BMS COLLEGE OF ENGINEERING, BENGALURU-19

Autonomous Institute, Affiliated to VTU

COURSE TITLE	ENGINEERING MATHEMATICS-1	COURSE CODE	18MA1BSEM1
CREDITS	04	L – T – P	3 – 1 – 0
CONTACT HOURS	48 Hours		

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-I

DIFFERENTIAL CALCULUS – 1

Polar curves - Angle between the radius vector and tangent, angle between two curves, length of the perpendicular from pole to the tangent, pedal equation. Curvature and radius of curvature- Cartesian and polar forms (without proof). Taylor's and Maclaurin's series expansions for function of one variable (without proof). **[9 hours]**

UNIT-II

DIFFERENTIAL CALCULUS – 2

Partial differentiation; Total derivatives-differentiation of composite functions. Jacobians, Taylor's and Maclaurin's series expansions for function of two variables. Maxima and minima for a function of two variables. **[10 hours]**

UNIT-III

INTEGRAL CALCULUS

Multiple integrals: Evaluation of double integrals- change of order of integration and changing into polar co-ordinates, triple integrals. Applications: Area (Polar curves) and volume.

Beta and Gamma functions: Definitions, Relation between Beta and Gamma functions and problems. **[11 hours]**

UNIT-IV

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER

Bernoulli's equation. Exact and reducible to exact differential equations.

$(i)\frac{M_y - N_x}{N} = g(x)$ $(ii)\frac{N_x - M_y}{M} = h(y)$. Initial value problems. Applications: Orthogonal trajectories and Mixing problems. **[9 hours]**

UNIT-V

ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER

Second and higher order linear ordinary differential equations with constant coefficients- Inverse differential operators, Particular Integrals of e^{ax}, $\sin(ax), \cos ax$ and x^m. Method of variation of parameters; Cauchy's and Legendre homogeneous equations. **[9 hours]**

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

3) Advanced Engineering Mathematics, Erwin Kreyszig, edition 2014, Vol.1 and Vol.2, 2014, Wiley-India.
4) Advanced Engineering Mathematics, Dennis Zill, Warren S Wright, Michael R. Cullen, 4th edition, 2011, Jones & Bartlett Learning.

E-books and Online Resources

5) Advanced Engineering Mathematics, P.V. O'Neil, 7th Indian reprint, 2011, Cengage learning India Pvt. Ltd.
https://ndl.iitkgp.ac.in/ and
https://www.pdfdrive.com/engineering-mathematics-books.html
6) Engineering Mathematic, K. A. Stroud, Dexter J. Booth, Industrial Press,2001,
https://ndl.iitkgp.ac.in/ and
https://www.pdfdrive.com/engineering-mathematics-books.html

NPTEL/SWAYAM/MOOCs:

7) http://nptel.ac.in/courses.php/
8) https://www.class-central.com/subject/math (MOOCS)

Course Outcomes:

Course Code	CO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
18MA1BSEM1	CO 1	**Understand** the concepts of Calculus and differential equations.	--	--
	CO 2	**Apply** the concepts of calculus and Differential Equations to Engineering Problems.	1	3
	CO 3	**Demonstrate** an understanding of the multiple integrals using alternate tools.	5	1

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BMS COLLEGE OF ENGINEERING, BENGALURU-19

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COURSE TITLE	ENGINEERING MATHEMATICS-2	COURSE CODE	18MA2BSEM2
CREDITS	04	L – T – P	3 – 1 – 0
CONTACT HOURS	48 Hours		

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

UNIT-I

LAPLACE TRANSFORMS

Definitions, properties, transforms of elementary functions, transforms of derivatives and integrals. Applications: Evaluation of Improper integrals using Laplace transforms, Laplace transform of Periodic functions and Unit step function. **[9 hours]**

UNIT-II

INVERSE LAPLACE TRANSFORMS

Inverse Laplace Transforms-properties, inverse transforms of standard functions, $L^{-1}\left[\frac{F(s)}{s}\right]$, $L^{-1}\left[e^{-as}F(s)\right]$, $L^{-1}\left[F^{n}(s)\right]$. Applications: Solution of differential Equations, LRC series circuits and system of differential Equations. **[10 hours]**

UNIT-III

PARTIAL DIFFERENTIAL EQUATIONS

Formation of partial differential equations by elimination of arbitrary constants and functions. Solution of non-homogeneous partial differential equations by direct integration. Solution of Lagrange's linear partial differential equations. Solution of partial differential equations by the method of separation of variables, Derivation of one dimensional heat and wave equations and various possible solutions by the method of separation of variables. **[10 hours]**

UNIT-IV

VECTOR CALCULUS

Scalar and vector point functions, Gradient, directional derivative, Divergence, Curl, Laplacian of a vector point function, solenoidal, irrotational vectors. Vector identities: divcurl $\vec{A}$, curlgradϕ, div $\phi\vec{A}$, curl $\phi\vec{A}$, div $\vec{A}\times\vec{B}$, curlcurl $\vec{A}$ and problems on vector identities.

Vector integration: Statement and problems on Green's theorem, Stokes' theorem and Gauss divergence theorem (without proofs). **[10 hours]**

UNIT-V

ORTHOGONAL CURVILINEAR COORDINATES (OCC):

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

Expressions for gradient, divergence, curl and Laplacian in orthogonal curvilinear coordinates. **[9 hours]**

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

3) Advanced Engineering Mathematics, Erwin Kreyszig, edition 2014, Vol.1 and Vol.2, 2014, Wiley-India.
4) Advanced Engineering Mathematics, Dennis Zill, Warren S Wright, Michael R. Cullen, 4th edition, 2011, Jones & Bartlett Learning.

E- Books and Online Resources

5) Advanced Engineering Mathematics, P.V. O'Neil, 7th Indian reprint, 2011, Cengage learn ing India Pvt. Ltd.
https://ndl.iitkgp.ac.in/ and
https://www.pdfdrive.com/engineering-mathematics-books.html
6) Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001, https://ndl.iitkgp.ac.in/ and
https://www.pdfdrive.com/engineering-mathematics-books.html

NPTEL/SWAYAM/MOOCs:

7) http://nptel.ac.in/courses.php/
8) https://www.class-central.com/subject/math (MOOCS)

Course Outcomes:

COURSE CODE	CO's	At the end of the course, the student will be able to:	PO's	CO-PO Mapping (Strength)
18MA2BSEM2	CO 1	Understand the concepts of transforms, partial differential equations and vector calculus.	--	--
	CO 2	Apply the concepts of transforms, partial differential equations and calculus to Engineering problems.	1	3
	CO 3	Demonstrate an understanding of the Laplace transforms of functions using alternate tools.	5	1

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B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
Autonomous Institute, Affiliated to VTU
DEPARTMENT OF MATHEMATICS

SYLLABUS (2019 - 2020)

THIRD SEMESTER B.E COURSE
(Common to AS/CV/EEE/ECE/EIE/IEM/ME/ML/TCE)

Course Title	**Engineering Mathematics - 3**	**Course Code**	**19MA3BSEM3**
Credits	**04**	**L – T – P**	**3 - 1 - 0**
Contact hours	**48 hours**		

Prerequisites: Basic concepts of Trigonometry, methods of differentiation, methods of integration, solution of ordinary differential equations.

Course Objectives: The purpose of the course is to make the students conversant with concepts of Linear Algebraic systems, Fourier series, Fourier Transforms and develop computational skills using efficient numerical methods for problems arising in science and engineering.

UNIT-1

MATRICES **[9 hours]**

Introduction: Elementary row transformations, Echelon form of a matrix, rank of a matrix by elementary row transformations. Consistency of a system of linear equations and solution. Solution of a system of non-homogenous equations: Gauss elimination method, Gauss-Seidel method, LU decomposition method, eigenvalues and eigenvectors of matrices, reduction of a matrix to diagonal form. **(7L + 2T)**

UNIT-2

FOURIER SERIES **[9 hours]**

Introduction: Dirichlet's conditions, Fourier series of periodic functions of period $2l$, Fourier series of functions having points of discontinuity. Applications: Fourier series of typical waveforms like saw toothed waveform, triangular waveform, square waveform, half-wave rectifier, full wave rectifier and modified saw tooth waveform, exponential Fourier series, practical harmonic analysis. **(7L + 2T)**

UNIT-3

FOURIER TRANSFORMS **[9 hours]**

Infinite Fourier transform: Fourier Sine and Cosine transforms, properties, Inverse transforms. Convolution theorem, Parseval's identities. **(6L + 3T)**

UNIT-4

NUMERICAL METHODS **[10 hours]**

Solution of algebraic and transcendental equations: Newton-Raphson method.

Finite Differences and interpolation: Forward differences, backward differences. Newton- Gregory forward interpolation formula, Newton-Gregory backward interpolation formula, Lagrange's interpolation formula, Lagrange's inverse interpolation. Numerical integration: Simpson's $1/3^{rd}$ rule, Simpson's $3/8^{th}$ rule, Weddle's rule.

Numerical solution of ordinary differential equations: modified Euler's method, Runge-Kutta method of fourth order**.** **(8L + 2T)**

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DEPARTMENT OF MATHEMATICS

UNIT-5

CALCULUS OF VARIATIONS **[11 hours]**

Variation of a functional, Euler's equation, variational problems.

Applications: Hanging cable problem, Brachistochrone problem.

Z -TRANSFORMS

Definition, Properties, Transforms of standard functions, Inverse transforms. Solution of difference equations using Z- transforms. **(8L + 3T)**

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

Course Code	CO #	COURSE OUTCOME (CO)	PO
19MA3BSEM3	CO 1	Apply Numerical techniques to solve problems arising in engineering.	1
	CO 2	Demonstrate an understanding of Fourier Series, Fourier Transforms and Z- Transforms.	
	CO 3	Apply the concepts of calculus to functionals.	

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, 43rd edition, 2014, Khanna Publishers.
2. Advanced Engineering Mathematics, 4th edition, 2011, Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd.

Reference Books:

1. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition Vol.1 and Vol.2, 2014, Wiley-India.

E books and online course materials:

1. https://ocw.mit.edu/courses/mechanical-engineering/2-993j-introduction-to-numerical-analysis-for-engineering-13-002j-spring-2005/lecture-notes/
2. https://www.pdfdrive.com/calculus-of-variations-e34313748.html

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/111103021/22 (Fourier series and Transforms, Heat and Wave Equations)
2. https://nptel.ac.in/courses/122104018/2 (Numerical Methods)
3. https://nptel.ac.in/courses/111104025/ (Calculus of variation)

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question each from units 1, 2, 4 and two questions each from Unit 3 and Unit 5.

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2019 - 2020)

THIRD SEMESTER B.E COURSE
(CSE/ISE)

Course Title	**Statistics and Discrete Mathematics**	**Course Code**	**19MA3BSSDM**
Credits	**04**	**L – T – P**	**3 – 1 – 0**
Contact hours	**48 hours (36L+12T)**		

Prerequisites: Basic Concepts of Probability and Statistics.

Course Objectives: To acquaint the student with various concepts of discrete mathematics, Probability, Statistics and Queuing required in several streams of Computer/Information Science.

UNIT-1

GRAPH THEORY **[11 hours]**

Basic concepts: Types of graphs, order and size of a graph, in-degree and out-degree, connected and disconnected graphs, Eulerian graph, Hamiltonian graphs, sub-graphs, isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix. Trees: spanning tree, minimal spanning tree: Kruskal's algorithm, Prim's algorithm, shortest path-Dijkstra's algorithm.

(8L+3T)

UNIT-2

COMBINATORICS **[9 hours]**

Principles of counting: The rules of sum and product, permutations. Combinations- Binomial and multinomial theorems. Catalan numbers, the principle of inclusion and exclusion. Derangements.

(7L+2T)

UNIT-3

PROBABILITY **[8 hours]**

Theoretical distributions: Poisson distribution, Exponential and Normal distributions.

Joint probability distributions: Discrete random variable, Mathematical expectations, Covariance and Correlation. **(6L+2T)**

UNIT-4

STATISTICAL INFERENCE **[11 hours]**

Introduction, procedure for testing of hypothesis, level of significance.

[Large sample] Test of significance for single mean, difference between two means, single proportion, difference between two proportions.

[Small sample] Test of significance for single mean, difference between two means, paired t-test, ratio of variances (F- distribution), Chi-Square distribution-goodness of fit.

(8L+3T)

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UNIT-5

MARKOV CHAIN AND QUEUING THEORY **[9 hours]**

Markov Chain, Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chains. Queuing models: Concept of Queue, M/M/1 queuing systems. **(7L+2T)**

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

Course Code	CO #	COURSE OUTCOMES (CO)	PO
19MA3BSSDM	CO 1	Use graphs as representation tool in network analysis	1
	CO 2	Demonstrate an understanding of the basic concepts of Combinatorics.	
	CO 3	Apply the concepts for probability, Statistics and Queuing theory.	

Text Books:

1. Discrete Mathematics, Seymour Lipchitz. M. Lipson, 2005, Tata McGraw Hill.
2. Graph Theory and Combinatorics, D. S. Chandrasekharaiah, 4th edition, 2011-12, Prism Engineering Education Series.
3. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.

Reference Books:

1. Discrete Mathematics and its Applications, Kenneth H. Rosen, 2002, McGraw Hill.
2. Discrete Mathematics, Kolman, Busby Ross, 5th edition, 2004, Prentice Hall.
3. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Eastern Economy Edition, PHI Learning Pvt., Ltd.

E books and online course materials:

1. http://jlmartin.faculty.ku.edu/~jlmartin/courses/math725-S16/
2. https://www.whitman.edu/mathematics/cgt_online/cgt.pdf

Online Courses and Video Lectures:

1. https://www.coursera.org/learn/probability-intro
2. https://nptel.ac.in/courses/111104026/ (Discrete Mathematics)
3. https://nptel.ac.in/courses/111106086/ (Combinatorics)
4. https://nptel.ac.in/courses/111102112/ (Statistical Inference)

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question in Units 2, 3, 5 and two questions each in unit 1 and unit 4.

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2019 - 2020)

THIRD SEMESTER B.E COURSE
(CHEMICAL ENGINEERING / BIO-TECHNOLOGY)

Course Title	**Applied Mathematics**	**Course Code**	**19MA3BSAPM**
Credits	**04**	**L – T – P**	**3 – 1 – 0**
Contact hours	**48 hours (36L+12T)**		

Prerequisites: Basic concepts of Trigonometry, methods of differentiation, methods of integration, solution of ordinary differential equations.

Course Objectives: The purpose of the course is to make the students conversant with concepts of Fourier Series, Fourier Transforms, extremal of functionals and develop computational skills using efficient numerical methods for problems arising in science and engineering.

UNIT-1

MATRICES **[10 hours]**

Introduction: Elementary row transformations, Echelon form of a matrix, rank of a matrix by elementary row transformations. Consistency of a system of linear equations and solution. Solution of a system of non-homogenous equations: Gauss elimination method, Gauss-Seidel method. Eigenvalues and eigenvectors of matrices. **(8L+2T)**

UNIT-2

NUMERICAL METHODS **[10 hours]**

Solution of algebraic and transcendental equations: Newton-Raphson method. Finite Differences and interpolation: Forward differences, backward differences. Newton-Gregory forward interpolation formula, Newton-Gregory backward interpolation formula, Lagrange's interpolation formula, Lagrange's inverse interpolation. Numerical integration: Trapezoidal rule, Simpson's $1/3^{rd}$ rule.

Numerical solution of ordinary differential equations: Runge-Kutta method of fourth order.

(7L+3T)

UNIT-3

FOURIER SERIES **[10 hours]**

Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period $2l$, Fourier series of functions having points of discontinuity.

FOURIER TRANSFORMS

Infinite Fourier transform, Fourier sine and cosine transforms, Inverse transforms.

(7L + 3T)

UNIT-4

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS **[9 hours]**

Finite-Difference formulas to partial derivatives.

Applications: Solution of one-dimensional heat equation using 2-level formula and Schmidt explicit formula and Crank-Nicolson two-level implicit formula. Solution of one-dimensional wave equation using explicit three level formula and implicit scheme. **(7L+2T)**

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UNIT- 5

CALCULUS OF VARIATIONS **[9 hours]**

Variation of a functional, Euler's equation, variational problems.
Applications: Geodesic on a plane, minimal surface of revolution, hanging cable problem, Brachistochrone problem.

(7L +2T)

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

Course Code	CO #	COURSE OUTCOME (CO)	PO
19MA3BSAPM	CO 1	Apply Numerical techniques to solve problems arising in engineering.	1
	CO 2	Demonstrate an understanding of Fourier Series and Fourier Transforms.	
	CO 3	Apply the concepts of calculus to functionals.	

Text Books:

1. Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers.
2. Advanced Engineering Mathematics, Dennis G. Zill and Cullen, 4th edition, 2011, Jones and Bartlett India Pvt. Ltd.

Reference Books:

1. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.
2. Numerical methods for Engineers, R. P. Canale and S. C. Chapra, 7th edition, McGraw Hill Education India Private Ltd.

E books and online course materials:

1. https://www.math.ubc.ca/~peirce/M257_316_2012_Lecture_8.pdf
2. https://www.pdfdrive.com/calculus-of-variations-e34313748.html

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/111103021/22 (Fourier series and Transforms, Heat and Wave Equations)
2. https://nptel.ac.in/courses/122104018/2 (Numerical Methods)

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question from Units 1, 4, 5 and two questions from Unit 2 and Unit 3.

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SYLLABUS (2019 - 2020)

THIRD SEMESTER B.E COURSE

(Common to All Branches)

Course Title	**Additional Mathematics-I**	**Course Code**	**19MA3IMMAT**
Credits	**00**	**L – T – P**	**3 – 1 – 0**
Contact hours	**48 hours (36L+12T)**	**III semester Lateral Entry students**	

Prerequisites: Basic concepts of Trigonometry, Trigonometric formulas, concept of differentiation, concept of integration.

Course Objectives: To provide students with a solid foundation in mathematical fundamentals such as differentiation, differential equations, vectors and orthogonal curvilinear coordinates for different branches of engineering.

UNIT 1

DIFFERENTIAL AND INTEGRAL CALCULUS [9 Hours]

List of standard derivatives including hyperbolic functions, rules of differentiation. Taylor's and Maclaurin's series expansion for functions of single variable. List of standard integrals, integration by parts. Definite integrals – problems. **(7L+2T)**

UNIT 2

POLAR COORDINATES AND PARTIAL DERIVATIVES [10 Hours]

Polar curves: Polar coordinates, angle between radius vector and tangent, angle between two polar curves. Partial differentiation. Total differentiation-Composite and Implicit functions. Jacobians and their properties (without proof) – Problems. **(7L+3T)**

UNIT 3

VECTOR CALCULUS AND ORTHOGONAL CURVILINEAR COORDINATES [10 Hours]

Recapitulation of scalars, vectors and operation on scalars and vectors. Scalar and vector point functions. Del operator, gradient-directional derivative, divergence, curl and Laplacian operator. Vector identities (without proof). Cylindrical and Spherical polar coordinate systems. Expressing a vector point function in cylindrical and spherical systems. Expressions for gradient, divergence, curl and Laplacian in orthogonal curvilinear coordinates. **(7L+3T)**

UNIT 4

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS [9 Hours]

Introduction to first order differential equations. Linear equation and its solution. Bernoulli's equation and its solution. Exact differential equation and its solution. Orthogonal Trajectories.

(7L+2T)

UNIT 5

SECOND AND HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS [10 Hours]

Ordinary differential equations with constant coefficients: Homogeneous differential equations, non-homogeneous differential equations – Particular integral for functions of the type $f(x) = e^{ax}$, $\sin(ax)$, $\cos(ax)$, x^n, method of variation of parameters, Cauchy's and Legendre linear differential equations.

(8L+2T)

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DEPARTMENT OF MATHEMATICS

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

Course Code	CO #	COURSE OUTCOME (CO)	PO
19MA3IMMAT	CO 1	Understand the basic concepts of differentiation and integration.	1
	CO 2	Apply the concepts of polar curves and multivariate calculus.	
	CO 3	Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.	
	CO 4	Apply techniques of vector calculus to engineering problems.	
	CO 5	Comprehend the generalization of vector calculus in curvilinear coordinate system.	

Text Book:

1. Higher Engineering Mathematics, B. S. Grewal, 43rd edition, 2014, Khanna Publishers
2. Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd.

Reference Book:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.
2. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.

E books and online course materials:

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

Online Courses:

1. https:// www.khanacademy.org/Math
2. https:// www.class-central.com/subject/math (MOOCS)

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SYLLABUS (2019 - 2020)

FOURTH SEMESTER B.E COURSE
(Common to AS/CV/EEE/ECE/EIE/ML/TCE)

Course Title	**Engineering Mathematics - 4**	**Course Code**	**19MA4BSEM4**
Credits	**04**	**L – T – P**	**3 -1- 0**
Contact hours	**48 hours**		

Prerequisites: Complex numbers, multivariate calculus and basic concepts of Statistics and Probability.

Course Objectives: To prepare students with adequate knowledge in Probability and Statistics, Complex Analysis and develop computational skills using efficient numerical methods for problems in science and engineering.

UNIT-1

STATISTICS AND PROBABILITY **[10 hours]**

Curve fitting – Principle of least squares, fitting a straight line, fitting of a parabola, fitting of exponential curve of the form $y = ab^x$. Correlation and regression. Probability distributions: Discrete distribution - Poisson distribution. Continuous distribution- Normal distribution.

(8L + 2T)

UNIT-2

JOINT PROBABILITY AND MARKOV CHAIN **[9 hours]**

Joint Probability Distributions:

Discrete random variables, Mathematical expectations, Covariance and Correlation.

Markov Chain:

Markov Chain, Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chain.

(7L + 2T)

UNIT-3

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS **[9 hours]**

Finite-Difference formulas to partial derivatives.

Applications: Solution of one-dimensional heat equation using 2-level formula and Schmidt explicit formula and Crank-Nicolson two-level implicit formula. Solution of one-dimensional wave equation using explicit three level formula and implicit scheme. **(7L + 2T)**

UNIT-4

COMPLEX ANALYSIS – 1 **[10 hours]**

Functions of a complex variable, limits, continuity and differentiability of a complex valued function, Analytic functions, properties of analytic functions, Cauchy-Riemann equations in Cartesian and polar form, construction of analytic functions by Milne-Thomson method.

Conformal mapping: $w = z^2$ and $w = z + \frac{a^2}{z}\left(z \neq 0\right)$. Bilinear transformations. **(7L + 3T)**

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UNIT-5

COMPLEX ANALYSIS - 2 **[10 hours]**

Complex integration: Line integral, Problems on line integral, Cauchy's theorem, Cauchy's integral formula.

Complex series: Taylor's, Maclaurin's and Laurent's series (without proof)-examples.

Zeros, Poles and Residues, Cauchy's residue theorem (without proof)-examples. **(7L + 3T)**

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

Course Code	CO #	COURSE OUTCOMES (CO)	PO
19MA4BSEM4	CO 1	Demonstrate an understanding of concepts of statistical analysis and probability distributions.	1
	CO 2	Apply Numerical techniques to solve partial differential equations arising in engineering.	
	CO 3	Demonstrate an understanding of analytic functions and their application to evaluate integrals.	

Text Books:

1. Numerical Methods for Engineering, R. P. Kanale and S. C. Chapra, 6th edition, McGraw Hill, Publishers.
2. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.

Reference Books:

1. Advanced Modern Engineering Mathematics, Glyn James, 3rd edition, 2004, Pearson Education.
2. Higher Engineering Mathematics, B. S. Grewal, 43rd edition, 2013, Khanna Publishers.

E books and online course materials:

1. https://www.coursera.org/learn/basic-statistics
2. http://wiki.stat.ucla.edu/socr/index.php/Probability_and_statistics_EBook
3. https://ocw.mit.edu/courses/mathematics/18-112-functions-of-a-complex-variable-fall-2008/lecture-notes/
4. https://www.math.ubc.ca/~peirce/M257_316_2012_Lecture_8.pdf

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/111105090/ (Probability & statistics-Joint distribution, testing of hypothesis)
2. https://nptel.ac.in/courses/111103070/ (Complex Analysis - Analytic functions, Mobius transformation & Residue theorem)
3. https://nptel.ac.in/courses/111107056/ (Complex Analysis - Complex integration, conformal mapping)

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question in Units 1, 2, 3 and two questions each in unit 4 and unit 5.

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2019 - 2020)

FOURTH SEMESTER B.E COURSE - (CSE/ISE)

Course Title	**Linear Algebra**	**Course Code**	**19MA4BSLIA**
Credits	**04**	**L – T – P**	**3 – 1 – 0**
Contact hours	**48 hours (36L+12T)**	**CS/IS Cluster**	

Prerequisites: Vector Algebra, Matrix computations, Calculus, Geometry, Group Theory.

Course Objectives: To provide the students with a foundation of concepts in linear algebra that is essential to engineers of computer and information science.

UNIT-1

SYSTEM OF LINEAR EQUATIONS AND VECTOR SPACES [11 hours]

Elementary row operations, echelon forms, rank of matrix.

System of Linear Equations: solution of homogeneous equations, consistency of non-homogeneous system of linear equations. Gauss elimination method, LU decomposition method.

Vector spaces: Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates.

(9L+2T)

UNIT-2

LINEAR TRANSFORMATIONS [9 hours]

Introduction, Linear Mappings, Geometric linear transformation of $\mathbb{R}^2$, Kernel and Image of a linear transformations, Matrix representation of linear transformations, Rank-Nullity Theorem(No proof), Singular and Nonsingular linear transformations, Invertible linear transformations. **(7L+2T)**

UNIT-3

EIGENVALUES AND EIGENVECTORS [10 hours]

Introduction, Polynomials of Matrices, Characteristic polynomial, Cayley-Hamilton Theorem, eigenvalues and eigenvectors, eigen spaces of a linear transformation, Diagonalization, Minimal Polynomial, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form, Solving differential equations in Fundamental form. **(7L+3T)**

UNIT-4

INNER PRODUCT SPACES [10 hours]

Inner product, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problem and least square error. **(7L+3T)**

UNIT-5

SYMMETRIC MATRICES AND QUADRATIC FORMS [8 hours]

Diagonalization of real symmetric matrices, Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, Singular value decomposition.

(6L+2T)

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DEPARTMENT OF MATHEMATICS

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

Course Code	CO #	Course Outcome (CO)	PO
19MA4BSLIA	CO 1	Apply the concepts of Matrices to linear systems and Vectors spaces.	1
	CO 2	Relate the concepts of Eigen values, Eigen vectors & functions to linear algebra.	
	CO 3	Apply the concepts of inner products to matrix decomposition.	

Text Books:

1. Linear Algebra and its applications, David C. lay, Steven R. lay, Judi J Mc. Donald, 5th Edition, 2015, Pearson Education.
2. Linear Algebra and its applications, Gilbert Strang, 4th edition, 2005, Brooks Cole.

Reference Books:

1. Schaum's outline series-Theory and problems of linear algebra, Seymour Lipschutz, 5th edition, 2012, McGraw-Hill Education.
2. Linear Algebra an Introduction, Richard Bronson & Gabriel B. Costa, 2nd edition.

E books and online course materials:

1. https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm
2. https://www.math.ucdavis.edu/~linear/linear.pdf

Online Courses and Video Lectures:

1. https://www.coursera.org/learn/linear-algebra-machine-learning
2. https://nptel.ac.in/syllabus/111106051/

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question each in Units 2, 4, 5 and two questions each in Unit 1 and Unit 3.

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2019 - 2020)

FOURTH SEMESTER B. E. COURSE - (CHEMICAL ENGINEERING)

Course Title	Statistics and Probability	Course Code	19MA4BSSAP
Credits	03	L – T – P	3 – 0 – 0
Contact hours	36 hours		

Prerequisites: Basic concepts of Statistics and Probability, addition theorem, conditional probability, Bayes' theorem, discrete random variable, Binomial distribution. Basic concepts of statistics. Matrices.

Course Objectives: Student will get acquainted with the procedure of collecting, designing, analysing and drawing inference about the data

UNIT-1

STATISTICS & PROBABILITY **[7 hours]**

Curve fitting – Principle of least squares, fitting a straight line, fitting of a parabola, fitting of exponential curve of the form $y = ab^x$. Correlation and regression.

Probability distributions: Discrete distribution - Poisson distribution. Continuous distribution- Normal distribution.

UNIT-2

JOINT PROBABILTY AND MARKOV CHAIN **[7 hours]**

Joint Probability Distributions:

Discrete random variables, Mathematical expectations, Covariance and Correlation.

Markov Chain:

Markov Chain, Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chain.

UNIT-3

DESIGN OF EXPERIMENTS **[7 hours]**

Principles of experimental design – Randomization, Replication, Local Control.

Randomized block design, Completely Randomized block design, Latin Square Design, Factorial Experiments –Problems.

UNIT-4

STATISTICAL INFERENCE – I **[8 hours]**

Introduction, estimation – point, interval; procedure for testing of hypothesis, level of significance, construction of confidence interval.

[Large sample] Test of significance for single mean, difference between two means, single proportion, difference between two proportions, and difference of two Standard deviations for the biological data sets.

UNIT-5

STATISTICAL INFERENCE – II **[7 hours]**

[Small sample] Test of significance for single mean, difference between two means, paired t-test, ratio of variances (F- distribution), Chi -Square distribution-goodness of fit, independence of attributes. Analysis of variance (one-way and two-way classifications).

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

Course Code	CO #	COURSE OUTCOME (CO)	PO
19MA4BSSAP	CO 1	Appreciate the use of Statistical methods to Analyze and interpret the data from real world examples.	1,2,9,10
	CO 2	Apply the basic principles of probability and Probability distributions to the problems in Engineering.	1,2
	CO 3	Apply the concepts of Markov chain to the field of genetics.	1,2
	CO 4	Demonstrate an understanding of sampling distributions and principles of experimental design.	1,2

Text Books:

1. Fundamentals of Biostatistics, Khirfan A. Khan, Atiya Khanum, 3rd edition, 2012, Ukaaz Publications.
2. An Introduction to Biostatistics, P. S. S. Sundar Rao and J. Richard, 4th edition, 2006, Prentice Hall of India.

Reference Books:

1. Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, 6th edition, Wiley.
2. Biostatistics, P. N. Arora, P. K. Malhan, 2nd edition, 2013, Himalaya Publishing House.

E books and online course materials:

1. https://www.coursera.org/learn/basic-statistics
2. https://www.coursera.org/learn/probability-intro
3. https://www.classcentral.com/course/udacity-intro-to-statistics-361
4. http://wiki.stat.ucla.edu/socr/index.php/Probability_and_statistics_EBook

Online Courses and Video Lectures:

1. http://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability-and-statistics- spring-2014/
2. http://nptel.ac.in/courses/*111105041/1* NPTEL >> Mathematics >> Probability and Statistics
3. https:// www.khanacademy.org/Math
4. https:// www.class-central.com/subject/math (MOOCS)

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question from Units 2, 3, 4 and two questions from Unit 1 and Unit 5.

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SYLLABUS (2019 - 2020)

FOURTH SEMESTER B.E COURSE
(BIOTECHNOLOGY)

Course Title	**Biostatistics and Probability**	**Course Code**	**19MA4BSBSP**
Credits	**04**	**L – T – P**	**3 – 1 – 0**
Contact hours	**48 hours (36L+12T)**		

Prerequisites: Basic concepts of Statistics and Probability, addition theorem, conditional probability, Bayes' theorem, discrete random variable, Binomial distribution. Basic concepts of statistics. Matrices.

Course Objectives: Student will get acquainted with the procedure of collecting, designing, analysing and drawing inference about the data.

UNIT-1

STATISTICS & PROBABILITY **[11 hours]**

Curve fitting – Principle of least squares, fitting a straight line, fitting of a parabola, fitting of exponential curve of the form $y = ab^x$. Correlation and regression.

Discrete distribution: Poisson distribution, Continuous distributions: Normal and Gamma distributions. **(8L+3T)**

UNIT-2

JOINT PROBABILTY AND MARKOV CHAIN **[8 hours]**

Joint Probability Distributions:

Discrete random variables, Mathematical expectations, Covariance and Correlation.

Markov Chain:

Markov Chain, Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chain.

(6L+2T)

UNIT-3

DESIGN OF EXPERIMENTS **[9 hours]**

Principles of experimental design – Randomisation, Replication, Local Control.

Randomised block design, Completely Randomised block design, Latin Square Design, Factorial Experiments, Plackett Burman Design. **(7L+2T)**

UNIT-4

STATISTICAL INFERENCE – I **[9 hours]**

Introduction, estimation – point, interval; procedure for testing of hypothesis, level of significance, construction of confidence interval.

[Large sample] Test of significance for single mean, difference between two means, single proportion, difference between two proportions, and difference of two Standard deviations for the biological data sets. **(7L+2T)**

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UNIT-5

STATISTICAL INFERENCE – II **[11 hours]**

[Small sample] Test of significance for single mean, difference between two means, paired t-test, ratio of variances (F- distribution), Chi -Square distribution-goodness of fit, independence of attributes. Analysis of variance (one-way and two-way classifications). Non parametric test – Kruskal – Wallis One Way Analysis of Variance by Ranks for the biological data sets.

(8L+3T)

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

Course Code	CO #	COURSE OUTCOME (CO)	PO
19MA4BSBSP	CO 1	Appreciate the use of Statistical methods to Analyze and interpret the data from real world examples.	1,2,9,10
	CO 2	Apply the basic principles of probability and Probability distributions to the problems in Engineering.	1,2
	CO 3	Apply the concepts of Markov chain to the field of genetics.	1,2
	CO 4	Demonstrate an understanding of sampling distributions and principles of experimental design.	1,2

Text Books:

1. Fundamentals of Biostatistics, Khirfan A. Khan, Atiya Khanum, 3rd edition, 2012, Ukaaz Publications.
2. An Introduction to Biostatistics, P. S. S. Sundar Rao and J. Richard, 4th edition, 2006, Prentice Hall of India.

Reference Books:

1. Biostatistics: A foundation for Analysis in the Health sciences, Wayne W. Daneil, 10th edition, 2013, John Wiley & Sons.
2. Biostatistics, P. N. Arora, P. K. Malhan, 2nd edition, 2013, Himalaya Publishing House.

E books and online course materials:

1. https://www.coursera.org/learn/basic-statistics
2. https://www.coursera.org/learn/probability-intro
3. https://www.classcentral.com/course/udacity-intro-to-statistics-361
4. http://wiki.stat.ucla.edu/socr/index.php/Probability_and_statistics_EBook

Online Courses and Video Lectures:

1. http://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability-and-statistics- spring-2014/
2. http://nptel.ac.in/courses/*111105041/1* NPTEL >> Mathematics >> Probability and Statistics
3. https:// www.khanacademy.org/Math
4. https:// www.class-central.com/subject/math (MOOCS)

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question in Units 2, 3, 4 and two questions from Unit 1 and Unit 5.

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2019 - 2020)

FOURTH SEMESTER B.E COURSE - (MECHANICAL ENGINEERING)

Course Title	Higher Engineering Mathematics	Course Code	19MA4BSHEM
Credits	03	L – T – P	3 -0- 0
Contact hours	36 hours		

Prerequisites: Complex numbers, multivariate calculus and basic concepts of Statistics and Probability.

Course Objectives: To prepare students with adequate knowledge in Probability and Statistics, Complex Analysis and develop computational skills using efficient numerical methods for problems in science and engineering.

UNIT-1

STATISTICS AND PROBABILITY [8 hours]

Curve fitting – Principle of least squares, fitting a straight line, fitting of a parabola, fitting of exponential curve of the form $y = ab^x$. Correlation and regression.

Probability distributions: Discrete distribution - Poisson distribution. Continuous distribution-normal distribution.

UNIT-2

JOINT PROBABILITY AND MARKOV CHAIN [7 hours]

Joint Probability Distributions:

Discrete random variable, Mathematical expectation, Covariance and Correlation.

Markov Chain:

Markov Chain, Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chains.

UNIT-3

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS [7 hours]

Finite-Difference formulas to partial derivatives.

Applications: Solution of one-dimensional heat equation using 2-level formula and Schmidt explicit formula and Crank-Nicolson two-level implicit formula. Solution of one-dimensional wave equation using explicit three level formula and implicit scheme.

UNIT-4

COMPLEX ANALYSIS – 1 [7 hours]

Functions of a complex variable, limits, continuity and differentiability of a complex valued function, Analytic functions, properties of analytic functions, Cauchy-Riemann equations in Cartesian and polar form, construction of analytic functions by Milne-Thomson method.

Conformal mapping. Transformation: $w = z^2$ and $w = z + \frac{a^2}{z}\left(z \neq 0\right)$. Bilinear transformations.

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UNIT-5

COMPLEX ANALYSIS - 2 **[7 hours]**

Complex integration: Line integral, Cauchy's theorem, Cauchy's integral formula.
Complex series: Taylor's, Maclaurin's and Laurent's series (without proof)-examples.
Zeros, Poles and Residues: Cauchy's r esidue theorem (without proof)-examples.

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

Course Code	CO #	COURSE OUTCOMES (CO)	PO
19MA4BSHEM	CO 1	Demonstrate an understanding of concepts of statistical analysis and probability distributions.	1
	CO 2	Apply Numerical techniques to solve partial differential equations arising in engineering.	
	CO 3	Demonstrate an understanding of analytic functions and their application to evaluate integrals.	

Text Books:

1. Numerical Methods for Engineering, R. P. Kanale and S. C. Chapra, 6th edition, McGraw Hill, Publishers.
2. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.

Reference Books:

1. Advanced Modern Engineering Mathematics, Glyn James, 3rd edition, 2004, Pearson Education.
2. Higher Engineering Mathematics, B. S. Grewal, 43rd edition, 2013, Khanna Publishers.

E_books and online course materials:

1. https://www.coursera.org/learn/basic-statistics
2. http://wiki.stat.ucla.edu/socr/index.php/Probability_and_statistics_EBook
3. https://ocw.mit.edu/courses/mathematics/18-112-functions-of-a-complex-variable-fall-2008/lecture-notes/
4. https://www.math.ubc.ca/~peirce/M257_316_2012_Lecture_8.pdf

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/111105090/ (Probability & statistics-Joint distribution, testing of hypothesis)
2. https://nptel.ac.in/courses/111103070/ (Complex Analysis - Analytic functions, Mobius transformation & Residue theorem)
3. https://nptel.ac.in/courses/111107056/ (Complex Analysis - Complex integration, conformal mapping)

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question in Units 2, 3, 5 and two questions each in unit 1 and unit 4.

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SYLLABUS (2019 - 2020)

FOURTH SEMESTER B.E COURSE

(Common to All Branches)

Course Title	**Additional Mathematics-II**	**Course Code**	**19MA4IMMAT**
Credits	**00**	**L – T – P**	**3 – 1 – 0**
Contact hours	**48 hours (36L+12T)**	**IV semester Lateral Entry students**	

Prerequisites: Basic concepts of Trigonometry, Trigonometric formulas, concept of differentiation, concept of integration.

Course Objectives: To provide students with a solid foundation in mathematical fundamentals such as Laplace Transforms, Solution of ordinary differential equations using Laplace Transforms, vector integration, computation of area and volume using double and triple integrals respectively.

UNIT 1

LAPLACE TRANSFORMS **[9 Hours]**

Laplace transforms of standard functions. Properties and problems. Laplace Transform of Periodic functions with plotting, unit step function and dirac-delta function. **(7L+2T)**

UNIT 2

INVERSE LAPLACE TRANSFORMS **[10 Hours]**

Inverse Laplace transforms of standard functions. Properties and problems. Solution of ODE-Initial and Boundary value Problems. **(7L+3T)**

UNIT 3

DOUBLE INTEGRALS **[11 Hours]**

Evaluation of double integral. Change of order of integration. Change of variables to polar coordinates. Application: Area. **(8L+3T)**

UNIT 4

TRIPLE INTEGRALS AND IMPROPER INTEGRALS **[9 Hours]**

Evaluation of triple integral. Application: Volume. Beta and Gamma functions-definition, relation between Beta and Gamma functions, properties and problems.

(7L+2T)

UNIT 5

VECTOR INTEGRATION **[9 Hours]**

Line integral, Green's theorem, Stokes' theorem and Gauss divergence theorem.

(7L+2T)

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Autonomous Institute, Affiliated to VTU

DEPARTMENT OF MATHEMATICS

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

Course Code	CO #	COURSE OUTCOME (CO)	PO
19MA4IMMAT	CO 1	Use Laplace transforms to solve differential equations.	1
	CO 2	Apply multiple integrals of plane figures to compute areas and volume.	
	CO 3	Use Gamma and Beta functions to evaluate integrals.	
	CO 4	Ability to understand the use of integral calculus in scalar and vector fields.	

Text Book:

1. Higher Engineering Mathematics, B. S. Grewal, 43rd edition, 2014, Khanna Publishers.
2. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.

Reference Book:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.
2. Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd

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.
2. Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.
3. http://ocw.mit.edu/courses/mathematics/ (online course material)

Online Courses:

1. https:// www.khanacademy.org/Math
2. https:// www.class-central.com/subject/math (MOOCS)
3. E-learning: www.vtu.ac.in

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MATHEMATICS - 2016

Course Title	Number Theory (Institutional Elective)				
Course Code	16MA7IENMT	Credits	03	L-T-P-S	3-0-0-0

Course Objective: The course is a graduate level introduction Number Theory in which, it will cover fundamentals of the subject. It has contributed to many practical problems such as Coding Theory, Cryptography in modern information technology.		
UNIT-I		**09 hours**
CONGRUENCES: Introduction, Congruences and Equivalence Relations, Linear Congruences, Linear Diophantine Equations and the Chinese Remainder Theorem, Modular Arithmetic: Fermat's Theorem, Wilson's Theorem and Fermat Numbers. Polynomial congruences, Pythagorean equations.		
UNIT-II		**07 hours**
ARITHMETIC FUNCTIONS: Introduction, Sigma Function, Tau Function, Dirichlet Product, Dirichlet Inverse, Moebius Function, Euler's Function, Euler's Theorem, An application to Algebra.		
UNIT-III		**07 hours**
PRIMITIVE ROOTS AND INDICES: The order of a positive integer, primality tests, primitive roots for primes, the algebra of indices.		
UNIT-IV		**09 hours**
QUADRATIC CONGRUENCE AND CONTINUED FRACTION: Quadratic residues, the Legendre symbol, Quadratic reciprocity, the Jacobi symbol, finite continued fractions, infinite continued fractions.		
UNIT-V		**07 hours**
COMPUTATIONAL NUMBER THEORY: Introduction, Pseudoprimes, Carmichael numbers, Miller's test, Strong Pseudoprimes, Factoring: Fermat's method, Continued fraction method, Trial division, Quadratic Sieve method, Pollard p-1 method.		

Text books:	
1	Elementary number theory with Applications-2nd Edition-Thomas Koshy 2009.
2	Beginning Number Theory by Neville Robbins-2nd Edition-Jones and Barlett Publ.-2006.
Reference Book:	
1.	Elementary Number Theory by David M Burton - Tata McGraw Hill Publ.-6th Edition 2006
2.	Elementary Number Theory by Gareth A. Jones and Josephine Mary Jones - Springer-1998

COURSE OUTCOMES:

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

CO No	Course Outcomes	PO
1	Apply the concept of congruence to compute system of equations (algebraic equations)	1
2	Demonstrate an understanding towards the nature of different functions	1
3	Demonstrate an understanding primitive roots and indices	1
4	Apply concept of quadratic congruence to evaluate quadratic residues and understand continued fractions.	1
5	Identify the nature of large number by means of different algorithm	1

MATHEMATICS - 2016

Course Title	Computational Graph Theory (Institutional Elective)				
Course Code	16MA7IECGT	Credits	03	L-T-P-S	3-0-0-0

Course Objective: The objective of the course is to introduce the concepts in graph Theory, with a sense of some modern applications. They will be able to use these methods in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.

UNIT-I		08 hours

GRAPHS: Modelling using graphs, graph search – BFS, DFS. The shortest path algorithms- Dijkstra algorithm, Bellman algorithm. Minimum weight spanning tree –Kruskal's algorithm and Prim's algorithms. Applications: Job sequencing problems, designing an efficient computer drum, making a road system one-way.

UNIT-II		07 hours

EULERIAN AND HAMILTONIAN GRAPHS (Transportation Problems): Eulerian graphs, Fleury's algorithm, Chinese Postman Problem, Hamiltonian cycles, Traveling Salesman Problem, Longest cycles on graphs, Planar graphs and its dual.

UNIT-III		07 hours

TREES AND NETWORKS (Connection Problems): Definitions: Vertex and edge connectivity, blocks of a graph, k-connected graphs, Maximum Flow Problem, Ford-Fulkerson Algorithm, Min Cut - Max Flow Theorem, Maximum Flow of Minimum Cost, Feasible Flows, Transhipment problem. The connector problem, construction of reliable communication networks.

UNIT-IV		07 hours

MATCHING THEORY(Party Problems): Maximum matching, Hall's theorem, augmenting path, Edmond's algorithm, maximum matching and minimum vertex cover in bipartite graphs, König's Min-Max theorem, Min Cost bipartite matching, Stable Marriage, Gale-Shapley Algorithm, Minimum path cover, Friend's strangers problem, Ramsey numbers.

UNIT-V		08 hours

COLORING PROBLEMS (Scheduling Problems): Chromatic Number, BiChromatic, Chromatic Polynomial, Matchings, Perfect Matchings, Coverings- edge covering, vertex covering, Four Color Problem, Maximal Matching, independent set, Maximal Independent set, Edge coloring and its applications to timetabling and sport scheduling, Vizing's Theorem, König's bipartite graph edge coloring theorem, stable sets and cliques, vertex coloring and its applications to Latin squares. Graph coloring algorithm including chromatic polynomial.

Text books:	
1	Graph Theory, modelling, applications and algorithms: GeirAgnarsson & Raymond Greenlaw Pearson, Prentice Hall, 2007.
2	Graph Theory and Its Applications, Second Edition Jonathan L. Gross, Jay Yellen.
Reference Books:	
1.	Introduction to Graph Theory, Chartrand Zhang, TMH, 2006.
2.	A First Course in Graph Theory, by Gary Chartrand and Ping Zhang.
3.	Graph Theory by NarsingDeo. – Twenty – first Printing May, 2001

Course outcomes

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

CO No.	Course Outcome	PO
1	Demonstrate an understanding of the fundamental concepts of graph theory including but not limited to graphs, digraphs, trees, finding Paths and cycles, planarity, weighted graphs matching and graph coloring.	1,2
2	Apply appropriate graph algorithms to solve problems involving transportation, connection, social networking and scheduling.	1,2
3	Analyse the algorithms to find the shortest path, maximum flow of minimum cost, maximum matching and minimum path cover.	2
4	Use graphs as representation tools in a network analysis.	2
5	Model real world problems such as Job sequencing, timetabling, sport scheduling, Chinese postman problem, Travelling salesman problem, minimum weight spanning tree and problems on stable matching's using graphs.	2
6	Use of matlab to find the shortest path, minimum weighted panning tree, maximum flow.	5

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
DEPARTMENT OF MATHEMATICS
SYLLABUS (2014- 2015)

Course Name	Linear Algebra	Course Code	17MA8IELIA
Credits	03	L – T - P	3 -0- 0
Contact hours	36 hours		

Prerequisites:
Matrix theory, invertible matrices, system of linear equations, consistency and their solutions and Vector Algebra.

Course Objectives: To provide the students with a solid foundation in linear algebra by imparting the concepts like vector spaces, linear transformations, bases and dimension, Eigen values and vectors of the transformations, diagonalization and factorization of matrices .

UNIT-1

Review of Matrix theory: Rank, System of linear equations and its solution sets; elementary row operations and echelon forms, invertible matrices.
Vector spaces; subspaces; computations concerning subspaces; summary of row-equivalence; Linear combination, Linear dependence and Linear Independence; spanning sets, Row spaces of a matrix, Column space of a matrix, bases and dimension, coordinates.

[8 hours]

UNIT-2

Linear transformations; Algebra of Linear transformations, Matrix of linear transformations; Rank- Nullity theorem (no proof), problems on Rank-Nullity theorem, Singular and Non-singular Linear transformations, Invertible operators.

[7 hours]

UNIT-3

Characteristic values, Eigenvalues and Eigenvectors of a linear transformation methods for computing Eigenvalues- Rayleigh power method, Gerschgorin circle method, Jacobi's method, Givens method, invariant subspaces, Jordan canonical form.

[7 hours]

UNIT-4

Inner product, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problems and least square errors.

[7 hours]

UNIT-5

Diagonalization, Power of a matrix, Diagonalization of Real symmetric matrices, quadratic forms, Reduction of quadratic form to canonical form, Nature of quadratic form, Singular value decomposition.

[7 hours]

TEXT BOOKS:

1. Gilbert Strang- Linear Algebra and its Application 4th edition, Amazon.com
2. Schaum's outline series-Theory and problems of linear algebra, 3rd edition,Tata McGraw-Hill publications.
3. Bernard Kolman and David R. Hill - Introductory Linear Algebra with Applications, 8th edition, Pearson Education (Asia) Pte. Ltd,.

Question Paper Pattern:

1. Each unit consists of one full question.
2. Each full question consists of two, three or four subdivisions.
3. Five full questions to be answered.
4. Internal choice in Unit 1 and Unit 2.

Course Outcomes and Programme outcomes

Course Code	CO	COURSE OUTCOME (CO)	PO
17MA8IELIA	CO 1	Apply the concepts of Matrix theory to vector spaces.	1,2,5
	CO 2	Construct the matrix associated with a linear transformation and analyze the rank and nullity.	1,2,5
	CO 3	Compute and apprehend eigenvalues and eigenvectors by using different algorithm.	1,2,5
	CO 4	Relate the knowledge of inner product spaces to orthogonalization process and least squares solutions.	1,2,5
	CO 5	Construct the diagonal matrices and model Singular value decomposition of the given matrix.	1,2,5

Programme Outcomes:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and engg. specialization to the solution of complex engineering problems

2. **Problem analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Chandrashekara 17/3/17

Course Title	OPERATIONS RESEARCH				
Course Code	16MD8IE2OR	Credits		L-T-P-S	3-0-0-0
CIE	50 Marks (100% weightage)	SEE	100 Marks(50% weightage)		
Pre-requisites: Matrix computations, Statistics and Probability.					
Course Description: Course Objective: Operations research is an interdisciplinary branch of mathematics which uses mathematical methods to arrive at optimal decisions to problems in various disciplines including Engineering. It is recommended for study by Engineering students, as at the end of the course, they would be able to apply the techniques of optimal decision making and for maximizing performance of a process at minimal cost. They would also arrive at justifications for their decision making.					
UNIT-I					08 hours
INTRODUCTION: Definition, OR models characteristics and phases of OR. LPP Concepts and formulation, Graphical LP solution, SIMPLEX METHOD & BIG M METHOD, Primal and Dual problems.					
UNIT-II					07 hours
REPLACEMENT MODELS: Introduction, Problems on individual Replacement policy & Group Replacement policy.					
UNIT-III					08 hours
TRANSPORTATION MODEL: Formulation of transportation problem, obtaining initial basic feasible solution by NWCR & VAM technique, solving optimal solution by MODI method Assignment problems-unbalanced problems and maximization cases, solving by Hungarian method, traveling salesman.					
UNIT-IV					08 hours
GAME THEORY: Formulation of games, types, solution of games with saddle point, Solution of games without saddle point, 2x2 games without saddle point ,graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games.					
UNIT-V					08 hours

PERT & CPM TECHNIQUES: Introduction, network construction-AON & AOA diagrams, Fulkerson's rule for numbering the events, Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project. Predicting the completion time of project; crashing of simple projects.

Text books:	
1	"Operations Research"- S. D. Sharma, Published by Kedar Nath Ram Nath.
2	"R. Panneerselvam-Operations Research, Eastern Economy Edition.
Reference Book:	
1.	"Operations Research" Kanti Swarup, P. K. Gupta, Man Mohan, Sultan Chand & Sons, 1978.
2.	"Operations Research", Taha H A, Pearson Education.
e-books	
1.	https://books.google.co.in/books?isbn=8131711048 , Taha – 2008.
2.	https://books.google.co.in/books?isbn=8121902819 D S Hira – 2008.
3.	https://books.google.co.in/books?isbn=8131700003,A. M. Natarajan, P. Balasubramani – 2006.

Course outcomes
At the end of the course, the student will have the ability to
CO1: Apply strategic planning to solve real time problems in multidisciplinary fields. Use probability and deterministic techniques in games to attain an optimal solution (PO1,5).
CO2: Ability to select and apply appropriate techniques to solve engineering problems (PO2).
CO3: Ability to analyse the appropriate cost cutting strategies of various transportation problems (PO2).
CO4: Ability to demonstrate the knowledge of planning, scheduling, and optimal solutions for implementation in project management (PO1).

30/3/2017.

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