event ' 3 on the die ' . Check whether A and B are independent events or not ? **(Expected)**
6. A person buys a lottery ticket in 50 lotteries , in each of which his chance of winning a prize is $\frac{1}{100}$. What is the probability that he will win a prize a) at least once b) exactly once **(March 2014 , July 2018, March 2020, Model Paper 2022)**
7. Probability that a student is not a swimmer is $\frac{1}{5}$. Find the probability that out of 5 students , (i) at least four are swimmers and (ii) at most three are swimmers . **(March 2016)**
8. If a fair coin is tossed 10 times , find the probability of (i) exactly six heads (ii) at least six heads **(July 2014, July 2016, July 2017 , March 2018)**
9. A die is thrown 6 times . If " getting an odd number " is success , what is the probability of (i) 5 success (ii) at least 5 success (iii) at most 5 success . **(March 2015 , July 2019)**
10. Five cards are drawn successively with replacement from a well shuffled deck of 52 cards . What is the probability that (i) all the five cards are spades ? (ii) only 3 cards are spades ? (iii) none is a spade ? **(July 2015, March 2019)**
11. The probability that a bulb produced by a factory will fuse after 150 days of use 0.05 , find the probability that out of5 such bulbs (i) none (ii) not more than one (iii) more than one will fuse after 150 days of use . **(March 2017)**