MANGALORE UNIVERSITY

Mathematics Syllabus for B. Sc. Choice Based Credit System Programme from the academic year 2019-20

(Semester Scheme)

Preamble:

The Mathematics syllabus for B. Sc. (Credit Based Semester System) in use at present was introduced from the academic year 2014-15. As per the directions and guidelines of the University Grants Commission, and also with instructions from the Higher Education Council of Government of Karnataka, the Mangalore University has recently framed the regulations governing the Choice Based Credit System for the undergraduate graduate degree programmes so as to enable its programmes to be on par with global standards. Hence the following revised and restructured syllabus for the Mathematics as an optional subject in B.Sc. Choice Based Credit System programme has been prepared as per the new regulations of the University, by modifying the earlier syllabus, including Lab components and introducing new text and reference books. The Board observed that many universities in Karnataka have included Lab components in Mathematics subject of their B.Sc. programmes. The following new syllabus for Mathematics as an optional subject in the B.Sc.(Choice Based Credit System) of Mangalore University, framed by the U.G.B.O.S., has also taken into consideration the syllabus recommended by the UGC curriculum development committee and syllabi of other Universities of Karnataka. The syllabus is meant to be introduced from the academic year 2019-20.

Aims and objectives of introducing new syllabus

- To give greater exposure to the syllabus through open electives
- To improve the perspective of students on mathematics as per modern requirement
- To develop a spirit of inquiry and scientific temper in the student
- To initiate students to enjoy mathematics, pose and solve meaningful problems, to use abstraction to perceive relationships and structure and to understand the basic structure of mathematics
- To make learning process student-friendly
- To foster experimental, problem-oriented and discovery learning of mathematics
- To orient students towards relating mathematics applications
- To improve retention of mathematical concepts in the student
- To enable the teacher to demonstrate, explain and reinforce abstract mathematical ideas by using concrete objects, models, charts, graphs, pictures, posters with the help of FOSS tools on a computer
- To provide scope for greater involvement of both the mind and the hand
- To help the student build interest and confidence in learning the subject

CHOICE BASED CREDIT SYSTEM
COURSE PATTERN AND SCHEME OF EXAMINATION
CORE SUBJECT: MATHEMATICS

		Particulars	Instruction Hours/Week	Duration of Exams	Marks			Credits
					IA	Exam	Total	
I Semester B.Sc.								
Group I Core Subject	Theory BSCMTC131	Course I	4	3	20	80	100	2
	Practical BSCMTP132	Lab I	3	3	10	40	50	1
Group II Core Elective	Theory BSCMTCE133	Course A	2	2	10	40	50	1*
Total number of Credits for Core Subject in I Semester: 04								
II Semester B.Sc.								
Group I Core Subject	Theory BSCMTC181	Course II	4	3	20	80	100	2
	Practical BSCMTP182	Lab II	3	3	10	40	50	1
Group II Core Elective	Theory BSCMTCE183	Course B	2	2	10	40	50	1*
Total number of Credits for Core Subject in II Semester: 04								
III Semester B.Sc.								
Group I Core Subject	Theory BSCMTC231	Course III	4	3	20	80	100	2
	Practical BSCMTP232	Lab III	3	3	10	40	50	1
Group II Core Elective	Theory BSCMTCE233	Course C	2	2	10	40	50	1*
Total number of Credits for Core Subject in III Semester: 04								
IV Semester B.Sc.								
Group I Core Subject	Theory BSCMTC281	Course IV	4	3	20	80	100	2
	Practical BSCMTP282	Lab IV	3	3	10	40	50	1
Group II Open Elective	Theory BSCMTOE283	Course D	2	2	10	40	50	1*
Total number of Credits for Core Subject in IV Semester: 04								
V Semester B.Sc.								
Group I Core Subject	Theory BSCMTC331	Course V	3	3	20	80	100	2
	Theory BSCMTC332 / BSCMTC333	Course VI(a) / Course VI(b)	3	3	20	80	100	2
	Practical BSCMTP334	Lab V	4	3	10	40	50	2
Total number of Credits for Core Subject in V Semester: 06								
VI Semester B.Sc.								
Group I Core Subject	Theory BSCMTC381	Course VII	3	3	20	80	100	2
	Theory BSCMTC382 / BSCMTC383 / BSCMTC384	Course VIII(a) / Course VIII(b) / Course VIII(c)	3	3	20	80	100	2
	Practical BSCMTP385	Lab VI	4	3	10	40	50	2
Total number of Credits for Core Subject in VI Semester: 06								
Total number of Credits for Core Subject in I-VI Semesters: 28								

*Credits for Elective Courses will be considered for the entire B.Sc. Programme

Note:

1. Group I: For 5th and 6th semesters, Course V and Course VII respectively are compulsory Courses. In the 5th semester, a student has to choose one of the special Courses either VI(a) or VI(b). In the 6th semester, a student has to choose one of the special Courses from VIII(a), VIII(b), and VIII(c).

2. Group II: The student can opt any one of the elective courses (Course A to D) in each semester (I - IV). The core elective courses A, B and C can be taken by B Sc. students studying Mathematics, as one of the core elective subjects in group II. The open elective course D is for students of other streams in group II.

Group I

I Semester

BSCMTC131	Course I: Calculus and Analytical Geometry	2 Credits (48 Hours, 4 hours/week)

Unit I (12 Hours)

(Recapitulation: Increasing decreasing functions, critical points, local extrema). Rolle's Theorem, The mean value theorem. Concavity, Points of inflection, Second derivative test for concavity, Second derivatives test for local extrema, Asymptotes (horizontal, vertical and oblique), Sketching curves $y = f(x)$, Applied Optimization Problems.

Unit II (12 Hours)

Integration: Upper and Lower Riemann sums, Limits of Riemann sums, definite integrals, Integrable and non-integrable functions, Area under the graph of a non-negative function, Average value of a continuous function, Mean value theorem for definite integrals, Fundamental theorem of calculus (Part 1 and 2).

Derivation of reduction formulae for $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \log^n x\,dx$, $\int \sec^n x\,dx$, $\int \sin^n x\,\cos^m x\,dx$, etc. Evaluation of integrals using reduction formulae.

Unit III (12 Hours)

Functions of several variables: Domain, Range, Interior points, Boundary points, Closed, Open, Bounded and unbounded regions in the plane, Level curves and Level surfaces. Limits and Continuity, Two-Path tests for non-existence of limits, Partial derivatives, Implicit partial differentiation, Partial derivatives and continuity, Higher order partial derivatives, Mixed derivative theorem, Differentiability, Chain rule for differentiation.

Unit IV (12 Hours)

Conic sections : Conic sections and Quadratic equations (Recapitulation: Standard forms of equations of conics), Asymptotes of Hyperbolas and graphing, Shifting conic sections, Classifying conic sections by eccentricity, Quadratic equations and Rotations - The cross product term, Angle of rotation, Removal of cross product term, Discriminant test.

References

[1] Maurice D. Weir, George B. Thomas, Jr., Joel Hass, Frank R. Giordano, *Thomas' Calculus*, 11th Ed., Pearson, 2008.

[2] Louis Leithold, *Calculus with Analytic Geometry*, 5th Ed., Harper and Row International, 1986.

[3] George B. Thomas and Ross L. Finney, *Calculus and Analytic Geometry*, Addison-Wesley, 1992.

[4] Joseph Edwards, *Integral Calculus for Beginners*, Arihant Publishers, 2016 (original 1896).

BSCMTP132	Lab I	1 Credit

Practicals for I Semester

Practicals: Lab I

Mathematics practicals with Free and Open Source Software (FOSS) tools for computer programs

1) Introduction to Scilab.

2) Introduction to Maxima.

3) Commands for plotting functions in Scilab/Maxima.

4) Plotting of standard Cartesian curves using Scilab/Maxima-I.

5) Plotting of standard Cartesian curves using Scilab/Maxima-II.

6) Continuous and discontinuous functions using Scilab/Maxima.

7) Left hand and right hand limits using Scilab /Maxima.

8) Differentiability using Scilab/ Maxima.

9) Techniques of Integration in SciLab/Maxima.

10) Maxima commands for reduction formula with or without limits.

11) Solutions of optimization problems.

12) Integration of functions.

13) Obtaining partial derivative of some standard functions.

14) Conic sections, Rotation of Conics.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

II Semester

BSCMTC181	Course II: Number Theory and Calculus	2 Credits (48 Hours, 4 hours/week)

Unit I (12 Hours)

Number Theory: Division Algorithm, The Greatest Common Divisor (g.c.d), Euclidean Algorithm, Diophantine Equations, Fundamental Theorem of Arithmetic.

The Theory of Congruences, Basic Properties of Congruences, Binary and Decimal Representation of Integers.

Unit II (12 Hours)

Number Theory: Linear Congruences and The Chinese Remainder Theorem, Fermat's Theorem, Wilson's Theorem, Quadratic Congruence.

Euler's Phi-Function, Euler's Theorem, Some Properties of Phi-Function.

Unit III (12 Hours)

Calculus: Cauchy's Mean Value Theorem, Indeterminate Forms (all types), L'Hospital's Rules (First form and stronger form), Taylor Series, Maclaurin's series.

Vector Calculus: Directional Derivatives, Gradient of Functions of Two or Three Variables, Properties of Directional Derivatives, Gradients and Tangents to Level Curves, Level Surfaces, Tangent Planes and Normal Lines to Level Surfaces.

Unit IV (12 Hours)

Polar coordinates: Relating Cartesian and Polar Equations, Graphing in Polar Coordinates, Symmetry, Test for Symmetry, Slope of Curves. Areas and Lengths in Polar Coordinates: Area in the Plane, Area Between the Curves, Length of a Polar Curve.

Multiple Integrals: Doubles Integrals over Rectangles, Double Integrals as Volume, The Fubini's Theorem (First Form), Double Integrals over Bounded Non-rectangular Regions, Fubini's Theorem (Stronger Form), Finding Limits of Integration, Properties of Double Integrals. Reversing the Order of Integration.

References

[1] David M. Burton., *Elementary Number Theory*, 7th Ed., McGraw Hill, 2011.

[2] Gareth A. Jones and J. Marry Jones, *Elementary Number Theory*, Springer, 1998.

[3] Maurice D. Weir, George B. Thomas, Jr., Joel Hass, Frank R. Giordano, *Thomas' Calculus*, 11th Ed., Pearson, 2008.

[4] Louis Leithold, *Calculus with Analytic Geometry*, 5th Ed., Harper and Row International, 1986.

BSCMTP182	Lab II	1 Credit

Practicals for II Semester

Practicals: Lab II

Mathematics practicals with Free and Open Source Software (FOSS) tools for computer programs

1) Euclidean Algorithm.

2) Divisibility tests.

3) Solving system of congruences.

4) Euler's Phi-function.

5) Plotting polar curves.

6) Plotting standard parametric curves.

7) Evaluation of indeterminate forms.

8) Verification of Cauchy's mean value theorem.

9) nth derivatives.

10) Evaluation of limits by L'Hospital's rule.

11) Finding Taylor/Maclaurin series.

12) Evaluation of the double integral with variable limits.

13) Level curves and level surfaces.

14) To demonstrate the physical interpretation of gradient, divergence and curl.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

III Semester

BSCMTC231	Course III: Sequences, Series and Differential Equations	2 Credits (48 Hours, 4 hours/week)

Unit I (12 Hours)

Sequences: Functions, Sequences, The range, Bounds of a sequence, Convergence of sequences, Some theorems, Limit points of a sequence, Convergent sequences, Non-convergent sequences, Cauchy's general principle of convergence, Algebra of sequences, Some important Theorems, Monotonic sequences, Subsequences.

Unit II (12 Hours)

Infinite Series: A necessary conditin for convergence, Cauchy's general principle of convergence for series, Some preliminary theorems, Positive term series, Geometric series, A comparision test, Comparision tests for positive term series (first and second type), Cauchy root test, D'Alembert's test, Raabe's test, Logarithmic test, Integral test, Cauchy's integral test,

Alternating series, Absolute convergence, Conditional Convergence.

Unit III (12 Hours)
Differential Equations: (Recapitulation of Variable separable and homogeneous equations, Linear equation of order one). Exact equations, Integrating factors found by inspection, The determination of integrating factors, Bernoulli's equation, Co-efficients linear in the two variables.
Applications: Velocity of escape from the earth, Newton's law of cooling, Simple chemical conversions, Orthogonal trajectories - rectangular co-ordinates, Orthogonal trajectories - polar co-ordinates.

Unit IV (12 Hours)
Differential Equations: Linear equation with constant coefficients: Definition, operator D, complementary function of a linear equation with constant coefficients, Particular integral, General method of finding particular integral, Special methods for finding particular integral when RHS of the non-homogeneous differential equation is of the form: e^{ax}, $\cos ax$, $\sin ax$, x^m. Linear equations with variable coefficients. Special methods to solve any second order equation: (i) Reduction to normal form, (ii) Change of independent variable, (iii) Reduction of order, (iv) Variation of parameters.

References

[1] S.C Mallik, *Principles of Real Analysis*, New Age International Publications, 2008.

[2] Maurice D. Weir, George B. Thomas, Jr., Joel Hass, Frank R. Giordano, *Thomas' Calculus*, 11th Ed., Pearson, 2008.

[3] Donald R. Sherbert and Robert G. Bartle, *Introduction to Real Analysis*, 4th Ed., John Wiley & sons, 2011.

[4] Ajith Kumar and S. Kumaresan, *A Basic Course in Real Analysis*, CRC Press, 2014.

[5] Earl D Rainville and Philip E Bedient, *A Short Course in Differential Equations*, Macmillan Ltd., 4th Ed., 1969.

[6] Narayanan and Manicavachagom Pillay, *Differential Equations*, Viswanathan (Printers and Publisher) PVT Ltd., 1991.

[7] William E. Boyce, Richard C. DiPrima, *Elementary Differential Equations*, 10th Ed., Wiley Publishers, 2012.

BSCMTP232	Lab III	1 Credit

Practicals for III Semester

Practicals: Lab III

Mathematics practicals with Free and Open Source Software (FOSS) tools for computer programs

1) Illustration of convergent, divergent and oscillatory sequences.

2) Illustration of convergent, divergent and oscillatory series.

3) Programs to find the sum of the series.

4) Using Cauchy's criterion to determine convergence of a sequence (simple examples).

5) Using Cauchy's criterion on the sequence of partial sums of the series to determine convergence of a series.

6) Testing the convergence of binomial, exponential and logarithmic series and finding the sum.

7) Solution of Differential equation and plotting the solution - I.

8) Solution of Differential equation and plotting the solution - II.

9) Solution of Differential equation and plotting the solution - III.

10) Solution of Differential equation and plotting the solution - IV.

11) Solution of Differential equation and plotting the solution - V.

12) Solution of Differential equation and plotting the solution - VI.

13) Determination and Plotting of Orthogonal trajectories.

14) Applications of differential equations.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

IV Semester

BSCMTC281	Course IV: Algebra and Complex Analysis	2 Credits (48 Hours, 4 hours/week)

Unit I (12 Hours)

Group Theory: Binary Operations, Associativity, Commutativity, Examples for Binary Operations, Definition of a Group, Examples, Right inverse, Left inverse, Some properties, Abelian and Non-abelian groups, Laws of exponents, Subgroups, Intersection of subgroups, Centralizer of an element, Normalizer of a subgroup, Product of subgroups, Order of products of subgroups, Cyclic groups, Properties, Number of generators.

Unit II (12 Hours)

Group Theory: Permutation groups, Transpositions, Cycles, Cayley's theorem. Cosets, Lagrange's theorem, Index of a subgroup, Homomorphism, Kernel of a homomorphism, Properties of homomorphic images of groups, Isomorphism, Automorphisms, Normal subgroups, Quotient groups, First isomorphism theorem.

Unit III (12 Hours)

Complex Analysis: (Recapitulation of algebra of Complex numbers.) Polar and Exponential Forms, Powers and roots, Functions of a Complex variable, Limits, Continuity, Differentiability, Cauchy Riemann Equations, Analytic functions, Entire functions.

Unit IV (12 Hours)

Complex Analysis: Harmonic functions, Elementary functions: Exponential function, Trigonometric functions, Hyperbolic functions and Logarithmic functions.

References

[1] N. S Gopalakrishnan, *University Algebra*, 3rd Ed., New Age International Publications, 2015.

[2] G. D. Birkoff and S Maclane, *A brief Survey of Modern Algebra*, 2nd Ed., IBH Publishing Company, Bombay, 1967.

[3] Joseph Gallian, *Contemporary Abstract Algebra*, Narosa, 1999.

[4] I. N. Herstein, *Topics In Algebra*, 2nd Ed., Wiley Publishers, 1975.

[5] James Ward Brown, Ruel V. Churchil, *Complex Variables and Applications*, 8th Ed., Mc Graw Hill Publications, 2009.

[6] H.S. Kasana, *Complex variables theory and applications*, 2nd Ed., PHI Learning Pvt Ltd., New Delhi, 2005.

BSCMTP282	Lab IV	1 Credit

Practicals for IV Semester

Practicals: Lab IV

Mathematics practicals with Free and Open Source Software (FOSS) tools for computer programs

1) Verifying whether given operation is binary or not.

2) (i) To find identity element of a group.
   (ii) To find inverse element of a group.

3) Finding all possible subgroups of a finite group.

4) Examples to verify Lagrange's theorem.

5) Examples for finding left and right coset and finding the index of a group.

6) Finding generators of a cyclic group and computation of quotient group.

7) Determination of center and all possible normal subgroups of groups.

8) Some problems on Cauchy-Riemann equations (Cartesian and polar form).

9) Implementation of methods of constructing analytic functions(simple examples).

10) Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function.

11) Verifying real and imaginary parts of an analytic function being harmonic (in polar coordinates).

12) Illustrating the angle preserving property of simple entire functions such as $z^2, \exp(z)$, etc.,

13) Showing nth roots of unity is a group and plotting them on the unit circle.

14) Branches of the multiple valued functions: $\sqrt{z}$ and $\log z$.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

V Semester

BSCMTC331	Course V: Algebra and Laplace Transforms (Compulsory Course)	2 Credits (36 Hours, 3 hours/week)

Unit I (12 Hours)

Rings and Fields: Rings, unit element, commutative ring, Properties. Zero divisors, Integral domains (finite and infinite), Fields (finite and infinite).

Vector spaces: Vector spaces, Subspaces, Linear span, Sum of subspaces, Direct sum of subspaces, Linear dependence and independence, Bases, Generating sets, Minimal generating sets, Maximal linearly independent sets, Dimension.

Unit II (12 Hours)

Vector spaces: Extending a linearly independent set to a basis, Extracting a basis from a generating set, Dimensions and bases of subspaces. Inner product spaces, Schwarz inequality, Orthonormal sets, Gram Schmidt's orthogonalization process, Orthogonal complement of a subspace.

Unit III (12 Hours)

Laplace transforms: Transforms of elementary functions, Transforms of derivatives, Derivatives of the transforms of the gamma function, Periodic functions.

Inverse transforms: A step function, Convolution theorem, Simple initial value problems, Spring problems.

References

[1] N. S Gopalakrishnan, *University Algebra*, 3rd Ed., New Age International Publications, 2015.

[2] G. D. Birkoff and S Maclane, *A brief Survey of Modern Algebra*, 2nd Ed., IBH Publishing Company, Bombay, 1967

[3] Joseph Gallian, *Contemporary Abstract Algebra*, Narosa, 1999

[4] I. N. Herstein, *Topics In Algebra*, 2nd Ed., Wiley Publishers, 1975.

[5] Earl D Rainville and Philip E Bedient, *A Short Course in Differential Equations*, Macmillan Ltd., 4th Ed., 1969.

[6] Erwin Kreyszig, *Advanced Engineering Mathematics*, 8th Ed., Wiley Eastern, 2011.

BSCMTC332	Course VI(a): Graph Theory (Special Course)	2 Credits (36 Hours, 3 hours/week)

Unit I (12 Hours)

Definition of graph and examples, incidence and degree, subgraphs, isomorphism, complement of a graph, operation on graphs. Walks, trails and paths, connectedness and components, cut-points and bridges, blocks.

Unit II (12 Hours)

Eulerian graphs, Konigsburg bridge problem, Hamiltonian graphs. Trees, characteristics of

trees, center of a tree. Planarity of Graphs.

Unit III (12 Hours)
Colourability, chromatic number, Chromatic Polynomial, five-colour theorem, four-colour problem. Matrix associated with graphs: Incidence matrix, Adjacency matrix.

References

[1] S. Arumugam and S. Ramachandran, *Invitation to graph theory*, Scitech Publications (India) Pvt. Ltd., 2013.

[2] Narsingh Deo, *Graph Theory with Applications to Engineering and Computer Science*, PHI Learning Private Limited, 2004.

[3] Douglas B. West, *Introduction to Graph Theory*, Pearson, 2017.

[4] K.Chandrasekhara Rao, *Discrete Mathematics*, Narosa Publishing House, 2012.

[5] John Clark, D.A. Holton, *A first look at Graph Theory*, World Scientific, 1991.

[6] Robin J Wilson, *Introduction to Graph Theory*, 5th Ed., Pearson, 2010.

BSCMTC333	Course VI(b): Discrete Mathematics (Special Course)	2 Credits (36 Hours, 3 hours/week)

Unit I (12 Hours)
Graphs and Planar Graphs: Introduction, Basic terminology, Multigraphs and Weighted graphs, Digraphs and relations, Representation of graphs, Operations on graphs, Paths and circuits, Eulerian paths and circuits, Hamiltonian paths and circuits, Planar graphs, Graph colouring.

Unit II (12 Hours)
Trees and Cut-sets: Trees, Rooted trees, Path lengths in rooted trees, Prefix codes, Spanning trees and cut-sets, Minimum spanning trees; Kruskal's Algorithm, Prim's algorithm, Shortest path Alogrithms.

Unit III (12 Hours)
Discrete numeric functions and Generating functions: Introduction, Manipulation of numeric functions, Asymptotic behavior of numeric functions, Generating functions.
Recurrence relations and Recursive Algorithms: Introduction, Recurrence relations, Linear recurrence relations with constant coefficients, Homogeneous solutions, Particular solutions.

References

[1] C. L. Liu and D P Mohapatra, *Elements of Discrete Mathematics - A Computer Oriented Approach*, 4th Ed., Tata Macgraw Hill Publishers, 2013.

[2] J. P. Trembley and R. Manohar, *Discrete Mathematical Structures with Applications to Computer Science*, Tata Magraw Hill Publishers, 1975.

[3] K. Chandrasekhara Rao, *Discrete Mathematics*, Narosa Publishing House, 2012.

[4] Swapan Kumar Sarkar, *A Text Book of Discrete Mathematics*, S Chand and Company, New Delhi, 2008.

[5] J. K. Truss, *Discrete Mathematics for Computer Scientists*, Addison Wesley, 1999.

BSCMTP334	Lab V	2 Credits

Practicals for V Semester

Practicals: Lab V

Mathematics practicals with Free and Open Source Software (FOSS) tools for computer programs

1) Examples on different types of rings.

2) Finding zero divisors and units in finite rings.

3) Examples of integral domains and fields, and construction of finite fields.

4) Vector space, subspace – illustrative examples.

5) Examples on linear dependence and independence of vectors.

6) Generating sets, Basis and Dimension – illustrative examples.

7) Finding an orthonormal basis from given basis of an real inner product space.

8) Implementing Gram-Schmidt's orthogonalization process.

9) Finding orthogonal complements of subspaces in inner product sapces.

10) Finding the Laplace transforms of some standard functions.

11) Functions of Class-A and Properties of gamma function.

12) Finding the inverse Laplace transform of simple functions.

13) Implementing Laplace transform method of solving ordinary linear differential equations of first and second order with constant coefficient.

14) Solving spring problems.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

VI Semester

BSCMTC381	Course VII: Numerical Analysis (Compulsory Course)	2 Credits (36 Hours, 3 hours/week)

Unit I (12 Hours)

Errors in Computation: Accuracy of numbers, Errors, Useful rules for estimating errors, Error propagations, Error in the approximation of a function. Errors in a series approximation. Solutions of Algebraic and Transcendental Equations: Initial approximation, Bisection method, Regula-falsi method, Iteration method, Newton-Raphson method.

Solution of linear homogeneous equations: Direct Methods - Gauss elimination method,

Gauss-Jordan method. Iterative methods of solution - Jacobi's iteration method, Gauss-Seidel iteration method.

Unit II (12 Hours)
Finite differences: Introduction, Finite differences, differences of a polynomial, to find one or more missing terms. Interpolation: Introduction, Newton's forward interpolation formula, Newton's backward interpolation formula, Interpolation with unequal intervals, Lagrange's interpolation formula. Divided differences: Newtonís divided difference formula, Inverse interpolation. Numerical differentiation - Formulae for derivatives using forward difference, and backward difference formulae, Maximum and minimum values of a tabulated function.

Unit III (12 Hours)
Numerical integration: General formula, Trapezoidal rule, Simpson's 1/3 - rule, Simpson's 3/8 - rule.
Numerical Solution of Ordinary Differential Equations: Introduction, Solution by Taylor's series method, Picard's method, Euler's method, Modified Euler's method, Runge-Kutta Methods, Predictor-Corrector Methods - Adam's Bashforth Method.

References

[1] S. S. Sastry, *Introductory Methods of Numerical Analysis*, 4th Ed., PHI Learning Pvt Ltd., 2009.

[2] Dr. B .S. Grewal, *Numerical methods in Engineering and Science with Programs in C, C++*, 9th Ed., Khanna Publications, New Delhi, 2010.

[3] T. Veerarajan and T. Ramachandran, *Numerical Methods*, Sigma series, Tata McGraw-Hill Education, 2007.

[4] Erwin Kreyszig, *Advanced Engineering Mathematics*, 8th Ed., Wiley Eastern, 2011.

[5] Abhishek Gupta, *Numerical Methods using MATLAB*, Apress, 2015.

BSCMTC382	Course VIII(a): Linear Algebra (Special Course)	2 Credits (36 Hours, 3 hours/week)

Unit I (12 Hours)
Linear transformations : Kernel, Isomorphism of any n-dimensional space and $\mathbb{F}^n$, Quotient space, Dimension of quotient space, Vector space structure of $L(V,\ V')$.
Matrices and linear transformations: Idempotent, Nilpotent, Diagonal, Triangular, Singular, Non-singular matrices, Matrix of a linear transformation, Isomorphism between $L(V,\ V')$ and $M_{mn}(\mathbb{F})$, Relation between matrices of a linear transformation with respect to two different bases, Rank of a matrix.

Unit II (12 Hours)
Matrices: Elementary row and column operations, Row reduced echelon form of a matrix, Finding rank of a matrix and inverse of a non-singular matrix by row reducing, Rank and nullity of linear transformations and matrices.
Linear equations: Homogeneous and non-homogeneous equations, Testing consistency and

solving a system of linear equations.

Unit III (12 Hours)
Minimal Polynomial of a matrix, Minimal polynomial of a Linear transformation, Characteristic roots and characteristic vectors, Cayley Hamilton theorem and applications.

References

[1] N. S Gopalakrishnan, *University Algebra*, 3^{rd} edition, New Age International Publications, 2015.

[2] G. D. Birkoff and S Maclane, *A brief Survey of Modern Algebra*, 2nd Ed, IBH Publishing Company, Bombay, 1967.

[3] Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra*, 4th Ed., Prentice - Hall of India Pvt. Ltd., New Delhi, 2004.

[4] Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, New Delhi, 1999.

[5] Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007

[6] S. Kumaresan, *Linear Algebra- A Geometric Approach*, Prentice Hall of India, 1999

BSCMTC383	Course VIII(b): Linear Programming (Special Course)	2 Credits (36 Hours, 3 hours/week)

Unit I (12 Hours)
Mathematical formulation of the problem, Graphical method of solving LPP, Simplex algorithm, Non canonical LPP.

Unit II (12 Hours)
Duality equation, Duality theorem, Dual non-canonical LPP, Matrix games, Two Persons Zero sum Matrix game, The Von Neumann Minimax theorem.

Unit III (12 Hours)
Transportation problems: The balanced Transportation Problem, Vogel Advance start Method, Transportation algorithm, Unbalanced Transportation problem.
Assignment problem: The Hungarian Algorithm, Network-Flow problem, The Max-Flow Min-Cut theorems, The Maximal flow algorithm.

References

[1] P. M. Karak, *Linear programming and theory of games*, New central book agency (P) ltd., 2012.

[2] James K. Strayer, *Linear Programming and its Applications*, Springer-Verlag, 1989.

[3] Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.

[4] F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research - Concepts and Cases*, 9th Ed., Tata McGraw Hill, 2010.

[5] Hamdy A. Taha, *Operations Research - An Introduction*, 9th Ed., Prentice - Hall, 2010.

BSCMTC384	Course VIII(c): Partial Differential Equations (Special Course)	2 Credits (36 Hours, 3 hours/week)

Unit I (12 Hours)

Total Differential Equations: Total Differential forms and Total Differential equations and solutions.

Unit II (12 Hours)

Partial Differential Equations of the First Order: Classification of Integrals, Derivation (Origin) of Partial Differential Equations, Lagrange's Method of Solving the Linear Equations, Charpit's Method, Special types of first order equations.

Unit III (12 Hours)

Higher Order Partial Differential Equations: Origin of the second order differential Equations, Classification of Second Order Partial Differential Equations, Linear Partial Differential Equations with constant Coefficients.

References

[1] I. N. Snedon, *Elements of Partial Differential Equations*, Dover Publications, Mineola, New york, 2006.

[2] Narayanan and Manicavachagom Pillay, *Differential Equations*, Viswanathan (Printers and Publisher) PVT Ltd. 1991.

[3] K. Sankara Rao, *Introduction to Partial Differential Equations*, 3rd Ed., PHI, 2010.

[4] T. Amarnath, *An Elementary Course in Partial Differential Equations*, Narosa, 1997.

[5] M D Raisinghania, *Advanced Differential Equations, Revised Edition*, S Chand & Company Ltd., 2018.

[6] Shepley L Ross, *Differential Equations*, 3rd Ed., Wiley India (P.)Ltd., 1984.

BSCMTP385	Lab VI	2 Credits

Practicals for VI Semester

Practicals: Lab VI

Mathematics practicals with Free and Open Source Software (FOSS) tools for computer programs

1. Solving algebraic equation (Bisection method and Regula-Falsi).
2. Solving algebraic equation (Iteration and Newton-Raphson methods).

3. Solving system of equations (Jacobi and Gauss-Seidel methods).
4. Interpolations with equal intervals.
5. Interpolations with unequal intervals.
6. Derivatives using forward difference formulae
7. Derivatives using backward difference formulae.
8. Extreme values of tabulated functions.
9. Integrals using Trapezoidal rule, Simpson's 1/3 rule, and Simpson's 3/8 rule.
10. Solving ordinary differential equations by Picard's method.
11. Solving ordinary differential equations by Taylor's series method.
12. Solving ordinary differential equations by Euler's method and modified Euler's method.
13. Solving ordinary differential equations by Runge-Kutta Method.
14. Solving ordinary differential equations by Adam's Bashforth Method.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

Group II

BSCMTCE133	Core Elective - A : Functions and Applications	1 Credit (24 Hours, 2 hours/week)

Unit I (12 Hours)

Straight line: Straight line in economics, Break-Even point, System of straight lines, Effect of a Tax or Subsidy.

Parabola: Parabola in in economics, The non-linear model.

Rectangular hyperbola: Rectangular hyperbola in economics.

Circle: Circle in economics.

Inequalities and absolute values: Properties of inequalities, Linear inequality in one variable, Absolute values. Applications in economics.

Unit II (12 Hours)

Derivatives of functions: Economic applications, Demand function, Price demand, income demand, Cross demand, Law of supply, Revenue functions, Short-run production function, Short-run cost function, Relation between marginal product and marginal cost.

The maxima and minima of functions: Applications of maxima and minima of functions in economics and business.

References

[1] R S Bharadwaj, *Mathematics for Economics and Business*, 2nd Ed., Excel Books, 2007.

[2] M Ragahvacahri, *Mathematics for Management : an introduction*, Tata McGraw-Hill, 1980.

[3] Teresa Bradley, *Essential Methematics for Economics and Business*, 2nd Ed., Wiley India Publishers, 2008.

[4] Frank Werner and Yuri N. Sotskov, *Mathematics of Economics and Business*, Taylor & Francis, 2006.

BSCMTCE183	Core Elective - B : Vector Calculus	1 Credit (24 Hours, 2 hours/week)

Unit I (12 Hours)

Vector functions, Limits, Continuity, Derivative, Differentiation Rules, Integrals of vector functions, Modeling Projectile Motion, Arc length, Unit Tangent Vector, Curvature, Unit Normal Vector, Torsion, Unit Binormal vector.

Unit II (12 Hours)

Integration of Vector functions: Line Integrals, Vector fields, Gradient fields, Work, Circulation, Flux, Path independence, Potential Functions, Conservative fields, Exact Differential Forms, Green's Theorem, Surface Area, Surface Integrals, Parameterized surfaces, Stokes' Theorem, The Divergence Theorem.

References

[1] Maurice D. Weir, George B. Thomas, Jr., Joel Hass, Frank R. Giordano, *Thomas' Calculus*, 11th Ed., Pearson, 2008.

[2] Shanthi Narayan and P. K. Mittal, *A Text book of Vector Calculus*, S Chand & Company PVT. Ltd., 2014.

[3] Paul C. Matthews, *Vector Calculus*, 1st ed., Springer-Verlag Publishers, 1998.

[4] Murray R Spigel and Seymour Lipschutz, Vector Analysis, 2nd Ed., Schaum's Outline, McGrew Hill Publishers, 2009.

BSCMTCE233	Core Elective - C : Skill Development Techniques in Algebra and Calculus	1 Credit (24 Hours, 2 hours/week)

Unit I (12 Hours)

Real number system, properties, order, Inequalities. Groups, Examples, short answer problems in subgroups, normal subgroups, Lagrange's theorem homomorphisms, isomorphisms. Rings, Integral domain and Fields, ideals homomorphisms, isomorphisms, short answer problems.

Unit II (12 Hours)

Derivatives, Applications of derivatives, increasing and decreasing functions, critical number, maxima, minima, Curvature and poles, short answer problems.

References

[1] Rashmi Gupta and Suraj Ssingh, *A Complete Resource Mannual - Mathematics - M.Sc. Entrance Examination*, Unique Publishers, 2017.

[2] Amit Rastogi and Vicky Sain, *Post graduate Entrance Exam Mathematics*, Arihant Publications, 2016.

[3] R. Gupta, *Mathematics for Higer Level Competitive Examinations*, Ramesh Publications, 2016.

[4] Lloyd. R. Jaisingh and Frank Ayres, *Abstract Algebra*, 2nd Ed., Schaum outlines, Macgraw Hill Publications, 2003.

BSCMTOE283	Open Elective - D : Applications of Basic Arithmetics	1 Credit (24 Hours, 2 hours/week)

(For other Streams)

Unit I (12 Hours)

Number System, Decimal Fractions, Simplifications, Average, Problems on numbers, Problems on ages.

Unit II (12 Hours)

Concepts of Time and distance, Related problems, technique for problems related to Time and Work, Situations in Boats and Streams, velocity related problems, Simple problems on trains and other moving objects, different types of problems in Calendar, number of days, dates etc., Positions of hour hand and minute hand in Clocks, related problems.

References

[1] R. S. Agarwal, *Quantitative Aptitude*, S. Chand & company Pvt. Ltd., 2014.

[2] A. Balaraju, *Mental ability*, S M V Publishers, Kolar, 2015.

[3] B. S. Sijwalii and Indu Sijwali, *Verbal and Analytical Reasoning*, Arihant Publishers, 2014.

[4] H. S. Hall and F. H. Stevens, *An Elementary Course of Mathematics*, Macmillan and Co. Ltd., 1899.

* * * * * * * * *

Question Paper Patterns

Group I - Optional: For B.Sc. Mathematics

Theory

For I /II / III/ IV Semesters

End Semester Exam 80 marks + Internal Assessment 20 marks = 100 Total marks

End Semester Exam

Duration: 3 hours Max. Marks: 80

PART -A	
I. Answer any 10 questions ($10 \times 2 = 20$)	
Question Number	Unit Number
1 to 7	Unit - 1, 2
8 to 14	Unit - 3, 4
PART -B	
II. Answer any 6 questions ($6 \times 5 = 30$)	
Question Number	Unit Number
1 to 9	Unit - 1, 2
PART -C	
III. Answer any 6 questions ($6 \times 5 = 30$)	
Question Number	Unit Number
10 to 18	Unit - 3, 4

For V/VI Semesters

Duration: 3 hours Max. Marks: 80

PART -A	
I. Answer any 10 questions ($10 \times 2 = 20$)	
Question Number	Unit Number
1 to 14	Unit - 1, 2, 3
PART -B	
II. Answer any 12 questions ($12 \times 5 = 60$)	
Question Number	Unit Number
1 to 18	Unit - 1, 2, 3

Internal assessment: Internal assessment marks should be based on two tests of 90 minutes duration each.

Practicals

For I /II / III/ IV Semesters

End Semester Practical Exam 40 marks + Lab Internal Assessment 10 marks = 50 Total marks

End Semester Practical Exam: Question paper for each Lab exam of 2 hour duration shall contain TWO questions on lab programmes which are to be executed.

Lab Internal assessment: Lab internal assessment marks should be based on two lab tests of 90 minutes duration each.

For V/VI Semesters

End Semester Practical Exam 80 marks +Lab Internal Assessment 20 marks =100 Total marks

End Semester Practical Exam: Question paper for each Lab exam of 3 hour duration shall contain THREE questions on lab programmes which are to be executed.

Lab Internal assessment: Lab internal assessment marks should be based on two lab tests of 2 hours duration each.

Group II - General Electives

For Core/Open Electives A, B, C, D

End Semester Exam 40 marks + Internal Assessment 10 marks = 50 Total marks

Duration: 2 hours Max. Marks: 40

PART -A	
I. Answer any 5 questions ($5 \times 2 = 10$)	
Question Number	Unit Number
1 to 4	Unit -1
5 to 8	Unit -2
PART -B	
II. Answer any 3 questions ($3 \times 5 = 15$)	
Question Number	Unit Number
1 to 5	Unit -1
III. Answer any 3 questions ($3 \times 5 = 15$)	
6 to 10	Unit -2

Internal assessment: Internal assessment marks should be based on two tests of 60 minutes duration each.

* * * * * * * * * * * * *