THREE/FOUR YEARS UNDER-GRADUATE

COURSE IN

B. Sc. MATHEMATICS
(HONS. /HONS. WITH RESEARCH)
UNDER NEP 2020.

w.e.f. A.Y. 2023-2024

BANKURA UNIVERSITY

BANKURA

WEST BENGAL

PIN 722155

STRUCTURE IN MATHEMATICS (HONOURS. /HONS. WITH RESEARCH)

SEMESTER –I

Course Code	Course Title	Credit	Marks			No of. Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/MTH/ 101/MJC-1	Calculus, Geometry & Vector Analysis	04	10	40	50	03	01	00
S/MTH/ 102/MN - 1	Calculus, Geometry & Vector Analysis	04	10	40	50	03	01	00
S/MTH/ 103/MD -1	Basics of Set Theory & Numbers	03	10	40	50	02	01	00
S/MTH/104/SEC - 1	Logic & Sets	03	10	40	50	02	01	00
S/105/AEC-1	Compulsory English	02	10	40	50	01	01	00
S//106/VAC - 1	Environmental Studies	04	10	40	50	03	01	00
Total in Semester - I		**20**	**60**	**240**	**300**	**14**	**06**	**00**

SEMESTER –II

Course Code	Course Title	Credit	Marks			No of. Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/MTH/201/MJC - 2	Algebra	04	10	40	50	03	01	00
S/MTH/202/MN - 2	Algebra	04	10	40	50	03	01	00
S/MTH/203/MD -2	Basics of Probability & Statistics	03	10	40	50	02	01	00
S/MTH/204/SEC - 2	C Programming Language(Theory & Practical)	03	10	25+15	50	02	00	02
S/205/AEC- 2	MIL (Bengali /Sanskrit /Santali)	02	10	40	50	01	01	00
S//106/VAC - 2	**Any one of the following** • Health & Wellness • Understanding India	04	10	40	50	03	01	00
Total in Semester - II		**20**	**60**	**240**	**300**	**14**	**05**	**02**

S=Science, MTH = Mathematics, MJC = Major Core, MN = Minor Stream, MD = Multidisciplinary, VAC = Value Added Course, AEC = Ability Enhancement Course, SEC = Skill Enhancement Course, DSC = Discipline Specific Core, DSE = Discipline Specific Elective, IA = Internal Assessment, ESE = End-Semester Examination, Lec. = Lecture, Tu. = Tutorial, and Pr. = Practical.

SEMESTER –III

Course Code	Course Title	Credit	Marks			No of. Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/MTH/ 301/MJC-3	Analysis of Real Numbers and Real Functions	04	10	40	50	03	01	00
S/MTH/ 302/MJC - 4	Ordinary Differential Equations (ODE)	04	10	40	50	03	01	00
S/MTH/303/MN -3	Ordinary Differential Equations (ODE)	04	10	40	50	03	01	00
S/MTH/304/MD - 3	Mathematical Modelling	03	10	40	50	02	01	00
S/MTH/104/SEC - 3	Python (Theory & Practical)	03	10	25+15	50	02	00	02
S/105/AEC-3		02	10	40	50	01	01	00
Total in Semester - I		**20**	**60**	**240**	**300**	**14**	**06**	**00**

SEMESTER –IV

Course Code	Course Title	Credit	Marks			No of. Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/MTH/ 401/MJC-5	Riemann Integration and Series of Functions	04	10	40	50	03	01	00
S/MTH/ 402/MJC-6	Group Theory	04	10	40	50	03	01	00
S/MTH/ 403/MJC-7	Multivariate Calculus	04	10	40	50	03	01	00
S/MTH/ 404/MJC-8	Mechanics	04	10	40	50	03	01	00
S/MTH/ 405/MN - 4	Multivariate Calculus	04	10	40	50	03	01	00
		02	10	40	50			
Total in Semester - I		**22**	**60**	**240**	**300**	**14**	**06**	**00**

THREE/FOUR YEARS UNDER-GRADUATE

COURSE IN

B. Sc. MATHEMATICS (HONS. /HONS. WITH RESEARCH) UNDER NEP 2020.

w.e.f. A.Y. 2023-2024

BANKURA UNIVERSITY

BANKURA

WEST BENGAL

PIN 722155

1. Introduction

The syllabus for Mathematics at undergraduate level using the Choice Based Credit system has been framed incompliance with UGC, NEP 2020.

The main objective of framing this new syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Mathematics. Keeping in mind and in tune with the changing nature of the subject, adequate emphasis has been given on new techniques of mapping and understanding of the subject.

Mathematics is the study of quantity, structure, space and change. It has very broad scope in science, engineering and social sciences. The syllabus has given equal importance to the six main branches of mathematics – Calculus, Geometry and Algebra.

The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase.

It is essential that Mathematics students select their multidisciplinary courses from Physics, Chemistry and/or any branch of Life Sciences disciplines and/or any course from graduation level.
While the syllabus is incompliance with UGC, NEP 2020 curriculum, some changes have been made to ensure all topics are covered and any of the subjects don't become difficult to be completed in one semester. For example, Major(DSC) Core course 1 on "Calculus, Geometry & Vector Analysis" and major core course 2 on "Algebra" now also has introductory concepts on Geometry, Algebra and has been renamed accordingly.

The syllabus of Minor Stream (MN), MN-1 and MN-2 courses are same as of the syllabus of the Major (DSC) core courses, MJC-1 and MJC-2 respectively, but the standard (level) of the question paper may be different.

In general, evaluation process of each course is carried out through Internal Assessment (IA) and End-Semester Examination (ESE). 10 marks is allotted for Internal Assessment (IA) and 40 marks is allotted for End-Semester Examination (ESE). Question paper of each course for End Semester Examination contains three contents. 05(five) questions to be answered out of 08(eight) questions carrying 02 (two) marks of each in Unit –I. 04 (four) questions to be answered out of 06 (six) questions carrying 05 (five) marks of each in Unit –II and similarly, 01(one) question to be answered out of 02 (two) questions carrying 10 (ten) marks of each in Unit–III. Otherwise, the marks distributions of the particular course should be clearly mentioned.

The Bachelor's Degree in B.A./B.Sc. (Hons. / Hons. with research) is awarded to the students on the basis of knowledge, understanding, skills, attitudes, values and academic achievements sought to be acquired by learners at the end ofthese programmes. Hence, the course outcomes and course specific outcomes of mathematics for these courses are aimed at facilitating the learners to acquire these attributes, keeping in view of their preferences and aspirations for knowledge of mathematics.
The course outcomes and course specific outcomes of each paper are designed so that these may help learners to understand the main objectives of studying the course. This will enable learners to select elective papers depending on the individual inclinations and contemporary requirements. These syllabi in Mathematics under CBCS and NEP 2020 are recommended keeping in view of the wide applications of Mathematics in Science, Engineering, Social science, Business and a host of other areas. The study of the syllabi will enable the students to be equipped with the state of the art of the subject and will empower them to get jobs in technological and engineering fields as well as in business, education and healthcare sectors.

The text books mentioned in references are denotative/demonstrative. The divisions of each paper in units are specified to the context mentioned in courses. These units will help the learners to complete the study of concerned paper in certain periods and prepare them for examinations.

Hence, the programme has been chalked out in such manner that there is scope of flexibility and innovation in modifications of prescribed syllabi, teaching-learning methodology, assessment technique of students and knowledge levels, learning outcomes of courses, inclusion of new elective courses subject to availability of experts in across the country.

Programme Objectives (PO):

PO1: Mathematical Reasoning: Application of the mathematical knowledge to the solution of more complex problems in academic and in real life.

PO2: Analyzing Ability: Identification, formulation and solution of a problem which leads to conclusion using basic principles.

PO3: Developing Confidence: Analyzing more complicated problems and getting solutions helps to build up confidence.

PO4: Design/development of more accuracy: Design and development of methods/ procedures for solutions of problems which meet the specificqueries in industry as well as real life.

PO5: Ability of investigations for more complex problems: Use research-based knowledge and research methods to handle more complex problems.

PO6: Applications of theory based knowledge: Ability to apply the theoretical knowledge including theory, experiment and computational data; analysis and interpretation of data, to get the valid conclusions.

PO7: Ability of Modern tool usage: Application of appropriate techniques, resources, updated software and modernmathematical tools to solve mathematical activities with a good understanding of their limitations.

PO8: Team work practice: Collective efforts for functioning effectively as a member or leader in diverse teams, and/or in multidisciplinary settings.

PO9: Communication skill: Effective Communication skill for scientific activities helps to establish a good researcher with popular face in the scientific community.

PO10: Ability of presentation:Writing the effective reports and design document to give and receive clear instructions/limitations/restrictions for good presentations.

PO11: Life-long learning process: Recognize the needs, proper learning and ability to engage in life-long learning in the broadest context of scientific & technological changes.

PO12: Students undergoing this programme learn to logically question assertions, to recognize patterns and to distinguish between essential and irrelevant aspects of problems. They also share ideas and insights while seeking and benefitting from knowledge and insight of others. This helps them to learn behave responsibly in a rapidly changing interdependent society.

Programme Specific Outcomes (PSO):

The Department of Mathematics offers exciting opportunities to talented students pursuing a Bachelor's degree for acquiring a rigorous and modern education in mathematics and for pursuing master's degree in both pure and applied mathematics as well as higher studies based on Mathematics. This Program will introduce the classical topics of mathematics, which helps in acquiring thinking skills to undertake cutting-edge research in a higher education programme.

Career Opportunities:

This program will enable the students to take part and qualify for the state and national level examinations such as JAM, CUET etc. After completion of this programme, the students are well prepared for higher studies such as M. Sc., M.Tech., Integrated Ph.D. program, any professional degree.This programme will also help students to enhance their employability for governmentjobs, jobs in banking, insurance and investment sectors, data analyst jobs and jobs in variousother public and private enterprises.Completion of this programme will also enable the learners to join teaching profession inprimary and secondary schools.The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning which also helps more professional.

2. Scheme for CBCS Curriculum for B.A./B.Sc. (Hons. /Hons. with Research) Mathematics

2.1 Scheme for CBCS Curriculum

Semester	Course Name	Course Detail	Credits
I	Major Core (DSC) – 1	Calculus, Geometry & Vector Analysis	4
	Core course (DSC) –1 Practical	-	-
	Minor Stream - 1	Calculus, Geometry & Vector Analysis	4
	Minor Stream – 1 Practical	-	-
	Multidisciplinary – 1	Basics of Set Theory & Numbers	3
	Multidisciplinary – 1 Practical	-	-
	Skill Enhancement Course–1	Logic & Sets	3
	Skill Enhancement Course –1 Practical	-	-
	Ability Enhancement Course –1	Compulsory English	2
	Ability Enhancement Course –1 Practical	-	-
	Value Added Course for all - 1	Environmental Studies	4
	Value Added Course for all – 1 Practical	-	-
II	Major Core (DSC) – 2	Algebra	4
	Corecourse (DSC) –2 Practical	-	-
	Minor Stream - 2	Algebra	4
	Minor Stream – 2 Practical	-	-
	Multidisciplinary – 2	Basics of Probability & Statistics	3
	Multidisciplinary – 2 Practical	-	-
	Skill Enhancement Course –2	C Programming Language (Theory & Practical)	3
	Skill Enhancement Course –2 Practical	-	-
	Ability Enhancement Course –2		2

	Ability Enhancement Course –2 Practical	-	-
	Value Added Course for all - 2	Health & Wellness/ Understanding India	4
	Value Added Course for all – 2 Practical	-	-
	Internship* - 1	Internship on any topic of Major/Minor Courses	3(Additional)
	Internship* - 1 Practical	Internship on any topic of Major/Minor Courses	1(Additional)

Semester	Course Name	Course Detail	Credits
III	Major Core (DSC) – 3	Analysis of Real Numbers and Real Functions	4
	Core course (DSC) –3 Practical	-	-
	Major Core (DSC) – 4	Ordinary Differential Equations	4
	Core course (DSC) –4 Practical	-	-
	Minor Course – 3	Ordinary Differential Equations	3
	Minor Course – 3 Practical	-	-
	Skill Enhancement Course–1	Python (Theory and Practical)	3
	Skill Enhancement Course –1 Practical	-	-
	Ability Enhancement Course –1		2
	Ability Enhancement Course –1 Practical	-	-
	Multidisciplinary – 1	Mathematical Modelling	4
	Multidisciplinary – 1 Practical	-	-
IV	Major Core (DSC) – 5	Riemann Integration and Series of Functions	4
	Core course (DSC) –5 Practical	-	-
	Major Core (DSC) – 6	Group Theory	4
	Core course (DSC) –6 Practical	-	-
	Major Core (DSC) – 7	Multivariate Calculus	3
	Core course (DSC) –7 Practical	-	-
	Major Core (DSC) – 8	Mechanics	3
	Core course (DSC) –8 Practical	-	-
	Minor course – 4	Multivariate Calculus	2

	Minor course – 4 Practical	-	-
	Ability Enhancement Course –2	Compulsory Sanskrit/ Compulsory Santali	4
	Ability Enhancement Course –2 Practical	-	-
	Internship* - 1	Internship on any topic of Major/Minor Courses	3(Additional)
	Internship* - 1 Practical	Internship on any topic of Major/Minor Courses	1(Additional)

2.2 Choices for Ability Enhancement Courses (AEC)

Ability Enhancement Course - 1	Ability Enhancement Course - 2
Compulsory English	Compulsory Sanskrit
	Compulsory Santali

2.3 Choices for Value Added Courses (VAC) common for all

Value Added Courses – 1	Value Added Courses - 2
Environmental Studies	Health & Wellness
	Understanding India

B.A./B.Sc. (Hons. /Hons. with Research) Mathematics

3. Core Subjects (Syllabus): B.A./B.Sc. (Hons. /Hons. with Research) Mathematics

3.1 Major (DSC): Core T1–Calculus, Geometry & Vector Analysis

Calculus, Geometry & Vector Analysis	
	4 Credits

Course Objectives:
The main objective of this course is to give a deep insight of the differentiations and its consequence applications and techniques of sketching for curves in Cartesian and polar coordinate systems. This course also give the outstanding knowledge of two and three dimensional geometryalso the concept vector calculus.

Course Specific Outcomes:
After completion of this course a student would have

- a vast knowledge of Calculus which they can use for their furtherstudy.
- a clear idea of characterizations of two dimensional as well as three dimensional geometry.
- a clear concept of vector analysis and its applications

Unit 1

Higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax}+b\sin x$, $e^{ax}+b\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, Arc length, Derivative of arc length (Cartesian and Polar), Pedal equations, Curvature, Radius of curvature, Centre of curvature, concavity and inflection points, envelopes, asymptotes (Cartesian), Singular points, Classification of double points, Curve tracing in Cartesian coordinates and polar coordinates, Indeterminate forms: L'Hospital's rule.

Unit 2

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx, \int \cos^n x\,dx, \int \tan^n x\,dx,$, $\int \sec^n x\,dx, \int (\log x)^n\,dx, \int \sin nx \sin mx\,dx,$ Area under Cartesian and Polar curves, parametric equations, parameterizing of a curve, arc length, arc length of parametric curves, area and volume of surface of revolutions.

Unit 3

Reflection properties of conics, Transformation of axes and second degree equations, Invariants, classification of conics using the discriminant, Pair of straight lines, polar equations of straight lines, circles and conics.

Spheres, Cone, Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, Tangent, Normal, Enveloping Cone and Cylinder, Generating lines, classification of quadrics, Transformation of axes in space and general equation of second degree.

Unit 4

Product of three or more vectors, Applications in Geometry, introduction to vector valued functions of one independent variable, operations with vector-valued functions of one independent variable, limits and continuity of vector functions, differentiation and integration of vector functions of one independent variable.

Graphical Demonstration (Teaching Aid)

1. Plotting of graphs of function $e^{ax}+b$, $log(ax+b)$, $1/(ax+b)$, $sin(ax+b)$, $cos(ax+b)$,$|ax+b|$ and to illustrate the effect of a and b on the graph.
2. Plotting the graphs of polynomial of degree4 and 5, the derivative graph, the second derivative graph and comparing them.
3. Sketching parametric of curves (e.g. Trochoid, cycloid, epicycloids, hypocycloid).
4. Obtaining surface of revolution of curves.
5. Tracing of conics in Cartesian coordinates/polar coordinates.
6. Sketching of ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, and hyperbolic paraboloid using Cartesian coordinates.

Reference Books

- G. B. Thomas and R.L.Finney, Calculus, 9th Ed.,Pearson Education, Delhi, 2005.
- M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
- H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons(Asia) P.Ltd.,Singapore,2002.
- R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, NewYork, Inc., 1989.
- T. Apostol, Calculus, Volumes I and II.
- S. Goldberg, Calculus and Mathematical Analysis.
- J.E. Marsden, and A. Tromba, Vector Calculus, 6th Ed., McGraw Hill, 2011.
- K. C. Maity and R. K. Ghosh, Vector Analysis, New Central Book Agency (P) Ltd., Kolkata.
- R. K. Ghosh and K. C. Maity, An introduction to analysis: Differential Calculus (Part I), New Central Book Agency, 13th Edition, 2011
- M. R. Speigel, Schaum's Outline of Vector Analysis.

- R.M. Khan, Analytical Geometry of Two and Three Dimensions and Vector Analysis, New Central Book Agency, 2010.
- E.H. Askwith, The Analytical Geometry of the Conic Sections, Adam and Charles Black,
- London, 1908.
- S. Karmakar & S. Karmakar, Analytic Geometry: Two Dimensions, CRC Press (Taylor & Francis Group)/Levant Books (India), London, 2022.
- Robert J. T. Bell, An Elementary Treatise On Coordinate Geometry, Macmillan and Company Limited.
- B.K. Kar, Advanced Analytical Geometry and Vector Analysis, Books & Allied Pvt. Ltd., Kolkata, 2000.

3.2 Major (DSC): Core T2-Algebra

Algebra	
	4 Credits
Course Objectives: The main objective of this course is to give a deep insight of the roots of real and complex equations and learn various methods of obtaining roots. Employ De Moivre's theorem in a number of applications and able to knowledge to solve the system of linear equations.	
Course Specific Outcomes: After completion of this course a student would recognize the idea of consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank. Also, they are able to find out the eigenvalues and corresponding eigenvectors for a square matrix.	
Unit 1	
Polar representation of complex numbers, n^{th} roots of unity, De Moivre's theorem and its applications. Theory of equations: Relation between roots and coefficients, Transformation of equation, Location of roots: Descartes rule of signs, Sturm's theorem, Cubic and biquadratic equation, Cardon's, Ferrai's and Euler's method. Inequality: The inequality involving AM $\geq$ GM $\geq$ HM, Cauchy-Schwartz inequality.	
Unit 2	
Equivalence relations, partial order relation, poset, linear order relation. Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.	
Unit 3	

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.

Unit 4

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspace of $\mathbb{R}^n$, dimension of subspaces of $\mathbb{R}^n$, Geometric significance of subspaces. Rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

Reference Books

- T. Andreescu and D. Andrica, Complex Numbers from A to Z, Birkhauser, 2006.
- E.G. Goodaire and M.M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
- D.C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
- K.B. Dutta, Matrix and Linear Algebra. Prentice Hall India Pvt., Ltd., 2004.
- K. Hoffman and R. Kunze, Linear Algebra. 2nd Ed., Prentice Hall India Pvt., Ltd., 2015
- W.S. Burnstine and A.W. Panton, Theory of Equations. 7th Ed. Hodges, Figgis and Company, 1924

Major (DSC): MJC – 3 - Analysis of Real Numbers and Real Functions

Analysis of Real Numbers and Real Functions	
	4 Credits

Unit 1

Review of Algebraic and Order Properties of the set of real numbers $\mathbb{R}$, Intervals, ε-neighbourhood of a point in $\mathbb{R}$, Idea of countable sets, uncountable sets and uncountability of $\mathbb{R}$. Bounded above sets, bounded below sets, Bounded Sets, Unbounded sets. Suprema and Infima. Completeness Property of $\mathbb{R}$ and its equivalent properties. The Archimedean Property, Density of Rational (and Irrational) numbers in $\mathbb{R}$.

Limit points of a set, Isolated points, Interior points, Open set, closed set, union and intersection of open and closed sets, derived set, dense sets, Illustrations of Bolzano-Weierstrass theorem for sets, Compact sets in $\mathbb{R}$, Heine Boral Theorem (Statement only).

Unit 2

Sequences, Bounded sequence, Convergent sequence, Limit of a sequence, Uniqueness of limit, Limit theorems, Sandwich theorem, Nested interval theorem, Monotone Sequences, Monotone Convergence Theorem. Subsequences, lim-inf and lim-sup, Subsequential criterion of

convergence of a sequence, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion, Cauchy's first and second limit theorems with applications.

Infinite series, convergence and divergence of infinite series, Cauchy's Criterion, Series of positive terms, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Raabe's test, Logarithmic test, Alternating series, Leibniz test. Absolute and Conditional convergence, Riemann's rearrangement theorem.

Unit 3

Limits of functions (ε - δ approach), sequential criterion for limits. Limit theorems, one sided limit. Infinite limits and limits at infinity.

Continuous functions, sequential criterion for continuity. Algebra of continuous functions. Continuous functions on an interval. Neighbourhood properties, intermediate value theorem, location of roots theorem, preservation of intervals theorem, extreme value theorem.

Discontinuity of functions, different types of discontinuity, discontinuity of monotone functions.

Uniform continuity, non-uniform continuity criteria, theorems on uniform continuity.

Unit 4

Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Meaning of sign of derivatives, Chain rule, Lipschitz condition and associate result on derivative, Relative extrema and local extrema along with their determination process, interior extremum theorem.

Rolle's theorem. Mean value theorems: Lagrange's and Cauchy's; Intermediate value property of derivatives, Darboux's theorem.

Taylor's theorem with different forms. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $ln(1+x)$, $\frac{1}{ax+b}$ and $(1+x)^n$ with their range of validity, Applications of Taylor's theorem to inequalities.

Reference Books

- R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
- Gerald G. Bilodeau, Paul R. Thie, G. E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
- Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
- S.K. Berberian, A First Course in Real Analysis, Springer Verlag, NewYork,1994.
- Tom M. Apostol, Mathematical Analysis, Narosa Publishing House.
- Courant and John, Introduction to Calculus and Analysis, Vol I, Springer.
- W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill.

- Terence Tao, Analysis I, Hindustan Book Agency, 2006.
- S. Goldberg, Calculus and mathematical analysis.
- S.K. Mapa, Introduction to Real Analysis, Levant Books, Kolkata, 2019.

Major (DSC): MJC – 4 – Ordinary Differential Equations

Ordinary Differential Equations	
	4 Credits
Unit1	
First order ordinary differential equations (ODE): Exact differential equations and integrating factors, special integrating factors and transformations, linear equations and equations reducible to linear form, Bernoulli equations, the existence and uniqueness theorem of Picard (Statement only). First order higher degree equations solvable for *x*, *y* and *p*. Clairaut's equations and singular solution.	
Unit2	
Second and higher order linear ODE, General solution of homogeneous equation of second and higher order, principle of superposition for homogeneous equations, Wronskian: Its properties and applications, Non-homogeneous equations: C.F, P.I., G.S., D operator method, Euler's equations, method of undetermined coefficients, method of variation of parameters. Exact differential equations, Special forms.	
Unit3	
Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Simultaneous linear equations of form 2, Total differential equations. Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions: Solution by matrix method. Planar linear autonomous systems: Equilibrium (critical) points, Interpretation of the phase plane and phase portraits.	
Unit4	
Power series solution of a differential equation about an ordinary point, solution about a regular singular point (up to second order).	
Reference Books	

- Belinda Barnes and Glenn R. Fulford, Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab, 2nd Ed., Taylor and Francis group, London and New York, 2009.
- C.H. Edwards and D.E. Penny, Differential Equations and Boundary Value problems Computing and Modeling, Pearson Education, India, 2005.
- S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
- Martha L Abell, James P Braselton, Differential Equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.
- Murray, D., Introductory Course in Differential Equations, Longmans Green and Co. Ltd.
- Boyce and Diprima, Elementary Differential Equations and Boundary Value Problems, Wiley.
- G.F. Simmons, Differential Equations, Tata McGraw Hill.

Major (DSC): MJC - 5 –Riemann Integration and Series of Functions

Riemann Integration and Series of Functions	
	4 Credits
Unit1	
Riemann integration: inequalities of upper and lower sums, Darbaux integration, Darbaux theorem, Riemann conditions of integrability, Riemann sum and definition of Riemann integral through Riemann sums, equivalence of two Definitions. Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals. Fundamental theorem of Integral Calculus. First and Second Mean Value Theorems (different forms) and their applications. Improper integrals: First and second kind; Test of Convergence; Beta and Gamma functions and their properties.	
Unit2	
Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.	
Unit3	
Fourier series: Definition of Fourier coefficients and series, Reimann Lebesgue lemma, Bessel's inequality, Parseval's identity, Dirichlet's condition. Examples of Fourier expansions and summation	

results for series.

Power series, radius of convergence, Cauchy Hadamard Theorem. Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

Reference Books

- R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
- Gerald G. Bilodeau, Paul R. Thie, G. E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
- Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
- S.K. Berberian, A First Course in Real Analysis, Springer Verlag, NewYork, 1994.
- Tom M. Apostol, Mathematical Analysis, Narosa Publishing House.
- Courant and John, Introduction to Calculus and Analysis, Vol I, Springer.
- W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill.
- Terence Tao, Analysis I, Hindustan Book Agency, 2006.
- S. Goldberg, Calculus and mathematical analysis.
- S.K. Mapa, Introduction to Real Analysis, Levant Books, Kolkata, 2019.

Major (DSC): MJC – 6 – Group Theory

Group Theory	
	4 Credits
Unit1	
Symmetries of a square, definition of group, examples of groups including permutation groups, Dihedral groups and Quaternion groups (through matrices), elementary properties of groups, examples of commutative and non-commutative groups. Order of an element, order of a group. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of two subgroups.	
Unit2	
Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.	
Unit 3	

External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

Unit 4

Group homomorphism, properties of homomorphism, correspondence theorem and one-one correspondence between the set of all normal subgroups of a group and the set of all congruence on that group, Cayley's theorem, properties of isomorphism. First, Second and Third isomorphism theorems.

Reference Books

- John B. Fraleigh, A First Course in Abstract Algebra, 7thEd., Pearson, 2002.
- M. Artin, Abstract Algebra,2nd Ed., Pearson, 2011.
- David S. Dummit, R. M. Foote, Abstract Algebra, John Wiley and Sons, Inc., 2004.
- Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Books/Cole, Cengage Learning, Boston, 2006.
- Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., 1995.
- I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.
- D.S. Malik, John M. Mordeson and M.K. Sen, Fundamentals of abstract algebra, Tata McGraw-Hill, New York.
- S.K. Mapa, Higher Algebra: Abstract and Linear, Levant Books, Kolkata, 2019.

Major (DSC): MJC – 7 - Multivariate Calculus

Multivariate Calculus	
	4 Credits

Unit1

Concept of neighbourhood of a point in $R^n (n > 1)$, interior point, limit point, open set and closed set in $R^n (n > 1)$.

Unit2

Functions from $\mathbb{R}^n$ $(n > 1)$ to $\mathbb{R}^m (m \geq 1)$, limit and continuity of real-valued functions of two or more variables. Directional derivatives, Partial derivatives, total derivative and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, Partial derivatives of higher order, theorems on equality of mixed partial derivatives of two variables, Homogeneous functions and Euler's theorem;

Euclidean norm on $\mathbb{R}^n$, Derivative of a function from $\mathbb{R}^n$ to $\mathbb{R}^m$ as a linear transformation.

Unit3

Multiple integral: Concept of upper sum, lower sum, upper integral, lower-integral and double integral (no rigorous treatment is needed). Statement of existence theorem for continuous functions. Iterated or repeated integral, change of order of integration. Triple integral. Cylindrical and spherical coordinates. Change of variables in double integrals and triple integrals. Transformation of double and triple integrals (problems only). Determination of volume and surface area by multiple integrals (problems only). Differentiation under the integral sign, Leibniz's rule (problems only).

Unit4

Definition of vector field, the gradient, maximal and normal property of the gradient, tangent planes; Divergence and curl. Line integrals, applications of line integrals: mass and work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

Unit5

Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

Reference Books

- G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
- M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
- E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), 2005.
- James Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.
- T. Apostol, Mathematical Analysis, Narosa Publishing House.
- Courant and John, Introduction to Calculus and Analysis, Vol II, Springer.
- S. Karmakar, S. Karmakar, Multivariate Calculus, CRC Press (Taylor & Francis Group)/ Levant Books (India), London, 2022.
- M.R. Speigel, Schaum's Outline Series on Vector Analysis. McGraw-Hill, New York, 1959.
- J. Willard Gibbs and E.B. Wilson, Vector Analysis, Charles Scribner's Sons, London, 1901.
- E. Marsden, A.J. Tromba, Vector Calculus, W.H. Freeman and Company, New Tork, 2012.
- A. Galbis, M. Maestre, Vector Analysis Versus Vector Calculus, Springer, 2012.

Major (DSC): MJC – 8 - Mechanics

Mechanics

4 Credits

Unit 1

Equilibrium of a particle, Equilibrium of a system of particles, Necessary conditions of equilibrium, Moment of a force about a point, Moment of a force about a line, Couples, Moment of a couple,

Equipollent system of forces, Work and potential energy, Principle of virtual work for a system of coplanar forces acting on a particle or at different points of a rigid body, Forces which can be omitted in forming the equations of virtual work.

Unit 2

Centres of gravity of plane area including a uniform thin straight rod, triangle, circular arc, semicircular area and quadrant of a circle, Centre of gravity of a plane area bounded by a curve, Centre of gravity of a volume of revolution; Flexible strings, Common catenary, Intrinsic and Cartesian equations of the common catenary, Approximations of the catenary.

Unit 3

Kinematics and kinetics of the motion, Rectilinear motion under variable accelerations, Simple harmonic motion (SHM) and its geometrical representation, SHM under elastic forces, Motion under inverse square law, Motion in resisting media, Concept of terminal velocity.

Unit 4

Motion in two dimensions: Expressions for velocity and acceleration in Cartesian, polar and intrinsic coordinates; Motion in a vertical circle, projectiles in a vertical plane and cycloidal motion.

Unit 5

Equation of motion under a central force, Differential equation of the orbit, (p, r) equation of the orbit, Apses and apsidal distances, Areal velocity, Characteristics of central orbits, Planetary motion, Kepler's laws of planetary motion.

Reference Books:

- I. H. Shames and G. Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics, (4thEd.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
- R. C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics,11thEd., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.
- Chorlton, F., Textbook of Dynamics.
- Loney, S.L., An Elementary Treatise on the Dynamics of particle and of Rigid Bodies
- Loney, S.L., Elements of Statics and Dynamics I and II.
- Ghosh, M. C, Analytical Statics.
- Verma, R. S., A Text book on Statics, Pothishala, 1962.
- Matiur Rahman, Md., Statics.
- Ramsey,A.S., Dynamics (Part I).
- P. L. Srivatava (1964). *Elementary Dynamics*. Ram Narin Lal, Beni Prasad Publishers Allahabad.
- J. L. Synge & B. A. Griffith (1949). *Principles of Mechanics*. McGraw-Hill.
- A. S. Ramsey (2009). *Statics*. Cambridge University Press.
- A. S. Ramsey (2009). *Dynamics*. Cambridge University Press.

4. Multidisciplinary (MD)

4.1 MD T1–Basics of Set Theory & Numbers

Basics of Set Theory & Numbers	
	3 Credits
Course Objectives: The course will enable the students to: i) Obtain the conceptual idea of Sets and related topics like Venn diagram, cardinality of a set etc. ii) Idea of the relations and different types of mappings. iii) Learn about the algebraic structure of real numbers.	
Course Specific Outcomes: This course specifically enable to the students- **i)** Prime numbers and different properties along with operations of these numbers. **ii)** Knowing about the idea of real number series.	
Unit 1	
Sets, Venn diagrams, cardinality of a set, power set, operations on sets, De Morgan's law. Normal set, abnormal set, paradox. Relations, equivalence relations, equivalence class, partition, Fundamental theorem of equivalence relation, partial order, poset, chain with practical examples.	
Unit 2	
Mappings, bijective mappings, composition of mappings, inverse of a mapping.	
Unit 3	
Integers, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.	
Unit 4	
Real Numbers: Algebraic structure of real numbers, decimal representation of real numbers, upper and lower bound, lub and glb properties, Archimedean property, density property, modulus, Intervals. Different series of real numbers (example: Fibonacci series, and its presence in arts and nature).	
Reference Books	

- I. A. Herstein, Topics in Algebra, Willey Eastern Limited, 2nd Edition, 1975
- M. K. Sen, S. Ghosh, P. Mukhopadhyay and S. K. Maity, Topics in Abstract Algebra, Universities press, 3rd Edition, 2019
- J. A. Gallian, Contemporary Abstract Algebra, Cengage, 9th Edition, 2017
- T. A. Garrity, All the Math You Missed (But Need to Know for Graduate School), Cambridge University Press, 2nd Edition, 2021
- R. K. Ghosh and K. C. Maity, An introduction to analysis: Differential Calculus (Part I), New Central Book Agency, 13th Edition, 2011
- Shanti Narayan and M.D. Raisinghania, Elements of Real Analysis, S. Chand & Company Ltd., New Delhi, 2010
- B. K. Lahiri and K. C. Roy, Real Analysis, The World Press Private Ltd., 3rd Edition, 2008
- S. C. Malik and S. Arora, Mathematical Analysis, New Age International (P) Ltd., 2nd Edition, 1992
- W. Rudin, Principles of Mathematical Analysis, McGrow-Hill Book Company, 3rd Edition, 1976.
- R. R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Co., 1st Edition, 1964.

4.2 MD T2–Basics of Probability & Statistics

Basics of Probability & Statistics	
	3 Credits
Course Objectives: The course will enable the students to: i) understand the concept of random experiment and probability. ii) understand distributions and different types of distribution functions.	
Course Specific Outcomes: This course specifically enable to the students- i) axiomatic idea of probability and its related topics. ii) ii) different types of distribution functions like Discrete and Continuous.	
Unit 1	
Meaning and definition of Statistics; Scope of Statistics in Business, Commerce, Economics and different branches of Science. Organization of data, Primary and Secondary data, Univariate, Bivariate and Multivariate data, Population, Sample, Statistical survey, Errors in Statistics, Law of Statistical regularity, Tabular and graphical representation of data, Frequency distribution, Line, Bar and Pie diagrams, Histogram, Frequency polygon, Ogives.	

Unit 2
Measures of Central Tendency: Mean (AM, GM and HM), Positional averages: Median and Modes, Different position values: Quartiles, Deciles, Percentiles. Measures of Dispersions: Range, Quartile Deviations (QD), Concept of Mean Deviation (MD), MD about mean and median, Variations, Standard Deviations (SD), Coefficient of Variations (CV). Analysis of Bivariate data: Scatter diagram; Covariance, Correlation Coefficient, Rank Correlation, Fitting of bivariate data, Simple Linear Regression, Regression coefficients and related results.
Unit 3
Concept of Probability and its related terms; Definition of Probability: Classical and Statistical, Limitations of these definitions; Geometric Probability; Axioms of Probability, Theorems on total probability and compound probability; Conditional probability, Independent events, Bayes' theorem. Concept of Random variable and distribution functions, Probability mass density and density functions, Binomial, Poisson and Normal distributions.
Reference Books
► N. G. Das, Statistical Methods, Vol. 1 & 2 Combined ed., McGraw Hill Education, India, 2017 ► J. Sarkhel, S. K. Dutta, An Insight into Statistics, Book Syndicate (P) Ltd., Kolkata, 2012 ► A. Gupta, Ground work of Mathematical Probability and Statistics, Academic publishers, 2015. ► P. Mukhopadhyay, Mathematical Statistics, Books & Allied (P) Ltd., Kolkata, 2006. ► R.V. Hogg, Joseph W. Mc Kean and Allen T. Craig, Introduction to Mathematical Statistics, ► I. Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006. ► S. Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007. ► A.M. Gun, M. K. Gupta, B. Dasgupta, Fundamentals of Statistics (Vol. 1 & 2), World Press, India, 2013.

4.3 MD T3- Mathematical Modelling

Mathematical Modelling – MD-3	
	3 Credits
Unit 1	

Definition of a model, Definition of Mathematical modelling, Necessity of Mathematical models, Examples of Mathematical models starting from early school Mathematics.

Unit 2

Building Mathematical models, Different stages of Mathematical Modelling: Observation, Modelling and Predictions. Understanding the Problem, Formulation of Mathematical descriptions, Finding the solution of the Mathematical problem, Interpretation/Validation of the results.

Unit 3

Mathematical modelling using different topics of mathematics, for example, using Algebraic (linear as well as non-linear and scalar as well as system of) Equations, Ordinary Differential Equations, Partial Differential Equations, Linear Programming Problems, Probability and Statistics, Nonlinear Optimization, etc.

Reference Books

- Bender, Edward A. An Introduction to Mathematical Modeling. New York: Dover Publications, 2000.
- COMAP and Lynn Steen. For All Practical Purposes: Introduction to Contemporary Mathematics (3rd Edition). New York: W. H. Freeman & Co., 1994.
- Gershenfeld, Neil. The Nature of Mathematical Modeling. Cambridge: Cambridge University Press, 1999.
- Tannenbaum, Peter, and Robert Arnold. Excursions in Modern Mathematics (2nd Edition). Englewood Cliffs, NJ: Prentice Hall, 1995.

5. Skill Enhancement Courses (SEC)

5.1 SEC T1–Logic & Sets

Logic & Sets	
	3 Credits
Course Outcomes : The course will enable the students to i) Learn the syntax of first-order logic and semantics of first-order languages. ii) Understand the propositional logic and basic theorems like compactness theorem, meta theorem and post-tautology theorem. iii) Familiarize with syntax of propositional logic, sets and their consequences.	
Course Specific Outcomes: The student acquires the knowledge of i) Knowing about the concept of the Post tautology theorem. ii) Assimilating the concept of completeness interpretations and their applications with special emphasis on applications in algebra.	
Unit 1	
Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.	
Unit 2	
Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Power set of a set. Difference and Symmetric difference of two sets. De Morgan's law, Set identities. Family of sets. Generalized union and intersections. Cartesian product of sets.	
Unit 3	
Mappings, bijective mappings, composition of mappings, inverse of a mapping.	
Reference Books	
► R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998. ► P.R. Halmos, Naive Set Theory, Springer, 1974. ► E. Kamke, Theory of Sets, Dover Publishers, 1950. ► M. K. Sen, S. Ghosh, P. Mukhopadhyay and S. K. Maity, Topics in Abstract Algebra, Universities press, 3rd Edition, 2019	

5.2 SEC T2 – C Programming Language (Theory & Practical)

C Programming Language (Theory & Practical)	
	3 Credits
Course Outcomes: The course will enable the students to i) understand and apply the programming concepts of C which are important for mathematical investigation and problem solving. ii) use the mathematical library functions for computational objectives. iii) familiarize with syntax and/or error of the different command and their consequences.	
Course Specific Outcomes: The student acquires the knowledge of i) representing the outputs of programs visually in terms of well formatted text and plots. ii) identifying the specific decision-making loops and commands.	
Part I: Theory Part	**2 Credits**
Unit 1	
Computer Programming Languages; Classification: Low and Higher-level languages; Machine Language, Assembly Language; Source and Object programs; Language Translators: Assembler, Compiler and Interpreter.	
Unit 2	
C Programming Language and its importance: C Tokens, C Character set; Keywords and Identifiers, C Constants and variables, data types, expression, assignment statements, declaration. Operation and Expressions: Assignment, arithmetic, relational, logical, conditional operators. Decision Making and Branching: if statement, if-else statement, if ... else ladder format, Nesting if statement, switch statement, break and continue statements. Simple programs. Looping Statements: While, do-while and for loop. Simple programs.	
Unit 3	
Arrays and Subscripted variables: One and two-dimensional arrays, declaration of arrays, initialization of one and two dimensional arrays. Simple programs. User-defined Functions: Definition of functions, Scope of variables, return values and their types, function declaration, function call by value, nesting of functions, passing of arrays to functions, Recurrence of function. Simple programs; Introduction to Library functions.	
Evaluation: Unit I - 05 questions to be answered out of 08 questions carrying 01 marks of each; Unit II - 02 questions to be answered out of 03 questions carrying 05 marks of each and Unit III- 01 question to be answered out of 02 questions carrying 10 marks.	

Part II: Practical — 1 Credit

1. Calculate the sum of a finite series.
2. Enter 100 integers into an array and sort them in an ascending order.
3. GCD and LCM of two positive integers.
4. Finding maximum and minimum among some numbers.
5. Testing of prime number.
6. Finding prime numbers within a range.
7. Generating Fibonacci Series.
8. Matrix addition.

Evaluation: 01 questions to be answered out of 06 questions carrying 10 marks of each and viva-voce should be held for 05 marks.

Reference Books

- B.W. Kernighan and D.M. Ritchi, The C-Programming Language, 2nd Ed.(ANSI Refresher), Prentice Hall, 1977.
- E. Balagurnsamy, Programming in ANSI C, Tata McGraw Hill, 2004.
- Y. Kanetkar, Let Us C; BPB Publication, 1999.
- C. Xavier, C-Language and Numerical Methods, New Age International, 1999.
- Reema Thareja, Programming in C (2nd Ed.), Oxford University Press, 2011.
- B. S. Gottfried, Theory and Problems of Programming with C (2nd Ed.), Schaum's Outline Series, Mcgraw-Hill, 1996.
- V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall of India, 1980.

SEC 3- Python Programming Language (Theory & Practical)

Python Programming Language (Theory & Practical)

Part I: Theory Part — 2 Credits

Unit1

Python Programming Language, Input, Processing and Output, Editing, Saving, and Running a Script, Debugging: Syntax Errors, Runtime Errors and Semantic Errors.

Data types and expressions: Variables and the Assignment Statement, Program Comments and Doc strings. Data Types-Numeric integers and Floating-point numbers. Boolean string. Mathematical operators, PEMDAS.

Arithmetic expressions, Mixed-Mode Arithmetic and type Conversion, type( ). Input( ), print( ), program comments. id( ), int( ), str( ), float( ).

Unit2

Loops and selection statements: Definite Iteration: for Loop, Executing statements a given number of times, Specifying steps using range( ), Loops that count down, Boolean and Comparison operators and Expressions, Conditional and alternative statements- Chained and Nested Conditionals: if, if-else, if-else-if-else, nested if, nested if-else.

Compound Boolean Expressions, Conditional Iteration: while Loop –with True condition, break Statement. Random Numbers. Loop Logic, errors and testing. Strings, Lists, Tuple, Dictionary: Accessing characters, indexing, slicing, replacing. Concatenation (+), Repetition (*). Searching a substring with the 'in' Operator, Traversing string using while and for. String methods- find, join, split, lower, upper. len( ).

Unit3

Lists – Accessing and slicing, Basic Operations (Comparison, +), List membership and for loop. Replacing element (list is mutable). List methods append, extend, insert, pop, sort. Max( ), min( ). Tuples. Dictionaries-Creating a Dictionary, Adding keys and replacing Values, dictionary - key( ), value( ), get( ), pop(), Traversing a Dictionary. Math module: sin(), cos(), exp(), sqrt(), constants- pi, e.

Design with functions: Defining Simple Functions- Parameters and Arguments, the return Statement, tuple as return value. Boolean Functions. Defining a main function. Defining and tracing recursive functions.

Part II: Practical — 1 Credits

1. Write a program to read one subject mark and print pass or fail. Use single return-values function with argument.
2. Find the median of a given set of numbers.
3. Write a Python function that takes two lists and returns true if they have at least one common member.
4. Write a program for Enhanced Multiplication Table Generator.
5. Write down Unit converter code.
6. Write down Factor Finder code.
7. Write down a code for solving Single-Variable Inequalities.
8. Prepare an investment report by calculating compound interest.
9. Write a python program to open and write the content to file and read it.
10. Write a python program to check whether a given year is leap year or not.

Evaluation: 01 questions to be answered out of 06 questions carrying 10 marks of each and viva-voce should be held for 05 marks.

Reference Books

- Kenneth A Lambert, Fundamentals of Python: First programs, 2nd edition – Cengage Learning India, 2019.
- Saha Amit, Doing Math with Python - No starch press, San Francisco, 2015.
- E. Balgurusamy, Problem solving and Python programming- Tata McGraw Hill, 2017.
- R. Theresa, Python Programming, Oxford University Press, 2022.
- Y. Kanetkar and A. Kanetkar, Let Us Python - 4th Edition, BPB Publication, 2022.