Government of Karnataka
Department of Collegiate and Technical Education
Board of Technical Examinations, Bangalore

Course Code	20SC01T	**Semester**	I/II
Course Title	**ENGINEERING MATHEMATICS**	**Course Group**	Core
No. of Credits	4	**Type of Course**	Lecture
Course Category	Theory	**Total Contact Hours**	4Hrs Per Week
			52Hrs Per Semester
Prerequisites	10 Level Mathematics	**Teaching Scheme**	(L:T:P) = 4:0:0
CIE Marks	50	**SEE Marks**	50

RATIONALE

Engineering Mathematics specification provides students with access to important mathematical ideas to develop the mathematical knowledge and skills that they will draw on in their personal and work lives. The course enable students to develop mathematical conceptualization, inquiry, reasoning, and communication skills and the ability to use mathematics to formulate and solve problems in everyday life, as well as in mathematical contexts. At this level, the mathematics curriculum further integrates the three content areas taught in the higher grades into three main learning areas: Algebra; Measurement of angles and Trigonometry and Calculus.

1. COURSE SKILL SET

Student will be able to:
1. Solve system of linear equations arise in different engineering fields
2. Incorporate the knowledge of calculus to support their concurrent and subsequent engineering studies
3. Adept at solving quantitative problems
4. Ability to understand both concrete and abstract problems
5. Proficient in communicating mathematical ideas
6. Detail-oriented

2. COURSE OUT COMES

At the end of the course, student will be able to

CO1	Determine the inverse of a square matrix using matrix algebra. Apply the concepts of matrices and determinants to solve system of linear equations and find eigen values associated with the square matrix.
CO2	Find the equation of straight line in different forms. Determine the parallelism and perpendicularity of lines.
CO3	Calculate trigonometric ratios of allied angles and compound angles. Transform sum or difference of trigonometric ratios into product and vice versa.

CO4	Differentiate various continuous functions and apply the concept in real life situations.	
CO5	Integrate various continuous functions and apply the concept in evaluating the area and volume through definite integrals.	

3. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS

UNIT NO	UNIT TITLE	TEACHING HOURS	DISTRIBUTION(THEORY)			
			R LEVEL	U LEVEL	A LEVEL	TOTAL
1	Matrices and Determinants	10	8	20	12	40
2	Straight lines	10	8	20	12	40
3	Trigonometry	10	8	20	12	40
4	Differential Calculus and applications	11	8	20	12	40
5	Integral Calculus and applications	11	8	20	12	40
	Total	52	40	100	60	**200**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

4. DETAILS OF COURSE CONTENT

The following topics/subtopics is to be taught and assessed in order to develop Unit Skill sets for achieving CO to attain identified skill sets.

UNIT NO	Unit skill set (In cognitive domain)	Topics/Subtopics	Hours L-T-P
UNIT-1 MATRICES AND DETERMINANTS	➤ Use algebraic skills which are essential for the study of systems of linear equations, matrix algebra and eigen values	1.1 Matrix and types 1.2 Algebra of Matrices (addition, subtraction, scalar multiplication and multiplication) 1.3 Evaluation of determinants of a square matrix of order 2 and 3. Singular matrices 1.4 Cramer's rule for solving system of linear equations involving 2 and 3 variables 1.5 Adjoint and Inverse of the non-singular matrices of order 2 and 3 1.6 Characteristic equation and Eigen values of a square matrix of order 2	10-0-0

UNIT-2 STRAIGHT LINES	➢ Able to find the equation of a straight line in different forms ➢ Determine whether the lines are parallel or perpendicular	2.1 Slope of a straight line 2.2 Intercepts of a straight line 2.3 Intercept form of a straight line 2.4 Slope-intercept form of a straight line 2.5 Slope-point form of a straight line 2.6 Two-point form of a straight line 2.7 General form of a straight line 2.8 Angle between two lines and conditions for lines to be parallel and perpendicular 2.9 Equation of a straight line parallel to the given line 2.10 Equation of a straight line perpendicular to the given line	10-0-0
UNIT-3 TRIGONOMETRY	➢ Use basic trigonometric skills in finding the trigonometric ratios of allied and compound angles ➢ Able to find all the measurable dimensions of a triangle	3.1 Concept of angles, their measurement, Radian measure and related conversions. 3.2 Signs of trigonometric ratios in different quadrants (ASTC rule) 3.3 Trigonometric ratios of allied angles (definition and the table of trigonometric ratios of standard allied angles say $90^0\pm\Theta$, $180^0\pm\Theta$, $270^0\pm\Theta$ and $360^0\pm\Theta$) 3.4 Trigonometric ratios of compound angles (without proof) 3.5 Trigonometric ratios of multiple angles 3.6 Transformation formulae	10-0-0
UNIT-4 DIFFERENTIAL CALCULUS AND APPLICATIONS	➢ Able to differentiate algebraic, exponential, trigonometric, logarithmic and composite functions ➢ Able to find higher order derivatives ➢ Understand and work with derivatives as rates of change in mathematical models ➢ Find local maxima and minima of a function	4.1 Derivatives of continuous functions in an interval (List of formulae) 4.2 Rules of differentiation 4.3 Successive differentiation (up to second order) 4.4 Applications of differentiation	11-0-0
UNIT-5 INTEGRAL CALCULUS AND APPLICATIONS	➢ Understand the basic rules of integration and Evaluate integrals with basic integrands. ➢ Identify the methods to evaluate integrands ➢ Apply the skills to evaluate integrals representing areas and volumes	5.1 List of standard integrals and Basic rules of integration 5.2 Evaluation of integrals of simple function and their combination 5.3 Methods of integration 5.4 Concept of definite integrals 5.5 Applications of definite integrals	11-0-0

5. MAPPING OF CO WITH PO

CO	Course Outcome	PO Mapped	UNIT Linked	CL R/U/A	Theory in Hrs	TOTAL
CO1	Determine the inverse of a square matrix using matrix algebra. Apply the concepts of matrices and determinants to solve system of linear equations and find eigen values associated with the square matrix.	1, 7	1	R/U/A	10	**40**
CO2	Find the equation of straight line in different forms. Determine the parallelism and perpendicularity of lines.	1, 7	2	R/U/A	10	**40**
CO3	Calculate trigonometric ratios of allied angles and compound angles. Transform sum (difference) of trigonometric ratios into product and vice versa.	1, 7	3	R/U/A	10	**40**
CO4	Differentiate various continuous functions and apply the concept in real life situations.	1, 3, 7	4	R/U/A	11	**40**
CO5	Integrate various continuous functions and apply the concept in evaluating the area and volume through definite integrals.	1, 3, 7	5	R/U/A	11	**40**
					52	200

Course	CO's	Programme Outcomes (PO's)						
		1	2	3	4	5	6	7
ENGINEERING MATHEMATICS	CO1	3	1	0	0	0	0	3
	CO2	3	1	0	0	0	0	3
	CO3	3	1	0	0	0	0	3
	CO4	3	1	3	0	0	0	3
	CO5	3	1	3	0	0	0	3

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

7. INSTRUCTIONAL STRATEGY

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes

1. Explicit instruction will be provided in intervention classes or by using different differentiation strategies in the main classroom.
2. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching method and media that are employed to develop the outcomes.
3. Observing the way their more proficient peers use prior knowledge to solve current challenges and persevere in problem solving will help struggling students to improve their approach to engaging with rich contextual problems.
4. Ten minutes a day in homeroom, at the end of class, or as a station in a series of math activities will help students build speed and confidence.
5. Topics will be introduced in a multiple representation.
6. The teacher is able to show different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. In a perfect world, teacher would always be able to demonstrate how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding. When a concept cannot be applied in that manner, we can still share how it might be applied within mathematics.

8. SUGGESTED LEARNING RESOURCES:

Sl. No.	Author	Title of Books	Publication/Year
1	B.S. Grewal	Higher Engineering Mathematics	Khanna Publishers, New Delhi, 40th Edition,2007
2	G. B. Thomas, R. L. Finney	Calculus and Analytic Geometry	Addison Wesley, 9th Edition, 1995
3	S.S. Sabharwal, Sunita Jain, Eagle Parkashan	Applied Mathematics, Vol. I & II	Jalandhar.
4	Comprehensive Mathematics	Comprehensive Mathematics Vol. I & II	Laxmi Publications, Delhi
5	ReenaGarg &Chandrika Prasad	Advanced Engineering Mathematics	Khanna Publishing House, New Delhi

9. COURSE ASSESSMENT AND EVALUATION CHART

Sl.No.	Assessment	Duration	Max marks	Conversion
1	CIE Assessment 1 (Written Test -1) At the end of 3 ᵈ week	80 minutes	30	Average of three written tests 30
2	CIE Assessment 2 (Written Test -2) At the end of 7 week	80 minutes	30	
3	CIE Assessment 3 (Written Test -3) At the end of 13 week	80 minutes	30	
4	CIE Assessment 4 (MCQ/Quiz) At the end of 5 week	60 minutes	20	Average of three 20
5	CIE Assessment 5 (Open book Test) At the end of 9 week	60 minutes	20	
6	CIE Assessment 6 (Student activity/Assignment) At the end of 11 week	60 minutes	20	
	Total Continuous Internal Evaluation (CIE) Assessment			**50**
8	Semester End Examination (SEE) Assessment (Written Test)	3 Hours	100	**50**
	Total Marks			**100**

Note:

1. SEE (Semester End Examination) is conducted for 100 Marks theory courses for a time duration of 3 Hours.

2. Three CIE (written test), each of 30 marks for a time duration of 80 minutes shall be conducted. Also, three CIE (MCQ or Quiz/Open book test/student activity or assignment) each of 20 marks for the time duration of 60 minutes shall be conducted. Any fraction at any stage during evaluation will be rounded off to the next higher digit

3. Assessment of assignment and student activity is evaluated through appropriate rubrics by the respective course coordinator. The secured mark in each case is rounded off to the next higher digit.

10 DETAILED COURSE CONTENT

UNIT NO AND NAME	DETAILED COURSE CONTENT	CO	PO	CONTACT HRS	TOTAL
1 MATRICES AND DETERMINANTS	Definition and types of matrices	1	1,7	1	10
	Algebra of Matrices (addition, subtraction and scalar multiplication) problems	1	1,7	1	
	Multiplication of Matrices(problems)	1	1,7	1	
	Evaluation of 2x2 ,3x3 determinants and Singular matrices and problems in finding unknown variable	1	1,7	1	
	Cramer's rule to solve system of linear equation with 2 and 3 variables	1	1,7	1	
	Cramer's rule to solve system of linear equation with 2 and 3 variables.problems	1	1,7	1	
	Minors, Cofactors of elements of square matrices of order 2 and 3	1	1,7	1	
	Adjoint of a square matrix(2x2 and 3x3),Inverse of a non singular square matrix	1	1,7	1	
	Adjoint of a square matrix(2x2 and 3x3),Inverse of a non singular square matrix and problems	1	1,7	1	
	Characteristic equation and eigen values of a 2x2 matirx and problems	1	1,7	1	
2 STRAIGHTLINES	Slope of the straight line(provided with inclination and two points on the line as well) and problems	2	1,7	1	10
	Intercepts of a straight line and problems	2	1,7	1	
	Intercept form of a straight line and problems	2	1,7	1	
	Slope-intercept form of a straight line and problems	2	1,7	1	
	Slope-point form of the straight line and problems	2	1,7	1	
	Two-point form of a straight line and problems	2	1,7	1	
	General form of a straight line.problems on finding slope and intercepts.	2	1,7	1	
	Angle between two straight lines and conditions for the lines to be parallel and perpendicular and problems	2	1,7	1	
	Equation of a line parellel to the given line and problems	2	1,7	1	
	Equation of a line perpendicular to the given line.problems	2	1,7	1	

3 **TRIGONOMETRY**	Concept of angles and their measurement. Radian measures and related conversions (degree to radian and vice-versa) and problems	3	1,7	1	
	Signs of trigonometric ratios in different quadrants (ASTC rule)	3	1,7	1	
	Trigonometric ratios of allied angles (definition and the table of trigonometric ratios of standard allied angles say $90^0\pm\theta$, $180^0\pm\theta$, $270^0\pm\theta$ and $360^0\pm\theta$)	3	1,7	1	
	Problems on allied angles. (proving identities)	3	1,7	1	
	Problems on allied angles. (Finding values of x in an identity)	3	1,7	1	10
	Trigonometric ratios of compound angles (without proof)	3	1,7	1	
	Trigonometric ratios of multiple angles (sin2A, cos2A, tan2A, sin3A, cos3A and tan3A)	3	1,7	1	
	Problems on multiple angles sin2A, cos2A, tan2A, sin3A, cos3A and tan3A	3	1,7	1	
	Transformation formulae (without proof) as sum to product. (Simple problems)	3	1,7	1	
	Transformation formulae (without proof) as product to sum. (Simple problems)	3	1,7	1	
4 **DIFFERENTIAL CALCULUS AND APPLICATIONS**	Definition of a derivative of a function. Listing the derivatives of standard functions. (Algebraic, trigonometric, exponential, logarithmic and inverse trigonometric functions)	4	1,3,7	1	
	Addition and subtraction rule of differentiation and problems	4	1,3,7	1	
	Product rule and quotient rule of differentiation and problems	4	1,3,7	1	
	Product rule and quotient rule of differentiation and problems	4	1,3,7	1	11
	Composite functions and their derivatives. (CHAIN RULE)	4	1,3,7	1	
	Composite functions and their derivatives. (CHAIN RULE). Problems	4	1,3,7	1	
	Successive differentiation up to second order	4	1,3,7	1	
	Slope of the tangent and normal to the given curve and their equations and problems	4	1,3,7	1	

	Rate measure: velocity and acceleration at a point of time and problems	4	1,3,7	1	
	Local Maxima and Minima of a function	4	1,3,7	1	
	Local Maxima and Minima of a function. Problems	4	1,3,7	1	
5 **INTEGRAL CALCULUS AND APPLICATIONS**	Definition of an indefinite integral. Listing the Integrals of standard functions. (Algebraic, trigonometric, exponential, logarithmic and inverse trigonometric functions)	5	1,3,7	1	11
	Rules of Integration. Evaluation of integrals with simple integrands and their combinations	5	1,3,7	1	
	Rules of Integration. Evaluation of integrals with simple integrands and their combinations. Problems	5	1,3,7	1	
	Evaluation of integrals with simple integrands and their combinations. Problems	5	1,3,7	1	
	Evaluation of integrals by Substitution method	5	1,3,7	1	
	Evaluation of integrals by Integration by parts	5	1,3,7	1	
	Evaluation of integrals by Integration by parts. Problems	5	1,3,7	1	
	Definition of definite integrals and their evaluation	5	1,3,7	1	
	Evaluation of Definite integrals. Problems	5	1,3,7	1	
	Area enclosed by the curves by integral method	5	1,3,7	1	
	Volume generated by the curve rotated about an axis by integral method	5	1,3,7	1	

First Semester Examination, Model Question Paper – 2020
Engineering Mathematics

Duration: 3Hours]   **Subject Code: 20SC01T**   **[Max. Marks:100**

Instruction: Answer one full question from each section. One full question carries 20 marks.

SECTION – 1

1

a   If the matrix $\begin{bmatrix} 2 & 4 & 6 \\ 2 & x & 2 \\ 6 & 8 & 14 \end{bmatrix}$ is singular then find x .   **4**

b   Find the A^2 for the matrix $\begin{bmatrix} 1 & 3 & 4 \\ -1 & 2 & 1 \\ 0 & 3 & 3 \end{bmatrix}$.   **5**

c   Solve $2x - y = 3$ and $x + 2y = 4$ by using determinant method.   **5**

d   Find the inverse ofthe matrix $\begin{bmatrix} 2 & 3 & 1 \\ -1 & 2 & 1 \\ 5 & 4 & 3 \end{bmatrix}$.   **6**

2

a   If $A = \begin{bmatrix} 2 & -1 \\ 4 & 0 \\ 1 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -3 & 4 \\ -1 & -1 & 1 \\ 0 & 4 & 2 \end{bmatrix}$ then find $(AB)^T$.   **4**

b   Verify whether AB=BA for the matrices $A = \begin{bmatrix} 1 & 0 & 5 \\ -1 & 2 & 1 \\ 5 & 4 & 3 \end{bmatrix}$ and

$B = \begin{bmatrix} 3 & -1 & 4 \\ 0 & -1 & 1 \\ 2 & 4 & -2 \end{bmatrix}$.   **5**

c   Find the Adjoint of the matrix $A = \begin{bmatrix} 1 & 3 & 4 \\ -1 & 2 & 1 \\ 0 & 3 & 3 \end{bmatrix}$.   **5**

d   Find the charcteristic equation and eigen values for the matrix $\begin{bmatrix} 1 & 2 \\ 3 & 1 \end{bmatrix}$.   **6**

SECTION – 2

3

a   If the straight line is passing through the points (1, 2) and (3, 5) then find the   **4**
slope of the line.

b   Write the standard intercept form of the straight line and hence find the
equation of the straight line whose x and y intercepts are 2 and 3   **5**
respectively.

c   Write the standard slope-intercept form of a straight line. Find the equation   **5**
of the straight line passing through the point (3, 5) and slope 4 units.

d   Find the equation of the straight line parallel to the line passing through the   **6**
points (1, 3) and (4, 6).

4

a   i) If a line inclined at $45°$ with *x*-axis find its slope.   ii) Write   **2+2**
the x and y intercept of the line 2x+3y=10.

b   Find the equation of the straight line whose angle of inclination is 45^0 and   **5**
passingthrough the origin.

c   Find the equation of the straight line perpendicular to the line 2x+6y=3 and   **5**
with the y intercept 2 units.

d   Find the acute angle between the lines 7x-4y=0 and 3x-11y +5=0.   **6**

SECTION – 3

5   **a**   Express $75°$ in radian measure and $3\pi/2$ in degree.   **4**

b   Prove that $\cos(A+B)\cos(A-B) = \cos^2 A - \sin^2 B$.   **5**

c   Show that $\cos 2\theta = 2\cos^2 \theta - 1$.   **5**

d Find the value of $\sin 120^\circ \cdot \cos 330^\circ - \sin 240^\circ \cdot \cos 390^\circ$ without using calculator.   **6**

6 **a** Find the value of $\sin 15^\circ$.   **4**

b Simplify $\dfrac{\cos(360^\circ - A)\tan(360^\circ + A)}{\cot(270^\circ - A)\sin(90^\circ + A)}$.   **5**

c Prove that $\sin 3\theta = \sin 3\theta - 4\sin^3 \theta$.   **5**

d Prove that $\sin 20^\circ \cdot \sin 40^\circ \cdot \sin 80^\circ = \dfrac{\sqrt{3}}{8}$.   **6**

SECTION – 4

7 **a** Find the derivative of $y = x^2 + e^{2x} + \cos 2x - 2\log x$ with respect to x.   **4**

b Find dy/dx of $y = \dfrac{\sec x + \tan x}{\sec x - \tan x}$.   **5**

c Find dy/dx of $y = \tan^{-1}\left(\dfrac{1+x}{1-x}\right)$.   **5**

d If the $s = 2x^3 + 3x + 4$ repersents the displacement of the particle in motion at time x, then find the velocity of the particle at $x = 2$ secs and acceleration at $x = 3$ secs.   **6**

8 **a** Find $\dfrac{dy}{dx}$ of $y = 3x^4 + 4\log x + 2e^{3x} + \tan^{-1} x$.   **4**

b If $y = e^{2x} \sin 3x$ then find $\dfrac{dy}{dx}$.   **5**

c Find $\dfrac{d^2 y}{dx^2}$ if $y = 3\sin x + 4\cos x$ at $x = 1$.   **5**

d Find the equation of tangent and normal to the curve $y = x^2$ at the point (1, 1).   **6**

SECTION – 5

9 **a** Evaluate $\int (x-1)(x+1)dx$.   4

b Evaluate $\int_{0}^{p/2} \sin^2 x \, dx$ 5

c Evaluate $\int x \sin x dx$.   5

d Find the area bounded by the curve $y = 4x - x^2 - 3$, x-axis and ordinates   6
$x = 1$ and $x = 3$.

10 **a** Evaluate $\int_{0}^{2} e^x dx$.   4

b Evaluate $\int \dfrac{4\cos(\log x)}{x} dx$.   5

c Evaluate $\int x e^x \, dx$.   5

d Find the volume of the solid generated by revolving the curve $y = \sqrt{x^2 + 5x}$ 6
between $x = 1$ and $x = 2$.

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