CHAPTER 11

THREE DIMENSIONAL GEOMETRY

- Deleted Portions:
  - Relation between the Direction Cosines of a Line
  - Equation of a Line Passing through Two Given Points. Ques. 8–9 (Exercise11.2)
  - Coplanarity of Two Lines Plane Full. Ex 11(3)
  - Angle between Two Planes
  - Distance of a Point from a Line
  - Angle between a Line and a Plane Ques. 1, 2, 5, 7–8, 10–19, 21–23 (Miscellaneous Exercise)

JULY 2022

1. Write the vector equation of the line
$\frac{x}{2} = \frac{y-2}{3} = \frac{z+1}{1}$ (1)
2. *Deleted*
3. Find the shortest distance between the skew-lines
$\vec{r} = (\hat{\imath} + 2\hat{\jmath} + \hat{k}) + \lambda(\hat{\imath} - \hat{\jmath} + \hat{k})$ and
$\vec{r} = (2\hat{\imath} - \hat{\jmath} - \hat{k}) + \mu(2\hat{\imath} + \hat{\jmath} + 2\hat{k})$ (4)

MARCH 2022

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SAY 2021

4. Find the shortest distance between the skew-lines
$\vec{r} = (\hat{\imath} + 2\hat{\jmath} + 3\hat{k}) + \lambda(\hat{\imath} - 3\hat{\jmath} + 2\hat{k})$ and
$\vec{r} = (4\hat{\imath} + 5\hat{\jmath} + 6\hat{k}) + \mu(2\hat{\imath} + 3\hat{\jmath} + \hat{k})$ (4)

MARCH 2021

5. Find the shortest distance between the skew-lines
$\vec{r} = (\hat{i} + 2\hat{j} + \hat{k}) + \lambda(\hat{i} - \hat{j} + \hat{k})$ and
$\vec{r} = (2\hat{i} - \hat{j} - \hat{k}) + \mu(2\hat{i} + \hat{j} + 2\hat{k})$ (4)

SAY 2020

6. i) Deleted
   ii) Deleted
7. Consider two lines in space,
$\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(\hat{i} - 3\hat{j} + 2\hat{k})$ and
$\vec{r} = (4\hat{i} + 5\hat{j} + 6\hat{k}) + \mu(2\hat{i} + 3\hat{j} + \hat{k})$.
   a) Find the angle between the above lines. (2)
   b) Represent the above lines in Cartesian form. (2)

MARCH 2020

8. The Cartesian equation of two lines are
$\frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1}$ and $\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$.
   i) Write the vector equation. (1)
   ii) Find the shortest distance between these two lines. (3)

SAY 2019

9. Find the shortest distance between the skew-lines
$\vec{r} = (\hat{i} + 2\hat{j} + \hat{k}) + \lambda(\hat{i} - \hat{j} + \hat{k})$ and
$\vec{r} = (2\hat{i} - \hat{j} - \hat{k}) + \mu(2\hat{i} + \hat{j} + 2\hat{k})$ (4)

MARCH 2019

10. a) Write all the direction cosines of x axis (1)
    b) If a line makes angles α, β, γ with x, y, z axes respectively, then prove that
$\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 2$ (2)
    c) If a line makes equal angles with the three coordinate axes, find the direction cosines of the line. (1)
    b) The Cartesian equation of two lines are given

  | Cfust94@gmail.com

by $\frac{x+1}{7}=\frac{y+1}{-6}=\frac{z+1}{1}$ and

$\frac{x-3}{1}=\frac{y-5}{-2}=\frac{z-7}{1}$ (2)

c) Find the shortest distance between the lines mentioned in part (b). (2)

SAY 2018

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MARCH 2018

11. a) Find the angle between the lines:

$\frac{x-2}{2}=\frac{y-1}{5}=\frac{z+3}{-3}$ and

$\frac{x+2}{-1}=\frac{y-4}{8}=\frac{z-5}{4}$ (2)

b) Find the shortest distance between the pair of lines:

$\vec{r}=\hat{i}+2\hat{j}+3\hat{k}+\lambda\left(\hat{i}-3\hat{j}+2\hat{k}\right)$

$\vec{r}=4\hat{i}+5\hat{j}+6\hat{k}+\mu\left(2\hat{i}+3\hat{j}+\hat{k}\right)$ (2)

SAY 2017

12. Find the shortest distance between the lines

$\vec{r}=\hat{i}-2\hat{j}+3\hat{k}+t\left(-\hat{i}-2\hat{j}-2\hat{k}\right)$ and

$\vec{r}=\hat{i}-\hat{j}-\hat{k}+s\left(\hat{i}-\hat{j}-\hat{k}\right)$ (3)

13. Find the Cartesian equation of a line passing through (1,2,-4) and perpendicular to the lines $\frac{x-2}{2}=\frac{y-1}{-1}=\frac{z-1}{1}$ and $\frac{x-5}{1}=\frac{y}{1}=\frac{z-2}{1}$ (3)

MARCH 2017

14. a) The line $x-1=y=z$ is perpendicular to the lines

$\vec{r}=\hat{i}+2\hat{j}+3\hat{k}+\lambda\left(\hat{i}+\hat{j}+\hat{k}\right)$

$\vec{r}=\hat{i}+\hat{j}+\hat{k}+\mu\left(\hat{i}+\hat{j}+\hat{k}\right)$ (3)

SAY 2016

15. a) The equation of the line which passes through the point (1,2,3) and parallel to the vector $3\hat{i}+2\hat{j}-2\hat{k}$ is

i) $3\hat{i}+2\hat{j}-2\hat{k}+\lambda\left(\hat{i}+2\hat{j}+3\hat{k}\right)$

ii) $2\hat{i}-5\hat{k}+\lambda\left(3\hat{i}+2\hat{j}-2\hat{k}\right)$

iii) $\hat{i}+2\hat{j}+3\hat{k}+\lambda\left(-2\hat{i}+4\hat{j}-2\hat{k}\right)$

iv) $\hat{i}+2\hat{j}+3\hat{k}+\lambda\left(3\hat{i}+2\hat{j}-2\hat{k}\right)$ (1)

b) Find the angle between the pair of lines

$\vec{r}=2\hat{i}-5\hat{j}+\hat{k}+\lambda\left(3\hat{i}+2\hat{j}+6\hat{k}\right)$ and

$\vec{r}=7\hat{i}-6\hat{k}+\mu\left(\hat{i}+2\hat{j}+2\hat{k}\right)$ (3)

MARCH 2016

16. Find the shortest distance between the lines

$\vec{r}=2\hat{i}+\hat{j}-\hat{k}+\mu\left(3\hat{i}-5\hat{j}+2\hat{k}\right)$ and

$\vec{r}=\hat{i}+\hat{j}+\lambda\left(2\hat{i}-\hat{j}+\hat{k}\right)$. (4)

SAY 2015

17. a) Find the value of 'p' if the lines $\frac{x-5}{7}=\frac{y+2}{-5}=\frac{z}{1}$ and $\frac{x}{1}=\frac{y}{p}=\frac{z}{3}$ are perpendicular. (1)

b) Find the shortest distance between the lines:

$\vec{r}=\left(\hat{i}+2\hat{j}+3\hat{k}\right)+\lambda\left(\hat{i}-3\hat{j}+2\hat{k}\right)$ and

$\vec{r}=\left(4\hat{i}+5\hat{j}+6\hat{k}\right)+\mu\left(2\hat{i}+3\hat{j}+\hat{k}\right)$ (3)

MARCH 2015

18. a) Write the Cartesian equation of the straight line through the point (1,2,3) and along the vector $3\hat{i}+\hat{j}+2\hat{k}$. (1)

b) Write a general point on this straight line. (1)

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  | Cfust94@gmail.com

SAY2014

19. a) If a_1,b_1,c_1 and a_2,b_2,c_2 are the direction ratios of two lines, then write the condition of its perpendicularity. (1)

b) Find the angle between the lines:
$\frac{x+3}{3}=\frac{y-1}{5}=\frac{z+3}{4}$ and $\frac{x+1}{1}=\frac{y-4}{1}=\frac{z-5}{2}$. (3)

MARCH 2014

20. Given straight line
$\vec{r}=\left(3\hat{i}+2\hat{j}-4\hat{k}\right)+\lambda\left(\hat{i}+2\hat{j}+2\hat{k}\right)$ and
$\vec{r}=\left(5\hat{j}-2\hat{k}\right)+\mu\left(3\hat{i}+2\hat{j}+6\hat{k}\right)$

a) Find the angle between the lines (2)

b) Obtain a unit vector perpendicular to both the lines. (2)

c) Form the equation of the line perpendicular to the given lines and passing through the point(1,1,1). (1)

SAY 2013

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MARCH 2013

21. Consider the lines $\frac{x-3}{3}=\frac{y-8}{-1}=\frac{z-3}{1}$ and $\frac{x+3}{-3}=\frac{y+7}{2}=\frac{z-6}{4}$.

a) Express the equations of the lines into vector form. (1)

b) Find the shortest distance between the lines. (3)

SAY 2012

22. a) Find the angle between the lines having direction ratios 1,1,2 and $\sqrt{3}-1,-\sqrt{3}-1,4$ (2)

b) If the lines $\frac{x-1}{3}=\frac{y-1}{2\lambda}=\frac{z-3}{2}$ and $\frac{x-1}{3\lambda}=\frac{y-1}{1}=\frac{z-6}{-5}$ are perpendicular, find the value of λ. (2)

2012 MARCH

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SAY 2011

35. a) Consider the lines $\frac{x}{2}=\frac{y}{2}=\frac{z}{1}$ and $\frac{x-5}{4}=\frac{y-2}{1}=\frac{z-3}{8}$.

a) Write the direction ratios of this line (1)

b) Find the angle between these two lines. (3)

a) Find the shortest distance between the lines $\vec{r}=\left(\hat{i}+\hat{j}\right)+\lambda\left(2\hat{i}-\hat{j}+\hat{k}\right)$ and $\vec{r}=\left(2\hat{i}+\hat{j}-\hat{k}\right)+\mu\left(3\hat{i}-5\hat{j}+2\hat{k}\right)$ (4)

MARCH 2011

36. Consider the lines $\frac{x-3}{2}=\frac{y-1}{5}=\frac{z+3}{4}$ and $\frac{x+5}{1}=\frac{y+2}{1}=\frac{z-3}{2}$

a) Find the angle between them. (1)

b) Find the shortest distance between them. (3)

SAY 2010

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MARCH 2010

37. a) The coordinates of the foot of the perpendicular from (1,2,1) on the x-axis is …… (1)

b) If A,B,C are angles which a line makes with the co-ordinate axes, then the value of $\sin^2 A+\sin^2 B+\sin^2 C=$ …… (1)

38. a) Find the shortest distance between the skew-lines whose vector equations are:

  | Cfust94@gmail.com

$\vec{r} = \left(\hat{i} + 2\hat{j} + \hat{k}\right) + \lambda\left(\hat{i} - \hat{j} + \hat{k}\right);$

$\vec{r} = \left(2\hat{i} - \hat{j} - \hat{k}\right) + \mu\left(2\hat{i} + \hat{j} + 2\hat{k}\right)$ (4)

SAY 2009

39. i) Find the direction ratios of the line through the points P(1, –1, 2) and Q(3, 4, –2). (1)

ii) If R(0, 3, 2) and S(3, 5, 6), show that PQ is perpendicular to RS. (2)

40. a) A line passes through the point (3,–2,5) and parallel to the vector $2\hat{i} + \hat{j} - 2\hat{k}$.

i) What is the vector equation of the line? (1)

ii) What is the Cartesian equation of the line? (1)

b) Find the shortest distance between the skew lines whose vector equations are

$\vec{r} = \left(\hat{i} + 2\hat{j} + 3\hat{k}\right) + \lambda\left(\hat{i} - 3\hat{j} + 2\hat{k}\right);$

$\vec{r} = \left(4\hat{i} + 5\hat{j} + 6\hat{k}\right) + \mu\left(2\hat{i} + 3\hat{j} + \hat{k}\right)$ (4)

MARCH 2009

41. a) Write the direction ratio of the line

$x = 2y = 3z$ (1)

MARCH 2008

42. Consider the points (–1,2,4) and (1,0,5).

i) Find the direction cosines of the line joining the two points. (2)

"ENTHUSIASM IS A POWER that can give Dreames to the Dreamless, Life to the Lifeless, and Hope to the Hopeless".