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.	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						
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–x^{th} 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	SEMINAR
III	MATDSCT3.1	PO 1, PO 4, PO7, PO 8	MATDSCT2.1	SEMINAR	QUIZ
IV	MATDSCT4.1	PO 1, PO 4, PO7, PO 8	MATDSCT3.1	PROJECT BASED LEARNING	
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.	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	Credits					
			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

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.

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.

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

[7] Shanti Narayan and P. K. Mittal, Integral Calculus. S. Chand Ltd., India, 2005.

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

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

[10] S. Arora and S .C. Malik, Mathematical analysis, Wiley, India, 1992.

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.

Mangalore University

Mangalagangothri -574 199

SYLLABUS
(Semester III and IV)

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

2022

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

SEMESTER – III
(2022-23 onwards)

MATDSCT 3.1: Ordinary Differential Equations and Real Analysis – I	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (SEE- 60 + I.A. - 40)**

Course Learning Outcomes: This course will enable the students to:

- Solve first-order non-linear differential equations and linear differential equations.
- To model problems in nature using Ordinary Differential Equations.
- Formulate differential equations for various mathematical models
- Apply these techniques to solve and analyze various mathematical models.
- Understand the fundamental properties of the real numbers that lead to define sequence and series, the formal development of real analysis.
- Learn the concept of Convergence and Divergence of a sequence.
- Able to handle and understand limits and their use in sequences, series, differentiation, and integration.
- Apply the ratio, root, alternating series, and limit comparison tests for convergence and absolute convergence of an infinite series.

Ordinary Differential Equations:

Unit I: Recapitulation of Differential Equations of first order and first degree, Exact Differential equations, Necessary and sufficient condition for the equations to be exact, Reducible to the exact differential equations. Differential equations of the first order and higher degree: Equations solvable for p, x, y. Clairaut's equation and singular solution. Orthogonal trajectories of Cartesian and polar curves. **14hrs**

Unit II: Linear differential equations of the n^{th} order with constant coefficients. Particular Integrals when the RHS is of the form e^{ax}, $\sin(ax+b)$, $\cos(ax+b)$, x^n, $e^{ax}\ V$ and xV (with proofs), where V is a function of x. Cauchy – Euler equations, Legendre differential equations, Method of variation of parameters. Simultaneous differential equations with two and more than two variables. Condition for integrability of total differential equations $P\,dx + Q\,dy + R\,dz = 0$.

14 hrs

Unit III: Sequences: Recapitulation of number system - Real line, bounded sets, suprimum and infimum of a set, Archimedean property of R. Intervals, neighborhood of a point, open sets, closed sets, limit points.

Sequences of real numbers, Bounded sequences. Limit of a sequence. convergent, divergent, and oscillatory sequences. Monotonic sequences. Algebra of convergent sequences. Limit points of a sequence. Bolzano Weierstrass theorem for sequence. Limit superior and limit inferior of sequences. Cauchy's first and second theorem on limits of a sequence. Cauchy's general principle for convergence of a sequence. Subsequence and their properties. 14hrs

Unit IV: Infinite Series: Definition of convergent, divergent and oscillatory series. Series of non-negative terms, Cauchy's general principle of convergence. Geometric series, P-series (Harmonic series). Comparison tests for positive term series. D'Alembert's ratio test, Raabe's test. Cauchy's Root test and Cauchy's integral test. Alternating series. Leibnitz's theorem. Absolute convergence and conditional convergence of a series. Summation of series: Binomial, exponential and logarithmic. **14 hrs**

Reference Books:

1. M. D. Raisinghania, *Ordinary Differential Equations & Partial Differential Equations*, S. Chand & Company, New Delhi, 20th Edition- 2020. (For Unit I and Unit II)
2. S. C. Malik, and Savitha Arora, *Mathematical Analysis*, New Age International Publishers, 5th Edition- 2017. (For Unit III and Unit IV)
3. J. Sinha Royand SPadhy: *A Course of Ordinary and Partial Differential Equation*, Kalyani Publishers, New Delhi, 4th Edition - 2014.
4. D. Murray, *Introductory Course in Differential Equations*, Orient Black Swan - 2016
5. W. T. Reid, *Ordinary Differential Equations*, John Wiley, New York - 1971.
6. S. L. Ross, *Differential Equations,* John Wiley and Sons, 3rdEdition - 1984.
7. R. G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 3rdEdition - 2015.
8. K. A. Ross, *Elementary Analysis: The Theory of Calculus*, Springer, 2ndEdition - 2013
9. S. K. Berberian, *A First Course in Real Analysis,* Springer Verlag, NewYork -1994.
10. T. Apostol, *Mathematical Analysis*, Narosa Publishing House, 2nd Edition - 2002.
11. E. D. Rainville and P. E. Bedient, *Elementary Differential Equations*, Pearson, 8th Edition - 1996.

PRACTICAL

MATDSCP 3.1: Practical on Ordinary Differential Equations and Real Analysis – I	
Teaching Hours: 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 56 Hours	**Max. Marks: 50** **(SEE - 25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to gain hands-on experience of

- Free and Open Source software (FOSS) tools or computer programming.
- Solving exact differential equations
- Plotting orthogonal trajectories
- Finding complementary function and particular integral of linear and homogeneous differential equations.
- Acquire knowledge of applications of real analysis and differential equations.
- Verification of convergence/divergence of different types of series

Practical/Lab Work to be performed in Computer Lab

Use open-source software to executive the practical problems. (Maxima/Scilab/MatLab /Mathematica/Python)

1. Fundamentals of Ordinary differential equations and Real analysis using FOSS

2. Verification of exactness of a differential equation
3. Plot orthogonal trajectories for Cartesian and polar curves
4. Solutions of differential equations that are solvable for *x, y, p.*
5. To find the singular solution by using Clairaut's form.
6. Finding the Complementary Function and Particular Integral of linear and homogeneous differential equations with constant coefficients and plot the solutions.
7. Finding the Particular Integral of differential equations up to second order and plot the solutions.
8. Solutions to the Total and Simultaneous differential equations and plot the solutions.
9. Test the convergence of sequences
10. Verification of exponential, logarithm and binomial series.
11. Verification of geometric series, *p*-series, Cauchy's Integral test, root test, and D Alembert's Test
12. Examples on a series of positive terms.
13. Examples on alternating series using Leibnitz's theorem.
14. Finding the convergence of series using Cauchy's criterion for partial sums.

Open Elective Course

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

MATOET3.1(A) Ordinary Differential Equations	
Teaching Hours: 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(SEE - 60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to:

- Understand the concept of the differential equation and their classification
- Know the meaning of the solution of a differential equation.
- To solve first-order ordinary differential equations.
- To solve exact differential equations and Converts to separable and homogenous equations to exact differential equations by integrating factors.
- To Solve Bernoulli differential equations.
- To find the solution to higher-order linear differential equations.

Unit I: Recapitulation of Differential Equations of first order and first degree, Exact Differential equations, Necessary and sufficient condition for the equations to be exact, Reducible to the exact differential equations. **14hrs**

Unit II: Differential equations of the first order and higher degree: Equations solvable for *p, x, y*. Clairaut's equation and singular solution. Orthogonal trajectories of Cartesian and polar curves. **14hrs**

Unit III: Linear differential equations of the n^{th} order with constant coefficients. Particular Integrals when the RHS is of the form e^{ax}, $\sin(ax+b)$, $\cos(ax+b)$, x^n, $e^{ax}V$ where V is a function of x. **14 hrs**

Reference Books:

1. M. D. Raisinghania, *Ordinary Differential Equations & Partial Differential Equations*, S. Chand & Company, New Delhi, 20th Edition – 2020. (For Unit I and Unit II)
2. J. Sinha Roy and S Padhy : *Acourse of Ordinary and Partial Differential Equation,* Kalyani Publishers, New Delhi, 4th Edition - 2014.
3. D. Murray, *Introductory Coursein Differential Equations*, Orient BlackSwan–2016.
4. W. T. Reid, *Ordinary Differential Equations,* John Wiley, New York - 1971.
5. S. L. Ross, *Differential Equations,* John Wiley and Sons, 3rd Edition -1984.

Open Elective Course

(For students of other than Science stream)

MATOET 3.1(B): Quantitative Mathematics	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (SEE - 60 + IA - 40)**

Course Outcomes: This course will enable the students to:

- Understand number system and fundamental operations
- Understand the concept of linear quadratic and simultaneous equations and their applications in real life problems
- Understand and solve the problems based on Age.
- Solve Speed and Distance related problems.

Unit-I: Algebra

Set theory and simple applications of Venn Diagram, relations, functions, indices, logarithms, permutations and combinations. Examples on commercial mathematics.

14 Hrs

Unit-II: Number System

Numbers, Operations on Numbers, Tests on Divisibility, HCF and LCM of numbers. Decimal Fractions, Simplification, Square roots and Cube roots - Problems thereon. Surds and Indices. Illustrations thereon.

14 Hrs

Unit-III: Theory of equations

Linear equations, quadratic equations, simultaneous equations in two variables, simple application problems - Problems on Ages, Problems on conditional Age calculations, Present & Past age calculations. 14 Hrs

Reference Books:

1. R.S. Aggarwal, *Quantitative Aptitude*, S. Chand and Company Limited, New Delhi -2021.
2. Abhijit Guha, *Quantitative Aptitude*, Mc.Grawhill publications, 5thEdition - 2014.
3. R. V. Praveen, *Quantitative Aptitude and Reasoning*, PHI publishers, 3rd Edition – 2016.
4. R. S. Aggarwal, *Objective Arithmetic*, S. Chand & Company Ltd, Revised Edition – 2018.
5. Qazi Zameeruddin,Vijay K. Khanna, S. K. Bhambri, *Business Mathematics, S. Chand* publications, 2nd*Edition - 2009*

6. S. K. Sharma and Gurmeet Kaur, *Business Mathematics*, Sultan Chand & Sons – 2019.
7. Hazarika Padmalochan, *A Text Book of Business mathematics for B.Com and BBA Course,* S. Chand Publication - 2017
8. N. G. Dasand, J. K. Das, *Business Mathematics and Statistics,* Mc.Grawhill Education - 2017.

Open Elective Course

(For Students of other than Science Stream)

MATOET 3.1(C): Vedic Mathematics	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100(S.A.- 60 + I.A. – 40)**

Course Outcomes: This course will enable the students to:

- Understand the Vedic methods of arithmetic
- Understand the Vedic methods of division with two/three digit divisor
- Understand the Vedic methods of power and root power of two digit numbers

Unit-I: Multiplication:

1. Ekadhikenpurven method (multiplication of two numbers of two digits).
2. Eknunenpurven method (multiplication of two numbers of three digits).
3. Urdhvatiragbhyam method (multiplication of two numbers of three digits).
4. Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits).
5. Combined Operations. **14 Hours**

Unit-II: Division and Divisibility

Part A: Division

1. NikhilamNavtashchramamDashtaha (two digits divisor)
2. ParavartyaYojyet method (three digits divisor)

Part B:Divisibility

1. Ekadhikenpurven method (two digits divisor)
2. Eknunenpurven method (two digits divisor) **14 Hours**

Unit-III:

Power and Root Power:

1. Square (two digit numbers)
2. Cube (two digit numbers).

Root:

1. Square root (four digit number)
2. Cube root (six digit numbers).
3. Solution of linear simultaneous equations. **14 Hours**

Reference Books:

1. *Vedic Mathematics*, **Motilal Banarsidass Publishers,** NewDelhi -1990
2. *Vedic Ganita*: Vihangama Drishti-1,SikshaSanskriti Uthana Nyasa,NewDelhi.
3. *Vedic Ganita Praneta*, Siksha Sanskriti Uthana Nyasa, NewDelhi.
4. *Vedic Mathematics:Past, Present and Future*, Siksha Sanskriti Uthana Nyasa,NewDelhi.
5. Leelavati, Chokhambba Vidya Bhavan, Varanasi.
6. *Bharatiya Mathematicians*, Sharda Sanskrit Sansthan, Varanasi.

SEMESTER – IV

MATDSCT 4.1: Partial Differential Equations and Integral Transforms	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (SEE - 60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Solve the Partial Differential Equations of the first order and second order
- Formulate, classify and transform partial differential equations into canonical form.
- Solve linear and non-linear partial differential equations using various methods; and apply these methods to solving some physical problems.
- Able to take more courses on wave equation, heat equation, and Laplace equation.
- Solve PDE by Laplace Transforms and Fourier Transforms

Unit I: Basic concepts–Formation of a partial differential equations by elimination of arbitrary constants and functions, Solution of partial differential equations – Solution by Direct integration, Lagrange's linear equations of the form $Pp + Qq = R$, Standard types of first order non-linear partial differential equations, The integrals of the non-linear equation by Charpit's method. **14 Hrs**

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

Unit III: Laplace Transforms: Definition**,** Basic Properties. Laplace transforms of some standard functions. Laplace transform of Periodic functions. Laplace transform of derivative and integral of a function. Heaviside function. Dirac-delta function. Convolution theorem. Inverse Laplace transforms and its properties. Solution of differential equations by using Laplace transforms. **14 Hrs**

Unit IV: Fourier Series and Transforms: Periodic functions. Fourier Coefficients. Fourier series of functions with period 2 and period 2L. Fourier series of even and odd functions. Half range Cosine and Sine series. Fourier Transforms - Finite Fourier Cosine and Sine transform. Transforms of derivates**.** Applications of Fourier Transforms**.** **14 Hrs**

Reference Books:

1. D. A. Murray, *Introductory Course in Differential Equations,* Orient and Longman - 2017
2. H. T. H. Piaggio, *Elementary Treatiseon Differential Equations and their Applications,* CBS Publisher & Distributors, Delhi - 1985.
3. G. F. Simmons, *Differential Equations,* Tata McGrawHill, 1st Edition – 2006.
4. S. L. Ross, *Differential Equations*, JohnWileyand Sons, India, 3rdEdition -2004.
5. M. D. Raisinghania, *Ordinary Differential Equations & Partial Differential Equations*, S. Chand & Company, New Delhi, 20th Edition - 2020

6. K. Sankara Rao, *Introductionto Partial Differential Equations*, PHI, 3rdEdition -2015.
7. Ion N. Sneddon, *Elements of Partial differential equations*, McGraw-Hill International Editions -1986.
8. R. Murray and L. Spiegal (Schaum's Series), *Laplace Transforms,* McGraw Hill Education – 2005.
9. J. K. Goyal and K. P. Gupta, *Laplace and Fourier Transforms*, Pragathi Prakashan – 2016.
10. Sudhir Kumar, *Integral Transform Methods in Science & Engineering*, CBS Engineering Series - 2017.
11. Earl David Rainville and Philip Edward Bedient, *Ashortcoursein Differential Equations*, Prentice Hall College Div, Pearson College Div, 6th edition - 1981.
12. Sathya Prakash, *Mathematical Physics with classical Mechanics*, S Chand and Sons, New Delhi -2014

PRACTICALS

MATDSCP 4.1: Practical's on Partial Differential Equations and Integral Transforms	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 56 Hours	**Max. Marks: 50 (S.A.-25 + I.A. – 25)**

Mathematics practical with Free and open Source Software (FOSS) tools for computer programs

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open Source software (FOSS) tools or computer programming.
- Solve problems on Partial Differential Equations and Integral Forms
- To find Laplace transform of various functions
- To find the Fourier Transform of periodic functions
- To solve differential equations by using Integral transforms.

Programs using Scilab/Maxima/Python:

Elements of Partial differential equations and Integral transforms using FOSS

1 Solutions of Linear Partial differential equations of type1 to type4 and Lagrange's method
2 Solutions of partial differential equation using Charpit's method.
3 Solutions of Second order homogenous partial differential equation with constant coefficients.
4 Solutions to the partial differential equations using separation of variables method (Heat/ Wave/Laplace).
5 Finding the Laplace transforms of some standard and periodic functions.
6 Finding the inverse Laplace transform of simple functions
7 Verification of Convolution Theorem.
8 To solve ordinary linear differential equation using Laplace transform.
9 To solve Integral equation using Laplace transform.
10 To find full range Fourier series of some simple functions with period 2 and 2L
11 To find Half range sine and cosine series of some simple functions and ploting them.
12 To find Cosine Fourier transforms.
13 To find Sine Fourier transforms.

Open Elective Course

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

MATOET4.1(A): Partial Differential Equations	
Teaching Hours: 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (SEE-60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Explain the concept of the differential equation.
- Classifies the differential equations concerning their order and linearity.
- Explains the meaning of the solution of a differential equation.
- Solve first-order ordinary differential equations.
- Solves exact differential equations and Converts separable and homogenous equations to exact differential equations by integrating factors.
- Solves Bernoulli differential equations.
- Will be able to find the solution to higher-order linear differential equations.

Unit I: Basic concepts–Formation of a Partial differential equations by elimination of arbitrary constants and functions – Solution of partial differential equations – Solution by Direct integration, Lagrange's linear equations of the form $Pp + Qq = R$. **14 Hrs**

Unit II : Standard types of first order non-linear partial differential equations, The integrals of the non-linear equation by Charpit's method. Homogeneous Linear partial differential equations with constant coefficients. Partial differential equations of the second order. Classification of second- order partial differential equations, canonical forms.

15 Hrs

Unit III: Classification of second order linear equations as hyperbolic, parabolic, and elliptic. Solutions of the Heat equation, Laplace equation and Wave equation (using separation of variables). **14 Hrs**

Reference Books:

1. D. A. Murray, *Introductory Course in Differential Equations,* Orient and Longman - 2017
2. H. T. H. Piaggio, *Elementary Treatiseon Differential Equations and their Applications,* CBS Publisher & Distributors, Delhi - 1985.
3. G. F. Simmons, *Differential Equations,* Tata McGrawHill, 1st Edition – 2006.
4. S. L. Ross, *Differential Equations*, JohnWileyand Sons, India, 3rdEdition -2004.
5. M. R. Speigel, *Schaum's outline of Laplace Transforms* – 2005.
6. M. D. Raisinghania, *Ordinary Differential Equations & Partial Differential Equations*, S. Chand & Company, New Delhi, 20th Edition - 2020
7. K. Sankara Rao, *Introductionto Partial Differential Equations*, PHI, 3rdEdition -2015.
8. Ion N. Sneddon, *Elements of Partial differential equations*, McGraw-Hill International Editions -1986.

Open Elective Course

(For students of other than science stream)

MATOET4.1(B) : Mathematical Finance	
Teaching Hours: 3Hours/week	**Credits: 3**
Total Teaching Hours:42Hours	**Max.Marks:100 (S.A-60+I.A.-40)**

Course Learning Outcomes: This course will enable the students to

- Understand how compute profit and loss, discount and Banker's discount.
- Understand the concept of Linear equations and inequalities and their use in the solving the Linear Programming Problems.
- Formulation of Transportation Problem and its application in routing problem.

Unit-I: Commercial Arithmetic

Bill of exchange, Bill of discounting procedure. Basic formula related to profit, loss, discount and brokerage, Successive discount, True discount, Banker's discount.

14 Hrs

Unit-II: Linear Programming

Linear equations and inequalities- Rectangular coordinates, straight line, parallel and intersecting lines and linear inequalities, Introduction to linear programming, Mathematical formulation of LPP, Solution of a LPP by graphical method, special cases in graphical method

14 Hrs

Unit-III: Transportation problem

Introduction, Formulation of Transportation problem, Initial basic feasible solution, Steps involving a transportation problem, optimality check, special cases in Transportation problem. The Traveling salesman Problem (Routing Problem). **14 Hrs**

Reference Books:

1. R. S. Aggarwal, *Objective Arithmetic*, S. Chand & Company Ltd, Revised Edition - 2018.
2. Mizrahiand Sullivan, *Mathematics for Business and Social Sciences an Applied approach,* John Wiley & Sons – 1976.
3. Qazi Zameeruddin,Vijay K Khanna, S K Bhambri, *Business Mathematics,* Vikas Publishing House, 2nd Edition.
4. S. Kalavathy, *Operation Research*, Vikas publication house Pvt. Ltd, 4th Edition – 2013.
5. Sreenivasa Reddy M, *Operations Research*, Sanguine Technical publishers, Bangalore, 2nd edition – 2019.
6. S. D. Sharma, *Operation Research*, 20th Edition – 2014.

Open Elective Course

(For students other than science stream)

MATOET 4.1 (C): Mathematics for Social Sciences	
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 mathematical concept of sets and counting problems.
- Understand the concept of Probability and its applications in social sciences.
- Understand the concept of limits and continuity of functions and its applications in business and

social sciences.

Unit-I

Sets, counting, permutations, combinations, counting problems, binomial theorem and problems thereon. Probability – Introduction, sample space and assignment of probabilities, properties of the probability of an event, probability of equally likely events, conditional probability, Baye's formula and examples thereon.

14 Hours

Unit-II

Limit and continuity, Derivative- interpretation, derivative formulas, general derivatives for differentiation, composit functions, higher order derivaties and problems thereon.

14 Hours

Unit-III

Applications of the derivative – Relative maxima and Relative minima, Absolute maximum and Absolute minimum, Applied problems, Concavity, Asymptotes, Marginal analysis, Models- Maximizing tax revenue, Otimal trade-in time, and minimizing inventory cost.

14 Hours

REFERENCE BOOKS

1. Abe Mizrahi and Michael Sullivan, *Mathematics for Business and Social Sciences and Applied Approach,* John Wiley & Sons, 4th Edition - 1988.
2. Carl P. Simon and Lawrence Blume*, Mathematics for Economists,* Viva Books Private Limited, New Delhi - 2018.
3. L. Peccati, M. D'Amico and M. Cigola*, Maths for Social Sciences,* Springer – 2018.

Question Paper Pattern

Mathematics

(Major subject)

PART –A
Answer any **TEN** questions (10 x 2 = 20) • Total number of questions: 14 • Atleast 3 questions to be framed from each unit
PART – B
Answer any 8 questions by choosing two questions from each unit (5 marks each) 8 x 5 = 40 **UNITWISE (4 questions from each unit)**

(Open Elective)

PART –A
Answer any **TEN** questions (10 x 2 = 20) • Total number of questions: 12 • 4 questions from each unit
PART – B
Answer any 6 questions by choosing two questions from each unit (6 marks each) 6 x 5 = 36 **UNITWISE (4 questions from each unit)**