BANGALORE UNIVERSITY

Department of Mathematics
Jnanabharathi Campus
Bengaluru – 560 056

Syllabus for
Mathematics
Under-Graduate (UG) Programmme
III & IV Semester

Framed according to the
National Education Policy (NEP 2020)

August 18, 2022

Proceedings of the BOS meeting in UG-Mathematics-Regular, held on 18th August 2022 in the Department of Mathematics, JB Campus, Bangalore University, Bangalore-560 056 at 3.00 pm

The following members attended the meeting to frame the NEP new syllabus 3rd and 4th semester for undergraduate degree program B.A./B.Sc with mathematics as Major Subject, B.A./B.Sc.(Hons) Mathematics & Open electives

1.	Prof. Harina P. Waghmore	Chairperson	
2.	Prof. Jayadeva. M	Member	M. J
3.	Prof. T.R. Marulasiddappa	Member	T. R. Marulasiddappa
4.	Sri. Mahesh H.S	Member	
5.	Smt. Veena M.G	Member	
6.	Smt. Shobha. V	Member	
7.	Dr. Maheshwari P.G	Member	Maheshwari
8.	Dr. S. Sigarakanti	Member	ABSENT
9.	Dr. R. Sumithra	Member	

The Chairperson thanked the members for their cooperation.

[Dr. HARINA P. WAGHAMORE]
CHAIRPERSON

ಗಣಿತಶಾಸ್ತ್ರ ವಿಭಾಗ
ಜ್ಞಾನಭಾರತಿ ಆವರಣ
ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ
ಬೆಂಗಳೂರು – 560 056.

Preamble

The subject wise expert committee to draft model curriculum contents in Mathematics constituted by the Department of Higher Education, Government of Karnataka, Bangalore vide GO No. ED 260 UNE 2019 (PART-1) DATED 13.08.2021 is pleased to submit its partial report on the syllabus for the First Year (First & Second Semesters) B.Sc.(Basic/Honors) Mathematics and detailed Course Structure for B.Sc.(Honors) Mathematics and M.Sc. (One Year) Mathematics.

The committee discussed various models suggested by the Karnataka State Higher Education Council in its joint meetings with the Chairpersons of Board of Studies of all state universities in Karnataka and resolved to adopt Model IIA (Model Program Structure for the Bachelor of Science (Basic/Hons.) for the subjects with practical's with Mathematics as Major/Minor.

To achieve the core objectives of the National Education Policy 2020 it is unanimously resolved to introduce computer based practical's for the Discipline Core (DSC) courses by using Free and Open Source Software's (FOSS) tools for implementation of theory based on DSC courses as it is also suggested by the LOCF committee that the papers may be taught using various Computer Algebra System (CAS) software's such as Mathematica, MATLAB, Maxima and R to strengthen the conceptual understanding and widen up the horizon of students' self-experience. In view of these observations the subject expert committee suggested the software's Python/ Maxima/ Scilab/ Maple/ MatLab/ Mathematica for hands on experience of implementation of mathematical concepts in computer based lab.

The expert committee suggests the implementation this curriculum structure in all the Departments of Mathematics in Universities/Colleges in Karnataka.

The subject expert committee designed the Course Learning Outcome (CO) to help the learners to understand the main objectives of studying the courses by keeping in mind of the Programme outcomes (PO) of the graduate degree with honors in Mathematics or a graduate degree with Mathematics as a major subject.

As the Mathematics subject is a vast with several branches of specializations, it is difficult for every student to learn each branch of Mathematics, even though each paper has its own importance. Hence the subject expert committee suggests number of elective papers (for both Discipline electives and Open

Electives) along with Discipline Core Courses. The BoS in Mathematics of universities may include additional electives based on the expertise of their staff and needs of the students'.

A student can select elective paper as per her/his needs and interest. The subject expert committee in Mathematics suggests that the concerned Department/Autonomous Colleges/Universities to encourage their faculty members to include necessary topics in addition to courses suggested by the expert committee.

B.Sc. Mathematics (Honors)

Programme Outcomes (PO): By the end of the program the students will be able 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 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 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 and also equip them with mathematical modeling ability, problem solving skills.
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 equation 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 particular.
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 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
Experiential Learning (Internship etc.)	--	--

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

Model IIA

Semester	Course No.	Theory/ Practical	Credits	Paper Title	Marks	
					S.A.	I.A.
I	MATDSCT1.1	Theory	4	Algebra - I and Calculus - I	60	40
	MATDSCP1.1	Practical	2	Theory based Practicals on 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	Algebra - II and Calculus - II	60	40
	MATDSCP2.1	Practical	2	Theory based Practicals on 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 Real Analysis-I	60	40
	MATDSCP3.1	Practical	2	Theory based Practicals on Ordinary Differential Equations and Real Analysis-I	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 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 Analysis and Complex Analysis	60	40
	MATDSCP5.1	Practical	2	Theory based Practicals on Real Analysis and Complex Analysis	25	25
	MATDSCT5.2	Theory	3	Ring Theory	60	40
	MATDSCP5.2	Practical	2	Theory based Practicals on Ring Theory	25	25
	MATDSET5.1	Theory	3	(A) Vector Calculus (B) Mechanics (C) Mathematical Logic	60	40
VI	MATDSCT6.1	Theory	3	Linear Algebra	60	40
	MATDSCP6.1	Practical	2	Theory based Practicals on Linear Algebra	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	(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 Practicals on Discrete Mathematics	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 Analysis	60	40
	MATDSET 7.1	Theory	3	(A) Graph Theory (B) Entire and Meromorphic Functions (C) General Topology (D) Bhâratîya Trikoṇmiti Śâstra	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	Advanced Partial Differential Equations	60	40
	MATDSCT8.3	Theory	3	Fuzzy Sets and Fuzzy Systems	60	40
	MATDSET 8.1	Theory	3	(A) Operations Research (B) Lattice theory and Boolean Algebra (C) Mathematical Modeling (D) *Aṅkapâśa* (Combinatorics)	60	40
	MATDSET 8.2	Research Project	6 (3 + 3)	Research Project* OR Any Two of the following electives (A) Finite Element Methods (B) Cryptography (C) Information Theory and Coding (D) Graph Theory and Networking	120 OR 60 60	80 OR 40 40
Award of Bachelor of Science Honours, B.Sc.(Hons) Degree in Mathematics						

One Year M.Sc. degree in Mathematics (Two Semesters)						
Semester	**Course Number**	**Theory/ Practic al**	**Credits**	**Title of the Course**	**S.A.**	**I.A.**
I	PGMATDSCT1.1	Theory	3	C++ Programming for Mathematics	60	40
	PGMATDSCP1.1	Practical	2	Computer Practical's on C++ Programming for Mathematics	25	25
	PGMATDSCT1.2	Theory	3	Computational Numerical Methods	60	40
	PGMATDSCP1.2	Practical	2	Computer Practical's on CNM	25	25
	PGMATDSCT1.3	Theory	4	Functional Analysis	60	40
	PGMATDSET1.1	Theory	3	(A) Fluid Mechanics –I (B) Computational Fluid Mechanics (C) Contact Geometry (D) Fuzzy Topology (E) Ramanujan Theta Function and Continued Fractions	60	40
	PGMATDSET1.2	Theory	3	(A) Advanced Graph Theory (B) Partition Theory (C) Algebraic Number Theory (D) Riemannian Geometry	60	40
II	PGMATDSCT2.1	Theory	4	Measure Theory	60	40
	PGMATDSCT2.2	Theory	4	Differential Geometry	**60**	**40**
	PGMATDSCT2.3	Theory	3	Mathematical Methods	60	40
	PGMATDSET2.1	Theory	3	(A) Fluid Mechanics –II (B) Magneto hydrodynamics (C) Finsler Geometry and Relativity (D) Mathematical Modeling	60	40
	PGMATDSET2.2	Project	6	Research Project	120	80

- In lieu of the research Project, two additional elective papers/Internship may be offered

Abbreviation for MATDSCT1.1 /MATDSCP1.1

MAT – Mathematics ; DSC – Discipline Core; T – Theory/ P – Practical; 1 – First Semester; .1 – Course 1

PGMATDSCT1.1 : PG- Post Graduate ; MAT- Mathematics; DSC- Discipline Core; T- Theory 1 –First Semester; .1 – Course 1

CURRICULUM STRUCTURE FOR UNDERGRADUATE DEGREE PROGRAM

Name of the Degree Program : B.Sc. (Honors)
Subject : Mathematics
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	-	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	-----	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	ASSIGNMENTS	
VI	MATDSCT6.1	PO 6, PO 7, PO 10.	MATDSCT5.2	GROUP DISCUSSION	
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, PO5, PO 7, PO 9.	MATDSCT1.1 & MATDSCT2.1		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	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		VIVA-VOCE
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.Sc. with Mathematics as a Minor in the 3rd Sem

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 Practical's on Complex Analysis	25	25
VI	MATDSCMT6.1	Theory	3	Numerical Analysis	60	40
	MATDSCMP6.1	Practical	2	Theory based Practical's 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.Sc.(Honors) with Mathematics as Major in the 3rd Sem

(For Model IIA)

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	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 Courses4x(3+2) =20	-----	2Courses 2 x 3 =06	---	2Courses 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 1Course 1 x 3 =3 Total=25	-----	2Courses 2 x 3 =6 Res.Meth1 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 – 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 equation to be exact. 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 second and higher order with constant coefficients. Complimentary function, Particular integral when the RHS is of the form e^{ax}, sin(ax+b), cos(ax+b), x^n, e^{ax} V and x V, where V is a function of x. Cauchy – Euler equations. Second order ordinary linear differential equations with variable coefficients-Method of variation of parameters. Total differential equations P dx +Q dy+ R dz =0. Simultaneous equation of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$

14 hrs

Real Analysis :

Unit III: Sequences: Sequences of real numbers, supremum and infimum of a sequence, Bounded sequences. Limit of a sequence. convergent, divergent, and oscillatory sequences. Algebra of convergent sequences, nature of standard sequences. Monotonic sequences and its properties. Cauchy's general principle for convergence of a sequence.

14hrs

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

Reference Books:

1. M.D.Raisinghania, Ordinary Differential Equations & Partial Differential Equations, S. Chand & Company, NewDelhi, 2020.
2. J. Sinha Roy and S Padhy: A course of Ordinary and Partial Differential Equation, Kalyani Publishers, NewDelhi, 2014.
3. D. Murray, Introductory Course in Differential Equations, Orient Longman(India), 2017.
4. W. T. Reid, Ordinary Differential Equations, John Wiley, NewDelhi, 2010.
5. M. L. Khanna, Differential Equations, Jai PrakashNath& Co.Meerut, 1997.
6. S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons,1984, 1984.
7. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore,2015.
8. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett,2010.
9. K. A. Ross, Elementary Analysis: The Theory of Calculus (2^{nd}edition), Springer,2013
10. S. K. Berberian, A First Course in Real Analysis, Springer Verlag, New York,1994.
11. T. Apostol, Mathematical Analysis, Narosa PublishingHouse, 1973.
12. M.L Khanna and L.S. Varhiney, Real Analysis by, Jai Prakash Nath & Co.Meerut, 1997.
13. Kreyzig, Advanced Engineering Mathematics, John Wiley, NewDelhi, 2011.

PRACTICALS

MATDSCP 3.1: Practicals 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 handson 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

Practicals/Lab Work to be performed in Lab

Suggested software: Maxima/Python

1. Solution of Exact differential equation.
2. Solution of differential equations that are solvable for x, y, p.
3. Singular solution of Clairaut's equation.
4. Finding the orthogonal trajectories for cartesian and polar curves and plotting.
5. Finding the complimentary function of linear homogeneous differential equations with constant coefficients.
6. Finding the particular integral of linear homogeneous differential equations with constant coefficients.
7. Solution of second order ordinary linear differential equations with variable coefficients by the method of variation of parameters
8. Verification of integrability of total differential equations.
9. Test the convergence of sequences
10. Test the convergence of series using partial sums.
11. Test the convergence of series by using D'Alembert's ratio Test
12. Test the convergence of series by using Raabe's Test
13. Convergence of alternating series using Leibnitz's theorem.
14. Summation of series.

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 linear differential equations.
- To solve exact differential equations.
- To find the solution to higher-order linear differential equations with constant coefficients.

Unit I: Recapitulation of Differential equations of first order and first degree, Linear differential equations, Exact differential equations, Necessary and sufficient condition for the equations to be exact. **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 second and higher order with constant coefficients. Complimentary function, Particular integral when the RHS is of the form e^{ax}, sin(ax+b), cos(ax+b), x^n, e^{ax} V and x V, where V is a function of x. **14hrs**

Reference Books:

1. M.D.Raisinghania, Ordinary Differential Equations & Partial Differential Equations, S. Chand & Company, NewDelhi, 2020.
2. J. Sinha Roy and S Padhy: A Course of Ordinary and Partial Differential Equation Kalyani Publishers, NewDelhi, 2014.
3. D Murray, Introductory Course in Differential Equations, Orient Longman(India), 2017.
4. W T Reid, Ordinary Differential Equations, John Wiley, NewDelhi, 2010.
5. M. L. Khanna, Differential Equations, Jai Prakash Nath & Co.Meerut, 1997.
6. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons,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:NumberSystem

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 there on.

14 Hrs

Unit-II:Theory of equations

Linear equations, quadratic equations, simultaneous equations in two variables, simple application problems - Problems on age calculations. 14Hrs

Unit-III:Quantitative Aptitude

Percentage, Average, Average Speed-problems. Time and distance, problems based on trains, problems on-work and time, work and wages, clock and calendar.

14 Hrs

Reference Books:

1. R.S. Aggarwal, *Quantitative Aptitude*, S. Chand and Company Limited, NewDelhi-110 055, 2010.
2. Abhijit Guha, *Quantitative Aptitude*,5th Edition,Mc.Grawhill publications.2014.
3. R V Praveen,*Quantitative Aptitudeand Reasoning*,PHIpublishers, 2016.
4. R S Aggarwal, Objective Arithmetic, S. Chand & CompanyLtd.,2022.
5. Qazi Zameerddin,Vijay K Khanna, S K Bhambri, *Business Mathematics-II Edition,* vikas publication, 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, Chand Publication, 2017.
8. J K Thukrol, Business Mathematics, abci book: 2020 First Edition, 2020.
9. N. G. Das and J. K. Das, Business Mathematics and Statics, Mc Graw Hill Education, 2017

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 solve wave equation and heat equation.
- Understand the concept of Laplace Transforms.
- Able to find the Fourier series and Fourier Transform of given functions.

Partial Differential Equations:

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

Unit II: Homogeneous and non-homogeneous linear partial differential equations with constant coefficients, Partial differential equations of the second order. Classification of second-order partial differential equations, canonical forms. Solutions of the Heat equation and Wave equation (using Fourier series). **14Hrs**

Integral Transforms:

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. Convolution theorem. Inverse Laplace transforms and its properties. Solution of differential equations by using Laplace transforms. **14Hrs**

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

Reference Books:

1. D. A. Murray, Introductory Course in Differential Equations, Orient and Longman, 2017.
2. H. T. H.Piaggio, Elementary Treatise on Differential Equations and their Applications, CBS Publisher & Distributors,Delhi,1985.
3. G. F. Simmons, Differential Equations, Tata McGrawHill, 1991.

4. S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India,2004.
5. M. D. Raisinghania, Ordinary Differential Equations & Partial Differential Equations, S. Chand & Company, NewDelhi, 2020.
6. K.Sankara Rao, Introduction to Partial Differential Equations: PHI, Third Edition,2015.
7. I. N. Sneddean, Elements of Partial differential equations, McGraw-Hill International Editions,1986.
8. R. Murray and L. Spiegal (Schaum's Series), Laplace Transforms, 1965.
9. Goel and Gupta, Laplace Transform and Fourier Transforms, Pragati Prakashana, 2020.
10. Sudhir Kumar, Integral Transform Methods in Science & Engineering, CBS Engineering Series,2017.
11. Murray R. Spiegal L, Fourier Transforms, Schaum'Series, McGraw-Hill Education, 1965.
12. Earl David Rainville and Philip Edward Bedient–A short course in Differential Equations, Prentice Hall College Div; 6thEdition, 1981.
13. Sathya Prakash, Mathematical Physics, S Chand and Sons, NewDelhi, 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)**

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 transforms
- To find Laplace transform of various functions
- To find inverse Laplace transform of various functions
- To find the Fourier series of periodic functions
- To find the half range Fourier series of some functions

Practicals/Lab Work to be performed in Lab

Suggested software: Maxima/Python

1 Solution of Partial differential equations of type1 andtype2
2 Solution of Partial differential equations of type3 andtype4
3 Solution of partial differential equation using Charpit's method.
4 Finding the complimentary function of second order homogenous partial differential equation with constant coefficients.
5 Finding the particular integral of second order homogenous partial differential equation with constant coefficients.
6 Solutions to Heat equation using Fourier series method
7 Solutions to Wave equation using Fourier series method
8 Finding the Laplace transform of some simple functions.
9 Finding the inverse Laplace transform of some simple functions
10 Verification of Convolution Theorem.
11 To solve ordinary linear differential equation using Laplace transform.
12 To find the Fourier series of some simple functions withperiod2L
13 To find Half range sine series of some simple functions.
14 To find Half range cosine series of some simple functions.

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

- 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 solve wave equation and heat equation.

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

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

14 Hrs

Unit III: Partial differential equations of the second order. Classification of second-order partial differential equations, canonical forms, Solutions of the Heat equation and Wave equation (using Fourier series). **14Hrs**

Reference Books:

1. D.A. Murray, Introductory course in Differential Equations, Orient and Longman, 2017.
2. H.T. H.Piaggio, Elementary Treatise on Differential Equations and their applications, C.B.S Publisher & Distributors, Delhi,1985.
3. G.F.Simmons, Differential Equations, Tata McGraw Hill, 1991.
4. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India,2004.
5. M.R. Speigel, Schaum's outline of Laplace Transform, McGraw-Hill Education, 1965.
6. M. D. Raisinghania, Ordinary Differential equations &Partial differential equations, S. Chand & Company, NewDelhi, 2020.
7. K. Sankara Rao, Introduction to Partial Differential Equations: PHI, Third Edition, 2015.
8. I. N. Snedden, 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 to compute profit and loss, discount and Banker's discount.
- Understand the concept of Linear equations and inequalities and their use in 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 in solving a transportation problem, optimality check, special cases in Transportation problem. The Traveling salesman Problem (Routing Problem). **14Hrs**

Reference Books:

1. R S Agarwal, Objective Arithmetic, S. Chand & Company Ltd. 2022.
2. Mizrahi and Sullivan, Mathematics for Business and Social Sciences an Application approach, John Wiley &sons Inc., 1976.
3. Qazi Zameeruddin, Vijay K Khanna, S K Bhambri, Business Mathematics- II Edition, Vikas Publishing House,2009.
4. S. Kalavathy, Operation Research, Fourth edition, Vikas publication house Pvt.Ltd, 2013.
5. Sreenivasa Reddy M, Operations Research 2nd edition, Sanguine Technical publishers, Bangalore, 2015.
6. S. D. Sharma, Operation Research, Kedar Nath Ram Nath, 2014.