ಡಾ. ಮನಮೋಹನ ಸಿಂಗ್
ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

Dr. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

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PhNo.080-22131385, E-mail: registrar@bcu.ac.in/registrarbcu@gmail.com

No.MSBCU/BoS/Syllabus/Science/ 109 /2026-27 Date: 29.06.2026

NOTIFICATION

Sub: Syllabus for the V & VI Semester Under Graduate Courses in the Faculty of Science -reg

Ref: 1. Government Order No. ED 166 UNE 2023 Bengaluru dated. 08.05.2024
2. Recommendations of the Boards of Studies in the Faculty of Science
3. Approval of the Academic Council in its meeting held on 08.06.2026
4. Orders of Vice-Chancellor dated.29.06.2026

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The Syllabus prepared by the Boards of Studies for the different Subjects of V & VI semester Under Graduate Courses, in the faculty of Science based on the Guidelines and Curriculum Structure issued by the Government under ref(1) have been approved by Academic Council meeting held on 08.06.2026.

Accordingly, the CBCS Syllabus for the V & VI Semester UG Courses of Science Faculty in respect of following subjects are hereby notified for implementation from the academic year 2026-27.

Sl. No.	Subjects
1.	Botany– V & VI Semester
2.	Chemistry– V & VI Semester
3.	Zoology and Genetics– V & VI Semester
4.	BoS in Fashion and Apparel Design i. FAD – V & VI Semester ii. IDD– V & VI Semester
5.	Geography– V & VI Semester
6.	Mathematics– V & VI Semester
7.	Physics – V & VI
8.	BoS in Home Science i) Home Science – V & VI ii)Nutrition & Dietetics – V & VI iii)Clinical Nutrition & Dietetics – V & VI iv)Food Technology – I & II Sem

p.t.o

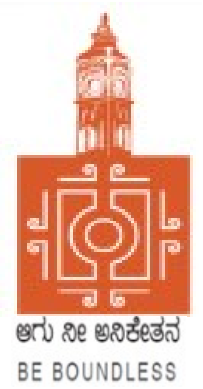
9.	Criminology and Forensic Science– V & VI
10.	Psychology– V & VI Semester
11.	Electronics – V & VI
12.	Statistics – V & VI
13.	Microbiology– V & VI
14.	Biotechnology– V & VI
15.	Environmental Science– V & VI

The detailed Syllabi for above subjects are notified in the University Website: www.bcu.ac.in for information of the concerned.

REGISTRAR

Copy to;

1. The Registrar(Evaluation), Dr. Manmohan Singh Bengaluru City University
2. The Dean, Faculty of Science, MSBCU.
3. The Principals of the concerned affiliated Colleges of MSBCU- through email.
4. The P.S. to Vice-Chancellor/Registrar/Registrar (Evaluation), MSBCU.
5. Office copy / Guard file / University Website: www.bcu.ac.in



Dr. MANMOHAN SINGH BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM
[As per SEP]

Syllabus for B.Sc.
Mathematics

2026-27 onwards

Name of the Degree Program: Bachelor of Science- BSc

Discipline Course: Mathematics

Starting Year of Implementation: 2026-27(V & VI Semester)

Programme Outcomes (PO): By the end of the program the students will be able to:

PO 1	**Disciplinary Knowledge:** Bachelor degree with Mathematics as one of subjects in chosen combination is the culmination of in-depth knowledge of Algebra, Calculus, Geometry, differential equations and several other branches of pure and applied mathematics. This also leads to study the related areas such as computer science and other allied subjects.
PO 2	**Communication Skills**: Ability to communicate various mathematical concepts effectively using examples and their geometrical visualization. The skills and knowledge gained in this program will lead to the proficiency in analytical reasoning which can be used for modeling and solving of real life problems.
PO 3	**Critical thinking and analytical reasoning:** The students undergoing this programme acquire ability of critical thinking and logical reasoning and capability of recognizing and distinguishing the various aspects of real life problems.
PO 4	**Problem Solving**: The Mathematical knowledge gained by the students through this programme develop an ability to analyze the problems, identify and define appropriate computing requirements for its solutions. This programme enhances students overall development and also equip them with mathematical modeling ability, problem solving skills.
PO 5	**Research related skills:** The completing this programme develop the capability of inquiring about appropriate questions relating to the Mathematical concepts in different areas of Mathematics.
PO 6	**Information/digital Literacy**: The completion of this programme will enable the learner to use appropriate software's to solve system of algebraic equation and differential equations.
PO 7	**Self – directed learning**: The student completing this program will develop ability of working independently and to make an in-depth study of various notions of Mathematics.
PO 8	**Moral and ethical awareness/reasoning:** The student completing this program will develop an ability to identify unethical behavior such as fabrication, falsification or misinterpretation of data and adopting objectives, unbiased and truthful actions in all aspects of life in general and Mathematical studies in particular.
PO 9	**Lifelong learning**: This programme provides self-directed learning and lifelong learning skills. This programme helps the learner to think independently and develop algorithms and computational skills for solving real word problems.
PO 10	Ability to peruse advanced studies and research in pure and applied Mathematical sciences.

Assessment

Weightage for the Assessments (in percentage)

Type of Course	Formative Assessment/I.A.	Summative Assessment (S.A.)
Theory	20%	80 %
Practical	20%	80 %
Projects	_	_
Experiential Learning (Internship etc.)	--	--

Syllabus for B.Sc. with Mathematics as Major Subject

SEMESTER – V

5.1: Algebra V and Numerical Analysis	
Teaching Hours : 4 Hours/Week	**Credits: 3**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-80+ I.A. – 20)**

Course Learning Outcomes:

The overall expectation from this course is that the student builds a basic understanding of fundamental concepts like rings, ideals homomorphism and isomorphisms. Numerical techniques for various computations such as finding roots, solving system of algebraic equations, finding the integrals and derivatives help in real world applications. Some broader course outcomes are listed as follows. At the end of this course, the student will be able to

1. Identify and analyze the algebraic structures such as ring, field, and integral domain.
2. Identify the ring Homomorphisim and Isomorphisims.
3. Understand the subject of various numerical methods that are used to obtain approximate solutions
4. Understand various finite difference concepts and interpolation methods.
5. Work out numerical differentiation and integration whenever and wherever routine methods are not applicable.
6. Find numerical solutions of ordinary differential equations by using various numerical methods.
7. Analyze and evaluate the accuracy of numerical methods.

Algebra - V

Unit I: Rings

Definition, properties and types of rings, Rings of integers modulo *n*, Subrings, Ideals - Principal, Prime and Maximal ideals in a commutative ring- standard properties and theorems, Ring Homomorphism, Isomorphism – properties, examples and theorems, Quotient rings, Integral Domains, Fundamental Theorem of Homomorphism of Rings. Fields – properties, examples and theorems. **(14 lecture hours)**

Numerical Analysis

Unit II: Polynomial Interpolations

Finite differences – Definition and properties of Δ , ∇ , δ and E, the relation between them, the *n*th differences of a polynomial, factorial notations, separation of symbols. Newton-

Gregory forward and backward interpolation formulae. Interpolation formulae for unequal intervals - Lagrange's formula and Newton's divided difference formula. Inverse interpolation. **(14 lecture hours)**

Unit - III: System of Linear Algebraic Equations

Numerical solutions of algebraic and Transcendental equations, method of successive bisection - method of false position, Newton-Raphson method, Secant Method. Numerical solutions of non-Homogeneous system of linear algebraic equations in three variables by Jacobi's method and Gauss-Seidel method. Computation of largest Eigenvalue of a square matrix by power method. **(14 lecture hours)**

Unit-IV: Numerical Differentiation and Integration

Derivation for derivatives of first and second order based on Newton-Gregory forward and backward interpolations and problems. Numerical Integration - General quadrature formula, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. Solutions of initial value problems for ordinary linear first order differential equations by Taylor's series, Euler's and Euler's modified method and Runge-Kutta 4th order method. **(14 lecture hours)**

Reference:

1. E. Isaacson and H. B. Keller, *Analysis of Numerical methods*, Dover Publications.
2. S. S. Sastry, *Introductory methods of Numerical Analysis*, 5th Edition, PHI learning private Limited.
3. E Kreyszig, *Advanced Engineering Mathematics*, Wiley India Pvt. Limited
4. B. S. Grewal, *Numerical Methods for Scientists and Engineers*, Khanna Publishers.
5. M. K. Jain, S. R. K. Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering computation*, 4th Edition, New Age International
6. H. C. Saxena, *Finite Difference and Numerical Analysis,* S. Chand Publishers
7. B. D. Gupta, *Numerical Analysis*, Konark Publishers Pvt. Ltd.
8. I. N. Herstein, *Topics in Algebra*, 2nd Edition, Wiley.
9. Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence (2003), Linear Algebra (4^{th} Edition), Printice-Hall of India Pvt. Ltd.

Web Links:

1. http://www.the mathpage.com
2. http://www.abstractmath.org
3. http://ocw.mit.edu/courses/mathematics/
4. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
5. https://nptel.ac.in/courses/109104124
6. https://www.geeksforgeeks.org/python-math-library-gamma-function/
7. https://ocw.mit.edu/courses/res-18-007-calculus-revisited multivariable-calculus-fall-2011/resources/lecture-6-equations-of-lines-planes/

5.2: Calculus III and Real Analysis II	
Teaching Hours : 4 Hours/Week	**Credits: 3**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-80+ I.A. – 20)**

Course Learning Outcomes: This course will enable the students to

1. Get introduced to the fundamentals of vector differential and integral calculus.
2. Get familiar with the various differential operators and their properties.
3. Get acquainted with the various techniques of vector integration.
4. Learn multiple integrals as a natural extension of definite integral to a function of two variables in the case of double integral / three variables in the case of triple integral.
5. Learn applications in terms of finding surface area by double integral and volume by triple integral.
6. Determine the gradient, divergence and curl of a vector and vector identities.
7. Evaluate line, surface and volume integrals.
8. understand relation between surface and volume integrals (Gauss divergence theorem), relation between line integral and double integral (Green's theorem), relation between line and surface integral (Stokes theorem)
9. Carry out certain computations such as improper integrals involving Beta and Gamma functions.

Calculus III

Unit – I: Geometry of space curves

Vector function of a scalar variable – interpretation as a space curve, derivative, tangent, normal and binormal vectors to a space curve; Curvature and Torsion of a space curve-definitions, derivation and problems, Serret - Frenet formulae.
Orthogonal curvilinear coordinates - relations between base vectors and normal vectors, reciprocity of these vectors, arc, area and volume element, specialization of Cartesian, cylindrical and spherical coordinates. **(14 lecture hours)**

Unit – II: Vector differential calculus

Scalar field - Gradient of a scalar field, geometrical meaning, directional derivative, unit normal on surfaces - tangent plane and normal to the surface, Vector field - divergence and curl of a vector, geometrical meaning, solenoidal and irrotational vectors, Laplacian and Vector identities. (**14 lecture hours)**

Unit III: Line And Multiple Integrals

Line integrals- Definition, basic properties, problems. Double integrals -Definition, problems, evaluation of double integrals by change of order of integration and by change of variables, computation of plane and surface areas using double integrals. Triple integrals-Definition, problems, change of variables, volume as a triple integral. **(14 lecture hours)**

Unit IV: Integral Theorems and Real Analysis II

Green's theorem (with proof) and evaluation problems. Divergence theorem (without proof) and evaluation problems. Stokes' theorem (without proof) and evaluation problems.

Beta-Gamma functions: Definitions, Properties and examples, relations between beta and gamma functions, standard theorems, evaluations of definite integrals, duplication formula and problems. **(14 lecture hours)**

Reference Books:

1. Robert J. T. Bell (1994). An Elementary Treatise on Coordinate Geometry of Three Dimensions. Macmillan India Ltd.
2. D. Chatterjee (2009). Analytical Geometry: Two and Three Dimensions. Narosa Publishing House.
3. M. D. Raisinghania, *Vector Calculus*, S Chand Co. Pvt. Ltd., 2013.
4. M. Spiegel, *Vector Analysis*, second Edition, Schaum's Outline Series, Mc-Graw Hill,Education, 2017.
5. C. E. Weatherburn, *Elementary Vector Analysis*, Alpha edition, 2019.
6. P. N. Wartikar and J. N. Wartikar, *A Textbook of Applied Mathematics*, Vol. II, Pune Vidyarthi Griha Prakashan, Pune, 2009.
7. C. E. Weatherburn, *Differential Geometry of Three Dimension*, Khosla Publishing House, 2020.
8. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers.

Web Links:

1. http://www.the mathpage.com
2. http://www.abstractmath.org
3. http://ocw.mit.edu/courses/mathematics/
4. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
5. https://nptel.ac.in/courses/109104124
6. https://www.geeksforgeeks.org/python-math-library-gamma-function/
7. https://ocw.mit.edu/courses/res-18-007-calculus-revisited multivariable-calculus-fall-2011/resources/lecture-6-equations-of-lines-planes/
8. www.python.org

V SEM Practicals: Algebra V, Numerical Analysis, Calculus III and Real Analysis II	
Teaching Hours : 3 Hours/Week	**Credits: 2**
Total Teaching Hours: 42 Hours	**Max. Marks: 50 (S.A.-40+ I.A. – 10)**

Course Outcomes: This course will enable students to

(1) Learn free and open source soft ware (FOSS) for computer programming
(2) Solve problems on rings and numerical methods by using FOSS software
(3) Acquire knowledge of application of numerical methods through FOSS
(4) solve problems related to differential geometry and multiple integrals and improper integrals

Programs:

1. Program to verify given ring is a commutative ring, ring with/without zero divisors, ring with/without unity.
2. Program to find the value of y(x) using Newton-Gregory forward / backward interpolation method.
3. Program to find root of an equation using bisection and Newton-Raphson method.

4. Program to solve system of algebraic equation using Gauss-Jacobi / Gauss-Seidel method.
5. Program to find differentiation at specified point using Newton-Gregory interpolation method.
6. Program to evaluate integral using Trapezoidal ,Simpson's 1/3 and 3/8 rules.
7. Solving ordinary differential equation by Runge-Kutta method of 4th order.
8. Program to find curvature and torsion of a space curve.
9. Program to find the gradient, divergence , curl and Laplacian .
10. Program to evaluate line integral with constant and variable limits.
11. Program to evaluate a double integral with constant and variable limits.
12. Program to evaluate a triple integral with constant and variable limits.
13. Program to evaluate line integral using Green's theorem.
14. Evaluation of the integrals using Beta and Gamma functions.

V SEM Skill Enhancement Course: Mathematical foundations of Machine Learning	
Teaching Hours : 3 Hours/Week	**Credits: 2**
Total Teaching Hours: 42 Hours	**Max. Marks: 50 (S.A.-40+ I.A. – 10)**

Course Outcomes (COs) After successful completion of this laboratory course, students will be able to: CO1: Apply fundamental Python libraries such as NumPy, Pandas, and Matplotlib for data handling, preprocessing, and visualization.
CO2: Represent real-world data using appropriate feature engineering techniques and perform normalization, standardization, and matrix-based transformations.
CO3: Demonstrate mathematical foundations of machine learning including linear algebra concepts such as matrices, eigenvalues, eigenvectors, and transformations.
CO4: Apply probability concepts and distributions, including Bayes' Rule, to model uncertainty in data-driven problems.
CO5: Implement and analyze core machine learning algorithms such as PCA, KNN, Linear Regression, and Decision Trees.
CO6: Evaluate model performance using appropriate metrics and understand concepts of training, testing, generalization, and overfitting.
CO7: Apply clustering and classification techniques such as K-Means, SVM, Logistic Regression, Naive Bayes, and Random Forest on real datasets.
CO8: Interpret results through visualization techniques and draw meaningful insights from data patterns and model outputs.

Programs on Mathematical foundations of Machine Learning
P1. Write a Python program to perform basic operations on datasets using libraries like NumPy and Pandas. Load a sample dataset and display summary statistics (mean, median, standard deviation).
P2. Write a Python program to load a dataset and identify different types of features (numerical, categorical) to perform feature extraction and represent the data in matrix form.
P3: Write a program to perform matrix addition, multiplication, and transpose using a dataset. Compute eigenvalues and eigenvectors of a matrix/covariance matrix.

P4: Write a program to apply linear transformation on a dataset using matrices and visualize the effect of transformation on 2D data points.
P5: Write a program to generate and plot different probability distributions (normal, uniform).
P6: Write a program to implement Baye's rule for a simple classification problem.
P7: Write a program to obtain Principal Component Analysis (PCA).
P8: Write a program to implement K-Nearest Neighbours (KNN) using a library to train the model on a classified dataset and test the model accuracy.
P9: Write a program to implement linear regression using a library and compute error metrics.
P10: Write a program to train a decision tree classifier on a dataset to visualize the decision tree structure and evaluate model accuracy.
P11: Write a program to implement K-Means Clustering on a dataset to visualize 2D-plots.
P12: Write a program to train a Linear Support Vector Machine (SVM) classifier on a dataset.
P13: Write a program to implement logistic regression for classification to plot decision boundary to evaluate model and confusion matrix.
P14: Write a program to implement Naive Baye's classifier on a dataset to calculate prior and likelihood probabilities.
P15: Write a program to train a Random Forest classifier on a dataset and analyze feature importance scores.

Reference Books:

1. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das
2. Tom Mitchell Machine Learning – Tom M. Mitchell
3. Pattern Recognition and Machine Learning – Christopher M. Bishop
4. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron
5. Machine Learning A Probabilistic Perspective – Kevin P. Murphy
6. Introduction to Machine Learning with Python – Andreas C. Müller & Sarah Guido
7. The Elements of Statistical Learning – Trevor Hastie, Robert Tibshirani, Jerome Friedman
8. Python for Data Analysis – Wes McKinney

9. Think Stats – Allen B. Downey
10. Machine Learning with Python – Manaranjan Pradhan, U Dinesh Kumar
11. Practical Machine Learning – Sunila Gollapudi

Syllabus for B.Sc. with Mathematics as Major Subject

SEMESTER – VI

6.1: Linear Algebra and Partial Differential Equations	
Teaching Hours : 4 Hours/Week	**Credits: 3**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-80+ I.A. – 20)**

Course Learning Outcomes:

The overall expectation from this course is that the student builds a basic understanding in few areas of linear algebra such as vector spaces, linear transformations and eigenvalue analysis. Some broader course outcomes are listed as follows.

1. Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.
2. Understand the concept of linear transformation and eigenvalue analysis.
3. Solve the partial differential equations of the first order and second order
4. Solve linear and non-linear partial differential equations using various methods; and apply these methods to solving some physical problems.
5. Solve Lagrange's equations by various methods, find integral Surface passing through a given curve and Surfaces orthogonal to a given system of Surfaces.
6. Find solutions of nonlinear partial differential equations of order one by using Char pit's method.
7. Understanding applications of wave equation, heat equation and Laplace equation.

Unit – I: Linear Algebra

Vector spaces - Definition, examples and properties; Subspaces - Examples, criterion for a sub- set to be a subspace and some properties; Linear Combination - Linear span, Linear dependence and Linear independence, basic properties of linear dependence and independence, techniques of determining linear dependence and independence in various vector spaces and related problems; Basis and dimension - Co-ordinates, ordered basis, basic properties of basis and dimension and subspace spanned by given set of vectors; Quotient space. Dimension of quotient space, Sum and Direct sum of subspaces - examples and properties**.** **(14 lecture hours)**

Unit – II: Linear Transformations

Linear transformation - Definition, examples, equivalent criteria, basic properties and matrix representation of linear transformations and change of basis matrix, similar matrices; Null space, Range space, rank nullity theorem-proof and related problems. Eigenvalues and eigenvectors of linear transformations. **(14 lecture hours)**

Partial Differential Equations

Unit III: Formation of a partial differential equations by elimination of arbitrary constants and functions, Solution of partial differential equations – Solution by Direct integration, Lagrange's linear equations of the form $Pp + Qq = R$, Standard types of first order non-linear partial differential equations, The integrals of the non-linear equation by Charpit's method.

(14 lecture hours)

Unit IV: Homogeneous linear partial differential equations with constant coefficients. Partial differential equations of the second order. Classification of second-order partial differential equations, canonical forms. Classification of second order linear equations as hyperbolic, parabolic and elliptic. Solutions of the Heat equation, Laplace equation and Wave equation using separation of variables. **(14 lecture hours)**

Reference Books:

1. H. T. H. Piaggio, Elementary Treatise on Differential Equations and their Applications, CBS Publisher & Distributors, Delhi,1985.
2. G. F. Simmons, Differential Equations, Tata McGraw Hill.
3. S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
4. M. D. Raisinghania, Ordinary Differential Equations & Partial Differential Equations,S. Chand & Company, New Delhi.
5. K. Sankara Rao, Introduction to Partial Differential Equations: PHI, Third Edition, 2015.
6.. I. N. Sneddean, Elements of Partial differential equations, McGraw-Hill International Editions, 1986.
7. R. Murray and L. Spiegal, Laplace Transforms, Schaum's Seri
8. Earl David Rainville and Philip Edward Bedient–A short course in Differential Equations, Prentice Hall College Div; 6th Edition.
9. Sathya Prakash, Mathematical Physics, S Chand and Sons, New Delhi.
10. Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence (2003), Linear Algebra (4th Edition), Printice-Hall of India Pvt. Ltd.
11. F. M. Stewart, *Introduction to Linear Algebra*, Dover Publications.
12. S. Kumaresan, *Linear Algebra*, Prentice Hall India Learning Private Limited.
13. Kenneth Hoffman & Ray Kunze (2015), Linear Algebra, (2nd Edition), Prentice Hall India Leaning Private Limited.
14. Vivek Sahai & Vikas Bist (2013), Linear Algebra (2nd Edition) Narosa Publishing.
15. T. K. Manicavasagam Pillai and K S Narayanan, Modern Algebra Volume 2.

Web Links:

1. http://www.the mathpage.com
2. http://www.abstractmath.org
3. http://ocw.mit.edu/courses/mathematics/
4. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
5. https://nptel.ac.in/courses/109104124
6. www.python.org
7. https://nptel.ac.in/courses/111101115
8. https://ocw.mit.edu/courses/res-18-008-calculus-revisited-complex-variables-differential-equations-and-linear-algebra-fall-2011/resources/ lecture-1-vector-spaces/
9. https://github.com/showell/abstract-algebra

6.2: Complex Analysis and Calculus of Variations	
Teaching Hours : 4 Hours/Week	**Credits: 3**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-80+ I.A. – 20)**

Course Learning Outcomes:

The overall expectation from this course is that the student builds a basic understanding on calculus of variations and complex analysis. The broader course outcomes are listed as follows. At the end of this course, the student will be able to:

1. Understand and apply fundamental concepts, including analytic functions, Cauchy-Riemann Equations, contour Integrals and series expansions
2. Prove some statements related to complex integral as well as in complex analysis
3. Carry out the existing algorithms to construct mathematical structures such as analytic functions.
4. Evaluate the utility of complex analysis in solving real world problems.
5. To solve problems in various mathematical and scientific contexts.
6. To understand the concept of conformal mapping and its applications.
7. Understand the concept of functionals Euler's Equation and applications.
8. Explain Brachistochrone problem, variational problem, Isoperimetric problem.

Complex Analysis

Unit – I: Complex numbers and functions of complex variables

Complex numbers-Cartesian and polar form, geometrical representation, complex-plane, Euler's formula- $e^{ix} = cosx + i\,sinx$. Functions of a complex variable-limit, continuity and differentiability of a complex function. Analytic function, Cauchy-Riemann equations in Cartesian and Polar forms with proofs. Harmonic function, Orthogonality of analytic functions-construction of analytic function when real or imaginary part is given, Milne Thomson method. **(14 lecture hours)**

Unit-II: Complex Integration

Definition, Line integral, properties and problems. Cauchy's Integral theorem-proof using Green's theorem-direct consequences. Cauchy's Integral formula with proof, Cauchy's generalized formula for derivatives with proof and applications for evaluation of simple line integrals. Cauchy's inequality with proof, Liouville's theorem with proof, fundamental theorem of algebra with proof. **(14 lecture hours)**

Unit –III: Complex Transformations

Transformations: Definition - Conformal, isogonal mappings. Elementary transformations- Identity, Reflection, Translation, Rotation, Inversion. Bilinear transformation- Cross-ratio of four points- Theorems on cross-ratio preserving property- Transformationsof the family of straight lines and circles. Discussion of standard transformations- $w = sinz$, $w = cosz$, $w = coshz$, $w = sinhz$, $w = e^z$, $w = 1/2(z+1/z)$ and $w = z^2$. **(14 lecture hours)**

Unit-IV: Calculus of Variations

Definitions-Variation of a function $f = f(x,y,y')$-variation of corresponding functional, extremal of a functional, variational problem, Euler's equation and particular forms, examples, standard problems - geodesics, minimal surface of revolution, hanging chain problem, Brachistochrone problem, isoperimetric problem. **(14 lecture hours)**

References:

1. G. E. Andrews, R Askey, R Roy, Special Functions, CUP, Cambridge
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, New Delhi
3. S. C. Malik, Real Analysis, New Age Internationals (India), I edition, 1982.
4. N. P. Bali, Real Analysis Golden Series, 2013.S
5. L.V. Ahlfors, Complex Analysis, 3rd Edition, McGraw Hill Education
6. B. P. Palka, Introduction to the Theory of Function of a Complex Variable, Springer
7. S. Lang, Complex Analysis, Springer
8. S. Shanthinarayan, Theory of Functions of a Complex Variable, S. Chand Publishers.
9. S. Ponnuswamy, Foundations of Complex Analysis, 2nd Edition, Alpha Science international Limited.
10. R. V. Churchil & J.W. Brown, Complex Variables and Applications, 5th ed, McGraw Hill Companies.
11. T. K. Manicavasagam Pillai and K S Narayanan, Modern Algebra Volume 2.

Web Links:

1. http://www.the mathpage.com
2. http://www.abstractmath.org
3. http://ocw.mit.edu/courses/mathematics/
4. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
5. https://nptel.ac.in/courses/109104124
6. www.python.org
7. https://nptel.ac.in/courses/111101115

VI SEM Practicals: Linear Algebra, Partial Differential Equation, Complex Analysis and Calculus of Variations	
Teaching Hours : 3 Hours/Week	**Credits: 2**
Total Teaching Hours: 42 Hours	**Max. Marks: 50 (S.A.-40+ I.A. – 10)**

This course will enable students to

(1) Learn free and open source soft ware (FOSS) for computer programming
(2) Solve problems on linear algebra and partial differential equations using FOSS software
(3) Acquire knowledge of application of linear algebra and partial differential equations through FOSS software
(4) solve problems complex analysis and calculus of variations using FOSS software
(5) Acquire knowledge of application of complex analysis and calculus of variations through FOSS software

Programs:

1. Program on linear combination, linear dependence and independence of vectors .
2. Program to find basis and dimension of the subspaces.
3. Program to verify if a function is linear transformation or not.
4. Program to find the matrix of linear transformation.

5. Solutions of linear partial differential equations of type 1 to type 4.

6. Solutions of Second order non-homogenous partial differential equation with constant coefficients.

7. Solution of one dimensional heat /wave equation using Fourier series with Dirichlet condition.

8. Program on verification of Cauchy – Riemann equations (Cartesian form) to test analyticity.

9. Program to check whether a function is harmonic or not.

10. Program to construct analytic functions through Milne–Thompson method when real part/ imaginary part is given.

11. Verification of problems on Cauchy's integral formula.

12. Program to find bilinear transformation.

13. Program to verify variational problem using Euler's equation.

14. Program to verify variational problems using particular forms of Euler's equation with equations independent of *y*.

VI SEM Skill Enhancement Course: Internship/ Project	
Teaching Hours : 3 Hours/Week	**Credits: 2**
Total Teaching Hours: 42 Hours	**Max. Marks: 50 (S.A.-40+ I.A. – 10)**