RANI CHANNAMMA UNIVERSITY, BELAGAVI

PROGRAM /COURSE STRUCTURE AND SYLLABUS

as per the Choice Based Credit System (CBCS) designed in accordance with Learning Outcomes-Based Curriculum Framework (LOCF) of National Education Policy (NEP) 2020 for

Bachelor of Science

(Mathematics)

w.e.f.

Academic Year 2021-22 and onwards

Board of studies (UG) committee

S.No.	Name	Designation
1.	Dr.Vijayalaxmi S. Shigehalli	Chairperson
2.	Dr. D. Radhakrishna	Member
3.	Dr.VithalYashavantPatil	Member
4.	Shri. S.K. Girigol	Co-opted Member
5.	Shri. Nagasuresh	Co-opted Member

Dr.Vijayalaxmi S. ShigehalliDr.Vijayalaxmi S. Shigehalli
Dean of Science Faculty Chairperson BoS(UG)
Rani Channamma University, BelagaviDearment of Mathematics,
RCU Belagavi

BOS COMMITTEE (NEP- MATHEMATICS)

B.Sc. MATHEMATICS (III & IV SEM) PROGRAM 2022-23

1	Prof. Vishwanath B. Awati, Department of Mathematics, RCU Belagavi	Chairman
2	Dr. L. M. Angadi, Govt First Grade College, Chikkodi	Member
3	Prof. (Smt) M. S. Shobani Sri Jagadamba Arts and Science First Grade College, Hittanalli tanda LT, Sindagi	Member

PREAMBLE

The subject wise expert committee to draft model curriculum contents in Mathematics constituted by the Department of Higher Education, Government of Karnataka, Bengaluru 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.A./B.Sc.(Basic/Honors) Mathematics and detailedCourse Structure for B.A./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 (ModelProgram Structure for the Bachelor of Arts (Basic/Hons.)/ 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 Phython /R /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 includeadditional 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.

PROGRAM OUTCOMES:

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.
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 modelling and solving of real-life problems.
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.
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 modelling ability, problem solving skills.

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.
6. **Information/digital Literacy:**The completion of this programme will enable the learner to use appropriate software's to solve system of algebraic equation and differential equations.
7. **Self-directed learning:** The student completing this program willdevelop an ability of working independently and to make an in-depth studyof various notions of Mathematics.
8. **Moral and ethical awareness/reasoning:**The student completing thisprogram will develop an ability to identify unethical behaviour such asfabrication, falsification or misinterpretation of data and adoptingobjectives, unbiased and truthful actions in all aspects of life in general andMathematical studies in particular.
9. **Lifelong learning:** This programme provides self-directed learning andlifelong learning skills. This programme helps the learner to thinkindependently and develop algorithms and computational skills for solvingreal word problems.
10. Ability to peruse advanced studies and research in pure and appliedMathematical sciences.

RANI CHANNAMMA UNIVERSITY
Vidyasangama, NH-4, Belagavi. -591156

Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Mathematics Major& One Minor Discipline Scheme for the Four Years Mathematics B.Sc. Undergraduate Honors Programme with effect from 2021-22.

SEMESTER-I										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
L1	21BSC1L1LK1	Kannada	40	60	100	4	-	-	3	2
	21BSC1L1LFK1	Functional Kannada								
L2	21BSC1L2LEN2	English	40	60	100	4	-	-	3	2
	21BSC1L2LHI2	Hindi								
	21BSC1L2LSN2	Sanskrit								
	21BSC1L2LTE2	Telugu								
	21BSC1L2LUR2	Urdu								
DSC1	21BSC1C1MAT1L	Algebra - I and Calculus – I	40	60	100	4	-	-	4	2
	21BSC1C1MAT1P	Theory based Practical's on Algebra -I and Calculus – I	25	25	50	-	-	4	2	3
DSC1	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	3
SEC1	21BSC1SE1CS1	Digital Fluency	25	25	50	1	-	2	2	2
VBC1	21BSC1V1PE1	Physical Education-Yoga	25	-	25	-	-	2	1	-
VBC2	21BSC1V2HW1	Health & Wellness	25	-	25	-	-	2	1	-
OEC1	21BSC1O1MAT1-A	Mathematics – I	40	60	100	3	-	-	3	2
	21BSC1O1MAT1-B	Business Mathematics – I								
			Total Marks		**700**	**Semester Credits**			**25**	

SEMESTER-II										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
L3	21BSC2L3LK2	Kannada	40	60	100	4	-	-	3	2
	21BSC2L3FKL2	Functional Kannada								
L4	21BSC2L4EN2	English	40	60	100	4	-	-	3	2
	21BSC2L4HI2	Hindi								
	21BSC2L4SN2	Sanskrit								
	21BSC2L4TE2	Telugu								
	21BSC2L4UR2	Urdu								
DSC2	21BSC2C2MAT2L	Algebra - II and Calculus –II	40	60	100	4	-	-	4	2
	21BSC2C2MAT2P	Theory based Practical's on Algebra- II and Calculus – II	25	25	50	-	-	4	2	3
DSC2	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	3
AECC1	21BSC2AE1ES2	Environmental Studies	20	30	50	3	-	-	2	2
VBC3	21BSC2V3PE2	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC4	21BSC2V4NC1	NCC/NSS/R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
OEC2	21BSC2O2MAT2-A	Mathematics – II	40	60	100	3	-	-	3	2
	21BSC2O2MAT2-B	Business Mathematics-II								
Total Marks					**700**	**Semester Credits**			**25**	

SECOND YEAR; SEMESTER-III										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
L5	21BSC3L5LK3	Kannada	40	60	100	4	-	-	3	2
	21BSC3L5LFK3	Functional Kannada								
L6	21BSC3L6EN3	English	40	60	100	4	-	-	3	2
	21BSC3L6HI3	Hindi								
	21BSC3L6SN3	Sanskrit								
	21BSC3L6TE3	Telugu								
	21BSC3L6UR3	Urdu								
DSC3	21BSC3C3MAT1L	Ordinary Differential Equations and Real Analysis-I	40	60	100	4	-	-	4	2
	21BSC3C3MAT1P	Theory based Practical's on Ordinary Differential Equations and Real Analysis-I	25	25	50	-	-	4	2	3
DSC3	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	3
SEC2	21BSC3SE2ES2	Artificial Intelligence	25	25	50	1	-	2	2	2
VBC5	21BSC3V5PE3	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC6	21BSC3V6NC2	NCC/NSS/R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
OEC3	21BSC3O3MAT3-A	Ordinary Differential Equations	40	60	100	3	-	-	3	2
	21BSC3O3MAT3-B	Quantitative Mathematics								
	21BSC3O3MAT3-C	Vedic Mathematiics								
Total Marks					**700**	**Semester Credits**			**25**	

SEMESTER-IV										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
L7	21BSC4L7LK4	Kannada	40	60	100	4	-	-	3	2
	21BSC4L7LFK4	Functional Kannada								
L8	21BSC4L8EN4	English	40	60	100	4	-	-	3	2
	21BSC4L8HI4	Hindi								
	21BSC4L8SN4	Sanskrit								
	21BSC4L8TE4	Telugu								
	21BSC4L8UR4	Urdu								
DSC4	21BSC4C4MAT2L	Partial Differential Equations and Integral Transforms	40	60	100	4	-	-	4	2
	21BSC4C4MAT2P	Theory based Practical's on Partial Differential Equations and Integral Transforms	25	25	50	-	-	4	2	3
DSC4	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	3
AECC 2	21BSC4AE1ES2	Constitution of India	20	30	50	3	-	-	2	2
VBC7	21BSC4V5PE4	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC8	21BSC4V6NC3	NCC/NSS/R&R(S&G)/Cultural	25	-	25	-	-	2	1	-
OEC4	21BSC4O4MAT4-A	Partial Differential Equations	40	60	100	3	-	-	3	2
	21BSC4O4MAT4-B	Mathematical Finance								
	21BSC4O4MAT4-C	Mathematics for Social Science								
Total Marks					**700**	**Semester Credits**			**25**	

SEMESTER-V										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Mathematics as Major Discipline										
DSC5	21BSC5C5MATMJ1L	Real Analysis and Complex Analysis	40	60	100	3	-	-	3	2
	21BSC5C5MATMJ1P	Theory based Practical's on Real Analysis and Complex Analysis	25	25	50	-	-	4	2	3
DSC6	21BSC5C5MATMJ2L	Ring Theory	40	60	100	3	-	-	3	2
	21BSC5C5MATMJ2P	Theory based Practical's on Ring Theory	25	25	50	-	-	4	2	3
DSC5	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	3
DSE	21BSC5DSEMAT-A	Vector Calculus	40	60	100	3	-	-	3	2
	21BSC5DSEMAT-B	Mechanics								
	21BSC5DSEMAT-C	Mathematical Logic								
VBC9	21BSC5V5PE5	Physical Education-Sports	25	25	50	-	-	2	1	-
VBC10	21BSC5V6NC4	NCC/NSS/R&R (S&G)/Cultural	25	25	50	-	-	2	1	-
SEC3	21BSC5SE3MAT3	Cyber Security	25	25	50	1	-	2	2	2
Total Marks					**650**	**Semester Credits**			**22**	

SEMESTER-VI										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Mathematics as Major Discipline										
DSC7	21BSC6C6MATMJ1L	Linear Algebra	40	60	100	3	-	-	3	2
	21BSC6C6MATMJ1P	Theory based Practical's on Linear Algebra	25	25	50	-	-	4	2	3
DSC8	21BSC6C6MATMJ2L	Numerical Analysis	40	60	100	3	-	-	3	2
	21BSC6C6MATMJ2P	Theory based Practical's on Numerical Analysis	25	25	50	-	-	4	2	3
DSC6	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	3
DSE	21BSC6DSEMAT-A	Analytical Geometry in 3D	40	60	100	3	-	-	3	2
	21BSC6DSEMAT-B	Number Theory								
	21BSC6DSEMAT-C	Special Functions								
	21BSC6DSEMAT-C	History of BhârtîyaGaṇita								
INT1	21BSC6 INT1L	Internship	25	50	75	-	-	-	2	2
VBC1	21BSC6V5PE5	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC2	21BSC6V6NC4	NCC/NSS/R &R(S&G) / Cultural	25	-	100	-	-	2	1	-
SEC4	21BSC6SE4MAT4	Professional Communication	25	25	50	1	-	2	2	2
			Total Marks		**700**	**Semester Credits**			**24**	
			Total Marks for BSC Program		**4175**	**Total Credits for BSC Program**			**146**	

Mathematics Subject as a Minor Discipline

SEMESTER-VI										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
DSC6 As a Minor Subject	21BSC6C6MATMN1L	Numerical Analysis	40	60	100	3	-	-	3	2
	21BSC6C6MATMN1P	Theory based Practical's on Numerical Analysis	25	25	50	-	-	3	2	3

Concept Note, Abbreviation Explanation and Coding:

Concept Note:

1. **CBCS** is a mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices, across various disciplines for completing a UG/PG program.
2. A credit is a unit of study of a fixed duration. For the purpose of computation of workload as per UGC norms the following is mechanism be adopted in the University:
   One credit (01) = One Theory Lecture (L) period of one (1) hour.
   One credit (01) = One Tutorial (T) period of one (1) hour.
   One credit (01) = One practical (P) period of two (2) hours.
3. Course: paper/subject associated with AECC, DSC, DSEC, SEC, VBC, OEC, VC, IC and MIL
4. In case of **B.Sc**. **Once a candidate chose two courses/subjects of a particular two department in the beginning, he/she shall continue the same till the end of the degree, then there is no provision to change the course(s) and Department(s).**
5. A candidate shall choose **one of the Department's courses as major and other Department course as minor in fifth and sixth semester and major course will get continued in higher semester.**
6. Wherever there is a practical there will be no tutorial and vice-versa
7. A major subject is the subject that's the main focus of Core degree/concerned.
8. A minor is a secondary choice of subject that complements core major/ concerned.
9. Vocational course is a course that enables individual to acquire skills set that are required for a particular job.

10. Internship is a designated activity that carries some credits involving more than **25 days** of working in an organization (either in same organization or outside) under the guidance of an identified mentor. Internship shall be an integral part of the curriculum.
11. **OEC: For non-mathematics students. Mathematics students have to opt for OEC from departments other than major and minor disciplines.**

Abbreviation Explanations:

1. AECC: Ability Enhancement Compulsory Course.
2. DSC: Discipline Specific Core Course.
3. DSEC: Discipline Specific Elective Course.
4. SEC: Skill Enhancement Course.
5. VBC: Value Based Course.
6. OEC: Open/Generic Elective Course
7. VC: Vocational Course.
8. IC: Internship Course
9. L1: Language One
10. L2: MIL
11. L= Lecture; T= Tutorial; P=Practical.
12. MIL= Modern Indian Language; English or Hindi or Telugu or Sanskrit or Urdu

Program Coding:

1. Code 21: Year of Implementation
2. Code BSC: BSC Program under the faculty of Applied Science of the University
3. Code 1: First Semester of the Program, (2 to 6 represent higher semesters)
4. Code AE: AECC, (C for DSC, S for SEC, V for VBC and O for OEC)
5. Code 1: First "AECC" Course in semester, similarly in remaining semester for such other courses
6. Code LK: Language Kannada, similarly Language English, Language Hindi, Language Telugu, Language Sanskrit, &Language Urdu
7. Code 1: Course in that semester.
8. MAT: Mathematics

ASSESSMENT METHODS
Evaluation Scheme for Internal Assessment:

Theory:

Assessment Criteria	**30 marks**
1st Internal Assessment Test for 30 marks of duration 1 hr after 8 weeks and 2nd Internal Assessment Test for 30 marks 1 hr after 15 weeks. Average of two tests should be considered.	30
Assignment	10
Total	**40**

Assessment Criteria	**25 marks**
1st Internal Assessment Test for 20 marks of duration 1/2 hr after 8 weeks and 2nd Internal Assessment Test for 20 marks of duration 1 hr after 15 weeks. Average of two tests should be considered.	20
Assignment	05
Total	**25**

Practical:

Assessment Criteria	**25 marks**
Semester End Internal Assessment Test for 20 marks of duration 2 hrs	20
Journal (Practical Record)	05
Total	**25**

Question Paper Pattern:
RANI CHANNAMMA UNIVERSITY
Department of Mathematics

I SemesterB.Sc (Mathematics)

Sub: Code: Maximum Marks: 70

a. Answer any Six Questions from Question 1

b. Answer any Three Questions from Question 2,3,4 and 5

Q.No.1.	**Answer any Five Questions (Two question from Each Unit)** **a.** **b.** **c.** **d,** **e.** **f.** **g.** **h.**	**2X6=12**
Q.No.2.	**(Should cover Entire Unit-I)** **a.** **b.** **c.** **d.**	**4X3=12**
Q.No.3.	**(Should cover Entire Unit-II)** **a.** **b.** **c.** **d.**	**4X3=12**
Q.No.4.	**(Should cover Entire Unit-III)** **a.** **b.** **c.** **d.**	**4X3=12**
Q.No.5.	**(Should cover Entire Unit-IV)** **a.** **b.** **c.** **d.**	**4X3=12**

COURSE-WISE SYLLABUS

Semester I

Year	I	**Course Code:** 21BSC1C1MAT1L	**Credits**	04
Sem.	1	**Course Title:** Algebra - I and Calculus – I	**Hours**	56
Course Pre-requisites, if any		NA		
Formative Assessment Marks: 40		Summative Assessment Marks: 60	Duration of ESA:.02 hrs.	

Course Outcomes	This course will enable the students to • Learn to solve system of linear equations. • Solve the system of homogeneous and non-homogeneous linear of m equations in n variables by using concept of rank of matrix, finding eigen values and eigen vectors. • Sketch curves in Cartesian, polar and pedal equations • Students will be familiar with the techniques of integration and differentiation of function with real variables. • Identify and apply the intermediate value theorems and L' Hospital rule.

Unit No.	**Course Content**	**Hours**
Unit I	**Matrix:** 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. Eigen values and Eigen vectors of square matrices, real symmetric matrices and their properties, reduction of such matrices to diagonal form,	14
Unit II	**Polar Co-ordinates:** Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms-center of curvature, asymptotes, evolutes and envelops.	14
Unit III	**Differential Calculus-I:** Limits, Continuity, Differentiability and properties. Properties of continuous functions. Intermediate value theorem, Rolle'sTheorem , 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.	14

Unit IV	**Successive Differentiation**: nth Derivatives of Standard functions e^{ax+b}, $(ax+b)^m$, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$, Leibnitz theorem and its applications. Tracing of curves (standard curves)	14
Recommended Leaning Resources		
Print Resources	**References:** 1. University Algebra - N.S. Gopala Krishnan, New Age International (P) Limited 2. Theory of Matrices - B S Vatsa, New Age International Publishers. 3. Matrices - A R Vasista, Krishna PrakashanaMandir. 4. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi. 5. Applications of Calculus, DebasishSengupta, Books and Allied (P) Ltd., 2019. 6. Calculus – LipmanBers, Holt, Rinehart & Winston. 7. Calculus - S Narayanan & T. K. ManicavachogamPillay, S. ViswanathanPvt. Ltd., vol. I & II. 8. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw. 9. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.	

Year	I	**Course Code:** 21BSC1C1MAT1P	**Credits**	02
Sem.	I	**Course Title:**Practical's on Algebra - I and Calculus – I	**Hours**	56
Course Pre-requisites, if any:		Knowledge of Programming		
Formative Assessment Marks: 25		Summative Assessment Marks: 25	Duration of ESA: 03 hrs.	
Course Outcomes		This course will enable the students to • Learn Free and Open Source Software (FOSS) tools for computer programming Solve problem on algebra and calculus theory studied in MATDSCT 1.1 by using FOSS software. Acquire knowledge of applications of algebra and calculus through FOSS Practical/Lab Work to be performed in Computer Lab (FOSS) • Suggested Software's: Maxima/Scilab/Maple/MatLab/Mathematica/Phython/R		
		Lab Practical's: **Part A:** Introduction to the software and commands related to the topic. 1. Computation of addition and subtraction of matrices, 2. Computation of Multiplication of matrices. 3. Computation of Trace and Transpose of Matrix 4. Computation of Rank of matrix and Row reduced Echelon form. 5. Computation of Inverse of a Matrix using Cayley-Hamilton theorem. 6. Solving the system of homogeneous and non-homogeneous linear algebraic equations. **Part B:** 7. Finding the nth Derivative of e^{ax}, trigonometric and hyperbolic functions 8. Finding the nth Derivative of algebraic and logarithmic functions. 9. Finding the nth Derivative of $e^{ax+b}\sin(bx+c)$, $e^{ax+b}\cos(bx+c)$. 10. Finding the Taylor's and Maclaurin's expansions of the given functions. 11. Finding the angle between the radius vector and tangent. 12. Finding the curvatures of the given curves. 13. Tracing of standard curves (Cartesian, polar and parametric)		

Evaluation Scheme for Lab Examination

Assessment Criteria		Marks
Program – 1 from Part A	Writing Program	03
	Execution of Program	07
Program -2 from Part B	Writing Program	03
	Execution of Program	07
Viva-Voce		05
Total		**25**

OPEN-ELECTIVE SYLLABUS :

A: For students of Science stream who have not chosen Mathematics as one of Core Subjects

Year	I	**Course Code:** 21BSC1O1MAT1	**Credits**	03
Sem.	I	**Course Title:** Mathematics – I	**Hours**	42

Course Pre-requisites, if any	NA	
Formative Assessment Marks: 40	Summative Assessment Marks: 60	Duration of ESA:.02 hrs.

Course Outcomes	This course will enable the students to • Learn to solve system of linear equations. • Solve the system of homogeneous and non-homogeneous m linear equations by using the concept of rank of matrix, finding eigen values and eigen vectors. • Students will be familiar with the techniques of differentiation of function with real variables. • Identify and apply the intermediate value theorems and L' Hospital rule. • Learn to trace some standard curves.	
Unit No.	**Course Content**	**Hours**
Unit I	**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, 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. Eigen values and Eigen vectors of square matrices, real symmetric matrices and their properties, reduction of such matrices to diagonal form.	14
Unit II	**Differential Calculus:** Limits, Continuity, Differentiability and properties. 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 examples.	14
Unit III	**Successive Differentiation**: nth Derivatives of Standard functions e^{ax+b}, $(ax+b)^m$, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$, Leibnitz theorem and its applications. Tracing of curves (standard curves)	14
Recommended Leaning Resources		

Print Resources	**References:** 1. University Algebra - N.S. Gopala Krishnan, New Age International (P) Limited 2. Theory of Matrices - B S Vatsa, New Age International Publishers. 3. Matrices – A. R. Vasista, Krishna PrakashanaMandir. 4. Applications of Calculus, DebasishSengupta, Books and Allied (P) Ltd., 2019. 5. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi. 6. Calculus – LipmanBers, Holt, Rinehart & Winston. 7. Calculus – S. Narayanan & T. K. ManicavachogamPillay, S. ViswanathanPvt. Ltd.,vol. I & II. 8. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc.Graw. 9. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.

B: For Students of other than Science Stream

Year	I	**Course Code:** 21BSC1O1MAT1	**Credits**	03
Sem.	I	**Course Title:** Business Mathematics – I	**Hours**	42
Course Pre-requisites, if any		NA		
Formative Assessment Marks: 40		Summative Assessment Marks: 60	Duration of ESA:.02 hrs.	
Course Outcomes	This course will enable the students to • Translate the real word problems through appropriate mathematical modellling. • Explain the concepts and use equations, formulae and mathematical expression and relationship in a variety of context. • Finding the extreme values of functions. • Analyze and demonstrate the mathematical skill require in mathematically intensive areas in economics and business.			
Unit No.	**Course Content**		**Hours**	
Unit I	**Algebra** – Set theory and simple applications of Venn Diagram, relations, functions, indices, logarithms, permutations and combinations. Examples on commercial mathematics.		14	
Unit II	**Matrices**: Definition of a matrix; types of matrices; algebra of matrices. Properties of determinants; calculations of values of determinants upto 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	
Unit III	**Differential Calculus**: Constant and variables, functions, Limits & continuity. Differentiability and Differentiation, partial differentiation, rates as a measure, maxima, minima, Partial Derivatives up to second order; Homogeneity of functions and Euler's Theorem; Total Differentials; Differentiation of implicit function with the help of total differentials, Maxima and Minima; cases of one variable involving second or higher order derivatives; Cases of two variables involving not more than one constraint		14	
Recommended Leaning Resources				
Print Resources	**References:** 1. Basic Mathematics, Allel R.G.A, Macmillan, New Delhi. 2. Mathematics for Economics, Dowling, E.T. ,Schaum's Series, McGraw Hill, London. 3. Quantitative Techniques in Management, Vohra, N.D., Tata McGraw Hill, New Delhi. 4. Business Mathematics, Soni R.S., Pitamber Publishing House, Delhi			

Semester II

Year	I	**Course Code:** 21BSC1C1MAT1L	**Credits**	04
Sem.	II	**Course Title:** Algebra - II and Calculus –II	**Hours**	56

Course Pre-requisites, if any	NA	
Formative Assessment Marks: 40	Summative Assessment Marks: 60	Duration of ESA:.02 hrs.

Course Outcomes	This course will enable the students to • Recognize the mathematical objects called Groups. • Link the fundamental concepts of groups and symmetries of geometrical objects. • Explain the significance of the notions of Cosets, normal subgroups and factor groups. • Understand the concept of differentiation and fundamental theorems in differentiation and various rules. • Find the extreme values of functions of two variables.

Unit No.	**Course Content**	**Hours**
Unit I	**Real Number System:** Recapitulation of number system. Countable and uncountable sets, standard theorems. Real line, bounded sets, suprimum and infimumof a set, completeness properties of R, Archimedean property of R. Intervals, neighborhood of a point, open sets, closed sets, limit points and Bolzano-Weierstrass theorem (Without proof).	14
Unit II	**Groups:** Definition of a group with examples and properties, congruence, problems. Subgroups, center of groups, order of an element of a group and its related theorems, cyclic groups, Coset decomposition, Factor groups, Lagrange's theorem and its consequences. Fermat's theorem, Euler's ϕ	14
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
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	14

	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.	
Recommended Leaning Resources		
Print Resources	**References** 1. Topics in Algebra, I N Herstein, Wiley Eastern Ltd., New Delhi. 2. Higher algebra, Bernard & Child, Arihant, ISBN: 9350943199/ 9789350943199. 3. Modern Algebra, Sharma and Vasista, Krishna PrakashanMandir, Meerut, U.P. 4. Differential Calculus, Shanti Narayan, S. Chand & Company, New Delhi. 5. Integral Calculus, Shanti Narayan and P K Mittal, S. Chand and Co. Pvt. Ltd., 6. Schaum's Outline Series, Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw Hill., 2008. 7. Mathematical Analysis, S C Malik, Wiley Eastern. 8. A Course in Abstract Algebra, Vijay K Khanna and S K Bhambri, Vikas Publications. 9. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.	

<table>
<tr><td>Year</td><td>I</td><td colspan="2">Course Code: 21BSC1C1MAT1P</td><td>Credits</td><td>02</td></tr>
<tr><td>Sem.</td><td>II</td><td colspan="2">Course Title:Practical's on Algebra - II and Calculus – II</td><td>Hours</td><td>56</td></tr>
<tr><td colspan="2">Course Pre-requisites, if any:</td><td colspan="4">Knowledge of Programming</td></tr>
<tr><td colspan="2">Formative Assessment Marks: 25</td><td colspan="2">Summative Assessment Marks: 25</td><td colspan="2">Duration of ESA: 03 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">This course will enable the students to
• Learn Free and Open Source Software (FOSS) tools for computer programming
• Solve problem on algebra and calculus by using FOSS software's.
• Acquire knowledge of applications of algebra and calculus through FOSS Practical/Lab Work to be performed in Computer Lab
Suggested Software's: Maxima/Scilab/Maple/MatLab/Mathematica/Phython/R.</td></tr>
<tr><td></td><td colspan="5">Lab Practical's:

Part A:
1. Program for verification of binary operations.
2. Computation of identity and inverse elements of a group.
3. Program to construct Cayley's table and test abelian for given finite set.
4. Program to find all possible cosets of the given finite group.
5. Program to find generators and corresponding possible subgroups of a cyclic group.
6. Programs to verification of Lagrange's theorem with suitable examples.

Part B:
7. Program to verify the Euler's ϕfunction for a given finite group.
8. Program to verify the Euler's theorem and its extension
9. Programs to construct series using Maclaurin's expansion for functions of two variables.
10. Program to evaluate the line integrals with constant and variable limits.
11. Program to evaluate the Double integrals with constant and variable limits
12. Program to evaluate the Triple integrals with constant and variable limits.</td></tr>
</table>

Evaluation Scheme for Lab Examination

Assessment Criteria		Marks
Program – 1 from Part A	Writing Program	03
	Execution of Program	07
Program -2 from Part B	Writing Program	03
	Execution of Program	07
Viva-Voce		05
Total		**25**

OPEN-ELECTIVE SYLLABUS :

A: For students of Science stream who have not chosen Mathematics as one of CoreSubjects

Year	I	**Course Code:** 21BSC1O1MAT1	**Credits**	03
Sem.	II	**Course Title:** Mathematics – II	**Hours**	42

Course Pre-requisites, if any	NA	
Formative Assessment Marks: 40	Summative Assessment Marks: 60	Duration of ESA:.02 hrs.

Course Outcomes	This course will enable the students to • Recognize the mathematical objects called Groups. • Link the fundamental concepts of groups and symmetries of geometrical objects. • Explain the significance of the notions of Cosets, normal subgroups and factor groups. • Understand the concept of differentiation and fundamental theorems in differentiation and various rules. • Find the extreme values of functions of two variables. • To understand the concepts of multiple integrals and their applications.

Unit No.	**Course Content**	**Hours**
Unit I	**Groups**: Definition of a group with examples and properties, congruence, problems. Subgroups, center of groups, order of an element of a group and its related theorems, cyclic groups, Coset decomposition, Factor groups, Lagrange's theorem and its consequences. Fermat's theorem and Euler's ϕfunction.	14
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
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	14

	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.	
Recommended Leaning Resources		
Print Resources	**References:** 1. Topics in Algebra, I N Herstein, 2nd Edition, Wiley Eastern Ltd., New Delhi. 2. Higher algebra, Bernard & Child, Arihant Pub. 3. Modern Algebra, Sharma and Vasishta, Krishna PrakashanMandir, Meerut, U.P. 4. A Course in Abstract Algebra, Vijay K Khanna and S K Bhambri, Vikas Publications. 5. Differential Calculus, Shanti Narayan, S. Chand & Company, New Delhi. 6. Integral Calculus, Shanti Narayan and P K Mittal, S. Chand and Co. Pvt. Ltd., 7. Schaum's Outline Series, Frank Ayres and Elliott Mendelson, 5th ed. USA: McGraw Hill., 2008. 8. Mathematical Analysis, S C Malik, Wiley Eastern. 9. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.	

SEMESTER – III

Year	II	**Course Code:** 21BSC3C3MAT1L	**Credits**	04
Sem.	III	**Course Title: Ordinary Differential Equations and Real Analysis – I**	**Hours**	56

Course Pre-requisites, if any	NA	
Formative Assessment Marks: 40	Summative Assessment Marks: 60	Duration of ESA:.02 hrs.

Course Outcomes	**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.	
Unit No.	**Course Content**	**Hours**
Unit I	**Ordinary Differential Equations:** 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.	14
Unit II	Linear differential equations of the nth 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 x V (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
Unit III	**Real Analysis – I :** **Sequences**: Sequences of real numbers, Bounded sequences. Limit of a sequence. convergent, divergent,	14

	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.	
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**
Recommended Leaning Resources		
Print Resources	**References:** 1. M.D.Raisinghania, Ordinary Differential Equations & Partial Differential Equations, S. Chand & Company, New Delhi. 2. J. Sinha Roy and S Padhy: A course of Ordinary and Partial Differential Equation, Kalyani Publishers, New Delhi. 3. D. Murray, Introductory Course in Differential Equations, Orient Longman (India) 4. W. T. Reid, Ordinary Differential Equations, John Wiley, New Delhi. 5. M. L. Khanna, Differential Equations, Jai PrakashNath& Co. Meerut. 6. S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 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 Publishing House 12. M.L Khanna and L.S. Varhiney, Real Analysis by, Jai Prakash Nath & Co. Meerut. 13. Kreyzig, Advanced Engineering Mathematics, John Wiley, New Delhi.	

Practicals

<table>
<tr><td>Year</td><td>II</td><td colspan="3">Course Code: 21BSC3C3MAT1P</td><td>Credits</td><td>02</td></tr>
<tr><td>Sem.</td><td>III</td><td colspan="3">Course Title: Practicals on Ordinary Differential Equations and Real Analysis – I</td><td>Hours</td><td>56</td></tr>
<tr><td colspan="2">Course Pre-requisites, if any</td><td colspan="5">NA</td></tr>
<tr><td colspan="2">Formative Assessment Marks: 25</td><td colspan="2">Summative Assessment Marks: 25</td><td colspan="3">Duration of ESA:.02 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">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
• Ploting 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</td></tr>
<tr><td></td><td colspan="5">Course Content</td><td>Hours</td></tr>
<tr><td></td><td colspan="5">Practicals/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.</td><td>56</td></tr>
</table>

Open Elective Course

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

Year	II	**Course Code:** 21BSC3O3MAT3-A	**Credits**	03
Sem.	III	**Course Title: Ordinary Differential Equations**	**Hours**	42
Course Pre-requisites, if any		NA		
Formative Assessment Marks: 40		Summative Assessment Marks: 60	Duration of ESA:.02 hrs.	

Course Outcomes	**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 No.	**Course Content**	**Hours**
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.	14
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.	14
Unit III	Linear differential equations of the nth 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 x V (with proofs), where V is a function of x.	14

Recommended Leaning Resources

Print Resources	**References:** 1. M.D.Raisinghania, Ordinary Differential Equations & Partial Differential Equations, S. Chand & Company, New Delhi. 2. J. Sinha Roy and S Padhy: A Course of Ordinary and Partial Differential Equation Kalyani Publishers, New Delhi. 3. D Murray, Introductory Course in Differential Equations, Orient Longman (India) 4. W T Reid, Ordinary Differential Equations, John Wiley, New Delhi 5. M. L. Khanna, Differential Equations, Jai PrakashNath& Co. Meerut. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.

Open Elective Course

(For students of other than Science stream)

Year	II	**Course Code:** 21BSC3O3MAT3-B	**Credits**	03
Sem.	III	**Course Title: Quantitative Mathematics**	**Hours**	42

Course Pre-requisites, if any	NA	
Formative Assessment Marks: 40	Summative Assessment Marks: 60	Duration of ESA:.02 hrs.

Course Outcomes	**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 No.	**Course Content**	**Hours**
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 thereon.	14
Unit II	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
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

Recommended Leaning Resources

Print Resources

References:

1. R.S. Aggarwal, *Quantitative Aptitude*, S. Chand and Company Limited, NewDelhi-110 055 .
2. Abhijit Guha, *QuantitativeAptitude*,5th Edition,Mc.Grawhillpublications.2014.
3. R V Praveen,*QuantitativeAptitudeand Reasoning*,PHI publishers.
4. R S Aggarwal, Objective Arithmetic, S. Chand & Company Ltd.
5. Qazi Zameerddin,Vijay K Khanna, S K Bhambri, *BusinessMathematics-II Edition.*
6. S. K. Sharma and Gurmeet Kaur, Business Mathematics , Sultan Chand & Sons.
7. Hazarika Padmalochan, A Text Book of Business mathematics for B.Com and BBA Course, Chand Publication.
8. J K Thukrol, Business Mathematics, abci book:2020 First Edition.
9. N. G. Das and J. K. Das, Business Mathematics and Statics, Mc Graw Hill Education, 2017.

Open Elective Course

(For Students of other than Science Stream)

Year	II	**Course Code:** 21BSC3O3MAT3-C	**Credits**	03
Sem.	III	**Course Title: Vedic Mathematics**	**Hours**	42

Course Pre-requisites, if any	NA	
Formative Assessment Marks: 40	Summative Assessment Marks: 60	Duration of ESA:.02 hrs.

Course Outcomes	**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 No.	**Course Content**	**Hours**
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
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
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). Solution of linear simultaneous equations.	14
Recommended Leaning Resources		
Print Resources	**Reference Books:** 1. Vedic Mathematics, Motilal Banarsi Das, New Delhi. 2. Vedic Ganita: Vihangama Drishti-1, SikshaSanskritiUthana Nyasa, New Delhi. 3. Vedic GanitaPraneta, Siksha Sanskriti Uthana Nyasa, New Delhi. 4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi. 5. Leelavati, ChokhambbaVidya Bhavan, Varanasi. 6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.	

SEMESTER – IV

Year	II	**Course Code:** 21BSC4C4MAT2L	**Credits**	04
Sem.	IV	**Course Title: Partial Differential Equations and Integral Transforms**	**Hours**	56

Course Pre-requisites, if any	NA	
Formative Assessment Marks: 40	Summative Assessment Marks: 60	Duration of ESA:.02 hrs.

Course Outcomes	**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 No.	**Course Content**	**Hours**
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
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
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
Unit IV	**Fourier Series and Transforms:** Periodic functions. Fourier Coefficients. Fourier series of functions with period 2π and period 2L. Fourier series of even and odd functions. Half range Cosine and Sine series. Fourier Transforms - Finite Fourier Cosine and Sine transform.	**14**

	Transforms of derivates**.** Applications of Fourier Transforms**.**	
Recommended Leaning Resources		
Print Resources	**References:** 1. D. A. Murray, Introductory Course in Differential Equations, Orient and Longman 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 McGraw Hill. 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, New Delhi. 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 9. Goel and Gupta, Laplace Transform. 10. Sudhir Kumar, Integral Transform Methods in Science & Engineering, CBS Engineering Series, 2017. 11. Murray R. Spiegal L, Fourier Transforms, Schaum' Series, 12. Earl David Rainville and Philip Edward Bedient–A short course in Differential Equations, Prentice Hall College Div; 6th Edition. 13. Sathya Prakash, Mathematical Physics, S Chand and Sons, New Delhi.	

Practicals

<table>
<tr><td>Year</td><td>II</td><td colspan="3">Course Code: 21BSC4C4MAT2P</td><td>Credits</td><td>02</td></tr>
<tr><td>Sem.</td><td>IV</td><td colspan="3">Course Title: Practical's on Partial Differential Equations and Integral Transforms</td><td>Hours</td><td>56</td></tr>
<tr><td colspan="2">Course Pre-requisites, if any</td><td colspan="5">NA</td></tr>
<tr><td colspan="2">Formative Assessment Marks: 25</td><td colspan="2">Summative Assessment Marks: 25</td><td colspan="3">Duration of ESA:.02 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">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 finf the Fourier Transform of periodic functions
• To solve differential equations by using Integral transforms.</td></tr>
<tr><td></td><td colspan="5">Course Content</td><td>Hours</td></tr>
<tr><td></td><td colspan="5">Practicals/Lab Work to be performed in Computer Lab
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 2π and 2L
11 To find Half range sine and cosine series of some simple functions and ploting them.
12 To find Cosine Fourier transforms.
15. To find Sine Fourier transforms.</td><td>56</td></tr>
</table>

Open Elective Course

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

Year	II	**Course Code:** 21BSC4O4MAT4-A	**Credits**	03
Sem.	III	**Course Title: Partial Differential Equations**	**Hours**	42

Course Pre-requisites, if any	NA	
Formative Assessment Marks: 40	Summative Assessment Marks: 60	Duration of ESA:.02 hrs.

Course Outcomes	**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 No.	**Course Content**	**Hours**
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
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.	14
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

Recommended Leaning Resources

Print Resources

References:

1. D.A. Murray, Introductory course in Differential Equations, Orient and Longman
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 14
4. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
5. M.R. Speigel, Schaum's outline of Laplace Transform
6. M. D. Raisinghania, Ordinary Differential equations & Partial differential equations, S. Chand & Company, New Delhi.
7. K.Sankara Rao, Introduction to Partial Differential Equations: PHI, Third Edition, 2015.
8. I. N. Snedden, Elements of Partial differential equations.

Open Elective Course

(For students of other than science stream)

Year	II	**Course Code:** 21BSC4O4MAT4-B	**Credits**	03
Sem.	IV	**Course Title: Mathematical Finance**	**Hours**	42

Course Pre-requisites, if any	NA	
Formative Assessment Marks: 40	Summative Assessment Marks: 60	Duration of ESA:.02 hrs.

Course Outcomes	Course Learning Outcomes: Thiscourse 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 No.	**Course Content**	**Hours**
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
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
Unit III	Transportation problem Introduction, Formulation of Transportation problem, Initial basic feasible solution, Steps insolving a transportation problem, optimality check, special cases in Transportation problem. The Traveling salesman Problem (Routing Problem).	14

Recommended Leaning Resources

Print Resources	Reference Books: 1. R S Aggarwal, Objective Arithmetic, S. Chand & Company Ltd. 2. Mizrahi and Sullivan, Mathematics for Business and Social Sciences an Application approach. 3. Qazi Zameeruddin, Vijay K Khanna, S K Bhambri, Business Mathematics-II Edition, Vikas Publishing House. 4. S. Kalavathy, Operation Research, Fourth edition, Vikas publication house Pvt. Ltd. 5. Sreenivasa Reddy M, Operations Research 2nd edition, Sanguine Technical publishers, Bangalore. 6. S. D. Sharma, Operation Research

Open Elective Course

(For students otherthan science stream)

Year	II	**Course Code:** 21BSC4O4MAT4-C	**Credits**	03
Sem.	IV	**Course Title: Mathematics for Social Sciences**	**Hours**	42
Course Pre-requisites, if any		NA		
Formative Assessment Marks: 40		Summative Assessment Marks: 60	Duration of ESA:.02 hrs.	

Course Outcomes	Course Learning Outcomes: Thiscourse will enable the students to • Understand the mathematical concept of sets and counting problems. • Understand the concept of Probalitity and its applications in social sciences. • Understand the concept of limits and continuity of functions and its applications in business and social sciences.

Unit No.	Course Content	Hours
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
Unit II	Limit and continuity, Derivative- interpretation, derivative formulas, general derivatives for differentiation, composit functions, higher order derivaties and problems thereon.	14
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

Recommended Leaning Resources

Print Resources	**REFERENCE BOOKS** 1. Abe Mizrahi and Michael Sullivan, Mathematics for Business and Social Sciences and Applied Approach – Third Edition, Wieley. 2. Carl P. Simon and Lawrence Blume, Mathematics for Economists, Viva Books Private Limited, New Delhi, 2015. 3. L. Peccati, M. D'Amico and M. Cigola , Maths for Social Sciences, , Springer.