



B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF MATHEMATICS
I SEMESTER

Course Title	Engineering Mathematics -1	Course Code	15MA1ICMAT
Credits	04	L – T – P- S	3 – 1 – 0 - 0

Prerequisites: Trigonometric formulas, methods of differentiation, methods of integration, solution of first order ordinary differential equations-variable separable method and solution of homogeneous first order ordinary differential equations.

Course Objectives: To acquaint the students with principles of mathematics through Calculus and Differential Equations, that serves as an essential tool in several engineering applications.

UNIT-1

DIFFERENTIAL CALCULUS OF ONE VARIABLE **[9 hours]**

Introduction to n^{th} derivatives of standard functions, Leibnitz's theorem (without proof). Taylor's and Maclaurin's series expansions for function of one variable.

Polar curves: Polar coordinates, angle between radius vector and tangent, angle between the polar curves.

Applications: curvature and radius curvature in polar coordinates (without proof). **(7L+2T)**

Suggested Reading: Hyperbolic functions, length of the perpendicular from pole to the tangent, pedal equation for polar curves.

UNIT-2

MULTIVARIATE DIFFERENTIAL CALCULUS **[9 hours]**

Partial differentiation: Partial derivatives, total differentiation, differentiation of composite and implicit functions, Jacobians and their properties (without proof). Taylor's and Maclaurin's series expansions for functions of two variables.

Applications: Maxima and Minima for functions of two variables (unconstrained optimization).

(7L+2T)

Suggested Reading: Indeterminate forms (L' Hospital's rule) and Lagrange's method of multipliers (constrained optimization).

UNIT-3

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS **[9 hours]**

Geometrical meaning of first order ordinary differential equations, solution and family of curves, motivating examples of first order ordinary differential equations, linear differential equations, Bernoulli's equation, exact equations, equations reducible to exact equations- case1: integrating factor of a homogeneous differential equation with $Mx + Ny \neq 0$, case2: integrating factor for equations of the type $f_1(xy)y dx + f_2(xy)x dy = 0$

Applications: Orthogonal trajectories. Newton's law of cooling.

(7L +2T)



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Suggested Reading: Solution of differential equations of the type $Mdx + Ndy = 0$ where
(i) $\frac{M_y - N_x}{N} = g(x)$ (ii) $\frac{N_x - M_y}{M} = h(y)$. Applications of ordinary differential equations to mixing problem.

UNIT-4

HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS [10 hours]

Linear differential equations of second and higher order with constant coefficients, method of variation of parameters, solution of Cauchy's homogenous linear differential equation and Legendre's differential equation.

Applications: LRC Circuit's and Newton's second law of motion (spring mass system). (7L+3T)

Suggested Reading: Method of undetermined coefficients, system of ordinary differential equations.

UNIT-5

SERIES SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS AND INTEGRAL CALCULUS [11 hours]

Equations of second order: Power series method – (i) solution near an ordinary point (ii) solution near a regular singular point. Series solution of Bessel's differential equation leading to Bessel's function and series solution of Legendre's differential equation.

Reduction formulae for the integration of $\sin^n x$, $\cos^n x$ (without proof) $\sin^m x \cos^n x$ (with proof) (m and n being positive integers) and evaluation of these integrals with standard limits.

Applications: Expressions for Derivatives of arc length (Cartesian and polar form-without proof).

Area under a plane curve (polar curves), length of plane curves. (8L+3T)

Suggested Reading: volume of revolution and surface area of revolution by a given curve.

MATHEMATICS LAB

- Tracing of standard curves: Cartesian form – Cissoid, Strophoid, Lemniscate,
- Parametric form - Cycloid, Astroid.
- Polar form - Cardioid, Lemniscate, n -leaved rose where $n = 3, 4, 5$.



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On completion of the course, the student will have the ability to:

Course Code	CO #	COURSE OUTCOME (CO)	PO	Bloom's level
15MA1ICMAT	CO 1	Apply the standard calculus computations on parametric and polar curves.	2, 3	3
	CO 2	Understand the use of Taylor's and Maclaurin's series of one and two variables.	2, 3	3
	CO 3	Apply the concepts of functions of two or three variables.	2, 3	3
	CO 4	Apply integration to find arc lengths, areas, volume and surface area of revolution.	2, 3	3
	CO 5	Use analytic techniques to compute solutions for ordinary differential equations.	2, 3	3
	CO 6	Demonstrate an understanding towards the nature of curves by tracing the same using certain properties.	1, 2	2

Program Outcomes:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to engineering.
2. Graduates will be able to identify problems related to engineering disciplines.
3. Graduates will analyse and derive valid conclusions with fundamental knowledge in chemistry, biology, Engineering and computation.

Bibliography

Text Books

- (1) Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers.
- (2) Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.

Reference Books

- (1) Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, Vol.1 and Vol.2, 2014, Wiley-India.
- (2) Calculus - Early Transcendentals, James Stewart, 7th edition, 2012, Cengage Learning
- (3) Multivariable Calculus- James Stewart, 7th Edition, 2012, Cengage Learning.



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E-books and online course materials

- (1) Engineering Mathematics, [K. A. Stroud](http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y), [Dexter J. Booth](http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y), Industrial Press, 2001
http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.
- (2) Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.
- (3):[://ocw.mit.edu/courses/mathematics/](http://ocw.mit.edu/courses/mathematics/) (online course material)

Online Courses:

- (1):[://nptel.ac.in/courses.php?disciplineId=111](http://nptel.ac.in/courses.php?disciplineId=111)
(2)<https://www.khanacademy.org/>
(3)<https://www.class-central.com/subject/math> (MOOCS)

ASSESSMENT:

- Each unit consists of one full question.
 - Each full question consists of three or four subdivisions.
 - Five full questions to be answered.
 - To set one question each from Units 1,3,5 and two questions each from Unit 2 and Unit 4
- Questions for CIE (50%) and SEE (50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:
- Remembering and understanding the course contents (weightage: 40%)
 - Applying the knowledge acquired from the course (weightage: 35%)
 - Designing and analyzing various engineering problems (weightage: 15%)
 - Understanding of various system models (weightage: 10%)

Continuous Internal Assessment	50 marks (Weightage 50%)
Three Tests (Average of two best Tests)	40 marks
Quiz	05 marks
Lab assessment	05 marks
Semester End Examination (SEE)	100 marks (Weightage 50%)



B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
MATHEMATICS DEPARTMENT
SYLLABUS (2015 - 2016)
SECOND SEMESTER B.E. COURSE - (Common to all branches)

Course Name	Engineering Mathematics -2	Course Code	15MA2ICMAT
Credits	04	L – T – P- S	3 - 1 – 0 - 0
Contact hours	48 hours (36L+12T)		

Prerequisites: Basic Trigonometric concepts, Trigonometric formulas, methods of differentiation, methods of integration, reduction formulae, vector algebra.

Course Objectives: To provide students with a solid foundation in mathematical fundamentals such as Laplace Transforms, multiple integrals, Beta and Gamma functions, vectors and orthogonal curvilinear coordinates required for different branches of engineering.

UNIT-1

LAPLACE TRANSFORMS **[9 hours]**

Definitions, properties, transforms of elementary functions, transforms of derivatives and integrals.

Applications: Laplace transforms of Periodic functions and Unit step function. **(7L+2T)**

Suggested Reading: Laplace transform of Unit impulse function-Dirac delta function.

UNIT-2

INVERSE LAPLACE TRANSFORMS **[10 hours]**

Inverse Laplace Transforms-properties, inverse transforms of standard functions,

$$L^{-1}\left[\frac{F(s)}{s}\right], L^{-1}\left[e^{-as}F(s)\right], L^{-1}\left[F'(s)\right].$$

Applications: Solving ordinary differential equations using Laplace transforms (initial and boundary value problems) arising in the study of deflection of beams and RLC Circuits.

(8L+2T)

Suggested Reading: Convolution theorem (without proof) and problems, solutions of a system of differential equations using Laplace transform.

UNIT-3

MULTIPLE INTEGRALS AND BETA, GAMMA FUNCTIONS **[10 hours]**

Double integrals, evaluation of double integrals by change of order of integration, evaluation of double integrals by changing to polar form, Triple integrals.

Applications: Computation of area using double integrals in polar form and volume using triple integrals.

BETA AND GAMMA FUNCTIONS

Properties, relation between Beta and Gamma functions and related problems. **(7L+3T)**

Suggested Reading: applications of double integrals to find area, mass and centroid (Cartesian forms).



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UNIT-4

VECTOR CALCULUS

[11 hours]

Curves in space, scalar and vector point functions, vector differentiation, Gradient, directional derivative, Divergence, Curl, Laplacian of a vector point function, solenoidal, irrotational vectors.

Vector identities: $\text{div curl } \vec{A}$, $\text{curl grad } \phi$, $\text{div}(\phi \vec{A})$, $\text{curl}(\phi \vec{A})$, $\text{div}(\vec{A} \times \vec{B})$, $\text{curl curl } \vec{A}$. and problems on vector identities.

Applications: Vector integration– Statement and problems on Green’s theorem, Stokes’ theorem and Gauss divergence theorem (without proof). **(8L+3T)**

Suggested Reading: Tangent curves, velocity and acceleration.

UNIT-5

ORTHOGONAL CURVILINEAR COORDINATES (OCC):

[8 hours]

Definitions - Orthogonal curvilinear coordinates, scale factors, base vectors, cylindrical and spherical coordinate systems, expressing a given vector in cylindrical and spherical coordinates.

Applications: Expressions for gradient, elementary arc length, divergence, elementary volume, curl and Laplacian in orthogonal curvilinear coordinates. **(6L+2T)**

Suggested Reading: Evaluation of volume integrals by change of coordinates. Maxwell’s field equations.

MATHEMATICS LAB

- Laplace transforms of standard functions.
- Double and Triple integrals.
- Compute area and volume using multiple integrals.



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On completion of the course, the student will have the ability to:

Course Code	CO #	COURSE OUTCOME (CO)	PO	Bloom's level
15MA2ICMAT	CO 1	Use Laplace transforms to solve differential equations	2, 3	3
	CO 2	Apply double integrals to compute areas and triple integrals in computing volumes.	2, 3	3
	CO 3	Demonstrate an understanding of vector calculus which finds application in electromagnetic fields, gravitational fields and fluid flow problems.	2, 3	3
	CO 4	Ability to understand the use of multiple integrals in vector fields.	2, 3	3
	CO 5	Use Gamma and Beta functions to evaluate integrals.	2	2
	CO 6	Appreciate the use of orthogonal curvilinear coordinates in solving engineering problems with different geometry.	2, 3	3

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- (2) Advanced Modern Engineering Mathematics, Glyn James 3rd edition, 2004, Pearson Education.
- (3) Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers.



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E books and online learning materials

- (1) Advanced Engineering Mathematics, [Alan Jeffrey](http://books.google.co.in/books/about/Advanced_Engineering_Mathematics.html?id=9nFDvk9vr3kC&redir_esc=y), Academic Press, 19-Jun-2001.
http://books.google.co.in/books/about/Advanced_Engineering_Mathematics.html?id=9nFDvk9vr3kC&redir_esc=y
- (2) Engineering Mathematics, [K. A. Stroud](http://books.google.co.in/books/about/Engineering_Mathematics.html?id=EZncL-xB8dEC&redir_esc=y), [Dexter J. Booth](http://books.google.co.in/books/about/Engineering_Mathematics.html?id=EZncL-xB8dEC&redir_esc=y), Industrial Press, 2001
http://books.google.co.in/books/about/Engineering_Mathematics.html?id=EZncL-xB8dEC&redir_esc=y
- (3) <http://ocw.mit.edu/courses/mathematics/>

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(2) khanacademy.org/Math

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