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

Autonomous Institute, Affiliated to VTU

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 (Autonomous), BENGALURU-19

MATHEMATICS DEPARTMENT

SYLLABUS (2015 - 2016)

THIRD SEMESTER B.E COURSE - (Common to CIVIL, MECHANICAL)

Course Title	Engineering Mathematics-3	Course Code	15MA3GCMAT
Credits	03	L – T – P- S	3-0- 0-0
Contact hours	36 hours		

Prerequisites: Basic concepts of Trigonometry, Trigonometric formulas, methods of differentiation, methods of integration, partial derivatives, solution to ordinary differential equations.

Course Objectives: The purpose of the course is to make the students well conversant with Fourier- Series, Fourier Transforms, formulate physical problems in terms of Partial Differential Equations, find insight into the physical behaviour of systems from mathematical solution and develop computational skills using efficient numerical methods for solution of a system of algebraic equations arising in science and engineering.

UNIT-1

MATRICES **[8 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, LU decomposition method, Gauss-Seidel method.

Eigenvalues and eigenvectors of matrices, reduction of a matrix to diagonal form.

Suggested Reading: Inverse of a matrix using Gauss-Jordan method. Largest eigenvalue and corresponding eigenvector using Rayleigh power method.

UNIT-2

FOURIER SERIES **[6 hours]**

Introduction: Periodic function, Dirichlet's condition, statement of Fourier Theorem, Fourier series of a periodic function of period $2l$, Fourier series of functions having points of discontinuity.

Applications: Fourier series of typical waveforms-saw toothed waveform, triangular waveform, square waveform, half-wave rectifier, full wave rectifier and modified saw tooth waveform.

Practical harmonic analysis.

Suggested Reading: half range Fourier series, Fourier series of discrete functions, Complex Fourier series.

UNIT-3

PARTIAL DIFFERENTIAL EQUATIONS **[7 hours]**

Formation of Partial differential equations-elimination of arbitrary constants, elimination of arbitrary functions. Equations of first order- The linear equation $P\,p + Q\,q = R$ **(**Lagrange's partial differential equation).

Applications: One-dimensional heat equation and wave equation (without proof), various possible solutions of these by the method of separation of variables.
Suggested Reading: Direct integration method, method of separation of variables, D'Alembert's solution of wave equation.

UNIT-4

FOURIER TRANSFORMS **[8 hours]**

Concept of finite Fourier Transform, Infinite Fourier transform: Fourier Sine and Cosine transforms, properties, Inverse transforms. Fourier transforms of the derivatives. Solution to boundary value problems using Fourier transforms.
Suggested Reading: Convolution theorem, Parseval's identities and physical significance of Parseval's identities.

UNIT-5

CALCULUS OF VARIATIONS **[7 hours]**

Variation of a functional, Euler's equation, variational problems.
Applications: Hanging cable problem, Geodesics of a right circular cylinder, Brachistochrone problem.
Isoperimetric problems.
Suggested Reading: Minimal surface of revolution, Geodesics of a right circular cone and sphere.

Mathematics Lab

- Solution of system of algebraic equations using Gauss Seidel method
- LU decomposition of matrices.
- Eigenvalues and eigenvectors of matrices.
- Largest, smallest eigenvalue and corresponding eigenvector of a matrix.

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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
15MA3GCMAT	CO 1	Compute solution of a system of algebraic equations.	2, 3	3
	CO 2	Demonstrate an understanding to Fourier Series and Fourier transforms.	2, 3	3
	CO 3	Formulate boundary value problems involving one dimensional heat and wave equation.	2, 3, 4	4
	CO 4	Employ analytical techniques to solve partial differential equations with appropriate boundary conditions	2, 3, 4	4
	CO 5	Obtain extremal of a functional	2, 3, 4	4

Bibliography

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, 7th reprint, 2009, Tata Mc. Graw Hill.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition Vol.1 and Vol.2, 2014, Wiley-India.

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 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)

(4) E-learning: www.vtu.ac.in

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, 2, 5 and two questions each from Unit 3 and Unit 4.

Questions for CIE and SEE 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 (CIE)	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%)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

MATHEMATICS DEPARTMENT

SYLLABUS (2015 - 2016)

THIRD SEMESTER B.E COURSE - (IEM)

Course Name	Higher Engineering Mathematics	Course Code	15MA3DCHEM
Credits	04	L – T –P-S	3-1-0-0

Prerequisites: Trigonometric formulas, methods of differentiation, methods of integration, partial derivatives, solution methods of ordinary differential equations.

Course Objectives: The purpose of the course is to make the students well conversant with Fourier- Series, Fourier Transforms, formulate physical problems in terms of Partial Differential Equations, find insight into the physical behaviour of systems from mathematical solution and develop computational skills using efficient numerical methods for a system of algebraic equations 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 system of linear equations and solution.

Solution of a system of non-homogenous equations: Gauss elimination method, LU decomposition method, Gauss-Seidel method. Eigenvalues and eigenvectors of matrices. Reduction of a matrix to diagonal form. **(7L + 2T)**

Suggested Reading: Inverse of a matrix using Gauss-Jordan method. Largest eigenvalue and corresponding eigenvector using Rayleigh power method.

UNIT-2

FOURIER SERIES [9 hours]

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

Suggested Reading: Half range Fourier series, Fourier series of discrete functions, Complex Fourier series.

UNIT-3

PARTIAL DIFFERENTIAL EQUATIONS [10 hours]

Formation of Partial differential equations-elimination of arbitrary constants, elimination of arbitrary functions. Equations of first order- The linear equation $P\,p + Q\,q = R$ **(**Lagrange's partial differential equation).

Applications: One-dimensional heat equation and wave equation (without proof), various possible solutions of these by the method of separation of variables. **(7L + 3T)**

Suggested Reading: Direct integration method, method of separation of variables, D'Alembert's solution of wave equation.

UNIT-4

FOURIER TRANSFORMS **[10 hours]**

Infinite Fourier transform, Fourier Sine and Cosine transforms, properties, Inverse transforms, Fourier transforms of derivatives. Solution to boundary value problems using Fourier transforms. **(7L + 3T)**

Suggested Reading: Convolution theorem, Parseval's identities and physical significance of Parseval's identities.

UNIT-5

Z –TRANSFORMS AND CALCULUS OF VARIATIONS **[10 hours]**

Z-transforms**:** Definition, Properties, Transforms of standard functions, Inverse transforms.
Applications: Solution of difference equations using Z- transforms.
Calculus of variations: Variation of a functional, Euler's equation, variational problems.
Applications: Hanging cable problem, Geodesics on a right circular cylinder. Brachistochrone problem. **(8L + 2T)**

Suggested Reading: Minimal surface of revolution, Geodesics of a right circular cone and sphere.

Mathematics Lab

- Solution of system of algebraic equations using Gauss Seidel method.
- LU decomposition of matrices.
- Eigenvalues and eigenvectors of matrices.
- Largest and smallest eigenvalue and corresponding eigenvector of a matrix.
- Diagonalisation of matrices.
- Z-transforms.

On completion of the course students will be able to:

Course Code	CO #	COURSE OUTCOME (CO)	PO	Bloom's level
15MA3DCMIE	CO 1	Compute solution of a system of algebraic equations.	2, 3	3
	CO 2	Demonstrate an understanding to Fourier Series and Fourier transforms techniques	2, 3, 4	4
	CO 3	Formulate boundary value problems involving one dimensional heat and wave equation.	2, 3, 4	4
	CO 4	Employ analytical techniques to solve partial differential equations with appropriate boundary conditions	2, 3, 4	4
	CO 5	Apply Z- transforms techniques to solve difference equations.	2, 3	3
	CO 6	Obtain the extremal of a functional.	2, 3	3

Bibliography

Text Books

1. "Advanced Engineering Mathematics", Erwin Kreyszig, 10th edition Vol.1 and Vol.2, 2014, Wiley-India.
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, 6th edition, 2007, Tata Mc. Graw Hill.
2. "Higher Engineering Mathematics", B.S. Grewal, 43rd edition, 2013, Khanna Publishers.
3. Advanced Engineering Mathematics, R.K. Jain, S. R. K. Iyengar, 4th edition, 2014, Narosa Publishers.

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.

Online Courses and Video Lectures:

(1) http://ocw.mit.edu/courses/mathematics/ (online course material)
(2) http://nptel.ac.in/courses.php?disciplineId=111
(3) https://www.khanacademy.org/
(4) E-learning: www.vtu.ac.in
(5) 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 from Units 1, 2, 4 and two questions from Unit 3 and Unit 5.

Questions for CIE and SEE 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%)
- Analysing various engineering problems (weightage: 15%)
- Understanding of various system models (weightage: 5%)

Continuous Internal Assessment (CIE)	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%)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

BMS COLLEGE OF ENGINEERING, BANGALORE – 560019

MATHEMATICS DEPARTMENT

SYLLABUS (2015 - 2016)

THIRD SEMESTER B.E COURSE - (For Chemical and BT)

Course Title	Applied Mathematics	Course Code	15MA3GCAPM
Credits	04	L – T – P- S	3 – 1 – 0 - 0
Contact hours	48 hours (36L+12T)		

Prerequisites: Concepts of Trigonometry, Trigonometric formulas, Concepts of: differentiation, partial differentiation and integration, solution to ordinary differential equations.

Course Objectives: The purpose of the course is to make the students well conversant with Fourier- Series, Fourier Transforms, formulate physical problems in terms of Partial Differential Equations, find insight into the physical behaviour of systems from mathematical solution and develop computational skills using efficient numerical methods for problems 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, LU decomposition method, Gauss-Seidel method. Eigenvalues and eigenvectors of matrices. Reduction of a matrix to diagonal form. **(7L+2T)**

Suggested Reading: Inverse of a matrix by Gauss-Jordan method. Largest eigenvalue and corresponding eigenvector using Rayleigh power method.

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: Simpson's 1/3rd, 3/8th rule, Weddle's rule. Numerical solution of ordinary differential equations: Runge-Kutta method of fourth order. **(8L+2T)**

Suggested Reading: Euler's modified method and Milne's method to solve ordinary differential equations. Solution of simultaneous differential equations by Runge-Kutta method of fourth order.

UNIT-3

FOURIER SERIES AND FOURIER TRANSFORMS **[13 hours]**

Introduction: Periodic function, Dirichlet's condition, and statement of Fourier Theorem. Fourier series of periodic function of period 2*l*, Fourier series of functions having points of discontinuity.

Applications: Fourier series of typical waveforms -saw toothed waveform, triangular waveform, square waveform, half-wave rectifier, full wave rectifier and modified saw tooth waveform. Practical harmonic analysis.

Fourier Transforms: Concept of finite Fourier Transform, Infinite Fourier Transform**:** Fourier Sine and Cosine transforms and properties. Inverse Transforms. **(9L+4T)**

Suggested Reading: half range Fourier series, Convolution theorem, Parseval's identities for Fourier transform and Physical Significance of Parseval's identities.

UNIT-4

PARTIAL DIFFERENTIAL EQUATIONS **[9 hours]**

Formation of Partial differential equations-elimination of arbitrary constants, elimination of arbitrary functions. Equations of first order- The linear equation $P\,p + Q\,q = R$ **(**Lagrange's partial differential equation).

Applications: One-dimensional heat equation and wave equation (without proof), various possible solutions of these by the method of separation of variables. **(7L +2T)**

Suggested Reading**:** Direct integration method. Method of separation of variables. D'Alembert's solution of wave equation. Solution of boundary value problems using Fourier Transform method.

UNIT- 5

CALCULUS OF VARIATIONS **[7 hours]**

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

Applications: Geodesics on a plane, hanging cable problem, Geodesics of a right circular cylinder. Brachistochrone problem.

Isoperimetric problems. **(5L +2T)**

Suggested Reading: Geodesics of a right circular cone, minimal surface of revolution.

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MATHEMATICS LAB

• Solution of system of algebraic equations using Gauss Seidel method
• LU decomposition of matrices.
• Eigenvalues and eigenvectors of matrices.
• Largest, smallest eigenvalue and the corresponding eigenvectors of a matrix.
• Diagonalisation of matrices

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

Course Code	COURSE OUTCOME (CO)	PO	Bloom's level
15MA3GCAPM	CO-1: Compute solution of a system of algebraic equations, algebraic and transcendental equations, and ordinary differential equations numerically.	2, 3	3
	CO-2: Demonstrate an understanding of Fourier series and Fourier transforms techniques.	2, 3, 4	4
	CO-3: Formulate boundary value problems involving one dimensional heat and wave equation.	2, 3, 4	4
	CO- 4: Employ analytical techniques to solve partial differential equations with appropriate boundary conditions.	2, 3, 4	4
	CO-5: Use calculus of variations to find the extremal of a functional.	2, 3	3

Program Outcome:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to Chemical and Biotechnology.
2. Graduates will be able to identify problems related to chemical engineering and biotechnology, analyse and derive valid conclusions with fundamental knowledge in chemistry, biology, Engineering and computation.
3. Graduates will be able to design, conduct experiments, analyse and interpret data for Investigating problems in chemical engineering, biotechnology and allied fields.

Bibliography

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) Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition Vol.1 and Vol.2, 2014, Wiley-India.
(2) Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.
(3)Numerical methods for Scientific and Engineering Computation, M. K. Jain, S.R. K Iyengar, R. K. Jain, 6th edition, 2010, New Age International (P) Limited Publishers.

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)

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(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 from Units 1, 2, 5 and two questions from Unit 3 and Unit 4

Questions for CIE and SEE 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%)
- Analyzing various engineering problems (weightage: 15%)
- Understanding of various system models (weightage: 5%)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

BMS COLLEGE OF ENGINEERING, BANGALORE – 560019

MATHEMATICS DEPARTMENT

SYLLABUS (2015 - 2016)

THIRD SEMESTER B.E COURSE - (ECE/EEE/IM/TCE/ML)

Course Title	Advanced Engineering Mathematics	Course Code	15MA3GCAEM
Credits	04	L – T – P- S	3 – 1 – 0 - 0
Contact hours	48 hours (36L+12T)	Branches	ECE/EEE/ML/TCE/IT

Prerequisites: Trigonometric formulas, methods of differentiation, methods of integration, partial derivatives, matrices. Fourier Series and Fourier Transforms.

Course Objectives: The purpose of the course is to make the students well conversant with

1. The computational skills using efficient numerical methods for solution of various equations arising in science and engineering.
2. Formulate physical problems in terms of Partial Differential Equations, find insight into the physical behaviour of systems from mathematical solution.
3. Have adequate knowledge in complex analysis.

UNIT-1

MATRICES **[9 hours]**

Introduction: Elementary row transformations, Echelon form of a matrix, rank of a matrix by elementary row transformations. Consistency of system of linear equations and solution.

Solution of a system of non-homogenous linear algebraic equations: Gauss elimination method, LU decomposition method, Gauss-Seidel method. Eigenvalues and eigenvectors of matrices. Reduction of a matrix to diagonal form. **(7L+2T)**

Suggested Reading: Inverse of a matrix using Gauss-Jordan method. Largest eigenvalue and corresponding eigenvector using Rayleigh power method.

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: Simpson's $1/3^{rd}$, $3/8^{th}$ rule, Weddle's rule. Numerical solution of ordinary differential equations: Euler's modified method, Runge-Kutta method of fourth order**.** **(8L+2T)**

Suggested Reading: Milne's method to solve ordinary differential equations. Solution of simultaneous differential equations by Runge-Kutta fourth order method.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

UNIT- 3

PARTIAL DIFFERENTIAL EQUATIONS **[10 hours]**

Formation of Partial differential equations-elimination of arbitrary constants, elimination of arbitrary functions. Equations of first order- Solution of the linear equation $P\ p + Q\ q = R$ **(**Lagrange's partial differential equation).

Applications: One-dimensional heat equation and wave equation (without proof), Transmission line-telegraph equations, various possible solutions of these by the method of separation of variables. **(7L+3T)**

Suggested Reading: Direct integration method, method of separation of variables, D'Alembert's solution of wave equation.

UNIT- 4

COMPLEX ANALYSIS 1 **[9 hours]**

Function 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-Transformations: $w = z^2$ and $w = z + \frac{a^2}{z}\ (z \neq 0)$.Bilinear transformations.

(7L+2T)

Suggested Reading: Standard transformations $w = c + z,\ w = cz,\ w = 1/z$, properties of bilinear transformations.

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 series, Maclaurin's series and Laurent's series (without proof).

Zeros, Poles and Residues: Residue theorem (without proof). Evaluation of real definite integrals using residues. **(7L+3T)**

Suggested Reading: Power series, radius of convergence. Removable and essential singularities, improper real integrals with singular points on real axis.

Applications: Use of harmonic function to a heat transfer problem. Analysing AC circuits, Current in a field- effect transistor.

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Mathematics Lab

- Solution of system of algebraic equations using Gauss Seidel method.
- LU decomposition of matrices.
- Eigenvalues and eigenvectors of matrices.
- Largest eigenvalue, smallest eigenvalue and corresponding eigenvectors of a matrix.
- Solution of algebraic and transcendental equations using Newton- Raphson method.
- Numerical integration.
- Numerical solution of ordinary differential equations.

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

Course Code	COURSE OUTCOMES		
15MA3GCAEM	**CO-1:** Obtain numerical solution a system of algebraic equations, algebraic and transcendental equations and ordinary differential equations.		
	CO-2: Formulate boundary value problems involving one dimensional heat and wave equation.		
	CO-3: Solve partial differential equations with appropriate boundary conditions using the method of separation of variables.		
	CO-4: Construct analytic functions and simple conformal mappings.		
	CO-5: Evaluate real and complex integrals using the calculus of residues.		

Program Outcome:

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, analyse and derive valid conclusions with fundamental knowledge in chemistry, biology, Engineering and computation.
3. Graduates will be able to design, conduct experiments, analyse and interpret data for Investigating problems in engineering and allied fields.

Bibliography

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, 9th reprint, 2007, Tata Mc. Graw Hill.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition Vol.1 and Vol.2, 2014, Wiley-India.

3. Numerical Methods for Scientific and Engineering Computation. M.K. Jain, S.R.K Iyengar, R.K. Jain, 6th edition, 2010, New Age International (P) Limited Publishers.

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 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)
4. E-learning: www.vtu.ac.in

Assessment

1. Each unit consists of one full question.
2. Each full question consists of three or four subdivisions.
3. Five full questions to be answered.
4. To set one question each from Units 1, 4, 5 and two questions from Unit 2 and Unit 3.

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 (CIE)	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%)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

MATHEMATICS DEPARTMENT

SYLLABUS (2015 - 2016)

THIRD SEMESTER B.E COURSE - (CS/IS)

Course Title	Discrete Mathematics	Course Code	15MA3GCDMS
Credits	04	L – T – P- S	3 – 1 – 0 - 0
Contact hours	48 hours (36L+12T)	CS/IS Cluster	

Prerequisites: Matrices, mathematical logic.

Course Objectives: To acquaint the student with various concepts of discrete mathematics required in several streams of computing.

UNIT-1

SET THEORY AND RELATIONS **[11 hours]**

Introduction to sets and subsets, operations on sets, laws of set theory. Duality, Principle of duality for the equality of sets. Countable and uncountable sets. Addition Principle.

Introduction to Relations. Definition, Types of functions, operations on relations, matrix representation of relations, composition of relations, properties of relations, equivalence relations, partial orders, Hasse diagram. Posets- extremal elements on posets. **(8L+3T)**

Suggested Reading: Some particular functions- Floor and ceiling functions, Projection, Unary and Binary operations.

UNIT-2

ALGEBRAIC STRUCTURES-GROUPS **[10 hours]**

Groups, properties of groups. Some particular groups- The Klein 4-group, additive group of integers modulo n, multiplicative group of integers mod p, permutation groups. Subgroups, Cyclic groups, Coset decomposition of a group, homomorphism, isomorphism. **(7L+3T)**

Suggested Reading: Lagrange's theorem and its consequences.

UNIT-3

COMBINATORICS **[9 hours]**

Principles of counting: The rules of sum and product, permutations. Combinations- Binomial and multinomial theorems. Catalan numbers, Ramsey numbers. The Pigeon hole principle, the principle of inclusion and exclusion. Derangements, Rook polynomials. **(7L+2T)**

Suggested Reading: Ordinary Generating Functions, Partitions of integers and their generating functions, exponential generating functions.

UNIT-4

GRAPH THEORY **[9 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, dual graphs, isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix. Trees: spanning tree, breadth first search. Minimal spanning tree: Kruskal's algorithm, Prim's algorithm, shortest path-Dijkstra's algorithm. **(7L+2T)**

Suggested Reading: Konigsberg bridge problem, Utilities problem, seating problem.

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UNIT-5

NUMBER THEORY **[9 hours]**

Introduction: Integers, properties of integers. Primes**.** Congruences**-:** Introduction, 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. **(7L+2T)**

Suggested Reading: Prime counting function, Test of primality by trial division, Sieve of Eratosthenes, Canonical factorization, Fundamental theorem of arithmetic, determining the Canonical factorization of a natural number**.**

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Mathematics Lab

- Hasse diagram
- Rook Polynomials
- Minimal spanning tree- Kruskal's algorithm, Prim's algorithm.
- Shortest Path- Dijkstra's algorithm.

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

Course Code	CO #	COURSE OUTCOMES (CO)	PO	Bloom's level
15MA3CCDMS	CO 1: Use the notation of set theory.		2, 3	3
	CO 2: Construct a Hasse diagram for partial orderings.		2, 3, 4	4
	CO 3: Differentiate between a relation and a function.		2, 3, 4	4
	CO 4: Recognize certain well known groups.		2, 3, 4	4
	CO 5: Apply basic tools of Combinatorics such as sum and product rules, pigeon-hole principle.		2, 3, 4	4
	CO6: Use graphs as representation tools in a network analysis.		2, 3	3
	CO 7: Understand basic properties of integers, greatest common divisor, congruence relations and arithmetic of residue classes.		2, 3	3

Program Outcome:

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, analyse and derive valid conclusions with fundamental knowledge in chemistry, biology, Engineering and computation.
3. Graduates will be able to design, conduct experiments, analyse and interpret data for Investigating problems in engineering and allied fields.

Bibliography

Text Books

1. Discrete Mathematical Structures, Dr. DSC, 4th edition, 2011-12, Prism Engineering Education Series.
2. Discrete Mathematics, Seymour Lipchitz. M. Lipson, 2005, Tata Mc. Graw Hill.
3. Graph Theory and Combinatorics, Dr. DSC, 4th edition, 2011-12, Prism Engineering Education Series.
4. Elementary Number Theory by David M Burton -6th Edition 2006. Tata McGraw Hill Publ.

Reference Books:

1. Discrete Mathematics and its Applications, Kenneth H Rosen, 2002, Mc. Graw Hill.
2. Discrete Mathematics, Kolman, Busby Ross, 5thedition, 2004, Prentice Hall.
3. Discrete Mathematics, J K Sharma, 3rd edition, 2013, Macmillan India Ltd

E books and online course materials

(1)Discrete Mathematics with Algorithms by M. O. Albertson, J. P. Hutchinson - J. 1988 Wiley.

(2) Discrete Mathematics for Computer Science, Gary Haggard, John Schlipf, Sue Whitesides, Thomson Brooks/Cole, 2006.

(3)http://ocw.mit.edu/courses/mathematics/ (online course material)

Online Courses and Video Lectures:

(1)http www.nptelvideos.in/2012/11/discrete-mathematical-structures.html

(2)https://www.khanacademy.org/

(3) www.cs.berkeley.edu/~daw/teaching/cs70-s05/

Assessment

1. Each unit consists of one full question.
2. Each full question consists of three or four subdivisions.
3. Five full questions to be answered.
4. To set one question in Units 1, 3, 5 and two questions each in 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 (CIE)	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
THIRD SEMESTER B.E COURSE (All Branches)

Course Title	Mathematics-I	Course Code	15MA3IMMAT
Credits	00	L – T – P- S	0 – 0 – 0 - 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. Differentiation of product of two functions using Leibnitz rule (direct problems). 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. Taylor's and Maclaurin's series expansion for functions of two variables. Jacobians and their properties (without proof) – Problems. **(7L+3T)**

UNIT 3

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS [8 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. **(6L+2T)**

UNIT 4

SECOND AND HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS [9 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, e^{ax} sin(bx), e^{ax} cos(bx). Method of variation of parameters. Cauchy's and Legendre differential equations. **(7L+2T)**

UNIT 5

VECTOR CALCULUS AND ORTHOGONAL CURVILINEAR COORDINATES (OCC)

[8 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 OCC. **(6L+2T)**

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

Course Code	CO	PO	Bloom's level
15MA3IMMAT	**CO-1:** Understand the basic concepts of differentiation and integration.	1	2
	CO-2: Apply the concepts of polar curves and multivariate calculus.	1	2
	CO-3: Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.	1	3
	CO-4: Apply techniques of vector calculus to engineering problems.	1	3
	CO-5: Comprehend the generalization of vector calculus in curvilinear coordinate system.	1	3

Program Outcome:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to relevant engineering field.

Bibliography

Text Book:

- Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.
- Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.

Reference Book:

- Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers
- 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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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

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MATHEMATICS DEPARTMENT
SYLLABUS (2015 - 2016)
FOURTH SEMESTER B.E COURSE - (Common to CIVIL, MECHANICAL)

Course Title	**Engineering Mathematics-4**	**Course Code**	**15 MA4GCMAT**
Credits	**03**	**L – T – P-S**	**3 -0- 0-0**
Contact hours	**36 hours**		

Prerequisites: Trigonometric formulas, methods of differentiation, methods of integration, partial derivatives. Basic concepts in Probability-addition theorem, conditional probability, Bayes' theorem, discrete random variable, Binomial distribution.

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

NUMERICAL METHODS **[7 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 $1/3^{rd}$, $3/8^{th}$ rule, Weddle's rule.

Numerical solution of ordinary differential equations: Euler's modified method, Runge-Kutta method of fourth order**.**

Applications: Application of numerical methods to engineering problems.

Suggested Reading: Milne's method to solve ordinary differential equations. Solution of simultaneous differential equations by Runge-Kutta method of fourth order**.**

UNIT-2

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS **[8 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-3

COMPLEX ANALYSIS 1 **[7 hours]**

Function 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. Transformations: $w = z^2$ and $w = z + \frac{a^2}{z}$ $(z \neq 0)$. Bilinear transformations.

Suggested Reading: Standard transformations $w = c + z$, $w = cz$, $w = 1/z$, properties of bilinear transformations

UNIT-4

COMPLEX ANALYSIS 2 **[7 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).

Zeros, Poles and Residues: Residue theorem (without proof). Evaluation of real definite integrals using residues.

Suggested Reading: Power series- radius of convergence. Problems on Taylor's and Maclaurin's series. Removable and essential singularities.

Applications: Use of harmonic function to a heat transfer problem.

UNIT-5

STATISTICS AND PROBABILITY **[7hours]**

Curve fitting – Principle of least squares, fitting a straight line, fitting of a parabola, fitting of exponential curves of the form $y = a\ b^x$, $y = ae^{bx}$. Correlation and regression.

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

Suggested Reading: Fitting the curve $y = a\ x^b$, exponential distribution and uniform distribution.

Mathematics Lab

- Newton-Raphson method
- Numerical integration
- Solution of ordinary differential equations
- Solution of one dimensional heat and wave equation.
- Curve fitting for a given data
- Correlation and regression for a bivariate distribution.
- Probability distributions.

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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
15MA4GCMAT	CO 1	Calculate numerical solutions of algebraic and transcendental equations, ordinary differential equations.	2, 3	3
	CO 2	Compute solution of one dimensional heat and wave equation using finite difference techniques.	2, 3	3
	CO 3	Construct analytic functions and evaluate real and complex integrals.	2	2
	CO 4	Apply the principles of least squares to fit a straight line, parabolic and exponential curve for a given data.		
	CO 5	Estimate the relation between two variables and perform regression analysis.	3	3
	CO6	Apply the basic principles of probability and probability distributions.	3	3

Program Outcomes:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to Civil and Mechanical engineering.
2. Graduates will be able to identify problems related to civil and mechanical engineering, analyse and derive valid conclusions with fundamental knowledge in civil and mechanical Engineering and computation.

Bibliography

Text Books

1. Advanced Engineering Mathematics, R.K. Jain, S. R. K. Iyengar, 4th edition, 2014, Narosa Publishers.
2. Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2013, Khanna Publishers.

Reference Books:

1. Advanced Modern Engineering Mathematics, Glyn James, 3rd edition, 2004, Pearson Education.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, vol.1, vol. II, 2014, Wiley-India

3. Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc.Graw Hill.
4. Numerical methods for Scientific and Engineering Computation, M. K. Jain, S.R. K Iyengar, R. K. Jain, 5th edition, 2008, New Age International (P) Limited Publishers.

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 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)

Assessment

3. Each unit consists of one full question.
4. Each full question consists of three or four subdivisions.
3. Five full questions to be answered.
4. To set one question in Units 1, 3, 5 and two questions each in 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 (CIE)	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%)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF MATHEMATICS
SYLLABUS (2015 - 2016)

Course Title	Statistics and Probability	Course Code	15MA4DCSAP
Credits	04	L – T – P- S	3 – 1 – 0 - 0
Contact hours	48 hours (36L+12T)	Chemical students only	

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

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

UNIT-1

STATISTICS & PROBABILITY DISTRIBUTIONS [11 hours]

Curve fitting: $y = a + bx$, $y = a + bx + cx^2$, $y = ab^x$, statistical measures, Correlation and regression.

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

UNIT-2

JOINT PROBABILTY AND MARKOV CHAIN [8 hours]

Introduction. Joint Probability distributions: Case of discrete random variables-Marginal probability distributions, independent random variables, mathematical expectation, correlation, covariance.

Introduction- classification of stochastic processes. Probability vectors, stochastic matrices, fixed points, regular stochastic matrices. Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states. **(6L+2T)**

UNIT-3

DESIGN OF EXPERIMENTS [9 hours]

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

Randomized block design, Completely Randomized block design, Latin Square Design, Factorial Experiments –Problems. **(7L+2T)**

UNIT-4

STATISTICAL INFERENCE - I [9 hours]

Introduction, Population and sampling, sampling distributions: sampling distributions of means.

Statistical 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. Suggested Reading: sampling distributions of proportions, sampling distributions of differences and sum. **(7L+2T)**

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 – Wilcoxon Rank Sum test and Kruskal – Wallis One Way Analysis of Variance by Ranks.

(8L+3T)

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

Course Code	COURSE OUTCOMES	PO	Bloom's level
15MA4DCSAP	**CO-1:** Estimate the closeness of two variables and prediction of one variable from the other.(To obtain the degree of relationship between two variables and perform regression analysis)	1,2	3
	CO-2: Apply the basic principles of probability and probability distributions to the problems in Bio-technology.	1,2	3
	CO-3: Apply the concepts of Markov chain to the field of genetics.	1,2	4
	CO-4: Demonstrate an understanding of sampling and its various techniques.	2,4	4
	CO-5: To draw inferences about the characteristics of population from the samples based on the parametric and non-parametric tests.	2,4	4

Program Outcome:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to Chemical engineering.
2. Graduates will be able to identify problems related to chemical engineering, analyze and derive valid conclusions with fundamental knowledge in biology, chemistry, Engineering and computation.
3. Graduates will be able to design, conduct experiments, analyze and interpret data for Investigating problems in chemical engineering and allied fields.

Bibliography

Text Books:

1. Probability and Statistics for Engineers and Scientists, Ronald Walpole, Raymond Myers, Sharon Myers, Keying Ye, 9th edition, 2013, Pearson New International Edition.
2. Applied Statistics and Probability for Engineers, Douglas C Montgomery, George C Runger, 5th edition, 2010, Wiley.
3. Fundamentals of Biostatistics, Khirfan A Khan, Atiya Khanum, 3rd edition, 2012, Ukaaz Publications.

Reference Books:

1. Schaum's Outline of Probability and Statistics, 4th edition, 2013, Schaum's outlines.
2. An Introduction to Biostatistics, P. S. S. Sundar Rao and J. Richard, 4th edition, 2006 Prentice Hall of India.

E books and online course materials

1. Statistics online computational resource
   wiki.stat.ucla.edu/socr/index.php/Probability_and_statistics_EBook

2. accessengineeringlibrary.com/.../schaums-outline-of-probability-and-statistics-fourth-edition.
3. Fundamentals of Statistics and Probability for Engineers, T.T. Soong, John Wiley and Sons Ltd.
4. fastebook.org/.../fundamentals-of-biostatistics-khan-and-khanum.html

Online Courses

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
3. https:// www.class-central.com/subject/math (MOOCS)
4. E-learning: www.vtu.ac.in

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 from Units 2, 3, 4 and two questions from Unit 1 and Unit 5.

Questions for CIE and SEE 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%)
- Analyzing various engineering problems (weightage: 15%)
- Understanding of various system models (weightage: 5%)

Continuous Internal Assessment (CIE)	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%)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
DEPARTMENT OF MATHEMATICS
SYLLABUS (2015 - 2016)

Course Title	**Biostatistics and Probability**	**Course Code**	**15MA4DCBSP**
Credits	**04**	**L – T – P- S**	**3 – 1 – 0 - 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.

Course Description: The course offers an extensive study to small and large data using various statistical methods. Emphasis is on the application to biological models.

UNIT-1

STATISTICS & PROBABILITY DISTRIBUTIONS **[11 hours]**

Curve fitting: $y = a + bx$, $y = a + bx + cx^2$, $y = ab^x$, Correlation and regression.

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

UNIT-2

MARKOV CHAIN AND GENETIC APPLICATION **[8 hours]**

Introduction, Probability vectors, stochastic matrices, fixed points, regular stochastic matrices. Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.

Genetic Applications: Hardy - Weinberg law, Wahlund's Principle, Sib mating, Selfing.

(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 –Problems. **(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.

(7L+2T)

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 – Wilcoxon Rank Sum test and Kruskal – Wallis One Way Analysis of Variance by Ranks.

(8L+3T

On completion of the course the student will have the:

Course Code	CO	PO	Bloom's level
15MA4DCBSP	CO-1: Ability to estimate the correlation of two variables and prediction of one variable from the other.	1,2	1,3
	CO-2: Apply the basic principles of probability and probability distributions to the problems in Bio-technology.	1,2	3
	CO-3: Apply the concepts of Markov chain to the field of genetics.	1,2	3,4
	CO-4: Demonstrate and understanding of sampling and its various techniques.	2,4	3,4
	CO-5: To draw inferences about the characteristics of population from the samples based on the parametric and non-parametric tests.	2,4	3,4

Program Outcome:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to Biotechnology.
2. Graduates will be able to identify problems related to biotechnology, analyze and derive valid conclusions with fundamental knowledge in biology, Engineering and computation.
3. Graduates will be able to design, conduct experiments, analyze and interpret data for Investigating problems in biotechnology and allied fields.

Bibliography

Text Books:

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

Reference Books:

1. Wayne W. Daneil – Biostatistics: A foundation for Analysis in the Health sciences 10th edition, 2013, John Wiley & Sons.
2. Schaum's Outline of Probability and Statistics, 4th edition, 2013, Schaum's outlines
3. Biostatistics – P.N.Arora, P.K. Malhan, 2nd edition, 2013, Himalaya Publishing House.
4. Fundamentals of Biostatistics by Veer BalaRastogi- 2nd edition, 2009, Ane books Pvt. Ltd. India.

E books and online course materials

1. Statistics online computational resource wiki.stat.ucla.edu/socr/index.php/Probability_and_statistics_EBook
2. accessengineeringlibrary.com/.../schaums-outline-of-probability-and-statistics-fourth-edition.
3. Fundamentals of Statistics and Probability for Engineers, T.T. Soong, John Wiley and Sons Ltd.
4. fastebook.org/.../fundamentals-of-biostatistics-khan-and-khanum.html

Online Courses

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)
5. E-learning: www.vtu.ac.in

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 from Units 2, 3, 4 and two questions from Unit 1 and Unit 5

Questions for CIE and SEE 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%)
- Analyzing various engineering problems (weightage: 15%)
- Understanding of various system models (weightage: 5%)

Continuous Internal Assessment (CIE)	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)

FOURTH SEMESTER B.E COURSE - (ECE/EEE/IM/TCE/ML)

Course Title	Discrete Mathematics and Probability	Course Code	15MA4GCDMP
Credits	04	L – T – P- S	3 – 1 – 0 - 0
Contact hours	48 hours (36L+12T)	ECE/EEE/IT/ML/TCE	

Prerequisites: Basic concepts of set theory, relations and functions. Matrices. Basic concepts of probability, addition theorem, conditional probability, Bayes' theorem, discrete random variable, Binomial distribution.

UNIT-1

SET THEORY AND RELATIONS **[12 hours]**

Introduction to sets and subsets, operations on sets, laws of set theory. Duality, Principle of duality for the equality of sets. Countable and uncountable sets. Addition Principle.

Introduction to Relations. Definition, Types of functions, operations on relations, matrix representation of relations, composition of relations, properties of relations, equivalence relations, partial orders, Hasse diagram. Posets- extremal elements on posets. **(9L+3T)**

Suggested Reading: Some particular functions- Floor and ceiling functions, Projection, Unary and Binary operations.

UNIT-2

ALGEBRAIC STRUCTURES-GROUPS **[10 hours]**

Groups, properties of groups. Some particular groups- The Klein 4-group, additive group of integers modulo n, multiplicative group of integers mod p, permutation groups. Subgroups, Cyclic groups, Coset decomposition of a group, homomorphism, isomorphism. **(7L+3T)**

Suggested Reading: Lagrange's theorem and its consequences.

UNIT-3

GRAPH THEORY **[9 hours]**

Basic concepts: Types of graphs, order and size of a graph, in-degree and out-degree, connected and disconnected graphs, Eulerian graph, Hamiltonain graphs, subgraphs, dual graphs, isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix. Trees: spanning tree, breadth first search. Minimal spanning tree: Kruskal's algorithm, Prim's algorithm, shortest path-Dijkstra's algorithm. **(7L+2T)**

Suggested Reading: Konigsberg bridge problem, Utility problem.

UNIT-4

PROBABILITY **[8 hours]**

Theoretical distributions: Poisson distribution, Normal distribution: Error function, Central limit theorem.

Two dimensional random variables: Discrete random variable, Mathematical expectation, Covariance and Correlation.

Suggested Reading: Exponential distribution, Uniform distribution. Continuous two dimensional random variables. **(6L+2T)**

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.

Suggested Reading: Power supply model, Economic cost profit model. **(7L+2T)**

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Mathematics Lab

• Probability distributions
• Minimal spanning tree- Kruskal's algorithm, Prim's algorithm.
• Shortest Path- Dijkstra's algorithm.

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

Course Code	COURSE OUTCOMES
15MA4GCDMP	**CO-1:** Understand the notation of set theory, relations and functions.
	CO-2: Construct a Hasse diagram for partial orderings, Use many terms associated with graphs and prove whether two graphs are isomorphic.
	CO-3: Obtain the probability of an event using discrete and continuous distributions, including the n-step transition probability.
	CO-4: Analyse and classify simple states (recurrent/transient)
	CO-5: Understand, derive and apply the properties of the M/M/m queuing model (properties like stationary probability, average waiting and system time, expected number of customers in the queue).

Program Outcome:

3. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to Engineering.
4. Graduates will be able to identify problems related to engineering, analyse and derive valid conclusions with fundamental knowledge in chemistry, biology, Engineering and computation.
3. Graduates will be able to design, conduct experiments, analyse and interpret data for Investigating problems in engineering and allied fields.

Bibliography

Text Books

1. Discrete Mathematical Structures, Dr. D.S. Chandrasekharaiah, 4th edition, 2011, Prism Engineering Education Series.
2. Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers.
3. Discrete Mathematics, Seymour Lipchitz, Marc Lipson, 3rd edition, 2009, Tata Mc Graw Hill.

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.
2. Discrete Mathematics, J K Sharma, 3rd edition, 2013, Macmillan India Ltd.
3. Queuing Theory and Telecommunications, Networks and applications, Giovanni Giambene, 2005, Springer.
4. Data Networks, Dimitri Bertsekas, Robert Gallager, 2nd edition, 1992, Prentice India.
5. Schaum's Outline of Probability and Statistics, John J Schiller, Murray R Speigel, 4th edition, 2013, Schaum's Outlines.

E books and online course materials

(1) Discrete Mathematics for Computer Science, Gary Haggard, John Schlipf, Sue Whitesides, Thomson Brooks/Cole, 2006.
(2) http://www.khanacademy.org/math/probability/random-variablestopic/random_variables_prob_dist/v/random-variables
(3) http://ocw.mit.edu/courses/mathematics/ (online course material)

Online Courses and Video Lectures:

(1) www.nptelvideos.in/2012/11/discrete-mathematical-structures.html
(2) www.cs.berkeley.edu/~daw/teaching/cs70-s05
(3) https://www.khanacademy.org/

Assessment

1. Each unit consists of one full question.
2. Each full question consists of three or four subdivisions.

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

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%)

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B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
BMS COLLEGE OF ENGINEERING, BANGALORE – 560019
MATHEMATICS DEPARTMENT
SYLLABUS (2015 - 2016)
FOURTH SEMESTER B.E COURSE - (CS/IS)

Course Title	Linear Algebra	Course Code	15MA4GCLIA
Credits	04	L – T – P- S	3 – 1 – 0 - 0
Contact hours	48 hours (36L+12T)	CS/IS Cluster	

Prerequisites:
Vector Algebra, Matrix computations.

Course Objectives: To provide the students with a solid foundation with concepts in linear algebra that is essential in mathematical computations.

Course Description: The course aims at introducing students to fundamental concepts of linear algebra culminating in abstract vector spaces and linear transformations. The course starts with systems of linear equations and some basic concepts of the theory of vector spaces in the concrete setting of real linear n-space Rn. The course then goes on to introduce abstract vector spaces over arbitrary fields and linear transformations, matrices, matrix algebra, similarity of matrices, eigenvalues and eigenvectors.

UNIT-1

SYSTEM OF LINEAR EQUATIONS AND VECTOR SPACES [12 hours]
System of Linear Equations: Elementary row operations and echelon forms, invertible matrices. Consistency of a system of linear equations. Solution of a system of algebraic equations: Gauss elimination method, LU decomposition method, Gauss Seidel method.
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. **(9L+2T)**
Suggested Reading: Solution of a system of equations using Gauss Jordan method, inverse of a matrix using Gauss Jordan method.

UNIT-2

LINEAR TRANSFORMATIONS [12 hours]
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, Eigenvalues and Eigenvectors of a linear transformation, Invertible operators. **(9L+2T)**

UNIT-3

EIGENVALUES AND EIGENVECTORS [10hours]
Rayleigh power method, Gerschgorin circle method, Jacobi's method, invariant subspaces, Jordan canonical form. **(9L+2T)**
Suggested Reading: Cayley Hamilton theorem, Givens method, inverse Power method.

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. **(9L+2T)**
Suggested Reading: least square errors.

UNIT-5

SYMMETRIC MATRICES AND QUADRATIC FORMS **[8 hours]**

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. **(9L+2T)**

:

Mathematics Lab

- Gauss Seidel method
- LU decomposition method
- Largest, smallest eigenvalue and corresponding eigenvectors.
- Linear transformations

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

Course Code	COURSE OUTCOME (CO)	PO	Bloom's level
15MA4GCLIA	CO 1: Solve system of linear algebraic equations.	2	2
	CO 2: Demonstrate competence with the ideas of vector spaces, subspaces, Basis and dimension.	2	2
	CO 3: Obtain the matrix associated with a linear transformation with respect to given bases.	2,3	3
	CO 4: Understand the relationship between the operations on linear transformations and their corresponding matrices.		
	CO 5: Compute eigenvalues, eigenvectors and eigenspaces of matrices.	2,3	3
	CO6: Apply Gram-Schmidt process to find an orthogonal base in a subspace of an inner product space, and to be able to characterize orthogonal matrices.	2,3	3
	CO7: Use of Singular value decomposition that finds applications in signal processing.	2,3	3

Program Outcome:

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, analyse and derive valid conclusions with fundamental knowledge in chemistry, biology, Engineering and computation.
3. Graduates will be able to design, conduct experiments, analyse and interpret data for Investigating problems in engineering and allied fields.

Bibliography

Text Books

1. Schaum's outline series-Theory and problems of linear algebra, Seymour Lipschutz, 5th edition, 2012, McGraw-Hill Education.
2. Linear Algebra and its applications, David C lay, Steven R lay, Judi J Mc. Donald, 5th Edition, 2015, Pearson Education.

Reference Books:

1. Linear Algebra and its applications, Gilbert Strang, 4th edition, 2005, Brooks Cole.
2. Linear Algebra and its applications, Peter D Lax, 2nd edition, 2007, Wiley Interscience.
3. Elementary Linear Algebra and its applications, Bernard Kolman and David R Hill , 9th edition, 2007, Pearson.

E books and online course materials

(1) https://www.math.ucdavis.edu/~**linear**/**linear**.pdf
(2)http://ocw.mit.edu/courses/mathematics/ (online course material)

Online Courses and Video Lectures:

(1)http www.linear-algebra-Gilbert- Strangs-lectures-or-the-lectures-from-Khan-Academy
(2) www.cs.berkeley.edu/~daw/teaching/cs70-s05/
(3) nptel.ac.in/courses/111108066

Assessment

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. To set one question each in Units 2, 3, 4 and two questions each in Unit 1 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%)

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19
FOURTH SEMESTER B.E COURSE

Course Title	Mathematics-II	Course Code	15MA4IMMAT
Credits	00	L – T – P- S	0 – 0 – 0 - 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 integrals triple integrals respectively.

UNIT 1

LAPLACE TRANSFORMS **[8 Hours]**

Laplace transforms of standard functions. Properties and problems. Laplace Transform of Periodic functions with plotting. Unit step function.

(6L+2T)

UNIT 2

INVERSE LAPLACE TRANSFORMS **[9 Hours]**

Inverse Laplace transforms of standard functions. Properties and problems. Solution of ODE-Initial and Boundary value Problems. **(7L+2T)**

UNIT 3

DOUBLE INTEGRAL **[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 **[8 Hours]**

Evaluation of triple integral. Application: Volume. Gamma and Beta functions-definition Relation between Gamma and Beta functions. Properties and Problems.

(6L+2T)

UNIT 5

VECTOR INTEGRATION **[8 Hours]**

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

(6L+2T)

Course Code	CO	PO	Bloom's level
15MA4IMMAT	**CO-1:** Use Laplace transforms to solve differential equations.	1	3
	CO-2: Apply double integrals to compute areas.	1	3
	CO-3: Learn to use triple integrals in computing volumes.	1	3
	CO-4: Use Gamma and Beta functions to evaluate integrals.	1	2
	CO-5: Ability to understand the use of integral calculus in scalar and vector fields.	1	3

Program Outcome:

1. Graduates will apply knowledge of Mathematics, Science and Engineering concepts to solve problems pertinent to relevant engineering field.

Bibliography

Text Book:

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

Reference Book:

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

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	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

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

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

Course Title	Advanced Numerical Methods	Course Code	17MA7IEANM
Credits	03	L – T – P- S	3 - 0 – 0 - 0

DEPARTMENT OF MATHEMATICS

VII SEMESTER

Pre-requisites: Matrix theory, Differential and Integral Calculus, Differential Equations.

Course Objectives:

1) The purpose of the course is to encourage the students to apply numerical techniques.
2) To enhance computational skills through programming in MATLAB.
3) To train the students to solve the complex engineering problems in their respective domain.

UNIT I

Linear System of Equations: Gauss Jacobi and Seidal iterative methods, Thomas Algorithms for Tridiagonal systems, Eigenvalue problems-Jacobi method, Gerschgorin's circle theorem, QR method, Power method.

UNIT II

Solution of Nonlinear Equations: Bisection method, Newton's method – Convergence of Newton's method, Newton's method for system of non-linear equations. Bairstow's Method for quadratic factors. Review of Lagrange interpolation techniques, piecewise linear, cubic splines and Bezier curves, error estimates.

UNIT III

Numerical Differentiation and Integration: Interpolation-NFDF, NBDF, Stirling's Interpolation formula, Richardson extrapolation, Newton-Cotes closed quadrature formula, Boole's and Weddle's. Romberg integration, Double integration-Trapezoidal rule and Simpson's rule.

UNIT IV

Numerical Solutions of Ordinary differential equations: Taylor's method, Picard's method, Euler's method and Euler's modified method, RK2 and RK4 method, Milne"s method – Adams Moulton method, Shooting method.

UNIT V

Numerical Solutions of Partial differential equations: Finite differences, Explicit and Implicit methods, Crank Nicolson method, Schmidt method, Lax-wendroff method, ADI method, SOR method.

B.M.S. COLLEGE OF ENGINEERING (Autonomous), BENGALURU-19

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

Course Code	CO #	COURSE OUTCOME (CO)	PO	Bloom's level
17MA7IEANM	CO 1	Determine the solution of the algebraic system of equations	1, 2, 5	3
	CO 2	Validate the solutions of non-linear equations	1, 2, 5	3
	CO 3	Apply numerical techniques to find differentiation and integration.	1, 2, 5	3
	CO 4	Interpret the solutions of ordinary differential equations	1, 2,3,5	3
	CO 5	Analyze the solutions of partial differential equations	1, 2,3,5	3

PO#	
PO 1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engg. Speciablization to the solution of complex engineering problems
PO 2	Problem analysis: Identify, formulate, research literature, and analyse engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural and engineering sciences.
PO 3	Design/ Development of solutions: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural , societal, and environmental considerations.
PO 5	Modern tool usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

BIBLIOGRAPHY

TEXT BOOKS

[1] Applied Numerical Methods with Matlab for Engineers and Scientists- Steven V. Chapra.
[2] Numerical methods for Scientific and Engineering Computation, M.K. Jain and S.R.K Iyengar.

REFERENCE BOOKS

[1] An Introduction to Programming and numerical methods in MATLAB, Otto and Danier.
[2] Applied Numerical Analysis, Gerald and Wheatley.
[3] Numerical Analysis, 9th Ed., 2010, Richard L. Burden, J. Douglas Faires, Brooks/Cole.

Chandrashekar

T S. Mallik

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.

30/3/2017.