

	P.R. Government College (Autonomous) KAKINADA	Program & Semester I B.Sc Major (I Sem) w.e.f. 2025-26 admitted Batch			
Course Code MAT-102 T	TITLE OF THE COURSE ANALYTICAL SOLID GEOMETRY				
Teaching	Hours Allocated: 60 (Theory)	L	T	P	C
Pre-requisites:	Basic Mathematics Knowledge on 2-D Geometry	5	-	-	4

Course Objectives:

1. To introduce fundamental concepts of planes, lines, and spheres in 3D geometry.
2. To develop analytical skills for deriving equations of planes, lines, and spheres in different forms.
3. To analyze geometric relationships, including angles, distances, and intersections between lines, planes, and spheres.
4. To study advanced properties of spheres, such as tangents, polar planes, and orthogonality conditions.
5. To apply geometric principles to solve problems involving coplanarity, shortest distances, and sphere-line/plane interactions.

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Derive and interpret equations of planes and lines in various forms.
CO2	Compute angles, distances, and intersection conditions between geometric elements (lines, planes, spheres).
CO3	Determine coplanarity of lines and solve problems involving shortest distances in 3D space.
CO4	Analyse sphere-related problems, including tangents, intersections, and circle equations in 3D.
CO5	Apply advanced concepts like polar planes, conjugate points, and orthogonality conditions of spheres.

Course with focus on employability/entrepreneurship /Skill Development modules

Skill Development		Employability		Entrepreneurship	
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SYLLABUS:

UNIT – I:

Equation of plane in terms of its intercepts on the axis - Equations of the plane through the given points - Length of the perpendicular from a given point to a given plane - Bisectors of angles between two planes - Combined equation of two planes

UNIT – II:

Equation of a line in various forms - Angle between a line and a plane - The condition that a given line may lie in a given plane - The condition that two given lines are coplanar - Number of arbitrary constants in the equations of straight line - Sets of conditions which determine a line

UNIT – III:

The shortest distance between two skew lines - The length and equations of the line of shortest distance between two skew lines - Length of the perpendicular from a given point to a given line.

UNIT – IV:

Definition and equation of the sphere - Equation of the sphere through four given points - Plane sections of a sphere - Intersection of two spheres - Equation of a circle - Sphere through a given circle - Intersection of a sphere and a line

UNIT –V:

Power of a point - Tangent plane - Plane of contact; Polar plane - Pole of a Plane - Conjugate points - Conjugate planes - Angle of intersection of two spheres - Conditions for two spheres to be orthogonal - Radical Plane – Coaxial system of spheres-Limiting Points.

Activities:

The activities include quizzes, assignments, seminars, and student presentations. Additional tasks involve mini projects, concept flowcharts, operator method charts, peer teaching, LMS-based quizzes, board work challenges, poster presentations, and visual aids like chalk talks to enhance learning and engagement.

Prescribed Text Book:

Analytical Solid Geometry by Shanti Narayan and P.K. Mittal, published by S. Chand & Company Ltd. 7th Edition.

Reference Books :

1. A text Book of Analytical Geometry of Three Dimensions, by P.K. Jain and Khaleel Ahmed, published by Wiley Eastern Ltd., 1999.
2. Co-ordinate Geometry of two and three dimensions by P. Balasubrahmanyam, K.Y. Subrahmanyam, G.R. Venkataraman published by TataMcGraw -Hill Publishers.
3. Solid Geometry by B. Rama Bhupal Reddy, published by Spectrum University Press.

CO-POMapping:

(1:Slight[Low];

2:Moderate[Medium];

3:Substantial[High],

'-':NoCorrelation)

BLUE PRINT FOR QUESTION PAPER PATTERN
COURSE-II- ANALYTICAL SOLID GEOMETRY

Unit	TOPIC	S.A.Q	E.Q	Marks allotted to the Unit
I	UNIT - I	2	1	20
II	UNIT - II	1	1	15
III	UNIT - III	1	1	15
IV	UNIT – IV	2	1	20
V	UNIT - V	1	2	25
		7	6	95

S.A.Q. = Short answer questions (5 marks)

E.Q = Essay questions (10 marks)

Short answer questions : 4 X 5 = 20 M

Essay questions : 3 X 10 = 30 M

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Total Marks = 50 M

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PITHAPUR RAJAH'S GOVERNMENT COLLEGE (AUTONOMOUS), KAKINADA

I year B.Sc., Degree Examinations - I Semester

Mathematics Course-II: Solid Geometry

(w.e.f. 2025-26 Admitted Batch)

Model Paper (w.e.f. 2025-2026)

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Time: 2Hrs

Max. Marks: 50M

Section -I

Answer any three of the following questions. Must attempt atleast one question from each part. Each question carries 10 Marks.

$3 \times 10 = 30M$

Part – A

1. Essay question from unit - I.
2. Essay question from unit - II.
3. Essay question from unit - III.

Part - B

4. Essay question from unit - IV.
5. Essay question from unit - V.
6. Essay question from unit - V.

Section II

Answer any four of the following questions. Each question carries 5 marks. $4 \times 5 = 20M$

7. Short answer question from unit - I.
8. Short answer question from unit - I.
9. Short answer question from unit – II.
10. Short answer question from unit - III.
11. Short answer question from unit - IV.
12. Short answer question from unit – IV.
13. Short answer question from unit – V.

PITHAPUR RAJAH'S GOVERNMENT COLLEGE (AUTONOMOUS), KAKINADA

I year B.Sc., Degree Examinations - I Semester
Mathematics Course Major - II: Analytical Solid Geometry
(w.e.f. 2025-2026 Admitted Batch)
QUESTION BANK
Short Answer Questions

Unit-I

1. Find the equation of the plane through (4, 4, 0) and perpendicular to the planes $x + 2y + 2z = 5$ and $3x + 3y + 2z - 8 = 0$.
2. Find the equation to the plane through the points (2, 2, 1), (9, 3, 6) and perpendicular to the plane $2x + 6y + 6z = 9$.
3. Show that the equation of the plane passing through the points (2, 2, -1), (3, 4, 2), (7, 0, 6) is $5x + 2y - 3z - 17 = 0$.
4. Find the angles between the planes $2x - y + z = 0$, $x + y + 2z = 7$.
5. Find the equation of the plane through the point (-1, 3, 2) and perpendicular to the planes $x + 2y + 2z = 5$ and $3x + 3y + 2z = 8$.
6. Find the equation of the plane through the line of intersection of $x - y + 3z = 5 = 0$ and $2x + y - 2z + 6 = 0$ and passing through (-3, 1, 1).

UNIT-II

7. Find the image of the point (2, -1, 3) in the plane $3x - 2y + z = 9$.
8. Find the image of the point (1, 6, 3) in the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$.
9. Find the symmetric form of the equation of the line $x + y + z + 1 = 0 = 4x + y - 2z + 2$.
10. Find the equation to the plane containing the line $\frac{x-1}{2} = \frac{y+1}{-1} = \frac{z-3}{4}$ and is perpendicular to the plane $x + 2y + z - 12 = 0$.
11. Find the equations of the line through the point (1, 1, 1) and intersecting the lines $2x - y - z - 2 = 0 = x + y + z - 1$; $x - y - z - 3 = 0 = 2x + 4y - z - 4$.

UNIT-III

12. Show that the equation to the plane containing the line $\frac{y}{b} + \frac{z}{c} = 1$, $x = 0$ and parallel to the line $\frac{x}{a} - \frac{z}{c} = 1$, $y = 0$ is $\frac{x}{a} - \frac{y}{b} - \frac{z}{c} = 1$ and if 2d is the S.D., prove that $\frac{1}{d^2} = \frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2}$.
13. Find the length of the perpendicular from the point (1, 2, 3) to the line through the point (6, 7, 7) whose d.r.s. are 3, 2, -2.
14. If the position vectors of A, B, C, d are respectively $-\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$, $-16\mathbf{i} + 6\mathbf{j} + 4\mathbf{k}$, $\mathbf{i} - \mathbf{j} + 3\mathbf{k}$ and $4\mathbf{i} + 9\mathbf{j} + 7\mathbf{k}$, find the S.D between the lines $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$.
15. Find the foot of the perpendicular from the origin to the line $2x + 3y + 4z + 5 = 0 =$

$x + 2y + 3z + 4$. Hence find the distance of the origin from the line.

UNIT-IV

16. Find the equation of the sphere through $O = (0, 0, 0)$ and making intercepts a, b, c on the axes.
17. A plane passes through a fixed point (a, b, c) and intersect the axes in A, B, C . Show that the centre of the sphere $OABC$ lies on $\frac{a}{x} + \frac{b}{y} + \frac{c}{z} = 2$
18. Find the equation of the sphere through the circle $x^2 + y^2 + z^2 = 9$, $2x + 3y + 4z = 5$.
19. Find the centre and radius of the circle $x^2 + y^2 + z^2 - 2y - 4z - 11 = 0$, $x + 2y + 2z - 15 = 0$.
20. Find the equation of the sphere through the points $(1, -4, 3)$, $(1, -5, 2)$, $(1, -3, 0)$ and whose centre lies on the plane $x + y + z = 0$.
21. Find the equation of the sphere through the circle $x^2 + y^2 + z^2 + 2x + 3y + 6 = 0$, $x - 2y + 4z = 9$ and the centre of the sphere $x^2 + y^2 + z^2 - 2x + 4y - 6z + 5 = 0$.
22. Find the equation of the sphere for which the circle $x^2 + y^2 + z^2 + 7y - 2z + 2 = 0$, $2x + 3y + 4z = 8$ is a great circle. Also find its centre and radius.

UNIT-V

23. Show that the spheres $x^2 + y^2 + z^2 + 6y + 2z + 8 = 0$, $x^2 + y^2 + z^2 + 6x + 8y + 4z + 20 = 0$ are orthogonal.
24. Find the equation of the sphere which touches the plane $3x + 2y - z + 2 = 0$ at $(1, -2, 1)$ and cuts orthogonally the sphere $x^2 + y^2 + z^2 - 4x + 6y + 4 = 0$.
25. Find the equation to the sphere with $(1, 2, -3)$, $(5, 0, 1)$ as the ends of one of its diameters. Also find an angle between it and the sphere $x^2 + y^2 + z^2 - 2x - 4y - 6z + 10 = 0$.
26. Find the equation to the sphere through the circle given by $x^2 + y^2 + z^2 - 2x - 4y - 11 = 0$, $x^2 + y^2 + z^2 + 2x - y + 12z + 5 = 0$ and through the point $(1, -1, -1)$.
27. Find the equation of the radical plane of the coaxial system whose limiting points are $(-1, 2, 1)$ and $(-2, 1, -1)$.

Essay Questions

UNIT-I

1. If a plane meets the coordinate axes in A, B, C such that the centroid of the triangle ABC is the point (p, q, r) then show that the equation of the plane is $\frac{x}{p} + \frac{y}{q} + \frac{z}{r} = 3$.
2. Find the planes bisecting the angles between the planes $2x - y + 2z + 3 = 0$ and $3x - 2y + 6z + 8 = 0$. Point out which of the planes bisects the acute angle and which bisects the obtuse angle in which the origin lies.
3. Prove that the equation represents a pair of planes, and find the angle between them.
 $6x^2 + 4y^2 - 10z^2 + 3yz + 4zx - 11xy = 0$
4. Show that the equation $x^2 + 4y^2 + 9z^2 - 12yz - 6zx + 4xy + 5x + 10y - 15z + 6 = 0$ represents a pair of parallel planes and find the distance between them.

UNIT-II

5. A variable plane makes intercepts on the axes, the sum of whose squares is k^2 (a constant). Show that the locus of the foot of the perpendicular from the origin to the plane is $x^{-2} + y^{-2} + z^{-2}(x^2 + y^2 + z^2)^2 = k^2$
6. Find the equation to the plane through the line $\frac{x-x_2}{l} = \frac{y-y_2}{m} = \frac{z-z_2}{n}$ and through the point (x_1, y_1, z_1)
7. Prove that the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$; $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$ are coplanar. Also find their point of intersection and the plane containing the lines.
8. Prove that $\frac{x+4}{3} = \frac{y+6}{5} = \frac{z-1}{-2}$ and $3x - 2y + z + 5 = 0 = 2x + 3y + 4z - 4 = 0$ are coplanar. Find the point of intersection.
9. Prove that the lines $x + 2y - 5z + 9 = 0 = 3x - y + 2z - 5$; $4x - 5y + z + 3 = 0 = 2x = 3y - z - 3$ are coplanar. Also find their point of intersection.

UNIT - III

10. Find the S.D between the lines $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$ and $\frac{x+3}{-3} = \frac{y+7}{2} = \frac{z-6}{4}$. find also the equation and the points in which the S.D meets the given lines.
11. Find the length and equations of shortest distance between the line $\frac{x}{2} = \frac{y}{-3} = \frac{z}{1}$ and $\frac{x-2}{3} = \frac{y-1}{-5} = \frac{z+2}{2}$.
12. Find the length and equation of the shortest distance between the lines $\frac{x}{1} = \frac{y}{2} = \frac{z}{1}$ and $x + y + 2z - 3 = 0 = 2x + 3y + 3z - 4$.
13. Find the S.D and the equations of the line of S.D between the lines $3x - 9y + 5z = 0 = x + y - z$ and $6x + 8y + 3z - 10 = 0 = x + 2y + z - 3$.

UNIT-IV

14. A sphere of radius k passes through the origin and meet the axes in A, B, C. Show that the centroid of the triangle ABC lies on the sphere $9(x^2 + y^2 + z^2) = 4k^2$
15. Show that the two circles $x^2 + y^2 + z^2 - y + 2z = 0$, $x - y + z = 2$; $x^2 + y^2 + z^2 + x - 3y + z - 5 = 0$, $2x - y + 4z - 1 = 0$ lie on the same sphere, and find its equation.
16. Find the equation of the sphere passing through the circle $x^2 + y^2 = 4$, $z = 0$ and is intersected by the plane $x + 2y + 2z = 0$ in circle of radius 3.
17. Show that the plane $2x - 2y + z + 12 = 0$ touches the sphere $x^2 + y^2 + z^2 - 2x - 4y + 2z - 3 = 0$ and find the point of contact.

UNIT-V

18. Find the pole of the plane $x - y - z + 9 = 0$ w.r.t the sphere $x^2 + y^2 + z^2 - 2x + 4y - 6z + 5 = 0$

19. Show that the radical line of the spheres $x^2 + y^2 + z^2 - 4x + 3 = 0$, $x^2 + y^2 + z^2 - 6y + 3 = 0$, $x^2 + y^2 + z^2 + 4x + 2y - 4z + 3 = 0$, is $\frac{x}{3} = \frac{y}{2} = \frac{z}{7}$.
20. Find the radical centre of the spheres $x^2 + y^2 + z^2 + 4y = 0$, $x^2 + y^2 + z^2 + 2x + 2y + 2z + 2 = 0$, $x^2 + y^2 + z^2 + 3x - 2y + 8z + 6 = 0$, $x^2 + y^2 + z^2 - x + 4y - 6z - 2 = 0$
21. If r_1, r_2 are the radii of two orthogonal spheres then the radius of the circle of their intersection is $\frac{r_1 r_2}{\sqrt{r_1^2 + r_2^2}}$.
22. Find the limiting points of the coaxial system of spheres determined by $x^2 + y^2 + z^2 + 4x - 2y + 2z + 6 = 0$, $x^2 + y^2 + z^2 + 2x - 4y + 2z + 6 = 0$.
23. Find the limiting points of the coaxial system of spheres determined by $x^2 + y^2 + z^2 + 3x - 3y + 6 = 0$, $x^2 + y^2 + z^2 - 6y - 6z + 6 = 0$.
