

SC-102-ENGINEERING MATHEMATICS

Course Title	Engineering Mathematics	Course Code	SC-102
Year	SEMISTER	Course Group	Foundation
Teaching Scheme in Periods (L : T : P)	4:1:0	Credits	3
Methodology	Lecture +Tutorial	Total Contact Periods	75
CIE	60 Marks	SEM-I	40 Marks

Prerequisites:

This course requires the basic knowledge of Algebra, Trigonometry and Co-ordinate Geometry at Secondary school level.

Course Outcomes (COs):

At the end of the course, the student will have the ability to:

CO1	Solve systems of linear equations arising in engineering problems using Matrices and Determinants.
CO2	Apply Trigonometric ratios of compound, multiple and sub-multiple angles, transform sums and differences into products (and vice versa).
CO3	Apply the concepts of straight lines, circles to analyze and solve engineering and geometrical problems.
CO4	Evaluate limits and derivatives of functions relevant to engineering applications.
CO5	Evaluate integrals of continuous functions using appropriate methods of integration.
CO6	Apply definite integration techniques to evaluate Mean and RMS values and perform Numerical integration of functions arising in engineering problems.

Course Content:

Unit–I Matrices

Duration: 12 Periods (L: 10– T:2)

Definition of Matrix-order of a matrix-Type of matrices with examples - Algebra of matrices: sum, difference, scalar multiplication and product of matrices - Equality of two matrices- Properties of Algebra of Matrices – Transpose of a Matrix with example – Properties of Transpose of a matrix -Determinant of a square Matrix of order 2×2 - Determinant of a square matrix of order 3×3 by using Laplace's Expansion-Singular and non-singular matrices. Solutions of system of simultaneous three linear equations in three unknown variables by using Cramer's rule.

Unit- II Trigonometry:

Duration: 13 Periods (L: 10 – T:3)

Trigonometric Ratios of Compound angles (without proof) -Trigonometric Ratios of Multiple and Sub- multiple angles ($2A$, $3A$, $A/2$) -Transformation of products into sums or differences and vice versa- Related problems.

Unit–III Co-ordinate Geometry:

Duration :12 Periods (L:10– T:02)

Straight lines: Slope of straight line - Various forms of straight line: Point-Slope form, Two- Point form, Intercept form and General equation of a Straight line - Angle between two Straight lines - Conditions for Parallelism and Perpendicularity of the Straight lines– Perpendicular distance from a point to the line - Distance between two Parallel lines.

Circles: General equation of a circle and its characteristics. To find the equation of a circle, given:

- i. Centre and radius,
- ii. Co-ordinates of end points of a diameter.

Unit–IV Differential Calculus:

Duration: 13 Periods (L:10– T:3)

Functions and Limits: Definition of a function - constants, variables, independent and dependent variables - Algebraic functions, Trigonometric functions, Inverse Trigonometric functions, Exponential functions and Logarithmic functions – composition of two functions - concept of limits - Standard Limits (without proof) - Evaluation of limits of the form: $\lim_{x \rightarrow l} \frac{f(x)}{g(x)}$ using Direct Substitution, and Factorization.

Differentiation: Definition of Derivative of a function - Derivatives of Standard Algebraic, Logarithmic, Exponential and Trigonometric functions - Algebra of derivative of functions: Derivatives of Sum, Difference, Scalar Multiplication, Product and Quotient of two functions - Derivative of function of a function (Chain rule).

Unit-V Integral Calculus-I:**Duration:13 Periods (L:10– T:3)**

Integration as an inverse process of Differentiation- Indefinite integral of standard functions-

Properties of Indefinite Integrals: $\int (u \pm v)dx$, and $\int ku dx$, where u, v are functions in x and k is a scalar - Substitution method of the types: $\int f(ax + b)dx$, $\int f(g(x))g'(x)dx$ and $\int \frac{f'(x)}{f(x)} dx$, where $f(x)$ is in standard form - Simple problems on Integration by parts and Bernoulli's rule for $\int uv dx$.

Unit-V Integral Calculus-II:**Duration: 12 Periods (L:10– T:2)**

Definition of definite integral - Fundamental Theorem of Integral calculus Evaluation of definite integrals by Substitution Method- - Mean and Root Mean Square (R.M.S) values of a function in a given interval – Related simple problems. Numerical Integration: Trapezoidal rule and Simpson's 1/3-rule to evaluate an approximate value of a definite integral in a given interval- problems leading to engineering applications.

Suggested Reference Books:

Sl. No.	Author	Title of Books	Publication/Year
1	B.S. Grewal	Higher Engineering Mathematics	Khanna publishers.
2	Shanti Narayan and P. K. Mittal	Text Book of Matrices	S. Chand Publishers
3	S. L. Loney	Plane Trigonometry	Arahant publications
4	S. L. Loney	Elements co-ordinate Geometry	Arahant publications
5	Shanti Narayan and P.K. Mittal	Integral Calculus	S. Chand Publishers
6	Shanti Narayan and P.K. Mittal	Differential Calculus	S. Chand Publishers
7	By senior faculty	NCERT Mathematics text books of Class XI and XII	NCERT

Suggested E-Learning references:

1. <https://www.khanacademy.org/>
2. <https://www.wolframalpha.com/>
3. <https://onlinecourses.nptel.ac.in/>
4. <http://tutorial.math.lamar.edu/>

Suggested Learning Outcomes:

At the end of the course, the student will have the ability to:

1.0 Solve systems of linear equations arising in engineering problems using matrices and determinants.

- 1.1 Define Matrix.
- 1.2 Classify the types of Matrices with examples.
- 1.3 Define Equality of two Matrices
- 1.4 Compute the sum of two Matrices.
- 1.5 Compute the difference of two Matrices.
- 1.6 Compute the scalar multiplication of a Matrix.
- 1.7 Compute the product of two Matrices.
- 1.8 Define Transpose of a Matrix with example.
- 1.9 State Properties of a Transpose of a matrix.
- 1.10 Expand the Determinant of a square of order 2×2 .
- 1.11 Expand the Determinant of a square of order 3×3 using Laplace's expansion.
- 1.12 Distinguish Singular and Non-singular Matrices.
- 1.13 Simple problems using 1.3 to 1.12
- 1.14 Solve the system of three linear equations in three unknown variables using Cramer's rule.

2.0 Apply trigonometric ratios of compound, multiple and sub-multiple angles, transform sums and differences into products (and vice versa) to solve engineering problems.

- 2.1 State the Trigonometric ratios of compound angles i.e. $\sin(A \pm B)$, $\cos(A \pm B)$, $\tan(A \pm B)$ and $\cot(A \pm B)$.
- 2.2 Derive the identities i.e., $\sin(A+B) \cdot \sin(A-B) = \sin^2 A - \sin^2 B$, etc.

- 2.3 Calculate the values of $\sin 15^\circ$, $\cos 15^\circ$, $\tan 15^\circ$, $\sin 75^\circ$, $\cos 75^\circ$, $\tan 75^\circ$ etc.
- 2.4 Solve the problems using 2.2 and 2.3
- 2.5 State the formulae for Trigonometric ratios of multiple angles $2A$ and $3A$.
- 2.6 State the formulae for Trigonometric ratios of sub multiple angle $\frac{A}{2}$.
- 2.7 Derive useful identities i.e. $\sin^2 A = \left(\frac{1-\cos 2A}{2}\right)$, $\cos^2 A = \left(\frac{1+\cos 2A}{2}\right)$ etc.
- 2.8 Solve the problems using 2.5, 2.6 and 2.7.
- 2.9 State the formulae on transform sum or difference of two Trigonometric ratios into a product and vice versa.
- 2.10 Solve the problems using 2.9

3.0 Apply the concepts of straight lines, circles and conic sections to analyze and solve engineering and geometrical problems.

- 3.1 Define slope of a straight line.
- 3.2 Classify various forms of a straight line:
- i. Point-slope form,
 - ii. Two-point form,
 - iii. Intercept form, and
 - iv. General equation of a straight line.
- 3.3 Solve the Problems on 3.2
- 3.4 Find the acute angle between two straight lines.
- 3.5 Explain the conditions for parallelism and perpendicularity of straight lines.
- 3.6 Calculate the perpendicular distance of a point from a line.
- 3.7 Evaluate the distance between two parallel lines.
- 3.8 Define circle.
- 3.9 Write the general equation of a circle with Centre and radius.
- 3.10 Find the equation of a circle having its Centre and radius.
- 3.11 Find the equation of a circle having two ends of a diameter.
- 3.13 Solve the related problems on 3.9, 3.10. and 3.11.

4.0 Evaluate limits and derivatives of functions relevant to engineering applications.

4.1 Define function with example.

4.2. Explain constants, variables, independent and dependent variables.

4.3 Explain various types of functions:

- i. Algebraic functions,
- ii. Trigonometric functions,
- iii. Inverse Trigonometric function,
- iv. Exponential functions and
- v. Logarithmic functions

4.4 State the standard limits:

$$\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}, \lim_{x \rightarrow 0} \frac{\sin x}{x}, \lim_{x \rightarrow 0} \frac{\tan x}{x}, \lim_{x \rightarrow 0} \frac{a^x - 1}{x}, \lim_{x \rightarrow 0} \frac{e^x - 1}{x}$$

4.5 Evaluate the limits of the form $\lim_{x \rightarrow l} \frac{f(x)}{g(x)}$ using

- (i) Direct substitution,
- (ii) Factorization and

4.6 List the formulae for derivatives of standard algebraic, logarithmic, exponential and trigonometric functions.

4.7 Explain the concept of algebra of derivatives of functions, i.e., derivative of sum, difference, scalar multiplication, product and quotient of functions to solve problems.

4.8 Find the derivatives using the method of Differentiation of a function of a function (Chain rule).

5.0 Evaluate integrals of continuous functions using appropriate methods of integration.

5.1 Explain the concept of Integration as an inverse process of Differentiation with standard notations.

5.2 Classify the Definite and Indefinite Integrals.

5.3 Formulate the standard Integrals using the definition of Integration.

5.4. State the properties of Indefinite Integrals (i.e., $\int (u \pm v) dx$, and $\int ku dx$, where u, v

are functions in x and k is a scalar).

5.5 Use the Indefinite integrals of standard functions and properties to solve engineering problems.

5.6 Evaluate Integrals involving simple functions of the type: $\int f(ax + b)dx$, where $f(x)$ is in standard form.

5.7 Evaluate Integrals involving simple functions of the type: $\int f(g(x))g'(x)dx$.

5.8 Evaluate Integrals involving simple functions of the type: $\int \frac{f'(x)}{f(x)} dx$, where $f(x)$ is in standard form.

5.9 Find the integrals of $\tan x$, $\cot x$, $\sec x$ and $\operatorname{cosec} x$.

5.10 Explain Integration by parts and Bernoulli's rule for $\int uvdx$.

5.11 Some simple problems on 5.4, 5.6, 5.7, 5.8, 5.9 and 5.10.

6.0 Apply definite integration techniques to evaluate mean and R.M.S values and perform numerical integration of functions arising in engineering problems.

6.1 Define definite integral.

6.2 Explain fundamental theorem of integral calculus with examples.

6.3 Evaluate the Definite Integrals by using Substitution Method

6.4 State the Mean Value, Mean Square Value and Root Mean Square (RMS) value of the function in any given interval.

6.5 Simple problems on 6.3 and 6.4.

6.6 Explain Trapezoidal rule.

6.7 Explain Simpson's $\frac{1}{3}$ rule.

6.8 Apply the Trapezoidal rule estimate the approximation of definite integrals.

6.9 Apply the Simpson's $\frac{1}{3}$ rule estimate the approximation of definite integrals.

6.10 Solve the problems leading to engineering applications by using above methods.

Suggested Student Activities:

1. Student visits Library to refer Standard Books on Mathematics and collect related material.
2. Quiz
3. Group discussion
4. Group Tests
5. Formulae Tests
6. Surprise tests
7. Seminars
8. Home Assignments.
9. Mathematics- for preparing competitive exams and solve some arithmetical ability examination questions.

CO / PO – MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Mapped POs
CO1	3	2	–	–	–	–	–	1, 2
CO2	3	2	1	–	–	–	–	1, 2, 3
CO3	3	2	1	–	–	–	–	1, 2, 3
CO4	3	2	–	–	–	–	1	1, 2, 7
CO5	3	2	1	–	–	–	1	1, 2, 3, 7
CO6	3	2	1	1	–	–	1	1, 2, 3, 4, 7

QUESTION PAPER PATTERN FOR MID SEMESTER EXAMS

MID-I EXAMINATION					
S.No	Unit Name	R	U	A	Remarks
1	Unit-I	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-II	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	
MID-II EXAMINATION					
S.No	Unit Name	R	U	A	Remarks
1	Unit-III	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-IV	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	

QUESTION PAPER PATTERN FOR SEM END EXAMINATION

Unit No	Questions to be set for YEE				
	R			U	A
I	Q4	Q1		Q9(a)	Q13(a)
II					
III		Q2		Q10(a)	Q14(a)
IV					
V		Q3	Q5,Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
VI					
Total Questions	8			8	8

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING,
TELANGANA DIPLOMA EXAMINATIONS (C - 26) SC-102**

**MID – I EXAM, MODEL PAPER
ENGINEERING MATHEMATICS**

Duration: 1: 00 Hour

Max. Marks: 20

PART-A

Instructions: 1. Answer **ALL** questions. 04 × 01 = 04
2 Each question carries **ONE** mark.

1. Define unit matrix.
2. Define singular matrix give one example.
3. Write the formulae for $\cos C + \cos D$.
4. Write the value of $\tan 15^\circ$

PART-B

Instructions: 1. Answer All questions. 02 × 03 = 06
2. Each question carries **THREE** marks.

5(a). If $A = \begin{pmatrix} 0 & -1 & 3 \\ 8 & 7 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} 8 & 0 & 1 \\ 0 & 12 & 0 \end{pmatrix}$ then find $B - A$.

OR

5(b). Find the adjoint of the matrix $A = \begin{pmatrix} 3 & 2 \\ 1 & 3 \end{pmatrix}$.

6(a). Prove that $\cos A + \cos(120^\circ + A) + \cos(120^\circ - A) = 0$.

OR

6(b). Find the value of $\sin 50^\circ - \sin 70^\circ + \sin 10^\circ$

PART C

Instructions: 1. Answer All questions 02 × 05 = 10
2. Each question carries **FIVE** marks

7(a). Show that $AB \neq BA$ if $A = \begin{pmatrix} 1 & 2 & 1 \\ 3 & 2 & 2 \\ 1 & 1 & 2 \end{pmatrix}$ and if $A = \begin{pmatrix} 2 & 3 & 1 \\ -2 & 1 & 4 \\ 1 & 0 & 0 \end{pmatrix}$

(OR)

7(b). Solve the system of equations $x + 2y - 3z = 0$, $4x - 5y + 6z = 5$, $-7x + 8y + 9 = 10$ using Cramer's rule.

8(a). Show that $\frac{\cos 19^\circ - \sin 19^\circ}{\cos 19^\circ + \sin 19^\circ} = \tan 26^\circ$.

(OR)

8(b). If $\sin x + \sin y = \frac{4}{5}$ and $\sin x - \sin y = \frac{2}{7}$, then prove that $5 \tan \frac{x+y}{2} + 14 \tan \frac{x-y}{2} = 0$.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA
DIPLOMA EXAMINATIONS (C - 26)
SC-102
MID – II EXAM, MODEL PAPER
ENGINEERING MATHEMATICS

Duration: 1: 00 Hour

Max. Marks: 20

PART-A

- Instructions: 1. Answer **ALL** questions. 04 × 01 = 04
2 Each question carries **ONE** mark.
1. Write the slope of the straight line $ax + by + c = 0$.
2. Write the equation of point circle whose center at (-2,3)
3. Find $\lim_{x \rightarrow 1} \frac{x+3}{3x+13}$.
4. Find the differentiation of $3\sin x - 7\cos x + 4x^2$.

PART-B

- Instructions: 1. Answer All questions. 02 × 03 = 06
2. Each question carries **THREE** marks.
- 5(a). Convert $7x + 11y + 81 = 0$ into intercept form.
OR
5(b). Find the center and radius of the circle $x^2 + y^2 + 2x - 4y - 4 = 0$
- 6(a). Calculate $\lim_{x \rightarrow 0} \frac{\sin 8x - \sin 6x}{\sin 2x}$
(OR)
6(b). Find the differentiation of $\frac{2x+4}{7x+1}$.

PART C

- Instructions: 1. Answer All questions. 02 × 05 = 10
2. Each question carries **FIVE** marks.
- 7(a). Find the distance of the point (2, 3) from the line $x - y + 3 = 0$.
(OR)
7(b). Find the equation of circle whose end points of diameter are (2,3) and (2, -4)
- 8(a). Find the derivative of $\log[\sin x]$ with respect to x .
(OR)
8(b). If $y = \sqrt{\tan(\sqrt{x})}$ then find $\frac{dy}{dx}$

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING,
TELANGANA DIPLOMA EXAMINATIONS (C - 26)**

SC-102

**SEMESTER END EXAM, MODEL PAPER
ENGINEERING MATHEMATICS**

Duration: 2:00 Hours

Max marks: 40

PART-A

- Instructions: 1. Answer **ALL** questions. 08 × 01 = 08
 2. Each question carries **ONE** mark.
1. Write any four types of matrices.
 2. Write the general form of straight line.
 3. Write the Bernoulli's formula for uv integration.
 4. Find the radius of the circle whose end points of diameter are (1,2) and (2, -3).
 5. Evaluate $\int e^{-2x} dx$.
 6. Evaluate $\int (x - 3\tan x + 5) dx$
 7. Define fundamental theorem of integral calculus.
 8. Find the value of $\int_0^1 \frac{1}{1+x^2} dx$.

PART-B

- Instructions: 1. Answer All question. 04 × 03 = 12
 2. Each question carries **THREE** marks.
- 9(a). Find A, B if $A+B=\begin{pmatrix} 3 & 5 \\ 5 & 8 \end{pmatrix}$ and $A-B=\begin{pmatrix} -3 & -5 \\ 5 & 2 \end{pmatrix}$.

OR

9(b). Find $\int \sin 5x \cdot \cos 3x \, dx$.

10(a). Find the center and radius of the circle $x^2 + y^2 - 4x - 6y + 11 = 0$

OR

10(b). Find the Mean value of xe^x between $x = 0$ and $x = 1$.

11(a). Evaluate $\int \frac{(\sin^{-1}x)^4}{\sqrt{1-x^2}} dx$.

OR

11(b). Evaluate $\int \frac{\cot x}{\log(\sin x)} dx$

12(a). Find R.M.S value of $\sqrt{x}$ over the range $x = 1$ to $x = 3$.

OR

12(b). Evaluate $\int_0^6 y dx$ using trapezoidal rule, given that

x	0	2	4	6
y	3	7	11	9

PART C

Instructions:

1. Answer All questions

04 × 05 = 20

2. Each question carries **FIVE** marks

13(a). Solve the system of equations $x + y - 3z = -0, x - y + 6z = 6, -x + 2y + 9 = 10$ using Cramer's rule.

OR

13(b). Evaluate $\int x \cdot \tan^{-1} x dx$.

14(a). Find the derivative of $\frac{a-b\cos x}{a+b\cos x}$ with respect to x .

OR

14(b). Find the R.M.S value of $\sqrt{\log x}$ between $x = 1$ and $x = e$.

15(a). Evaluate $\int x^3 \cos 5x dx$.

OR

15(b). Evaluate $\int x^2 \cdot \log x dx$.

16(a). Evaluate $\int_0^6 \frac{1}{1+x^2} dx$ using trapezoidal rule by taking $n = 6$.

OR

16(b). Evaluate $\int_1^{11} x^3 dx$ using Simpson's rule by taking $n = 10$.