Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

Course Title:**ENGINEERING MATHEMATICS – II**		Course Code	: **15SC02M**
Semester	: **II**	Course Group	: **Core**
Teaching Scheme (L:T:P)	: **4:0:0**(in hours)	Credits	: **4 Credits**
Type of course	: **Lecture + Assignments**	Total Contact Hours	: **52**
CIE	: **25 Marks**	SEE	: **100 Marks**
Programmes: **Common to all Engineering Diploma Programmes**			

Pre-requisites:

Engineering Mathematics-I in First Semester Diploma curriculum.

Course Objectives:

1. Apply the concept of straight line and conic section in engineering field.
2. Determine derivatives of functions involving two variables.
3. Apply the concepts of differentiation in physics and engineering courses.
4. Evaluate the integrals of functions of two variables.
5. Apply the concepts of definite integrals and its application over a region.
6. Solve the ODE of first degree, first order in engineering field.

Course Contents:

Topic and Contents	Hours	Marks
Unit-1: COORDINATE GEOMETRY	08hr	23
a. **Straight lines:** Differentforms of equations of straight lines: $y = mx + c$, $y - y_1 = m(x - x_1)$, $y - y_1 = \left(\frac{y_2 - y_1}{x_2 - x_1}\right)(x - x_1)$. General equation of a line$ax + by + c = o$ (graphical representation and statements) and problems on above equations. Equation of lines through a point and parallel or perpendicular to a given line. Problems.	04 hr	
b. **Conic Section:** Definition of conic section.Definition of axis, vertex, eccentricity, focus and length of latus rectum. Geometrical representation of parabola, ellipse and hyperbola: Equations of parabola$y^2 = 4ax$,	04hr	

Equation of ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$and Equation of hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$(without proof of above 3 equations). Equations of parabola, ellipse and hyperbolawith respect to x-axis as axis of conic. Finding axes, vertices, eccentricity, foci and length of lattice rectum of conics.Problemson finding the above said equations with direct substitution.		
UNIT – 2: DIFFERENTIAL CALCULUS	15hr	39
Differentiation. Definition of increment and increment ratio. Definition of derivative of a function. Derivatives of functions ofx^n, $\sin x$, $\cos x$and $\tan x$with respect to 'x' from first principle method. List of standard derivatives of $\operatorname{cosec} x$, $\sec x$, $\cot x$, $\log_e x$, a^x, e^x.....etc. Rules of differentiation: Sum, product, quotient rule and problems on rules. Derivatives of function of a function (Chain rule) and problems. Inverse trigonometric functions and their derivatives. Derivative of Hyperbolic functions, Implicit functions, Parametric functions and problems. Logarithmic differentiation of functions ofthe type u^v,where u and v are functions of x.Problems. Successive differentiation up to second order and problems on all the above types of functions.		
UNIT – 3: APPLICATIONS OF DIFFERENTIATION.	07hr	17
Geometrical meaning of derivative. Derivative as slope. Equations of tangent and normal to the curve y = f(x) at a given point- (statement only). Derivative as a rate measure i.e.to find the rate of change of displacement, velocity, radius, area, volume using differentiation. Definition of increasing and decreasing function. Maxima and minima of a function.		
UNIT-4: INTEGRAL CALCULUS.	12hr	30
Definition of Integration. List of standard integrals. Rules of integration (only statement) 1. $\int kf(x)dx = k\int f(x)dx.$ 2. $\int \{f(x)\pm g(x)\}dx = \int f(x)dx \pm \int g(x)dx$ problems. Integration by substitution method. Problems.		

Standard integrals of the type 1. $\int \frac{dx}{x^2+a^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right)+c$ 2. $\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1}\left(\frac{x}{a}\right)+c$. 3. $\int \frac{dx}{x\sqrt{x^2-a^2}} = \frac{1}{a}\sec^{-1}\left(\frac{x}{a}\right)+c$ (1 to 3 with proof) 4. $\int \frac{dx}{x^2-a^2} = \frac{1}{2a}\log\left(\frac{x-a}{x+a}\right)+c$ if x > a > 0. 5. $\int \frac{dx}{a^2-x^2} = \frac{1}{2a}\log\left(\frac{a+x}{a-x}\right)+c$ if a > x > 0. (4 & 5 without proof) and problems on above results Integration by parts of the type $\int x^n e^x dx$,$\int x\sin x dx$, $\int x\cos x dx$, $\int x\log x dx$, $\int \log x dx$, $\int \tan^{-1} x\, dx$, $\int x\sin^2 x\, dx$, $\int x\cos^2 x\, dx$where n=1, 2. Rule of integration by parts. Problems		
UNIT – 5: DEFINITE INTEGRALS AND ITS APPLICATIONS	05 hr	22
Definition of Definite integral. Problems on all types of integration methods. Area, volume, centres of gravity and moment of inertia by integration method. Simple problems.		
UNIT – 6: DIFFERENTIAL EQUATIONS.	05 hr	14
Definition, example, order and degree of differential equation with examples. Formation of differential equation by eliminating arbitrary constants up to second order. Solution of O. D. E of first degree and first order by variable separable method. Linear differential equations and its solution using integrating factor.		
Total	52	145

Course Delivery:

The Course will be delivered through lectures, class room interaction, exercises, assignments and self-study cases.

Course outcome:

On successful completion of the course, the student will be able to:

1. Formulate the equation of straight lines and conic sections in different forms.
2. Determine the derivatives of different types of functions.
3. Evaluate the successive derivative of functions and its application in tangent, normal, rate measure, maxima and minima.
4. Evaluate the integrations of algebraic, trigonometric and exponential function.
5. Calculate the area under the curve, volume by revolution, centre of gravity and radius of gyration using definite integration.
6. Form and solve ordinary differential equations by variable separable method and linear differential equations.

Mapping Course Outcomes with Program Outcomes:

Course outcomes	**Programme Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1	S	S										M
2	S	S										M
3	S	S										M
4	S	S										M
5	S	S										M
6	S	S										M

S: Strong relationship **M:** Moderate relationship

Reference Books:

1. NCERT Mathematics Text books of class XI and XII.
2. Higher Engineering Mathematics by B.S Grewal, Khanna publishers, New Delhi.
3. Karnataka State PUC mathematics Text Books of I & II PUC by H.K. Dass and Dr. Ramaverma published by S.Chand & Co.Pvt. ltd.
4. CBSE Class Xi & XII by Khattar & Khattar published PHI Learning Pvt. ltd.,
5. First and Second PUC mathematics Text Books of different authors.
6. E-books:www.mathebook.net
7. www.freebookcentre.net/mathematics/ introductory-mathematics -books.html

Course Assessment and Evaluation:

Method	What		To whom	When/where (Frequency in the course)	Max Marks	Evidence collected	Contributing to course outcomes
DIRECT ASSMENT	*CIE	Internal Assessment Tests	Student	Three tests (Average of Three tests to be computed).	20	Blue books	1 to 6
		Assignments		Two Assignments (Average of Two assignments to be computed)	5	Log of record	1 to 4
				Total	25		
	*SEE	Semester End Examination		End of the course	100	Answer scripts at BTE	1 to 6
INDIRECT ASSESSMENT	Student feedback		Students	Middle of the course	-NA-	Feedback forms	1 to 3, delivery of the course
	End of Course survey			End of course		Questionnaire	1 to 6, Effectiveness of delivery of instructions and assessment methods

***CIE** – Continuous Internal Evaluation ***SEE** – Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Any decimals shall be rounded off to the next higher digit.

Composition of Educational Components:

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom's taxonomy) such as:

Sl. No.	Educational Component	Weightage (%)
1	Remembering and Understanding	35
2	Applying the knowledge acquired from the course	25
3	Analysis&Evaluation	40

Model Question Paper:

Code: 15SC02M

II Semester Diploma Examination

ENGINEERING MATHEMATICS –II

(For All Engineering Diploma Programmes)

Time: 3 Hours] **[Max. Marks: 100**

NOTE: i)Answer any 10 questions from section A, 8 questions from section B and 5 questions from section-C

ii) Each question carries 3 marks in section A.

ii) Each question carries 5 marks in section B.

iii) Each question carries 6 marks in section C.

SECTION-A

1. Find the equation of the line passing through the point (2,-3) with slope 1/3.
2. Find the equation of parabola with vertex (2,0) and focus (5,0)
3. Differentiate: $(3x + 8)^7$ with respect to x.
4. If $y = \cos^{-1} x$ show that $\frac{dy}{dx} = \frac{-1}{\sqrt{1-x^2}}$.
5. If $y = x^x$, find $\frac{dy}{dx}$.
6. If $y = \frac{1+\sin x}{1-\sin x}$ find $\frac{dy}{dx}$.
7. Find the equation to the tangent to the curve $2x^3 + 5y - 4 = 0$ at (-2,4).
8. The volume of the sphere is increasing at the rate of 6cc/sec. Find the rate of change of radius when the radius is 3 cm.
9. Integrate: $(2x + 1)(x + 5)$ with respect to x
10. Evaluate: $\int \tan^2 x dx$
11. Evaluate: $\int \frac{\cos x}{1+\sin x} dx$
12. Evaluate: $\int_0^{\pi/4} (\sec^2 x + 1) dx$.
13. Find area bounded by the line $x + 2y = 0$, x- axis, and ordinates $x = 0, and x = 4$ by integration.
14. Form differential equation for curve $y^2 = 4ax$

SECTION – B

1. Find the equation of line passing through the point (2,5) and (-3,2).
2. Differentiate $\sqrt{x} + \log x + \sin^{-1} x + e^{\tan x} - a^x$ with respect to x.
3. Differentiate $\tan x$ with respect to x using first principal method.
4. If $y = \sinh 3x \cosh 2x$ then find $\frac{dy}{dx}$.
5. If $S = t^3 - t^2 + 9t + 8$, where S is distance travelled by particle in t seconds. Find the velocity and acceleration at t = 2 sec.
6. Integrate: $\frac{1}{x} - \tan x + e^{-3x} + \frac{1}{1+x^2} + 5$ with respect to x.
7. Evaluate: $\int \frac{(1+\log x)^2}{x} dx$
8. Evaluate: $\int x \sin x dx$

9. Evaluate: $\int_0^{\pi/2} \cos 5x \cos 3x \, dx$
10. Evaluate: $\int_0^{\pi/2} \cos^3 x \, dx$
11. Solve the differential equation $\sin^2 y dx - \cos^2 x dy = 0$

SECTION – C

1. Find the equation of median through B in a triangle with vertices A(-1 ,3), B(-3, 5) and C(7,-9)
2. Find the equation of hyperbola, given that vertices are $(\pm 7, 0)$ and eccentricity, e=4/3
3. If $x^y = a^x$, show that $\frac{dy}{dx} = \frac{x \log_e a - y}{x \log_e x}$.
4. If $y = e^{\tan^{-1} x}$ then show that $(1 + x^2)\frac{d^2y}{dx^2} + (2x - 1)\frac{dy}{dx} = 0$.
5. Find the maximum and minimum values of the function
$f(x) = 2x^3 - 21x^2 + 36x - 20$.
6. Evaluate: $\int \tan^{-1} x \, dx$
7. Find the volume of solid generated by revolving the curve
$y = \sqrt{x^2 + 5x}$ between x=1 & x=2.
8. Solve the differential equation $x\frac{dy}{dx} - 2y = 2x$

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Question Paper Blue Print:

Course: **ENGINEERING MATHEMATICS – II** Course Code**: 15SC02M**

UNIT NO		HOURS	Questions to be set (3 Marks) Section - A	Question to be set in two sub division (5 Marks) Section - B	Question to be set in two sub division (6 Marks) Section- C	Weightage of Marks
1	a	4	01	01	01	23
	b	4	01	--	01	
2		15	04	03	02	39
3		07	02	01	01	17
4		12	03	03	01	30
5		05	02	02	01	22
6		05	01	01	01	14
TOTAL		52	14	11	08	145
Questions to be answered			**10**	**08**	**05**	**100**

Guidelines to Question Paper Setting:

1. The question paper must be prepared based on the blue print without changing the weight age of model fixed for each unit.
2. The question paper pattern provided should be adhered to
   Section-A: 10 questions to be answered out of 14 questions each carrying 03 marks.
   Section-B: 08 questions to be answered out of 11 questions each carrying 05 marks.
   Section-C: 05 questions to be answered out of 08 questions each carrying 06 marks.
3. Questions should not be set from the recapitulation topics.

Model Question Bank:

Course Title:**ENGINEERING MATHEMATICS – II**	Course Code: **15SC02M**

UNIT-1: STRAIGHT LINES AND CONIC SECTION:

3 MARK QUESTIONS

1. Find the equation of the straight line passing through (2,3) and having slope 5.
2. Find the slope and x-intercept and y-intercepts of the line $2x + 3y - 11 = 0$.
3. Find the vertex and focus of the parabola $(y - 2)^2 = 8x$.
4. Show that the lines 3x-2y+2=0, 2x+3y+7=0 are perpendicular.
5. Find the eccentricity of the ellipse $\frac{x^2}{64} + \frac{y^2}{9} = 1$

5 MARK QUESTIONS

1. Find the equation to the line passing through the point (6,-4) and perpendicular to the line 7x-6y+3=0.
2. Find the equation to the line passing through the point (2,3) parallel to the line joining the points (-8,-6) & (2,-4).
3. Find the equation of straight line inclined at 135o to the x-axis having y-intercept 2/3.
4. Find the equation of straight line joining the points (2,3) & (-4,6).
5. Find the equation of the line passes through (-3,-2) which is perpendicular to x-axis.

6 MARK QUESTIONS

1. Find the equation to the median of the triangle through the vertex A with vertices A(-1,3), B(-3,5) &C(7,-9).
2. The vertices of a quadrilateral taken in order are A(1,2), B(2,1),C(3,4) & D(-1,-2). Find the equation to the diagonal BD.

3. Obtain the equation of the hyperbola in the form $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, whose eccentricity is 8 and distance between the foci is 12.
4. Find the equation of the ellipse with length of major axis is 8 and minor axis is 3.
5. Find the equation to the line passing through point (3,-2) and perpendicular to the line joining points (5,2) &(7,-6).

UNIT-2: DIFFERENTIATION:

3 MARK QUESTIONS

1. Find $\frac{dy}{dx}$, if $y=2x^2-3x+1$.
2. Differentiate xtanx with respect to x.
3. Find $\frac{dy}{dx}$, if $x^2+y^2=25$
4. Find $\frac{dy}{dx}$ if $x=ct, y=\frac{c}{t}$,
5. If $y=4ax$, find $\frac{d^2y}{dx^2}$.

5 MARK QUESTIONS:

1. Differentiate the function x^n by method of first principle.
2. Find $\frac{dy}{dx}$ if $y=6x^3-3\cos x+4\cot x+2e^{-x}-\frac{5}{x}$.
3. Find $\frac{dy}{dx}$ if $y=\frac{\cos x+\sin x}{\cos x-\sin x}$
4. Find $\frac{dy}{dx}$ if $y=(\cos x)^{\sin x}$
5. If $y=\tan^{-1}x$, provethat $(1+x^2)y_2+2xy_1=0$

6 MARK QUESTIONS:

1. Find $\frac{dy}{dx}$ if $y=\frac{x\log x}{1+\sin x}$
2. Find $\frac{dy}{dx}$ if $x=a\cos^3\theta, y=a\sin^3\theta$ at $\theta=\pi/4$.
3. Find $\frac{dy}{dx}$ if $y=x^{x^{x^{x^{\cdot^{\cdot^{\cdot^{\infty}}}}}}}$.
4. If $y=\tan^{-1}\left(\frac{1+x}{1-x}\right)$, find $\frac{dy}{dx}$.
5. If $y=e^{m\sin^{-1}x}$, provethat $(1-x^2)y_2-xy_1-m^2y=0$

UNIT-3 APPLICATIONS OF DIFFERENTIATION

3 MARK QUESTIONS

1. Find the slope of the tangent to the curve $x^2 + 2y^2 = 9$ at a point (1, 2) on it.
2. Find the slope of the normal to the curve $y = 2 - 3x + x^2$ at (1, 0).
3. The law of motion of a moving particle is $S = 5t^2 + 6t + 3$ where 'S' is the distance in metres and 't' time in seconds. Find the velocity when t=2.
4. Find the rate of change of area of a circle with respect to its radius.
5. Show that the curve $2x^3 - y = 0$ is increasing at the point (1, 2).

5 MARK QUESTIONS

1. For a moving body vertically upwards, the equation of motion is given by $S = 98t - 4.9t^2$. When does the velocity vanish?
2. Find the equation to the tangent to the curve $y = 2x^2 - 3x - 1$ at (1,-2).
3. A circular patch of oil spreads on water and increases its area at the rate of 2 sq.cm/min. find the rate of change of radius when radius when radius is 4 cm.
4. The volume of the spherical ball is increasing at the rate of 36π cc/sec. Find the rate at which the radius is increasing. When the radius of the ball is 2cm.
5. Find the max value of the function $y = x^3 - 3x + 4$.

6 MARK QUESTIONS

1. Find the max & min values of the function $y = x^5 - 5x^4 + 5x^3 - 1$.
2. Find the equation of normal to the curve $y = x^2 + 2x + 1$ at (1,1).
3. If S is the equation of motion where $S = t^3 - 2t^2$ find its acceleration when velocity is 0.
4. The volume of sphere is increasing at 3c.c per second. Find the rate of increase of the radius, when the radius is 2cm.
5. Water is flowing into a right circular cylindrical tank of radius 50 cms at the rate of 500π cc/min. Find how fast is the level of water going up.

UNIT-4: INTEGRATION

3 MARK QUESTIONS

1. Evaluate: $\int (x^2 + x + 1)\, dx$.
2. Evaluate: $\int \cot^2 x\, dx$
3. Evaluate: $\int e^{5x+8}\, dx$
4. Evaluate: $\int \frac{1}{2x+5} dx$
5. Evaluate: $\int \sin^5 x \cos x\, dx$

5 MARK QUESTIONS

1. Evaluate $\int \left(x^4 - \frac{1}{x} + \operatorname{cosec}^2 x - e^{-2x} + \cos x\right) dx.$
2. Evaluate: $\int \cos^3 x \, dx$
3. Evaluate: $\int \sin 6x \cos 2x \, dx$
4. Evaluate: $\int \log x \, dx$
5. Evaluate: $\int \frac{(\tan^{-1} x)^3}{1+x^2} dx$

6 MARK QUESTIONS

1. Evaluate: $\int (\tan x + \cot x)^2 dx.$
2. Evaluate: $\int (x+1)(x-2)(x-3) dx$
3. Evaluate: $\int x^2 \cos x \, dx$
4. Prove that $\int \frac{dx}{x^2 + a^2} = \frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + c$
5. Evaluate: $\int \frac{1}{9\sin^2 x + 4\cos^2 x} dx$

UNIT-5: DEFINITE INTEGRATION AND ITS APPLICAITON.

3 MARK QUESTIONS

1. Evaluate: $\int_2^3 (2x+1) \, dx.$
2. Evaluate: $\int_0^{\pi/4} \sec^2 x \, dx.$
3. Evaluate: $\int_0^2 e^x \, dx$
4. Evaluate: $\int_0^1 \frac{(\sin^{-1} x)^2}{\sqrt{1-x^2}} dx.$
5. Evaluate: $\int_0^{\pi/2} \cos x \, dx.$

5 MARK QUESTIONS

1. Evaluate: $\int_0^{\pi/2} \sin 3x \cos x \, dx.$
2. Evaluate: $\int_0^{\pi} \frac{\cos x}{1+\sin^2 x} dx.$
3. Evaluate: $\int_0^1 x(x-1)(x-2) \, dx.$
4. Find the area bounded by the curve $y = x^2 + 1$ the x-axis and ordinates$x = 1, x = 3.$
5. Find the volume of the solid generated by the revolving of the curve $y^2 = x^2 + 5x$ between the ordinates x=1, x=2 about x-axis.

6 MARK QUESTIONS

1. Evaluate: $\int_0^1 \frac{\cos(\tan^{-1} x)}{1+x^2} dx$.
2. Find the area between the curves $y = x^2 + 5$ and $y = 2x^2 + 1$.
3. Find the volume of ellipsoid generated by revolving $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ between the ordinates $x = \pm a$ about x-axis.
4. Find the centre of gravity of a solid hemisphere.
5. Determine the moment of inertia of a uniform rod of length 2l,
   Cross-sectional area "a" about an axis perpendicular to the rod and passing through the mid-point of the rod.

UNIT-6: INTEGRATION

3 MARK QUESTIONS

1. Write the order and degree of the differential equation $\left(\frac{dy}{dx}\right)^8 + 3\frac{d^2y}{dx^2} - ye^x = 0$.
2. Form the differential equation by eliminating arbitrary constants in $y = m e^{2x}$.
3. Solve $xdx + ydy = 0$.
4. Solve $\frac{dy}{1+y^2} = \frac{dx}{1+x^2}$.
5. Solve $e^x dx + dy = 0$.

5 MARK QUESTIONS

1. Form the differential equation by eliminating arbitrary constants A and B in $y = Ae^x + Be^{-x}$.
2. Form the differential equation by eliminating arbitrary constants in $y = a\cos mx + b\sin mx$.
3. Solve $(1 + y)dx + (1 + x)dy = 0$.
4. Solve $\frac{dy}{dx} + 3y = e^{2x}$.
5. Solve $\frac{dy}{dx} + y\tan x = \cos x$

6 MARK QUESTIONS

1. Solve $x(1 + y^2)dx + y(1 + x^2)dy = 0$.
2. Solve $\sec^2 x \tan y\, dx + \sec^2 y \tan x\, dy = 0$.
3. Solve $x\frac{dy}{dx} + y = x^3$
4. Solve $\frac{dy}{dx} + 3y = e^{2x}$.
5. Solve $\frac{dy}{dx} + 2y\cot x + \sin 2x = 0$

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