GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma Engineering in Mechanical/Mechatronics/Automobile/Chemical/Petrochemical Technology/ Civil/ Electrical/Computer/Information Technology/Agriculture/Biomedical / Electronics & Communication		
Semester	I	Version	1.0.0.0
Effective from Academic Year	2025-26	Effective for the batch Admitted in	JULY 2025
Course Code	1BS1101	Course Name	Mathematics - I

I. TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Type	Course Code and Name	Learning Scheme						Assessment Scheme										
		Actual Contact Hrs./Week			SLH	NLH	Credits	Theory				Practical				Based on SL		Total Marks
		CL	TL	LL				FA-TH	SA-TH	TOTAL		FA-PR	SA-PR	TOTAL		SLA		
								MAX	MAX	MAX	MIN	MAX	MAX	MAX	MIN	MAX	MIN	
AEC	1BS1101 Mathematics-I	3	-	-	1	4	2	40	60	100	40	-	-	-	-	20	8	120

Abbreviation:	**CL**- Classroom Learning	**TL**- Tutorial Learning	**LL**-Laboratory Learning
	SLH-Self Learning Hours	**NLH**-Notional Learning Hours	**SLA**-Self Learning Assessment
	FA-Formative Assessment (Term work +Mid Sem Exam+ Attendance) **SA-**Summative Assessment		

II. PRE-REQUISITES

- Basic arithmetic operations (addition, subtraction, multiplication, division)
- Algebraic manipulation
- Understanding of functions
- Graph reading skills
- Familiarity with coordinate axes and plotting

III. INDUSTRY /EMPLOYER EXPECTED OUTCOMES

- Ability to apply matrix operations and solve systems of equations in technical and data-driven problem-solving.
- Ability to model and analyse physical quantities like force, direction, and motion in engineering and applied sciences.
- Ability to simplify complex calculations and work with exponential relationships in electronics, computing, and data analysis.
- Ability to accurately calculate area and volume for design, construction, and manufacturing applications.
- Ability to apply trigonometric functions in engineering fields for measurements and design.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the following course learning outcomes:

CO1. Apply the concepts of determinants and matrices to solve engineering problems involving linear equations and analyse systems using matrix operations like multiplication, adjoint, and inverse.

CO2. Utilize vector algebra to solve engineering problems related to force, direction, and motion by performing vector operations such as addition, subtraction, and cross/dot products.

CO3. Use logarithmic functions to simplify complex engineering calculations, solve exponential equations, and relate logarithms to indices for practical applications in the field of Engineering.

CO4. Calculate surface areas and volumes of various geometrical shapes, and apply these measurements in engineering designs.

CO5. Apply trigonometric functions to solve problems related to angles, heights, distances, and periodic phenomena in engineering fields for measurements and design.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:				
Name of Unit	**Theory Learning outcomes (TLO's) aligned to CO's**	**Learning Content mapped with Theory Learning outcomes (TLO's)&CO's**	**Marks**	**Hours**
Unit-1 Determinants and Matrices	**TLO1.1:** Define a determinant and explain its significance in solving systems of linear equations. **TLO1.2:** Identify and classify different types of matrices based on their order, elements, and structure. **TLO1.3:** Explain the concept of the order (m×n) of a matrix and interpret its meaning in engineering applications. **TLO1.4:** Perform addition and subtraction of matrices and verify the basic properties of matrix operations. **TLO1.5:** Compute the product of two compatible matrices and analyze its application in system modelling. **TLO1.6:** Find the determinant of a matrix and interpret its use in solving linear equations. **TLO1.7:** Compute the adjoint of a matrix and describe its role in finding the inverse. **TLO1.8:** Calculate the inverse of a matrix using the adjoint method and determine conditions for its existence. **TLO1.9:** Apply matrix inversion to solve systems of simultaneous equations in two variables. **TLO1.10:** Use the matrix method to represent and solve engineering problems involving linear systems. **TLO1.11:** Interpret the consistency and nature of solutions (unique, infinite, or none) using matrix and determinant concepts.	**1.1:** Concept and definition of determinant with simple examples. **1.2:** Classification of matrices: square, row, column, zero, diagonal, identity, etc. **1.3:** Understanding order (m×n) of matrices and interpretation in context **1.4:** Rules and examples of addition and subtraction of matrices. **1.5:** Matrix multiplication (conditions, rules, and applications) **1.6:** Calculation of determinant of a matrix **1.7:** Finding the adjoint of a matrix with explanation. **1.8:** Method to calculate inverse of a matrix using adjoint and determinant. **1.9:** Solving simultaneous linear equations using matrix inversion. **1.10:** Application of matrix methods to represent real-world linear systems. **1.11:** Analysis of solution types: unique, infinite, and no solution based on determinants.	**16**	**11**
Unit-2 Vectors	**TLO2.1:** Define a vector and distinguish between scalar and vector quantities with suitable examples. **TLO2.2:**	**2.1** Introduction to vectors: scalar vs vector quantities, physical interpretation **2.2** Graphical and analytical	**14**	**9**

	Perform vector addition and subtraction using both graphical and analytical methods. **TLO2.3:** Calculate the modulus (magnitude) of a vector and interpret its physical meaning. **TLO2.4:** Determine the unit vector in the direction of a given vector. **TLO2.5:** Find the direction cosines and direction ratios of vectors. **TLO2.6:** Calculate the angle between two vectors using the dot product formula. **TLO2.7:** Apply the dot product to solve engineering problems involving projections and work done. **TLO2.8:** Apply the cross product to find torque or area of a parallelogram formed by vectors. **TLO2.9:** Solve problems involving work done by a force using vector components and direction.	methods for vector addition and subtraction **2.3** Determining modulus (magnitude) of a vector with geometric meaning **2.4** Finding the unit vector of a given vector and understanding its significance **2.5** Computing direction cosines and direction ratios of vectors. **2.6** Calculating angle between two vectors using the dot product formula. **2.7** Application of dot product: projection of vectors and work done calculation. **2.8** Application of cross product: area of parallelogram and torque using vector components **2.9** Engineering application of vector algebra in calculating work done by a force in a given direction		
Unit-3 Logarithm	**TLO3.1:** Define logarithm and explain its relation to exponential functions with suitable examples. **TLO3.2:** State and apply the fundamental laws (working rules) of logarithms to simplify expressions. **TLO3.3:** Solve numerical problems involving product, quotient, and power rules of logarithms. **TLO3.4:** Apply base change formula to convert logarithms from one base to another. **TLO3.5:** Establish and use the relationship between logarithms and indices to simplify exponential expressions. **TLO3.6:** Solve engineering-related exponential equations using logarithmic operations.	**3.1** Introduction to logarithms and their relation to exponential functions with examples **3.2** Explanation and application of fundamental logarithmic laws (product, quotient, and power rules) **3.3** Solving numerical problems using logarithmic rules (simplification and calculation) **3.4** Concept and application of logarithmic base change formula with solved examples **3.5** Demonstrating the relationship between indices and logarithms with examples **3.6** Solving real-world and engineering-based exponential equations using logarithmic techniques	**8**	**6**

Unit-4 Mensuration	**TLO4.1:** Identify and define basic 2D shapes such as triangle, square, rectangle, trapezium, parallelogram, rhombus, and circle with their standard area formulas. **TLO4.2:** Calculate the surface area of 2D figures using appropriate formulas and units. **TLO4.3:** Define 3D geometrical bodies such as cuboids, cones, cylinders, and spheres with their properties. **TLO4.4:** Calculate the surface area of 3D bodies used in engineering structures and objects. **TLO4.5:** Calculate the volume of standard 3D shapes such as cuboids, cones, cylinders, and spheres. **TLO4.6:** Apply concepts of surface area and volume to solve practical engineering problems involving material estimation and design.	**4.1** Introduction to 2D geometrical shapes: triangle, square, rectangle, trapezium, parallelogram, rhombus, and circle **4.2** Calculation of surface area of 2D shapes using standard formulas and correct units. **4.3** Properties and definitions of 3D geometrical shapes: cuboid, cone, cylinder, and sphere **4.4** Calculation of surface area of 3D bodies using appropriate geometrical formulas. **4.5** Calculation of volume for cuboids, cones, cylinders, and spheres. **4.6** Application of surface area and volume concepts in real-world engineering scenarios like tank, pipe, and duct design	**10**	**6**
Unit-5 Trigonometry	**TLO5.1:** Define trigonometric functions and identify them on the basis of right-angled triangles. **TLO5.2:** Convert angles between degrees and radians and explain the use of different angle units. **TLO5.3:** Solve simple numerical problems using basic trigonometric ratios (sin, cos, tan, etc.). **TLO5.4:** Explain and use the concept of allied angles in trigonometric calculations. **TLO5.5:** Apply compound angle formulas such as sin(A ± B), cos(A ± B), and tan(A ± B). **TLO5.6:** Solve problems using multiple angle identities such as sin(2A), cos(2A), and tan(2A). **TLO5.7:** Apply sub-multiple angle formulas in trigonometric simplifications. **TLO5.8:**	**5.1** Introduction to trigonometric functions using right-angled triangles. **5.2** Conversion of angles between degrees and radians; understanding angle measurement units. **5.3** Solving basic trigonometric ratio problems involving sin, cos, tan in practical contexts. **5.4** Understanding and using allied angles (90°±θ, 180°±θ, etc.) in trigonometric functions. **5.5** Application of compound angle formulas such as sin(A±B), cos(A±B), and tan(A±B) **5.6** Solving expressions and equations using multiple angle identities like sin(2A), cos(2A), tan(2A). **5.7** Using sub-multiple angle formulas for simplifying trigonometric expressions.	**12**	**13**

	Sketch the graphs of sine and cosine functions and interpret their key features (amplitude, period, phase). **TLO5.9:** Identify periodicity in sine and cosine functions and apply periodic properties to solve problems. **TLO5.10:** Use sum-to-product and product-to-sum identities to simplify trigonometric expressions. **TLO5.11:** Solve real-life problems involving angles of elevation and depression using trigonometric concepts. **TLO5.12:** Apply trigonometric concepts to solve height and distance problems in engineering design. **TLO5.13:** Interpret and solve periodic phenomena in engineering systems using trigonometric functions.	**5.8** Plotting and analysing the graphs of sine and cosine functions, identifying amplitude, period, and phase. **5.9** Understanding and applying the periodic nature of trigonometric functions in problem solving **5.10** Using sum-to-product and product-to-sum formulas for simplification and identity transformation **5.11** Solving real-world problems involving angle of elevation and depression using trigonometric principles. **5.12** Application of trigonometric ratios in solving height and distance problems in engineering scenarios **5.13** Applying sine/cosine functions to analyse and interpret periodic behaviour in engineering systems (e.g., waveforms, signals)		

VI. SUGGESTED MICRO PROJECT/ASSIGNMENTS/ACTIVITIES FOR SELF LEARNING/SKILL DEVELOPMENT (SELF LEARNING)

- Develop a digital or physical toolkit that demonstrates types of matrices, their operations (addition, multiplication), and the use of determinants, adjoint, and inverse to solve real-life linear equations (e.g., traffic network, budget allocation, or electrical circuits).
  Tools: Excel, Python, manual worksheet.
- Create a mini-project demonstrating applications of vector operations (addition, dot/cross product, direction, and magnitude) in engineering situations such as force systems, work done, or torque. Use graphical tools or drawings to support.
  Tools: GeoGebra, manual drawings, simple simulations.
- Prepare a case study or worksheet demonstrating the use of logarithms and exponentials in fields like electronics (e.g., decibels), civil (e.g., earthquake magnitude), or chemical engineering (e.g., pH). Include solving equations and converting bases.
  Tools: Scientific calculator, Excel, hand-drawn flowchart.
- Choose real-world objects (water tank, storage box, pipe) and calculate their surface area and volume using 2D/3D geometry formulas. Extend to estimating material usage or cost for manufacturing or construction.
  Tools: Measuring tools, calculator, drawing sheets, CAD (optional), 3D Printer.
- Model and solve height & distance problems, simulate periodic waveforms (AC current, sound waves), and graph sine/cosine functions. Create a visual or digital concept map including allied/compound/multiple angle identities.
  Tools: Desmos, Excel, smartphone clinometer, graph paper.

VII. LIST OF REFERENCE BOOKS			
Sr.No.	**Title**	**Author**	**Publication**
1	Engineering Mathematics – I	H.K. Dass	S. Chand
2	Mathematics for Polytechnic Students (Volume I & II)	S.P. Deshpande	Pune Vidyarthi Griha (PVG Publications)
3	Textbook of Mathematics for Polytechnic Diploma Courses	N.K. Sinha & S.K. Roy	Dhanpat Rai Publishing
4	Basic Engineering Mathematics	John Bird	Routledge
5	પોલીટેકનિક માટે ગણિત (Maths for Polytechnic)	A.R. Patel and Others	GTU-prepared notes

VIII. LINK OF LEARNING WEB RESOURCE	
1	https://onlinecourses.nptel.ac.in/noc21_ma58/preview
2	https://youtu.be/WBaKvYM5QbQ?si=gkubu_zBC1dECFsA
3	https://www.youtube.com/live/oSVYz6fMKzg?si=zITnsIBcZysarCk9
4	https://youtu.be/AEXxKCuu_Lg?si=0TcwDkJNFnDcxDvK
5	https://www.youtube.com/watch?v=m9c_Gom_O2s
6	https://www.youtube.com/watch?v=AnYUItIozz8

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE							
Unit	**Unit Title**	**Aligned COs**	**Learning Hours**	**R-Level**	**U-Level**	**A-Level**	**Total Marks**
1	Determinants and Matrices	CO1	11	4	6	6	16
2	Vectors	CO2	9	3	5	6	14
3	Logarithm	CO3	6	2	3	3	8
4	Mensuration	CO4	6	2	3	5	10
5	Trigonometry	CO5	13	3	4	5	12
	Grand Total		45	14	21	25	60

X. COs AND POs AND PSOs MAPPING										
Course outcome (Cos)	**Programme Outcomes (POs)**							**Programme Specific Outcomes (PSOs)**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	0	0	0	2			
CO2	3	3	2	2	0	0	0			
CO3	3	2	2	0	0	0	2			
CO4	3	2	3	2	2	0	0			
CO5	3	3	2	0	0	0	0			
Legends: - *3- High* *2-Moderate/Medium* *1-Slight/Low* *0-None*										