Mangalore University
Mangalagangothri -574 199

SYLLABUS

B.A./B.Sc. (Hons) Mathematics,
B.A./B.Sc. with Mathematics as a Major/Minor Subject
(ACCORDING TO NATIONAL EDUCATION POLICY 2020)

2021

Name of the Degree Program : B.A./B.Sc.
Discipline Course : Mathematics
Starting Year of Implementation : 2021-22

Programme Outcomes (PO):

By the end of the program it is expected that the students will be benefited by the following:

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 such as computer science and other allied subjects
PO 2	**Communication Skills**: Ability to communicate various mathematical concepts effectively using examples and their geometrical visualization. The skills and knowledge gained in this program will lead to the proficiency in analytical reasoning which can be used for modeling and solving of real life problems.
PO 3	**Critical thinking and analytical reasoning:** The students undergoing the 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 the programme develop an ability to analyze the problems, identify and define appropriate computing requirements for its solutions. This programme enhances students overall development and also equip them with mathematical modelling ability, problem solving skills.
PO 5	**Research related skills**: Student completing the program will 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 the programme will enable the learner to use appropriate softwares to solve system of algebraic equation and differential equations.
PO 7	**Self – directed learning**: Student completing the 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 the program will develop an ability to identify unethical behavior such as fabrication, falsification or misinterpretation of data and adopting objectives, unbiased and truthful actions in all aspects of life, in general and Mathematical studies, in particular.
PO 9	**Lifelong learning**: The programme provides self-directed learning and lifelong learning skills. The programme helps the learner to think independently and develop algorithms and computational skills for solving real word problems.
PO 10	Ability to peruse advanced studies and research in pure and applied Mathematical sciences.

Assessment

Weightage for the Assessments (in percentage)

Type of Course	Formative Assessment/ I.A.	Summative Assessment (S.A.)
Theory	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 suggested by the Karnataka State Higher Education Council)

Semester	Course No.	Theory/ Practical	Credits	Paper Title	Marks S.A.	Marks I.A.
I	MATDSCT1.1	Theory	4	Number Theory-I, Algebra-I and Calculus-I	60	40
	MATDSCP1.1	Practical	2	Theory based Practicals on Number Theory-I, Algebra-I and Calculus-I	25	25
	MATOET1.1	Theory	3	(A) Mathematics - I (B) Business Mathematics - I	60	40
II	MATDSCT2.1	Theory	4	Number Theory-II, Algebra - II and Calculus - II	60	40
	MATDSCP2.1	Practical	2	Theory based Practicals on Number Theory-II, Algebra - II and Calculus - II	25	25
	MATOET2.1	Theory	3	(A) Mathematics – II (B) Business Mathematics-II	60	40
Exit Option with Certificate						
III	MATDSCT3.1	Theory	4	Ordinary Differential Equations and Algebra - III	60	40
	MATDSCP3.1	Practical	2	Theory based Practicals on Ordinary Differential Equations and Algebra - III	25	25
	MATOET3.1	Theory	3	(A) Ordinary Differential Equations (B) Mathematical Logic	60	40
IV	MATDSCT4.1	Theory	4	Partial Differential Equations and Integral Transforms	60	40
	MATDSCP4.1	Practical	2	Theory based Practicals 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 and Complex Analysis	60	40
	MATDSCP5.1	Practical	2	Theory based Practicals on Real and Complex Analysis	25	25
	MATDSCT5.2	Theory	3	Modern Algebra - I	60	40
	MATDSCP5.2	Practical	2	Theory based Practicals Modern Algebra - I	25	25
	MATDSET5.1	Theory	3	Any ONE of the following electives: a) Vector Calculus b) Elementary Graph Theory c) Discrete Mathematics	60	40
VI	MATDSCT6.1	Theory	3	Linear Algebra - I	60	40
	MATDSCP6.1	Practical	2	Theory based Practicals on Linear Algebra - I	25	25
	MATDSCT6.2	Theory	3	Numerical Analysis	60	40

	MATDSCP6.2	Practical	2	Theory based Practicals on Numerical Analysis	25	25
	MATDSET6.1	Theory	3	Any ONE of the following electives: a) Analytical Geometry in 3D b) Linear Programming c) Special Functions d) Fourier Series and Fourier Transforms	60	40

Exit Option with Bachelor of Arts (B.A.)/ Bachelor of Science(B.Sc.) Degree

Sem	Code	Type	Credits	Title		
VII	MATDSCT7.1	Theory	3	Linear Algebra -II	60	40
	MATDSCP7.1	Practical	2	Theory based Practicals on Linear Algebra -II	25	25
	MATDSCT7.2	Theory	3	Advanced Ordinary Differential Equations	60	40
	MATDSCP7.2	Practical	2	Theory based Practicals on Advanced Ordinary Differential Equations	25	25
	MATDSCT7.3	Theory	4	Advanced Real Analysis	60	40
	MATDSET 7.1	Theory	3	Any ONE of the following electives: a) Graph Theory b) Advanced Number Theory c) Mathematical Statistics d) Advanced Numerical Analysis	60	40
	MATDSET 7.2	Theory	3	Research Methodology in Mathematics	60	40
VIII	MATDSCT8.1	Theory	4	Advanced Complex Analysis	60	40
	MATDSCT8.2	Theory	4	Abstract Algebra	60	40
	MATDSCT8.3	Theory	3	General Topology	60	40
	MATDSET 8.1	Theory	3	Any ONE of the following electives: a) Operations Research b) Lattice theory c) Mathematical Modelling d) Advanced Discrete Mathematics	60	40
	MATDSET 8.2	Research Project	6 (3 + 3)	Research Project OR Any TWO of the following electives a) Theory of Modules b) Theory of Partitions c) Cryptography d) Finite Element Methods	120 OR 60 60	80 OR 40 40

Award of Bachelor of Arts Honours (B.A. Hons)/
Bachelor of Science Honours (B.Sc. Hons) Degree in Mathematics

Abbreviation for MATDSCTx.y/MATDSCPx.y/MATDSETx.y/MATOETx.y
MAT – Mathematics;
DSC – Discipline Core; DSE – Discipline Elective; OE – Discipline Elective;
T – Theory, P – Practical;
x.y–xth Semester.Course y

MATOETx.y(A) - For students of Science stream who have not chosen Mathematics as one of Core subjects
MATOETx.y(B) - For Students of other than Science Stream

CURRICULUM STRUCTURE FOR UNDERGRADUATE DEGREE PROGRAM

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

PROGRAM ARTICULATION MATRIX

Semester	Course No.	Programme Outcomes that the Course Addresses	Pre-Requisite Course(s)	Pedagogy*	Assessment**
I	MATDSCT1.1	PO 1, PO 2, PO 3	PU level Mathematics	MOOC	CLASS TESTS
II	MATDSCT2.1	PO 1, PO 2, PO 3, PO 8	MATDSCT1.1	PROBLEM SOLVING	
III	MATDSCT3.1	PO 1, PO 4, PO7, PO 8	MATDSCT2.1	SEMINAR	SEMINAR
IV	MATDSCT4.1	PO 1, PO 4, PO7, PO 8	MATDSCT3.1	PROJECT BASED LEARNING	QUIZ
V	MATDSCT5.1	PO 1, PO 2, PO 3, PO 5	----		ASSIGNMENT
V	MATDSCT5.2	PO 3, PO 4, PO 7, PO10	MATDSCT2.1 MATDSCT3.1	ASSIGNMENTS	
VI	MATDSCT6.1	PO 6, PO 7, PO 10.	MATDSCT5.2	GROUP DISCUSSION	
VI	MATDSCT6.2	PO 5, PO 8, PO 9, PO 10.	MATDSCT5.1		
VII	MATDSCT7.1	PO 3, PO 4, PO5, PO 7, PO 9.	MATDSCT6.1		TERM END EXAM
VII	MATDSCT7.2	PO 2, PO 4, PO 5, PO 10	MATDSCT3.1		
VII	MATDSCT7.3	PO 2, PO 4, PO 5, PO 10	MATDSCT5.1		
VIII	MATDSCT8.1	PO 2, PO 4, PO 5, PO 10	MATDSCT5.1		
VIII	MATDSCT8.2	PO 2, PO 4, PO 5, PO 10	MATDSCT5.2		
VIII	MATDSCT8.3	PO 2, PO 4, PO 5, PO 10	MATDSCT5.1		VIVA-VOCE

*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 a Minor in the 3rd Year

Semester	Course No.	Theory/Practical	Credits	Paper Title	Marks S.A.	Marks I.A.
V	MATDSCMT5.1	Theory	3	Complex Analysis	60	40
	MATDSCMP5.1	Practical	2	Theory based Practicals on Complex Analysis	25	25
VI	MATDSCMT6.1	Theory	3	Numerical Analysis	60	40
	MATDSCMP6.1	Practical	2	Theory based Practicals on Numerical Analysis	25	25

Abbreviation for MATDSCMT5.1 / MATDSCMP5.1

MAT – Mathematics; **DSC** – Discipline Core; **M** – Minor; **T** – Theory /**P** – Practical;
5 – Fifth Semester; **.1** – Course 1

Credit Distribution for B.A./B.Sc.(Honors) with Mathematics as Major in the 3rd Year
(Model IIA suggested by the Karnataka State Higher Education Council)

Subject	Semester	Major/Minor in the 3rd Year	Discipline Specific Core (DSC)	Open Elective (OE)	Discipline Specific Elective (DSE)	AECC & Languages	Skill Enhancement Courses (SEC)	Total Credits
Mathematics	I - IV	Major	4 Courses (4+2)x 4=24	4 Courses 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)=20	-----	2 Courses 2 x 3 = 06	---	2 Courses 2 x 2 = 4	30
Other Subject		Minor	10	--	--	--	--	10
					(96+40)=136			
Mathematics	VII & VIII	Major	2 Courses 2x(3+2)=10 3 Courses 3 x 4 = 12 1 Course 1 x 3 = 3 Total=25	-----	2 Courses 2 x 3 = 6 Res.Meth 1 x 3 = 3 2 Courses 2 x 3 = 6 Total= 15	----	-----	40
Total No. of Courses			14	04	07	08	04	
					136+40=176			

Syllabus for B.A./B.Sc. with Mathematics as Major Subject & B.A./B.Sc. (Hons.) Mathematics

SEMESTER – I

MATDSCT1.1: Number Theory-I, 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
- Understand the elementary concepts of Number Theory.
- Solve the system of homogeneous and non-homogeneous m linear equations in n variables.
- Sketch curves in Cartesian and polar co-ordinates.
- Identify and apply intermediate value theorem, mean value theorems and L'Hospital rule.

Unit-I: 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. Linear Congruences and The Chinese Remainder Theorem.
14 Hours

Unit-II: Matrices: Recapitulation of Symmetric and Skew Symmetric matrices, Cayley-Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). Algebra of Matrices, Row and column reduction to Echelon form. Rank of a matrix, Inverse of a matrix by elementary operations, 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.
14 Hours

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, Tracing of curves (standard curves). **14 Hours**

Unit-IV: Differential Calculus: 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 rule. Leibnitz theorem and its applications.
14 Hours

Reference Books:
[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] N. S Gopalakrishnan, University Algebra, 3rd Ed., New Age International Publications, 2015.
[4] B. S. Vatssa, Theory of Matrices, New Age International Publishers, New Delhi, 2005.

[5] A. R. Vasishtha and A. K. Vasishtha, Matrices, Krishna Prakashana Media (P) Ltd., 2008.

[6] Shanti Narayan and P.K. Mittal, Text book of Matrices, 5th Ed., S Chand and Co. Pvt. Ltd., New Delhi, 2013.

[7] Shanthi Narayan and P.K. Mittal, Differential Calculus, Reprint. S Chand and Co. Pvt. Ltd., New Delhi, 2014.

[8] Debasish Sengupta, Applications of Calculus, Books and Allied (P) Ltd., 2019.

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

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

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

[12] S. Narayanan and T. K. Manicavachogam Pillay, Calculus, Vol. I & II, S. Viswanathan Pvt. Ltd., 1996.

MATDSCP1.1: Practicals on Number Theory-I, 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 problems on Number theory, Algebra and Calculus 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 Softwares: Maxima/Scilab/Python.

1. Introduction to the software and commands related to the topic.
2. Program for Euclidean Algorithm.
3. Program for Divisibility tests.
4. Programs for Binary and Decimal Representation of Integers.
5. Program to solve Simultaneous Congruences involving Chinese Remainder Theorem.
6. Computation of addition and subtraction of matrices.
7. Computation of Multiplication of matrices.
8. Computation of Trace and Transpose of Matrix.
9. Computation of Rank and Row reduced Echelon form of a matrix.
10. Computation of Inverse of an invertible Matrix using Cayley-Hamilton theorem.
11. Solving systems of homogeneous and non-homogeneous linear algebraic equations.
12. Tracing of standard curves (Cartesian form).
13. Tracing of standard curves (Polar form).
14. Taylor's and Maclaurin's expansions of the given functions.

Open Elective Course

(For students of Science stream who have not chosen Mathematics as one of Core subjects)

MATOET1.1 (A): 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
- Understand the elementary concepts of Number Theory.
- Solve the system of homogeneous and non-homogeneous m linear equations in n variables.
- Identify and apply intermediate value theorem, mean value theorems and L'Hospital rule.

Unit-I: Number Theory: Division Algorithm, The Greatest Common Divisor (g.c.d), Euclidean Algorithm, Diophantine Equations, Fundamental Theorem of Arithmetic. Theory of Congruences, Basic Properties of Congruences, Binary and Decimal Representation of Integers. Linear Congruences and The Chinese Remainder Theorem.   **14 Hours**

Unit-II: Matrices: Recapitulation of Symmetric and Skew Symmetric matrices, Cayley-Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). Algebra of Matrices, Row and column reduction to Echelon form. Rank of a matrix, Inverse of a matrix by elementary operations, 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.   **14 Hours**

Unit-III: Differential Calculus: 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 rule. Leibnitz theorem and its applications.   **14 Hours**

Reference Books:
[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] N. S Gopalakrishnan, University Algebra, 3rd Ed., New Age International Publications, 2015.
[4] B. S. Vatssa, Theory of Matrices, New Age International Publishers, New Delhi, 2005.
[5] A. R. Vasishtha and A. K. Vasishtha, Matrices, Krishna Prakashana Media (P) Ltd., 2008.
[6] Shanti Narayan and P.K. Mittal, Text book of Matrices, 5th Ed., S Chand and Co. Pvt. Ltd., New Delhi, 2013.
[7] Shanthi Narayan and P.K. Mittal, Differential Calculus, Reprint. S Chand and Co. Pvt. Ltd., New Delhi, 2014.
[8] Debasish Sengupta, Applications of Calculus, Books and Allied (P) Ltd., 2019.
[9] George B. Thomas and Ross L. Finney, Calculus and Analytic Geometry, Addison-Wesley, 1992.

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

[11] S. Narayanan and T. K. Manicavachogam Pillay, Calculus, Vol. I & II, S. Viswanathan Pvt. Ltd., 1996.

Open Elective
(For Students of other than Science Stream)

MATOET1.1 (B): Business 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

- Solve the system of homogeneous and non-homogeneous m linear equations in n variables.
- Translate the real world problems through appropriate mathematical modeling.
- Explain the concepts and use equations, formulae and mathematical expressions in a variety of context.
- Find the extreme values of functions.
- Analyze and demonstrate the mathematical skill required in mathematically intensive areas such as economics, business etc.

Unit-I: Matrices: Definition of a matrix, types of matrices, algebra of matrices. Properties of determinants; calculations of values of determinants up to third order, Adjoint of a matrix, elementary row and column operations, solution of a system of linear equations having unique solution and involving not more than three variables. Examples on commercial mathematics.

14 Hours

Unit-II: Straight line and Conics: Straight line in economics, Break-Even point, System of straight lines, Effect of a Tax or Subsidy. Parabola in economics, The non-linear model. Rectangular hyperbola: Rectangular hyperbola in economics. Circle in economics. Inequalities and absolute values: Properties of inequalities, Linear inequality in one variable, Absolute values. Applications in economics.

14 Hours

Unit-III: 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.

14 Hours

Reference Books:
[1] B. S. Vatssa, Theory of Matrices, New Age International Publishers, New Delhi, 2005.

[2] A. R. Vasishtha and A. K. Vasishtha, Matrices, Krishna Prakashana Media (P) Ltd., 2008.

[3] Shanti Narayan and P.K. Mittal, Text book of Matrices, 5th Ed., S. Chand and Co. Pvt. Ltd., New Delhi, 2013.

[4] E.T. Dowling, Mathematics for Economics, Schaum's Outline, 3rd Ed., McGraw Hill, London, 2011.

[5] R.G.D. Allen, Basic Mathematics, Macmillan, UK, 1968.

[6] N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill, New Delhi, 2007.

[7] R. S. Soni, Business Mathematics with Applications in Business and Economics, Pitambar Publishing, India 1996.

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

SEMESTER – II

MATDSCT 2.1: Number Theory-II, 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
- Understand the Euler's ϕ-function and finite continued fractions.
- Recognize the mathematical objects called Groups.
- Identify cyclic and non-cyclic groups
- Link the fundamental concepts of groups and symmetries of geometrical objects.
- Understand the concept of partial derivatives of functions of several variables.
- Find the Taylor's and Maclaurin's series of functions of two variables.
- Find the extreme values of functions of two variables.
- Understand the concepts of line integrals, multiple integrals and their applications.

Unit-I: Number Theory: Fermat's Theorem, Wilson's Theorem, Quadratic Congruence. Euler's ϕ-function, definition and properties, Euler's theorem and corollaries, finite continued fractions. **14 hours**

Unit-II: Groups: 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. **14 hours**

Unit-III: Partial Derivatives: 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**

Unit-IV: Integral Calculus: Recapitulation of definite integrals and its properties. *Line integral*: Definition of line integral and basic properties, examples on evaluation of line

12

integrals. *Double integral*: Definition of Double integrals and its conversion to iterated integrals. Evaluation of double integrals by changing the order of integration and change of variables. Computation of plane surface areas, volume underneath a surface of revolution using double integral. *Triple integral*: Definition of triple integrals and evaluation-change of variables, volume as triple integral. Differentiation under the integral sign by Leibnitz rule.

14 hours

Reference Books:

[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] N. S Gopalakrishnan, University Algebra, 3rd Ed., New Age International Publications, 2015.
[4] I. N. Herstein, Topics in Algebra, 2nd Ed., Wiley Publishers, 1975.
[5] A. R. Vasishtha and A. K. Vasishtha, Modern Algebra, Krishna Prakashan Mandir, Meerut, U.P., 2008.
[6] Bernald and Child, Higher Algebra, Arihant Publication India Limited, India, 2016.
[7] Vijay K Khanna and S K Bhambri, A Course in Abstract Algebra, 5th Ed., Vikas Publishing House, India, 2016.
[8] Shanthi Narayan and P. K. Mittal, Differential Calculus, Reprint, S. Chand and Co. Pvt. Ltd., New Delhi, 2014.
[9] Shanti Narayan and P. K. Mittal, Integral Calculus. S. Chand Ltd., India, 2005.
[10] George B. Thomas and Ross L. Finney, Calculus and Analytic Geometry, Addison-Wesley, 1992.
[11] Maurice D. Weir, George B. Thomas, Jr., Joel Hass and Frank R. Giordano, Thomas' Calculus, 11th Ed., Pearson, 2008.
[12] S. Arora and S .C. Malik, Mathematical analysis, Wiley, India, 1992.

MATDSCP2.1: Practicals on Number Theory-II, 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 Number Theory, Algebra and Calculus by using FOSS softwares.
- Acquire knowledge of applications of algebra and calculus through FOSS.

Practical/Lab Work to be performed in Computer Lab

Suggested Softwares: Maxima/Scilab/Python.

1. Program to compute Euler's ϕ-function values for positive integers.
2. Program to write rational numbers as finite continued fractions.
3. Program to find the rational numbers corresponding to given finite continued fractions.
4. Program for verification of binary operations.
5. Programs: (i) To find identity element of a group. (ii) To find inverse of an element in a group.

13

6. Program to construct Cayley's table and test abelian for given finite set.
7. Program to find generators and corresponding possible subgroups of a cyclic group.
8. Finding all possible subgroups of a finite group.
9. Obtaining partial derivative of some standard functions.
10. Solutions of optimization problems.
11. Programs to develop Maclaurin's expansion for functions of two variables.
12. Program to evaluate the line integrals.
13. Program to evaluate the Double integrals with constant and variable limits.
14. Program to evaluate the Triple integrals with constant and variable limits.

Open Elective
(For students of Science stream who have not chosen Mathematics as one of the Core subjects)

MATOET2.1(A): 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
• Recognize the mathematical objects called Groups.
• Identify cyclic and non-cyclic groups
• Link the fundamental concepts of groups and symmetries of geometrical objects.
• Find the extreme values of functions of two variables.
• Understand the concepts of line integrals, multiple integrals and their applications.

Unit-I: Groups: 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.   **14 hours**

Unit-II: Partial Derivatives: 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**

Unit-III: Integral Calculus: Recapitulation of definite integrals and its properties. *Line integral:* 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. Evaluation of double integrals by changing the order of integration and change of variables. Computation of plane surface areas, volume underneath a surface of revolution using double integral. *Triple integral:* Definition of triple integrals and evaluation-change of variables, volume as triple integral. Differentiation under the integral sign by Leibnitz rule.   **14 hours**

Reference Books:

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

[2] I. N. Herstein, Topics in Algebra, 2nd Ed., Wiley Publishers, 1975.

[3] A. R. Vasishtha and A. K. Vasishtha, Modern Algebra, Krishna Prakashan Mandir, Meerut, U.P., 2008.

[4] Bernald and Child, Higher Algebra, Arihant Publication India Limited, India, 2016.

[5] Vijay K Khanna and S K Bhambri, A Course in Abstract Algebra, 5th Ed., Vikas Publishing House, India, 2016.

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

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Open Elective
(For Students of other than science stream)

MATOET2.1(B): Business 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
- Integrate concepts in international business with functioning global trade.
- Evaluate the legal, social and economic environment of business.
- To learn different techniques of simplification of real number system
- To enable student to answer competitive examinations
- Will be able to apply knowledge of business concepts and functions in an integrated manner.

Unit-I: Commercial Arithmetic: Interest: Concept of Present value and Future value, Simple interest, Compound interest, Nominal and Effective rate of interest, Examples and Problems Annuity: Ordinary Annuity, Sinking Fund, Annuity due, Present Value and Future Value of Annuity, Equated Monthly Instalments (EMI) by Interest of Reducing Balance and Flat Interest methods, Examples and Problems.   **14 Hours**

Unit II: Techniques of solving problems involving number system and decimal fraction to calculate share of profit ,simplification of equations involving cost and expenditure, Average, Profit and loss.   **14 Hours**

Unit III: Percentage, Ratio and proportion, Partnership, Time and work, Situations in Boats and Streams, Simple problems on trains and other moving objects, different types of problems in Calendar, number of days and dates to calculate period of payments, Stocks and shares and Problems related clock. **14 Hours**

Reference Books:

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

[2] S. A. Bari, Practical Business Mathematics, New Literature Publishing Company, Bombay, 1971.

[3] K. Selvakumar, Mathematics for Commerce, Notion Press, Chennai, 2014.

[4] Dinesh Khattar and S. R. Arora, Business Mathematics with Applications, S. Chand Publishing, New Delhi, 2001.

[5] M. K. Bhowal, Fundamentals of Business Mathematics, Asian Books Pvt. Ltd., New Delhi, 2009

[6] Martin Anthony and Norman Biggs, Mathematics for Economics and Finance: Methods and Modelling, Cambridge University Press, Cambridge, 1996.

[7] Ahmad Nazri and Wahidudin, Financial Mathematics and its Applications, Ventus Publishing, APS, Denmark, 2011.