



**B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19**  
(Autonomous College under VTU)

<b>Course Code</b>	<b>14MA11CMAT</b>	<b>Course Name</b>	<b>Engineering Mathematics - I</b>
<b>Credits</b>	<b>04</b>	<b>L - T - P - S</b>	<b>3 - 1 - 0 - 0</b>

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

**UNIT - 1**

**Calculus of one variable**

**[9 hours]**

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

**(4L+1T)**

Polar curves: Polar coordinates, angle between radius vector and tangent, angle between the polar curves, length of the perpendicular from pole to the tangent.

Applications: Curvature, radius of curvature in polar coordinates (without proof).

**(3L+1T)**

Suggested Reading: geometrical meaning of second derivatives, hyperbolic functions, Pedal equation for polar curves, Indeterminate forms (L' Hospital's rule).

**UNIT - 2**

**Multivariate 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 expansion for functions of two variables.

**(4L+2T)**

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

**(2L+1T)**

Suggested Reading: Lagrange's method of multipliers (constrained optimization).

**UNIT - 3**

**Curve tracing and Integral Calculus**

**[11 hours]**

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. Tracing of standard curves: Cartesian form - Strophoid, Lemniscate, Parametric form - Cycloid, Astroid, Polar form - Cardioid, Lemniscate.

**(6L+2T)**

Expressions for Derivatives of arc length (cartesian and polar form-without proof).

Applications: Area under a plane curve (polar curves), length of plane curves.

**(2L+1T)**

Suggested Reading: Proof of Reduction formulae for the integration of  $\sin^n x, \cos^n x$ , volume of revolution and surface area of revolution of standard curves.



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**UNIT – 4**

**Ordinary Differential Equations – 1**

**[10 hours]**

Geometrical meaning of first order ordinary differential equation, solution and family of curves, motivating examples of first order ordinary differential equation, linear differential equations, Bernoulli's equation, exact equations, equations reducible to exact equations (integrating factor of homogeneous equations, integrating factor for the equations of the type  $f_1(xy)ydx + f_2(xy)xdy = 0$ ).

**(4L+1T)**

Applications: Orthogonal trajectories. Simple electric circuits (RL-circuit, RC-circuit), Newton's law of cooling, heat flux, mixing problem. (model building)

**(4L+1T)**

Suggested Reading: Homogeneous and non-homogeneous ordinary differential equations, equations reducible to exact equations (cases 4 & 5), velocity of escape from earth, chemical reaction.

**UNIT – 5**

**Ordinary Differential Equations - 2**

**[9 hours]**

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

**(5L+1T)**

Applications: LRC Circuit's and Newton's second law of motion (spring mass system).

**(2L+1T)**

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

**Course Outcomes:**

- CO 1** - Apply the standard calculus computations on parametric and polar curves.
- CO 2** - Apply the concepts of functions of several variables.
- CO 3** - Demonstrate an understanding towards the nature of curves by tracing the same using certain properties.
- CO 4** - Apply integration to find arc lengths, areas, volume and surface area of revolution.
- CO 5** - Use analytical techniques to compute solutions of ordinary differential equations.

**Text Books:**

- (1) Higher Engineering Mathematics, B.S. Grewal, 42<sup>nd</sup> edition, 2013, Khanna Publishers.
- (2) Higher Engineering Mathematics, B.V. Ramana, 7<sup>th</sup> reprint, 2009, Tata Mc. Graw Hill.

**Reference Books:**

- (1) Advanced Engineering Mathematics, Erwin Kreyszig, 10<sup>th</sup> edition, 2010, Wiley-India.
- (2) Calculus - Early Transcendentals, 7<sup>th</sup> Edition, James Stewart, Thomson's books.



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**E books and online course materials:**

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

**Online Courses and Video Lectures:**

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

**Prerequisites:**

Trigonometric identities, concepts of differentiation, differentiation using product rule and quotient rule, integration of standard functions, integration of rational and irrational functions.



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<b>Course Code</b>	<b>14MA2ICMAT</b>	<b>Course Name</b>	<b>Engineering Mathematics - 2</b>
<b>Credits</b>	<b>04</b>	<b>L – T – P- S</b>	<b>3 - 1 – 0 - 0</b>

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

**UNIT - 1**

**Laplace Transforms [8 hours]**

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

Applications: Laplace Transforms of - Periodic function, Unit step function and impulse function.

**(6L+2T)**

Suggested Reading: Plotting periodic functions, engineering oriented applications on unit step function and unit impulse functions.

**UNIT – 2**

**Inverse Laplace Transforms [11 hours]**

Inverse Laplace Transforms-properties.

**(6L+2T)**

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

**(2L+1T)**

Suggested Reading: solutions of a system of linear differential equations using Laplace transform (initial value problems).

**UNIT-3**

**Multiple Integrals [10 hours]**

Double integrals, evaluation of double integrals by change of order of integration, evaluation of double integrals by changing to polar co-ordinates, Triple integrals.

Application: Computation of area using double integrals, computation of volume using triple integrals.

**(6L+2T)**

**BETA AND GAMMA FUNCTIONS**

Properties, relation between Beta and Gamma functions - related problems.

**(2L)**

Suggested Reading: applications of double integrals to find moment of inertia, mass and centroid.



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**UNIT – 4**

**Vector Calculus and Vector Integration [11 hours]**

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

Vector identities:  $\text{div curl } \vec{F}$ ,  $\text{curl grad } \vec{F}$ ,  $\text{div}(\phi \vec{F})$ ,  $\text{curl}(\phi \vec{F})$ ,  $\text{curl curl } \vec{F}$ ,  $\text{div}(\vec{A} \times \vec{B})$

and problems. (5L + 2T)

Applications: Vector integration– Statement and problems on Green's theorem, Stokes' theorem and Gauss divergence theorem (without proof).

(3L+1T)

Suggested Reading: derivatives (tangent curves, velocity and acceleration)

**UNIT - 5**

**Orthogonal Curvilinear Coordinates (OCC) [8 hours]**

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

**Course Outcomes:**

- CO 1** Use Laplace transforms to solve differential equations
- CO 2** Apply double integrals to compute areas and learn to use triple integrals in computing volumes.
- CO 3** Apply vector calculus in electromagnetic fields, gravitational fields and fluid flow problems.
- CO 4** Ability to understand the use of multiple integrals in vector fields.
- CO 5** Use Gamma and Beta functions to evaluate integrals.

**Text Books:**

- Higher Engineering Mathematics, B.S. Grewal, 42<sup>nd</sup> edition, 2013, Khanna Publishers.
- Advanced Engineering Mathematics, [Dennis Zill](#), [Warren S. Wright](#), [Michael R. Cullen](#), 5<sup>th</sup> edition, 2014, Jones & Bartlett Learning.

**Reference Books:**

- Advanced Engineering Mathematics, Erwin Kreyszig, 10<sup>th</sup> edition, 2010, Wiley-India.
- Advanced Modern Engineering Mathematics, Glyn James 4<sup>th</sup> edition, 2012, Pearson Education.
- Advanced Engineering Mathematics, P. V. O'Neil, 7<sup>th</sup> Indian reprint, 2011, Cengage learning India Pvt. Ltd.



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### E books and online learning materials:

- Advanced Engineering Mathematics, [Alan Jeffrey](#), Academic Press, 19-Jun-2001.  
[http://books.google.co.in/books/about/Advanced\\_Engineering\\_Mathematics.html?id=9nFDvk9yr3kC&redir\\_esc=y](http://books.google.co.in/books/about/Advanced_Engineering_Mathematics.html?id=9nFDvk9yr3kC&redir_esc=y)
- Engineering\_Mathematics, [K. A. Stroud](#), [Dexter J. Booth](#), Industrial Press, 2001  
[http://books.google.co.in/books/about/Engineering\\_Mathematics.html?id=FZncl-xB8dEC&redir\\_esc=y](http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncl-xB8dEC&redir_esc=y)
- <http://ocw.mit.edu/courses/mathematics/>

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- [khanacademy.org/Math](http://khanacademy.org/Math)
- <https://www.class-central.com/subject/math> (MOOCS)

### Prerequisites:

Trigonometric identities, concepts of differentiation, differentiation using product rule and quotient rule, integration of standard functions, integration of rational and irrational functions, Concept of vectors (dot product, cross product, scalar triple product and vector product of three vectors)