BENGALURU CITY UNIYERSITY

CHOICE BASED CREDIT SYSTEM

Semester Scheme with Multiple Entry and Exit Options for Under Graduate Course)

Syllabus for Mathematics

(I&II Semester)

2021-22 onwards

Proceedings of the BOS(UG) meeting

The BOS (UG) meeting in Mathematics was held on 28-09-2021 at 11am in the Department of Mathematics, Bengaluru Central University, Central College Campus, Bengaluru-560001.

The following members attended the meeting.

Sl. No	Name	Designation	Signature
1.	Dr. Medha Itagi Huilgol	Chairperson	
2.	Dr. D Sujatha	Member	28.9.21
3.	Prof. T. Gangadaraiah	Member	
4.	Dr.D.Radhakrishna	Member	
5.	Dr. M. S. Nagashree	Member	
6.	Prof. Ramesh Babu .V.S	Member	
7.	Prof. Vittal V. Kulkarni	Member	
8.	Dr. S. B. Satyanarayana	Member	
9.	Dr. S. Bhagya	Member	28.9.21
10.	Prof. Sanjay Kumar Pattankar	Member	28/9/2021

- Finalized draft NEP syllabus was checked.
- A discussion was held on the new syllabus.
- The syllabus was approved by the Chairperson and members present.
- The committee decided to get approval for **first two** semesters only.
- The Chairperson thanked members for attending and approving.

Medha Itagi Huilgol

Chairperson
Department of Mathematics
Bengaluru City University
Central College Campus
Bengaluru-560001.

BENGALURU CITY UNIVERSITY

Syllabus for B.A/B.Sc (Honors) Mathematics

Name of the Degree Program : B.Sc.
Discipline Cours: Mathematics

Starting Year of Implementation : 2021-22

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

PO 1	Disciplinary Knowledge : Bachelor degree in Mathematics 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.
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
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 softwares to solve system of algebraic equations and differential equations.
PO 7	Self – directed learning: The student completing this program will develop an 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 general.
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 world 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	40%	60 %
Practical	50%	50 %
Projects	40 %	60 %
Experiential Learning (Internship etc.)	--	--

Contents of Courses for B.A./B.Sc. with Mathematics as Major Subject &B.A./B.Sc. (Hons) Mathematics
Model IIA

	Course No.			Paper Title	Marks		Remark
					S.A.	I.A.	
I	MATDSCT1.1	Theory	4	Algebra - I and Calculus - I	60	40	Approved with Syllabus
	MATDSCP1.1	Practical	2	Theory based Practical's on Algebra- I and Calculus - I	25	25	
II	MATDSCT2.1	Theory	4	Algebra - II and Calculus - II	60	40	
	MATDSCP2.1	Practical	2	Theory based Practical's on Algebra - II and Calculus - II	25	25	
Exit Option with Certificate							
III	MATDSCT3.1	Theory	4	Ordinary Differential Equations and Real Analysis-I	60	40	To be approved in subsequent BOS
	MATDSCP3.1	Practical	2	Theory based Practical's on Ordinary Differential Equations and Real	25	25	
	MATOET3.1	Theory	3	(A) Ordinary Differential Equations (B) Quantitative Mathematics	60	40	
IV	MATDSCT4.1	Theory	4	Partial Differential Equations and Integral Transforms	60	40	
	MATDSCP4.1	Practical	2	Theory based Practical's on Partial Differential Equations and Integral Transforms	25	25	
	MATOET4.1	Theory	3	(A) Partial Differential Equations (B) Mathematical Finance	60	40	
Exit Option with Diploma							
V	MATDSCT5.1	Theory	3	Real Analysis and Complex analysis	60	40	To be approved in subsequent BOS
	MATDSCP5.1	Practical	2	Theory based Practical's on Real Analysis and Complex Analysis	25	25	
	MATDSCT5.2	Theory	3	Ring Theory	60	40	

	MATDSCP5.2	Practical	2	Theory based Practical's on Ring theory	25	25	
VI	MATDSET5.1	Theory	3	(A) Vector Calculus (B) Mechanics (C) Mathematical Logic	60	40	
	MATDSCT6.1	Theory	3	Linear Algebra	60	40	
	MATDSCP6.1	Practical	2	Theory based Practical's on Linear Algebra	25	25	To be approved in subsequent BOS
	MATDSCT6.2	Theory	3	Numerical Analysis	60	40	
	MATDSCP6.2	Practical	2	Theory based Practical's on Numerical Analysis	25	25	
	MATDSET6.1	Theory	3	(A) Analytical Geometry in3D (B) Number Theory (C) Special Functions (D) History of Bhârtîya gaṇita	60	40	
	Exit Option with Bachelor of Arts, B.A./ Bachelor of Science, B.Sc. Degree						
VII	MATDSCT7.1	Theory	3	Discrete Mathematics	60	40	
	MATDSCP7.1	Practical	2	Theory based Practical's on Discrete Mathematics	25	25	To be approved in subsequent BOS
	MATDSCT7.2	Theory	3	Advanced Ordinary Differential Equations	60	40	
	MATDSCP7.2	Practical	2	Theory based Practical's on Advanced Ordinary Differential Equations	25	25	
	MATDSCT7.3	Theory	4	Advanced Analysis	60	40	
	MATDSET7.1	Theory	3	(A) Graph Theory (B) Entire and Meromorphic Functions (C) General Topology (D) Bhâratîya TrikoṇmitiŚâstra	60	40	
	MATDSET7.2	Theory	3	Research Methodology in Mathematics	60	40	
VIII	MATDSCT8.1	Theory	4	Advanced Complex Analysis	60	40	
	MATDSCT8.2	Theory	4	Advanced Partial Differential Equations	60	40	

	MATDSCT8.3	Theory	3	Fuzzy Sets and Fuzzy Systems	60	40	To be approved in subsequent BOS
	MATDSET8.1	Theory	3	(A) Operations Research (B) Lattice theory and Boolean Algebra (C) Mathematical Modelling (D) Aṅkapâśa(Combinatorics)	60	40	
	MATDSET8.2	Research Project	6 (3	Research Project* OR	120	80	
			+	Any Two of the following electives	OR	OR	
			3)	(A) Finite Element Methods	60	40	
				(B) Cryptography	60	40	
				(C) Information Theory and Coding (D) Graph Theory And Networking			
Award of Bachelor of Arts Honours, B.A. (Hons)/ Bachelor ofScience Honours, B.Sc.(Hons) Degree inMathematics							

OPEN ELECTIVES FOR FIRST TWO SEMESTERS

Course			Paper Title	Marks(SA)	MarksI(IA)	Remark
MATOET1	Theory	3	Corporate Mathematics	60	40	Approved with Syllabus
MATOET2	Theory	3	Mathematics - I	60	40	
MATOET3	Theory	3	Mathematics- II	60	40	
MATOET4	Theory	3	Commercial Mathematics	60	40	

CURRICULUM STRUCTURE FOR UNDERGRADUATE DEGREEPROGRAM

Name of the Degree Program : B.A. / B.Sc.(Honors)
Discipline/Subject : Mathematics
Starting Year of Implementation: 2021-22

PROGRAM ARTICULATION MATRIX

Course number		Program outcomes that courses addresses	Prerequisite courses	Pedagogy *	Assessment **
I	MATDSCT1.1	PO 1,PO 2,PO 3	---------	MOOC PROBLEM SOLVING SEMINAR PROJECT BASED LEARNING ASSIGNMENTS GROUP DISCUSSION	CLASS TESTS SEMINAR QUIZ ASSIGNMENT TERM END EXAM VIVA-VOCE
II	MATDSCT2.1	PO 1,PO 2,PO 3 ,PO 8	MATDSCT1.1		
III	MATDSCT3.1	PO 1,PO 4,PO 7 PO 8	----------		
IV	MATDSCT4.1	PO 1,PO 4,PO 7, PO 8	MATDSCT3.1		
V	MATDSCT5.1	PO 1, PO 2, PO 3, PO 5	---------		
V	MATDSCT5.2	PO 3,PO 4, PO 7, PO 10	MATDSCT2.1		
VI	MATDSCT6.1	PO 6, PO 7, PO 10	MATDSCT5.1		
VI	MATDSCT6.2	PO 3,PO 4, PO 5, PO 8 PO 9, PO 10	MATDSCT1.1 & MATDSCT2.1		
VII	MATDSCT7.1	PO 3,PO 4, PO 5, PO 7, PO 9	MATDSCT1.1 & MATDSCT2.1		
VII	MATDSCT7.2	PO 2,PO 4, PO 5, PO 10	MATDSCT3.1		
VII	MATDSCT7.3	PO 2,PO 4, PO 5, PO 10	MATDSCT3.1		
VIII	MATDSCT8.1	PO 2,PO 4, PO 5, PO 10	MATDSCT5.1		
VIII	MATDSCT8.2	PO 2,PO 4, PO 5, PO 10	MATDSCT4.1		
VIII	MATDSCT8.3	PO 2,PO 4, PO 5, PO 10	MATDSCT7.3		

* Pedagogy for student engagement is predominantly Lecture. However, other pedagogies enhancing better student engagement to be recommended for each course. This list includes active learning/ course projects / Problem based or

Project based Learning / Case Studies / Self Study like Seminar, Term Paper or MOOC.

** Every Course needs to include assessment for higher order thinking skills(Applying/Evaluating / Creating). However, this column may contain alternate assessment methods that help formative assessment (i.e. assessment for Learning).

B.A./B.Sc. with Mathematics as Minor in the 3rd Year

Semester	Course No.		Credits	Paper Title	Marks	
					S.A.	I.A.
V3	MATDSCMT5.1	Theory		Complex Analysis	60	40
	MATDSCMP5.12	Practical		Theory based Practical's on Complex Analysis	25	25
V3	MATDSCMT6.1	Theory		Numerical Analysis	60	40
	MATDSCMP6.12	Practical		Theory based Practical's on Numerical Analysis	25	15

Abbreviation for MATDSCMT5.1 / MATDSCMP5.1
MAT – Mathematics; DSC – Discipline Core; M – Minor; T – Theory /P –Practical; 5 – Fifth Semester; .1 – Course1

Credit Distribution for B.A./B.Sc.(Honors) with Mathematics as Major inthe 3rd Year
(For Model IIA)

Subject		Major/ Minor in the 3rd Year	Credit						
			Discipline Specific Core (DSC)		Open (OE)	Discipline Specific & Elective (DSE)	AECC Elective Languages	Skill Enhancement Courses (SEC)	Total Credits
Mathematics	I-IV	Major	4 Courses (4+2)x		4Courses 3 x 4 =12	---	(4+4=8) Courses 8x(3+1) = 32	2 Courses 2x(1+1)= 4	72
Other Subject		Minor	24		--	--	--	--	24
									96
Mathematics	V & VI	Major	4 Courses 4x(3+2)=24		----	2Courses 2 x 3 =06	---	2Courses 2 x 2 =4	30
Other Subject		Minor	10		--	--	--	--	10
			(96+40)=136						
Mathematics	VII & VIII	Major	2 Courses2x(3+2)=1 3 Courses 3 x 4 = 12 1Course1 x 3 =3 Total=25		----	2 Courses 2 x 3 = 6 Res.Meth1 x 3 =3 2Courses 2 x 3 =6 Total= 15	----	----	40
Total No. of courses			14		04	07	08	04	
									136+40=176

SEMESTER – I

MATDSCT 1.1: Algebra - I and Calculus - I	
Teaching Hours : 4 Hours/Week	Credits: 4
Total Teaching Hours: 56 Hours	Max. Marks: 100 (S.A.-60 + I.A -40)

Course Learning Outcomes: This course will enable the students to

- Learn to find rank of a matrix.
- Solve the system of homogeneous and non-homogeneous linear system of ' m' equations in' n' variables by using concept of rank of matrix, finding eigenvalues and eigen vectors
- be familiar with the techniques of finding nth derivatives of some standard functions
- Identify and apply the intermediate value theorems and L'Hospital's rule.
- learn partial differentiation, Jacobians and related properties.
- learn expansion of Taylor's and Maclaurin's series of functions of 2 variables and maxima and minima of functions of 2 variables.

Algebra-I

Unit-I: Matrices: Recapitulation of Symmetric and Skew Symmetric matrices, Algebra of Matrices; Row and column reduction to Echelon form. Rank of a matrix; Finding rank of a matrix by reducing to row reduced echolen form and normal form;Solution of system of linear equations; Criteria for existence of non-trivial solutions of homogeneous system of linear equations. Solution of non-homogeneous system of linear equations. Eigenvalues and Eigenvectors of square matrices, standard properties; Cayley- Hamilton theorem(With Proof), inverse of matrices by Cayley- Hamilton theorem, finding A^2, A^3,A^{-1}, A^{-2}.

14 Hours

Calculus I

Unit-II:-Limits, Continuity, Differentiability and properties. Properties of continuous functions. n^{th} Derivatives of Standard functions e^{ax+b},$(ax+b)^n$, log(ax+b), sin(ax+b), cos(ax+b), e^{ax}sin(bx+c), e^{ax}cos(bx+c). Leibnitz theorem and its applications.

14Hours

Unit-III: Mean Value Theorems : Intermediate value theorem, Rolle's Theorem, Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem, Maclaurin's series, Indeterminate forms and evaluation of limits using L'Hospital's rule. 14 Hours

Unit-IV: **Partial Differentiation:** Functions of two or more variables-explicit and implicit

functions, partial derivatives. Homogeneous functions- Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables.

14 Hours

Reference Books:

1. University Algebra -N.S. Gopala Krishnan, New Age International (P) Limited
2. Theory of Matrices - B S Vatsa, New Age InternationalPublishers.
3. Matrices - A R Vasista, Krishna PrakashanaMandir.
4. Differential Calculus - Shanti Narayan, S. Chand & Company, NewDelhi.
5. Applications of Calculus, DebasishSengupta, Books and Allied (P) Ltd.,2019.
6. Calculus – LipmanBers, Holt, Rinehart &Winston.
7. Calculus - S Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt.Ltd., vol. I &II.
8. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed.USA: Mc. Graw.

MATDSCP 1.1: Practical's on Algebra - I and Calculus – I	
Practical Hours : 4 Hours/Week	Credits: 2
Total Practical Hours: 56 Hours	Max. Marks: 50 (S.A.-25 + I.A.-25)

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open Source Software (FOSS) tools for computer programming Solve problem on algebra and calculus theory studied in MATDSCT 1.1 by using FOSS
- Solve problem on algebra and calculus theory studied in MATDSCT 1.1 by using FOSS softwares
- Acquire knowledge of applications of algebra and calculus through FOSS

Practical/Lab Work to be performed in Computer Lab (FOSS)

Suggested Software's: Maxima/Scilab/Maple/MatLab/Mathematica/Python/R. Introduction to the software and commands related to the topic.

Practical -I

1. Basics of software with simple examples.

2. Basics of software with simple examples.

3. Matrices –Algebra of Matrices with problems.

4.Computation of rank of a matrix by row reduced and normal forms.

5.Solving the system of homogeneous and non- homogeneous linear equations.

6.Computation of inverse of a matrix using Cayley-Hamilton theorem.

7. Finding the nth derivatives of functions without Leibnitz theorem.

8. Finding the nth derivatives of functions with Leibnitz's theorem.

9. Partial Differentiation of some standard functions and Jacobians.

10. Verification of Euler's theorem with examples.

11. Finding the Taylor's and Maclaurin's expansion of the given function.

12. Indeterminate forms and evaluation of limits using L-Hospital's rule.

Note: Each problem given in the Lab-manual has to be solved manually.

SEMESTER – II

MATDSCT 2.1: Algebra - II and Calculus - II	
Teaching Hours : 4 Hours/Week	Credits:4
Total Teaching Hours: 56 Hours	Max. Marks: 100 (S.A.-60 + I.A. - 40)

Course Learning Outcomes: This course will enable the students to

- Recognize the mathematical objects called Groups.
- Link the fundamental concepts of groups and symmetries of geometrical objects.
- Explain the significance of the notions of cosets, normal subgroups and factor groups.
- Learn the quotient groups, concepts of homomorphism, isomorphism and properties related to isomorphism.
- Learn solve problems related to angle between radius vector and tangent, angle between two curves.
- Learn expressing the curves in pedal form, derivative of an arc
- Learn the center of curvature, asymptotes, evolutes and envelops of the given curve
- Learn the reduction formulae
- Learn to find length of an arc, area of plane curves and surface area, volume of revolution

Algebra-II

Unit-I: Groups-I-Definition o f a group with examples and properties, congruence, problems. Subgroups, center of groups, order of an element of a groupand its related theorems, cyclic groups, Coset decomposition, Factor groups, Lagrange's theorem and its consequences. Fermat's theorem and Euler's ϕ function.

14 Hours

Unit-II: Groups-II-Normal Subgroups-Examples & Problems –Quotient group-Homomorphism & Isomorphism of groups – kernel & image of a homomorphism – Normality of the kernel –Fundamental theorem of homomorphism – Properties related to isomorphism – Permutation group – Cayley's Theorem.

14 Hours

CALCULUS-II

Unit-III : Polar Co-ordinates: Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from

pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- center of curvature, asymptotes, evolutes and envelops.

14 Hours

Unit-IV: Integral Calculus: Recapitulation of definite integrals and its properties. Reduction formulae- $\int \sin^n x \, dx$, $\int \cos^n x \, dx$, $\int \sin^n x \ \cos^n x \, dx$, $\int_0^{\frac{\pi}{2}} \sin^n x \, dx$, $\int_0^{\frac{\pi}{2}} \cos^n x \, dx$, $\int_0^{\frac{\pi}{2}} \sin^n x \ \cos^n x \, dx$, problems, computation of length of an arc, Area of plane curves, surface area and volume of revolution in Cartesian and polar forms.

14 hours

Reference Books:

1. Elements of Number Theory; I. M. Vinogradov.
2. Differential Calculus, Shanti Narayan, S. Chand & Company, NewDelhi.
3. Integral Calculus, Shanti Narayan and PK Mittal, S. Chand and Co. Pvt. Ltd.,
4. Schaum's Outline Series, Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill.,2008.
5. Mathematical Analysis, S C Malik, WileyEastern.
6. A Course in Abstract Algebra, Vijay K Khanna and S K Bhambri,Vikas Publications.

PRACTICAL

MATDSCP 2.1: On Algebra -II and Calculus - II	
Practical Hours : 4 Hours/Week	Credits: 2
Total Practical Hours: 56 Hours	Max. Marks: 50 (S.A.-25 + I.A. -25)

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open Source Software (FOSS) tools for computer programming
- Solve problems on algebra and calculus by using FOSS.
- Acquire knowledge of applications of algebra and calculus

through FOSSPractical/Lab Work to be performed in

Computer Lab.

Suggested Software's: Maxima/Scilab/Maple/MatLab/Mathematica/Python

MATDSCP2.1:

Practicals-II

1. Program to construct Cayley's table and test commutatively for a given finite set.
2. Program to find all possible cosets of the given finite group.
3. Program to find generators and corresponding possible subgroups of a cyclic group.
4. Program to verify Lagrange's theorem with suitable examples.
5. Program to verify Euler's φ Function for a given finite group.
6. Program to verify the given function is homomorphism and isomorphism.
7. Program to solve problems using reduction formulae.
8. Program to compute surface area.
9. Program to compute volume of revolution.
10. Finding the angle between the radius vector and tangent.
11. Finding the angle between two curves.
12. Finding the radius of curvature of the given curve.

Open Elective 1

MATOET 1: Mathematics - I	
Teaching Hours : 3 Hours/Week	Credits: 3
Total Teaching Hours: 42 Hours	Max. Marks: 100 (S.A.-60 + I.A. -40)

Course Learning Outcomes: This course will enable the students to

- Learn row and column operations, rank of matrix
- Learn to solve system of linear equations.
- Solve the system of homogeneous and non homogeneous m linear equations by ,finding eigenvalues and eigenvectors.
- Students will be familiar with the techniques of differentiation of function withreal variables.
- Identify and apply the intermediate value theorems andL'Hospital's rule.
- Learn to evaluate integrals , find arc -lengths , areas and volume.

Unit-I: Matrices: : Recapitulation of Symmetric and Skew Symmetric matrices, Algebra of Matrices; Row and column reduction to Echelon form. Rank of a matrix; Finding rank of a matrix by reducing to row reduced echolen form and normal form ;Solution of system of linear equations; Criteria for existence of non-trivial solutions of homogeneous system of linear equations. Solution of non-homogeneous system of linear equations. Eigenvalues and Eigen vectors of square matrices, Cayley- Hamilton theorem(Without Proof), inverse of matrices by Cayley-Hamilton theorem.

14Hours

Unit-II: Differential Calculus: Limits, Continuity, Differentiability and properties. Intermediate value theorem(statement only with examples), Rolle's Theorem(statement only with examples), Lagrange's Mean Value eorem(statement only with examples), Cauchy's Mean value theorem (statement only with examples) and examples. Taylor's theorem(without proof), Maclaurian's series and L'Hospital's rule-problems.

14 Hours

Unit-III: Integral Calculus: Recapitulation of Definite integrals and its properties. Computation of length of arc, area of plane curves, surface area and volume of revolution in Cartesian form.

14 Hours

Open Elective 2

MATOET 1: **Corporate Mathematics**	
Teaching Hours : 3 Hours/Week	Credits: 3
Total Teaching Hours: 42 Hours	Max. Marks: 100 (S.A.- 60 + I.A.-40)

Course Learning Outcomes: This course will enable the students to

- Learn types of equations and methods to solve linear, quadratic equations.
- Learn how to represent data through graphs and analyze.
- Learn frequency distribution , mean, median and mode.
- Learn GM,HM,AM concepts
- Learn formation and solution of LPP through graphical methods.

Unit I:

Theory of Equations:

Introduction meaning and types of equations. Simple linear equations, simultaneous equations (only two variables) elimination method, Substitution method and rule of cross multiplication (RCM). Quadratic equations, factorization method formula method and application problems.

14hours

Unit II:

Statistical Methods:

Frequency distribution: Raw data, attributes and variables, Classification of data, frequency distribution, cumulative frequency distribution, Histogram. Requisites of ideal measures of central tendency, Arithmetic Mean, Median and Mode for ungrouped and grouped data. Combined mean, Merits and demerits of measures of central tendency, Geometric mean: definition, merits and demerits, Harmonic mean: definition, merits and demerits, Choice of A.M., G.M. and H.M. Concept of dispersion, Measures of dispersion: Range, Variance, Standard deviation (SD) for grouped and ungrouped data, combined SD, Measures of relative dispersion: Coefficient of range, coefficient of variation. Examples and problems.

14 hours

Unit IV:

Data Interpretation:

Tabulation, Bar graphs, Pie charts, line graphs and application problems.

Linear Programming:

Meaning, linear inequalities and their graphs, Formation of LPP and solution of linear programming problems by graphical method.(only two variables)

14 hours

Open Elective 3

MATOET3: Mathematics –II	
Teaching Hours : 3 Hours/Week	Credits: 3
Total Teaching Hours: 42 Hours	Max. Marks: 100 (S.A.- 60 + I.A. -40)

Course Learning Outcomes: This course will enable the students to

- learn how to find the roots of equations.
- relation between roots and coefficients.
- Learn Descartes' rule of signs to find roots.
- Understand the concept of partial differentiation, Jacobians and Taylors and Meclaurin's expansion.
- Find the extreme values of functions of two variables.
- To understand the concepts of multiple integrals and their applications.

Unit-I: Theory of Equations- Euclid's Algorithm- Polynomials with integral coefficients- Remainder theorem- Factor theorem- Fundamental theorem of algebra(statement only) –Irrational and complex roots occurring in conjugate pairs – Relation between roots and coefficients of a polynomial equations, symmetric functions – Transformation- Reciprocal equations- Descartes' rule of signs- multiple roots.

14 Hours

Unit-II: Partial Differentiation-Functions of two or more variables-explicit and implicit functions, partial derivatives. Homogeneous functions- Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians, standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables.

14 Hours

Unit-III: Integral Calculus-Definition of line integral and basic Properties ,examples on evaluation of line integrals. Double integral- Definition of Double integrals and its conversion to iterated integrals. Computation of plane surface areas. Triple integral- Definition of triple integrals and evaluation, volume as triple integral.

14 Hours

Open elective 4

MATOET 4: Commercial Mathematics	
Teaching Hours : 3 Hours/Week	Credits:3
Total Teaching Hours: 42 Hours	Max. Marks: 100 (S.A.- 60 + I.A.-40)

Course Learning Outcomes: This course will enable the students to

- Learn concepts of set ,types of sets and Venn diagrams.
- Learn concepts of Relations and functions
- Learn concept of permutation and combination with application problems.
- Learn concept of probability, definitions of events , occurrences of events.
- Learn some rules of probability and application problems
- Learn to calculate percentage and ratios in application problems.
- learn definitions of proportions and properties.
- apply these concepts in commercial problems.

Unit-I: Set theory:

Sets, subset, empty set, power set, operations on sets, Venn diagrams, relations, types of relations, domain and range of a relations, functions, types of functions, binary operations.

14 hours

Unit - II: Permutation ,Combinations and probability

Fundamental principle of counting ,Factorial, permutation and combinations, simple applications. Random experiments,

Introduction to probability, sample spaces(Set representation),events; the probability of an event, some rules of probability .Occurrences of events. 'not', 'AND','OR' events, exhaustive events, mutually exclusive events. Axiomatic(set theoretic) probability ;probability of 'and', 'or', 'not', events and conditional probability.

14 Hours

Unit - III: Percentage, Ratio &Proportions: Percentage-Definition, Calculation of percentage, Ratios-Types of Ratios-Duplicate, Triplicate & Sub-duplicate of a ratio. Proportions-Definition &properties-cross product property &reciprocal property, united proportions-continued proportion-compound proportions, examples on commercial Mathematics.

14 Hours

Reference books for open electives:

1. Algebra, Natarajan, Manicavasagam pillay and Ganapathi
2. Differential Calculus, Shanti Narayan, S. Chand & Company, New Delhi.
3. Integral Calculus, Shanti Narayan and PK Mittal, S. Chand and Co. Pvt. Ltd.,
4. University Algebra - N.S. Gopala Krishnan, New Age International (P)
5. Theory of Matrices - B S Vatsa, New Age International Publishers.
6. M.K. Jain, S.R. K Iyengar and R.K .Jain, Numerical methods for Scientific and engineering Computations, 4thed.New Delhi, India, New age International,2012
7. John Kisulas,Numerical methods in engineering with python3, Cambridge University press,2013
8. Practical Business Mathematics, S. A. Bari New Literature Publishing Company, New Delhi
9. Mathematics for Commerce, K. Selvakumar Notion Press, Chennai
10. Business Mathematics with Applications, Dinesh Khattar& S. R. Arora S. Chand Publishing New Delhi
11. Business Mathematics and Statistics, N.G. Das &Dr. J.K. Das McGraw Hill New Delhi
12. Fundamentals of Business Mathematics, M. K. Bhowal, Asian Books Pvt.Ltd New Delhi
13. Statistical Methods, Gupta S. P.: Sultan Chand andSons, New Delhi.
14. Fundamentals of Statistics, Goon A. M., Gupta, M. K. and Dasgupta, B. World Press Calcutta.
15. Statistical methods: An introductory text, New Age.

Question paper pattern for all semesters(Core paper)

Theory Paper

PART - A (questions from all units)	6 questions out of 8 questions	6*2=12 marks
Part-B		
Unit - I	3 questions out of 5 questions	3*4=12 marks
Unit - II	3 questions out of 5 questions	3*4=12 marks
Unit - III	3 questions out of 5 questions	3*4=12 marks
Unit - IV	3 questions out of 5 questions	3*4=12 marks
Total		**60 marks**

Distribution of IA marks: Assignment - 5 marks
: Conducting Student Seminar -5 marks
: Two internal Tests - 30 marks

Open Elective Paper

PART - A (questions from all units)	5 questions out of 9 questions	5*3=15 marks
Part-B		
Unit - I	3 questions out of 5 questions	3*5=15 marks
Unit - II	3 questions out of 5 questions	3*5=15 marks
Unit - III	3 questions out of 5 questions	3*5=15 marks
Total		**60 marks**

Distribution of IA marks: Assignment - 5 marks
:Two internal Tests - 30 marks
: Conducting Student Seminars - 5 marks

Practical Question Paper

PART-I 1 question out of 2 questions	1*5=5 marks
PART-II 1 question out of 2 questions	1*5=5 marks
PART-III 1 question out of 2 questions	1*5=5 marks
PART-IV 1 question out of 2 questions	1*5=5 marks
Record	5 marks
Total	**25 marks**

Distribution of IA marks: Observation Book - 5 marks
: Two Internal Tests - 20 marks

Note: Distribution of Marks for manual work and execution will be done proportionately.