JSS MAHAVIDYAPEETA

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

OOTY ROAD, MYSURU- 570 025

Syllabus for B.Sc. programmes

- **Physics and Mathematics**
- **Mathematics and Computer Science**

With effective from

2023-24

DEPARTMENT OF MATHEMATICS

List of Courses with Credit Pattern B.Sc.

Sem	programme	Programme code	Course code	Title of the course	Course type	Credit Pattern L:T:P	Total credit	Teaching hrs/week	Evaluation pattern			
									C1	C2	C3	Total Marks
I	PM	BScPhMa32	FSA43032	Algebra-I and Calculus-I	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSA43332	Algebra-I and Calculus-I Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
	MCs	BScMaCs34	FSA43034	Algebra-I and Calculus-I	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSA43334	Algebra-I and Calculus-I Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
			FSA840	Mathematical Aptitude-I	OE-Theory	3:0:0	3	3	20	20	60	100
			FSA850	Business Mathematics-I	OE-Theory	3:0:0	3	3	20	20	60	100
			FSA860	Optional Mathematics- I	OE-Theory	3:0:0	3	3	20	20	60	100
II	PM	BScPhMa32	FSB43032	Algebra-II (Number Theory) and Calculus-II	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSB43332	Algebra-II (Number Theory) and Calculus-II Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
	MCs	BScMaCs34	FSB43034	Algebra-II (Number Theory) and Calculus-II	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSB43334	Algebra-II (Number Theory) and Calculus-II Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
			FSB840	Mathematical Aptitude-II	OE-Theory	3:0:0	3	3	20	20	60	100
			FSB850	Business Mathematics-II	OE-Theory	3:0:0	3	3	20	20	60	100
			FSB860	Optional Mathematics- II	OE-Theory	3:0:0	3	3	20	20	60	100

Sem	programme	Programme code	Course code	Title of the course	Course type	Credit Pattern L:T:P	Total credit	Teaching hrs/week	Evaluation pattern			
									C1	C2	C3	Total Marks
III	PM	BScPhMa32	FSC43032	Algebra-III and Differential Equations-I	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSC43332	Algebra-III and Differential Equations-I Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
	MCs	BScMaCs34	FSC43034	Algebra-III and Differential Equations-I	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSC43334	Algebra-III and Differential Equations-I Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
			FSC840	Mathematical Aptitude -III	OE-Theory	3:0:0	3	3	20	20	60	100
			FSC850	Discrete Mathematics-I	OE-Theory	3:0:0	3	3	20	20	60	100
IV	PM	BScPhMa32	FSD43032	Real Analysis-I and Differential Equations-II	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSD43332	Real Analysis-I and Differential Equations-II Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
	MCs	BScMaCs34	FSD43034	Real Analysis-I and Differential Equations-II	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSD43334	Real Analysis-I and Differential Equations-II Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
			FSD840	Mathematical Aptitude -IV	OE-Theory	3:0:0	3	3	20	20	60	100
			FSD850	Basics of Number Theory	OE-Theory	3:0:0	3	3	20	20	60	100

Sem	programme	Programme code	Course code	Title of the course	Course type	Credit Pattern L:T:P	Total credit	Teaching hrs/week	Evaluation pattern			
									C1	C2	C3	Total Marks
V	PM	BScPhMa32	FSE43032	Real Analysis-II and Complex Analysis	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSE431P32	Real Analysis-II and Complex Analysis Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
	MCs	BScMaCs34	FSE43034	Real Analysis-II and ComplexAnalysis	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSE431P34	Real Analysis-II and Complex Analysis Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
	PM	BScPhMa32	FSE43232	Advanced Algebra and Discrete Mathematics	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSE433P32	Advanced Algebra and Discrete Mathematics Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
	MCs	BScMaCs34	FSE43234	Advanced Algebra and Discrete Mathematics	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSE433P34	Advanced Algebra and DiscreteMathematics Practical	DSC-Practical	0:0:2	2	4	10	15	25	50

Sem	programme	Programme code	Course code	Title of the course	Course type	Credit Pattern L:T:P	Total credit	Teaching hrs/week	Evaluation pattern			
									C1	C2	C3	Total Marks
VI	PM	BScPhMa32	FSF43032	Linear Algebra	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSF431P32	Linear Algebra Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
	MCs	BScMaCs34	FSF43034	Linear Algebra	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSF431P34	Linear Algebra Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
	PM	BScPhMa32	FSF43232	Numerical Analysis	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSF433P32	Numerical Analysis Practical	DSC-Practical	0:0:2	2	4	10	15	25	50
	MCs	BScMaCs34	FSF43234	Numerical Analysis	DSC-Theory	4:0:0	4	4	20	20	60	100
			FSF433P34	Numerical Analysis Practical	DSC-Practical	0:0:2	2	4	10	15	25	50

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 *Bachelor of Science (Basic*) 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 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.

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

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 software's to solve system of algebraic equation and differential equations.
PO 7	**Self – Directed Learning**: The student completing this program will develop 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.

PROGRAMME SPECIFIC OUTCOME:

Bachelor of Science in

(i) Physics and Mathematics

(ii) Mathematics and Computer Science

After completing the graduation in the above discipline, they are able to:

PSO1: Find carrier opportunities in organization, industries/civil service exam/teaching where a high level competence in mathematics and physics is demanded

PSO2: Develop proficiency in the analysis of complex physical problems and the use mathematical or other appropriate technique to solve them

PSO3: Apply for research in Mathematics or in Physics

PSO4: Apply for research in Mathematics or Computer Science

PSO5: Find jobs at all levels in corporate field

PSO6: Demonstrate skills in the use of computers for control, data acquisition and data analysis in experimental investigation.

Assessment

Weight age for the Assessments (in percentage)

Type of Course	Formative Assessment/ Internal Assessment	Summative Assessment (S.A.)
Theory	40%	60%
Practical	50%	50%
Projects	--	--
Experiential Learning (Internship etc.)	--	--

THEORY EXAMINATION (For Discipline Specific Courses):

Internal Assessment

(i) C1 Component: 20 Marks. This will be based on test for 10 marks and seminar for 10 marks. This should be completed by the 8th week of the semester.

C2 Component: 20 Marks. This will be based on test for 10 marks and assignment for 10 marks. This should be completed by the 15th week of the semester.

(ii) C3 Component (Main Examination of 2.30 hours duration): 60 Marks. The pattern of the question paper will be as follows:

There will be 04 questions. All questions must be answered. All questions carry 15 marks.

Question Paper Pattern

Question 1. This question covers unit I of the syllabus. There will be 5 sub- questions each carrying 5 marks. The student has to answer any three of the 5 sub-questions.

Question 2. This question covers unit II of the syllabus. There will be 5 sub- questions each carrying 5 marks. The student has to answer any three of the 5 sub-question

Question 3. This question covers unit III of the syllabus. There will be 5 sub- questions each carrying 5 marks. The student has to answer any three of the 5 sub-questions.

Question 4. This question covers unit IV of the syllabus. There will be 5 sub- questions each carrying 5 marks. The student has to answer any three of the 5 sub-questions.

PRACTICAL EXAMINATION (For Discipline Specific Courses):

(i) Internal Assessment: 25 (10 +10+5)

This will be based on C1-test (10 marks), C2-test (10 marks), Seminar/Practical record maintenance (5 marks)). This should be completed by the 15th week of the semester.

(ii) Main Examination (2 hours duration):25 (20 + 5)

There will be 3 questions each carrying equal marks. The student has to answer any two of the 3 questions. Each student will be subjected to viva-voce examination, based on practical syllabus, for 5 marks.

THEORY EXAMINATION (For Open Elective (OE) papers):

(i) Internal Assessment

C1 Component: 20 Marks. This will be based on test for 10 marks and seminar for 10 marks. This should be completed by the 8th week of the semester.

C2 Component: 20 Marks. This will be based on test for 10 marks and assignment for 10 marks. This should be completed by the 15th week of the semester.

(ii) C3 component (Main Examination of 2.30 hours duration): 60 Marks. The pattern of the question paper will be as follows:

There will be 03 questions. All questions must be answered. All questions carry 20 marks.

Question 1. This question covers unit I of the syllabus. There will be 6 sub- questions each carrying 5 marks. The student has to answer any four of the 6 sub-questions.

Question 2. This question covers unit II of the syllabus. There will be 6 sub- questions each carrying 5 marks. The student has to answer any four of the 6 sub-questions.

Question 3. This question covers unit III of the syllabus. There will be 6 sub- questions each carrying 5 marks. The student has to answer any four of the 6 sub-questions.

1. Minimum marks for Securing Credits: 30% in Theory Examination and 40% overall.

2. Minimum credits for getting B.Sc. Degree: As per NEP regulations.

3. Award of certificate/diploma/degree: As per NEP regulations.

SEMESTER – I

Algebra - I and Calculus – I	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100** **(S.A.-60 + I.A. – 40)**
Course Code	**FSA43032 / FSA43034**

Course Learning 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.
- Students will be familiar with the techniques of integration and differentiation of function with real variables.
- Students learn to solve polynomial equations.
- Learn to apply Reduction formulae.

Unit-I: Matrix: Recapitulation of Symmetric and Skew Symmetric matrices, 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. Cayley- Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). **14 Hours**

Unit-II: Theory of equations: Euclid's algorithm, Polynomials with integral coefficients, Remainder theorem, Factor theorem, Fundamental theorem of algebra(statement only), Irrational and complex roots occurring in conjugate pairs, Relation between roots and coefficients of a polynomial equation, Symmetric functions, Transformation, Reciprocal equations, Descartes' rule of signs, Multiple roots, Solving cubic equations by Cardon's method, Solving quartic equations by Descarte's Method. **14 Hours**

Unit-III: Polar Co-ordinates: Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- center of curvature, circle of curvature. **14 Hours**

Unit-IV: Successive Differentiation and Integral Calculus-I: nth Derivative of Standard functions e^{as+b}, a^s, $(ax + b)^n$, log(ax + b), sin(ax + b) , cos (ax+ b), e^{as} sin(bx + c), e^{as}cos(bx +c), Leibnitz theorem and its applications.Recapitulation of definite integrals and its properties. Reduction formulae fo $\int \sin^n x\, dx$,$\int \cos^n x\, dx$, $\int \sin^n x \cos^N x\, dx$, $\int \tan^n x\, dx$, $\int \cot^n x\, dx$, $\int \sec^n x\, dx$, $\int \operatorname{cosec}^n x\, dx$,$\int x^n \sin x\, dx$,$\int x^n \cos x\, dx$, $\int x^n e^{as}\, dx$, $\int x^n (\log x)^N\, dx$ with definite limits. **14 Hours**

Reference Books:

1. University Algebra - N.S. Gopala Krishnan, New Age International (P) Limited.

2. Algebra – Natarajan, Manicavasagam Pillay and Ganapathy.

3. Theory of Matrices - B S Vatsa, New Age International Publishers.

4. Matrices - A R Vasista, Krishna Prakashana Mandir.

5. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.

6. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.

7. Calculus – Lipman Bers, Holt, Rinehart & Winston.

8. Calculus - S Narayanan & T. K.Manicavachogam Pillay,S. Viswanathan Pvt. Ltd., vol.I & II.

9. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw.

10. Shanthinarayan – Integral Calculus, New Delhi: S. Chand and Co. Pvt. Ltd.

11.Shanthinarayan and P K Mittal, Integral Calculus, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013

Algebra - I and Calculus-I Practical	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50** **(S.A.-25 + I.A.-25)**
Course Code	**FSA43332 / FSA43334**

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open Source Software (FOSS) tools for computer programming
- Solve problem on algebra and calculus theory studied in FSA43032/FSA43034 by using FOSS software's.
- 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 / Python /R.

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.
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 $e^{ax} \sin(bx + c)$, $e^{ax} \cos(bx + c)$.
10. Finding the roots of the equation, factoring.
11. Finding the angle between the radius vector and tangent.
12. Finding the curvatures of the given curves.

Open Elective
(For Students of all Streams)

Mathematical Aptitude-I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSA840**

Course Learning Outcomes: This course will enable the students to

- have a strong base in the fundamental mathematical concepts.
- grasp the approaches and strategies to solve problems with speed and accuracy
- gain appropriate skills to succeed in preliminary selection process for recruitment

Unit-I: Number System, Types of Numbers, series (AP and GP), Algebraic operations BODMAS, Divisibility, LCM and HCF, Fraction, Simplification. **14 Hours**

Unit-II: Time and Distance, Problems based on Trains, Boats and Streams.

14 Hours

Unit-III: Time, work and wages, Pipes and Cistern, Problems on Clock, Problems on Calendar.

14 Hours

Reference Books:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan Pratogitaprakasan, Kic X, Kiran Prakasan publishers.
4. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill publications.

Open Elective

(For Students of all Streams)

Business Mathematics-I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSA850**

Course Learning Outcomes: This course will enable the students to

- Translate the real word problems through appropriate mathematical modelling.
- 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-I: Algebra – Set theory and simple applications of Venn Diagram, relations, functions, indices, logarithms, permutations and combinations. Examples on commercial mathematics. **14 Hours**

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

14 Hours

Unit - 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 Hours**

Reference Books:

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.

Open Elective Course

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

Optional Mathematics – I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.-60 + I.A. – 40)**
Course Code	**FSA860**

Course Learning 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.
- 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 apply Reduction formulae.

Unit-I: Matrices: Recapitulation of Symmetric and Skew Symmetric matrices, 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. Cayley- Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). **14 Hours**

Unit-II: Theory of equations: Euclid's algorithm, Polynomials with integral coefficients, Remainder theorem, Factor theorem, Fundamental theorem of algebra(statement only), Irrational and complex roots occurring in conjugate pairs, Relation between roots and coefficients of a polynomial equation, Symmetric functions, Transformation, Reciprocal equations, Descartes' rule of signs, Multiple roots, Solving cubic equations by Cardon's method, Solving quartic equations by Descarte's Method. **14 Hours**

Unit-III: Polar Co-ordinates: Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- centre of curvature, circle of curvature. **14 Hours**

Reference Books:

1. University Algebra - N.S. Gopala Krishnan, New Age International (P) Limited.
2. Algebra – Natarajan, Manicavasagam Pillay and Ganapathy.
3. Theory of Matrices - B S Vatsa, New Age International Publishers.
4. Matrices – A. R. Vasista, Krishna Prakashana Mandir.
5. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
6. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
7. Calculus – Lipman Bers, Holt, Rinehart & Winston.
8. Calculus – S. Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd.,vol.I & II
9. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw.
10. Shanthinarayan – Integral Calculus, New Delhi: S. Chand and Co. Pvt. Ltd.
11. Shanthinarayan and P K Mittal, Integral Calculus, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.

SEMESTER – II

Algebra – II {Number Theory) and Calculus – II	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100** **(S.A.-60 + I.A. – 40)**
Course Code	**FSB43032 / FSB43034**

Course Learning Outcomes: This course will enable the students to

- Learn the concept of Divisibility.
- Learn about prime and composite numbers.
- Learn the concept of congruences and its applications.
- Identify and apply the intermediate value theorems and L'Hospital rule.
- Understand the concept of differentiation and fundamental theorems in differentiation and various rules.
- Find the extreme values of functions of two variables.
- Students learn to find areas and volumes using integration.

Unit-I: Number Theory: Division Algorithm, Divisibility, Prime and composite numbers, Euclidean algorithm, Fundamental theorem of Arithmetic, The greatest common divisor and least common multiple. Congruences, Linear congruences, Simultaneous congruences, Euler's Phi-function, Wilson's, Euler's and Fermat's Theorems and their applications. **14 Hours**

Unit-II: Differential Calculus-I: Limits, Continuity, Differentiability and properties. Properties of continuous functions. Intermediate value theorem, Rolle's Theorem, Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem, Maclaurin's series, Indeterminate forms and evaluation of limits using L'Hospital rule. **14 Hours**

Unit-III: Partial Derivatives: Functions of two or more variables-explicit and implicit functions, partial derivatives. Homogeneous functions- Euler's theorem and extension of Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables. **14 Hours**

Unit-IV: Integral Calculus-II: Line integral: Definition of line integral and basic properties, examples on evaluation of line integrals. Double integrals: 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 using double integrals. Triple integrals: Definition of triple integrals and evaluation- change of variables, volume as triple integral.

14 Hours

Reference Books:

1. Differential Calculus, Shantinarayan, S. Chand & Company, New Delhi.
2. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
3. Calculus – Lipman Bers, Holt, Rinehart & Winston.
4. Calculus - Shanthinarayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II.
5. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill, 2008.
6. Integral Calculus, Shanthinarayan, New Delhi: S. Chand and Co. Pvt. Ltd.
7. Integral Calculus, Shantinarayan and P K Mittal, S. Chand and Co. Pvt. Ltd.
8. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.
9. David M Burton, Elementary Number Theory, 6th edition, McCraw Hill, 2007.
10. Emil Grosswald, Topics from the Theory of Numbers, Modern Birhauser, 1984.
11. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery, An Introduction to the Theory of Numbers, John Willey (New York), 1991

Algebra – II (Number Theory) and Calculus – II practical	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. –25)**
Course Code	**FSB43332 / FSB43334**

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open Source Software (FOSS) tools for computer programming
- Solve problem on algebra and calculus 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 / Phython / R.

1. Programs related to Number Theory.
2. Program to verify Mean value theorems.
3. Program for finding the Taylor's and Maclaurin's expansions of the given functions.
4. Program to verify the Euler's theorem and its extension.
5. Programs to construct series using Maclaurin's expansion for functions of two variables.
6. Program to evaluate the line integrals with constant and variable limits.
7. Program to evaluate the Double integrals with constant and variable limits.
8. Program to evaluate the Triple integrals with constant and variable limits.

Open Elective
(For Students of all Streams)

Mathematical Aptitude-II	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSB840**

Course Learning Outcomes: This course will enable the students to

- have a strong base in the fundamental mathematical concepts.
- grasp the approaches and strategies to solve problems with speed and accuracy
- gain appropriate skills to succeed in preliminary selection process for recruitment

Unit-I: Percentage, Average, Problems based on Ages, Ratio and Proportion, Partnership and share, Mixtures. **14 Hours**

Unit-II: Profit, Loss and Discount, Simple Interest, Compound Interest, Shares and Debentures.

14 Hours

Unit-III: Permutations and Combinations, Probability, True discount and Banker's discount.

14 Hours

Reference Books:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan, Pratogitaprakasan, Kic X, Kiran Prakasan publishers.
4. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill publications.

Open Elective
(For Students of all streams)

Business Mathematics-II	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSB850**

Course Learning Outcomes: This course will enable the students to

- Integrate concept in international business concept with functioning of global trade.
- Evaluate the legal, social and economic environment of business.
- Apply decision-support tools to business decision making.
- Will be able to apply knowledge of business concepts and functions in an integrated manner.

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

Unit - II: Measures of central Tendency and Dispersion: Frequency distribution: Raw data, attributes and variables, Classification of data, frequency distribution, cumulative frequency distribution, Histogram and give curves. Requisites of ideal measures of central tendency, Arithmetic Mean, Median and Mode for ungrouped and grouped data. Combined mean, Merits and demerits of measures of central tendency, Geometric mean: definition, merits and demerits, Harmonic mean: definition, merits and demerits, Choice of A.M., G.M.and H.M. Concept of dispersion, Measures of dispersion: Range, Variance, Standard deviation (SD) for grouped and ungrouped data, combined SD, Measures of relative dispersion: Coefficient of range, coefficient of variation. Examples and problems. **14 Hours**

Unit - III: Correlation and regression: Concept and types of correlation, Scatter diagram, Interpretation with respect to magnitude and direction of relationship. Karl Pearson's coefficient of correlation for ungrouped data. Spearman's rank correlation coefficient. (with tie and without tie) Concept of regression, Lines of regression for ungrouped data, predictions using lines of regression. Regression coefficients and their properties (without proof). Examples and problems.

14 Hours

Reference Books:

1. Practical Business Mathematics, S. A. Bari New Literature Publishing Company New Delhi
2. Mathematics for Commerce, K. Selvakumar Notion Press Chennai
3. Business Mathematics with Applications, Dinesh Khattar & S. R. Arora S. Chand Publishing New Delhi
4. Business Mathematics and Statistics, N.G. Das &Dr. J.K. Das McGraw Hill New Delhi
5. Fundamentals of Business Mathematics, M. K. Bhowal, Asian Books Pvt. Ltd New Delhi
6. Mathematics for Economics and Finance: Methods and Modelling, Martin Anthony and Norman, Biggs Cambridge University Press Cambridge
7. Financial Mathematics and its Applications, Ahmad Nazri Wahidudin Ventus Publishing APS Denmark
8. Fundamentals of Mathematical Statistics, Gupta S. C. and Kapoor V. K.:, Sultan Chand and Sons, New Delhi.
9. Statistical Methods, Gupta S. P.: Sultan Chand and Sons, New Delhi.
10. Applied Statistics, Mukhopadhya Parimal New Central Book Agency Pvt. Ltd. Calcutta.
11. Fundamentals of Statistics, Goon A. M., Gupta, M. K. and Dasgupta, B. World Press Calcutta.
12. Fundamentals of Applied Statistics, Gupta S. C. and Kapoor V. K.:, Sultan Chand and Sons, New Delhi.

Open Elective

Optional Mathematics – II	
Teaching Hours : 3 Hours/Week	**Credits:3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSB860**

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

Course Learning Outcomes: This course will enable the students to

- Learn the concept of Divisibility.
- Learn about prime and composite numbers.
- Learn the concept of congruence's and its applications.
- 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-I: Number Theory: Division Algorithm, Divisibility, Prime and composite numbers, Euclidean algorithm, Fundamental theorem of Arithmetic, The greatest common divisor and least common multiple. Congruences, Linear congruences, Simultaneous congruences, Euler's Phi-function, Wilson's, Euler's and Fermat's Theorems and their applications.

14 Hours

Unit-II: Partial Derivatives: Functions of two or more variables-explicit and implicit functions, partial derivatives. Homogeneous functions- Euler's theorem and extension of Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables. **14 Hours**

Unit-III: Integral Calculus: 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, Triple integral: Definition of triple integrals and evaluation-change of variables, volume as triple integral. **14 Hours**

Reference Books:

1. Differential Calculus, Shanti Narayan, S. Chand & Company, New Delhi.
2. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
3. Calculus – Lipman Bers, Holt, Rinehart & Winston.
4. Calculus - Shanthinarayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II.
5. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill, 2008.
6. Integral Calculus, Shanthinarayan, S. Chand and Co. Pvt. Ltd.
7. Integral Calculus, Shantinarayan and P K Mittal, S. Chand and Co. Pvt. Ltd.
8. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.
9. David M Burton, Elementary Number Theory, 6th edition, McCraw Hill, 2007.
10. Emil Grosswald, Topics from the Theory of Numbers, Modern Birhauser, 1984.
11. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery, An Introduction to the Theory of Numbers, John Willey (New York), 1991.

SEMESTER – III

Algebra - III and Differential Equations – I	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100** **(S.A.-60 + I.A. – 40)**
Course Code	**FSC43032 / FSC43034**

Course Learning Outcomes: This course will enable the students to

- enhance learning in Algebra and Differential Equations.
- apply the concepts of algebra in practical problems.
- solve various differential equations of practical interest.

UNIT I: Group Theory – I

Definition and examples of groups – Some general properties of Groups, Subgroups, Group of permutations – Cyclic permutations – Even and odd permutations. Order of an element of a group – Cyclic groups problems and theorems. **14 Hours**

UNIT II: Group Theory – II

Cosets, Index of a group, Lagrange's theorem, consequences, Normal Subgroups, Quotient groups – Homomorphism. – Kernel of homomorphism – Isomorphism – Automorphism – Fundamental theorem of homomorphism, Cayley's theorem. **14 Hours**

UNIT III: Differential Equations – I

Recapitulation of Definition, examples of differential equations, Formation of differential equations by elimination of arbitrary constants, Differential equations of first order – Separation of variables, Reducible to separation of variables, Homogeneous differential equations, Reducible to homogeneous, Exact differential equations, Reducible to exact, Integrating factors found by inspection and the determination of integrating factors, Linear differential equations, Bernoulli's differential equations. **14 Hours**

UNIT IV: Differential Equations – II

Equations of First order and higher degree – Solvable for p, Solvable for x, Solvable y, Clairaut's equations – Singular and General solutions. Ordinary Linear differential equations with constant coefficients – Complementary function – particular integral – Inverse differential operators. Simultaneous differential equations (two variables with constant coefficients)

14 Hours

Books for References:

1. Daniel A Murray – Introductory Course to Differential equations
2. Earl David Rainville and Philip Edward Bedient – A short course in Differential equations, Prentice Hall College Div; 6th edition.
3. I N Herstien – Topics in Algebra.
4. Joseph Gallian – Contemporary Abstract Algebra, Narosa Publishing House, New Delhi, Fourth Edition.
5. G. D. Birkhoff and S Maclane – A brief Survey of Modern Algebra.
6. J B Fraleigh – A first course in Abstract Algebra.
7. Michael Artin – Algebra, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
8. Vashista, A First Course in Modern Algebra, 11th ed.: Krishna Prakasan Mandir, 1980.
9. R Balakrishan and N.Ramabadran, A Textbook of Modern Algebra, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
10. M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd., 2013.
11. F Ayres, Schaum's outline of theory and problems of Differential Equations, 1st ed. USA McGraw-Hill, 2010.
12. S Narayanan and T K Manicavachogam Pillay, Differential Equations .: S V Publishers Private Ltd., 1981.
13. E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt. Ltd.
14. G F Simmons, Differential equation with Applications and historical notes, 2nd ed.: McGraw- Hill Publishing Company, Oct 1991.

Algebra - III and Differential Equations – I Practical	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. – 25)**
Course Code	**FSC43332 / FSC43334**

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open Source Software (FOSS) tools for computer programming
- Solve problem on algebra and differential equations studied in FSC43032/FSC43034 by using FOSS software's.
- Acquire knowledge of applications of algebra and differential equations through FOSS

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's: Maxima/Scilab /Python/R.

Introduction to the software and commands related to the topic.

1. Generate Cayley's table.
2. Verifying whether given operator is binary or not.
3. Finding identity and inverse elements of a group.
4. Finding left and right cosets of a group.
5. Solving Differential equation using Maxima and plotting the solution.

Open Elective
(For Students of all Streams)

Mathematical Aptitude-III	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSC840**

Course Learning Outcomes: This course will enable the students to

- have a strong base in the fundamental mathematical concepts.
- grasp the approaches and strategies to solve problems with speed and accuracy
- gain appropriate skills to succeed in preliminary selection process for recruitment

Unit I: Algebraic Expressions, Polynomials, Fundamental operations on Algebraic expressions, Factorisation, Linear equations and problems based on Ages, Quadratic equations. **14 Hours**

Unit II: Mensuration, Area, Volume and Surface area (Cylinder, Cone, Sphere). **14 Hours**

Unit III: Verbal Reasoning Direction Test, Relation Test, Venn Diagram Analysis Test, Seating puzzles. **14 Hours**

Reference Books:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan, Pratogita prakasan, Kic X, Kiran Prakasan publishers.
4. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill Publications

Open Elective Course
(For Students of all Streams)

Discrete Mathematics	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSC850**

Course Learning Outcomes: This course will enable the students to

- know the concept of set theory.
- know graph theory which helps in decision making in various capacities in organization.
- Enhance the knowledge towards Electronics and computer science.

Unit I: Basics of Set Theory

Sets-Subsets – Notation -Inclusion and Equality of sets-The power set, Operation on sets - Venn diagram - Set identities - Ordered pairs and Cartesian products.

Relations and ordering – Properties of binary relation in a set, Relation matrix and Graph of a relation - Equivalence relations - Compatibility relations - composition of Binary relation.

14 Hours

Unit II: Graph Theory

Basic definitions - Paths and Connectedness - Matrix representation of Graphs - Trees.

14 Hours

Unit III: Mathematical Logic

Statements and Notation – Connectives – Negation – Conjunction – Disjunction - Statement formulas and Truth tables - Conditional and Bi-conditional – Tautologies - Equivalence of formulas –Tautological Implications. **14 Hours**

References:

1) Discrete Mathematical Stuctures with Application to computer science by J. P. Tremblay, R. Manohar 3rd Edition – Tata McGraw Hill.

2) Discrete Mathematical Structures by B. Kolman, R. C. Busby and S. Rose, 3rd edition.

3) Introduction to discrete mathematics by C. L. Liu, McGraw Hill, 2nd edition, 1985.

4) Discrete Mathematics by S. A. Witala, McGraw Hill, 1987.

SEMESTER – IV

Real Analysis – I and Differential Equations – II	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**
Course Code	**FSD43032 / FSD43034**

Course Learning Outcomes: This course will enable the students to

- enhance learning in Analysis and Differential Equations.
- apply the concepts of analysis in practical problems.
- solve various differential equations of practical interest.

UNIT I: Sequences

Sequence of real numbers – Bounded and unbounded sequences – Infimum and supremum of a sequence – Limit of a sequence – Sum, product and quotient of limits – Standard theorems on limits – Convergent , divergent and oscillatory sequences – Discuss the convergence of $\{x^n\}$,$\left\{n^{1/n}\right\}$ or $\left\{\sqrt[n]{n}\right\}$, $\left\{(1+\frac{1}{n})^n\right\}$ and standard problems – Monotonic sequences and their properties – Cauchy's general principle of convergence. **14 Hours**

UNIT II: Infinite Series

Infinite series of real numbers – Convergence and Divergence - Oscillation of series – Properties of convergence – Series of positive terms – Geometric series – p – series – Comparison tests – D'Alembert's ratio test – Raabe's test – Cauchy's root test – Leibnitz's test for alternating series.

14 Hours

UNIT III: Linear differential equations

Cauchy – Euler differential equations, Solution of ordinary second order linear differential equations with variable coefficients by various methods such as:

(i) When a part of complementary function is given.

(ii) Changing the independent variable.

(iii) Changing the dependent variable.

(iv) By method of variation of parameters.

(v) Exact method.

Total differential equations - Necessary and sufficient condition for the equation Pdx + Qdy + Rdz = 0 to be exact (proof only for the necessary part) – Simultaneous equations of the form dx/P=dy/Q=dz/R . **14 Hours**

UNIT IV: Partial differential equations

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 – Charpit's method – Homogenous linear equations with constant coefficient – Rules for finding the complementary function – Rules for finding the particular integral, Method of separation of variables (product method).

14 Hours

Books for References:

1. G. Stephonson – An introduction to Partial Differential Equations.
2. B. S. Grewal – Higher Engineering Mathematics
3. E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt. Ltd.
4. E D Reinville and P E Bedient – A Short Course in Differential Equations
5. D A Murray – Introductory Course in Differential Equations.
6. G P Simmons – Differential Equations
7. F. Ayres – Differential Equations (Schaum Series)
8. Martin Brown – Application of Differential Equations.
9. M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd., 2013.
10. S C Malik –Real Analysis
11. Leadership project – Bombay university- Text book of mathematical analysis
12. S S Bali – Real analysis.
13. Richard R Goldberg, Methods of Real Analysis, Indian ed.

Number Theory and Calculus – II Practical	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. – 25)**
Course Code	**FSD43332 / FSD43334**

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open Source Software (FOSS) tools for computer programming
- Solve problem on real analysis and differential equations by using FOSS software's.
- Acquire knowledge of applications of real analysis and differential equations through FOSS

Practical/Lab Work to be performed in Computer Lab Suggested Software's: Maxima/Scilab//Python/R.

1. Test for convergence, divergence and oscillation sequences.
2. Test for convergence, divergence and oscillation series.
3. Test the convergence of the series using D'Alembert's ratio test and Raabe's test.
4. Programs on Linear differential equations with variable coefficients.
5. Programs on Partial differential equations.

Open Elective
(For Students of all Streams)

Mathematical Aptitude – IV	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSD840**

Course Learning Outcomes: This course will enable the students to

- have a strong base in the fundamental mathematical concepts.
- grasp the approaches and strategies to solve problems with speed and accuracy
- gain appropriate skills to succeed in preliminary selection process for recruitment

Unit I: Data interpretation, Data sufficiency. **14 Hours**

Unit II: Surds & Indices, Logarithm and its properties. **14 Hours**

Unit III: Non-verbal Reasoning Series Test, Analogy, Classification, Cube and Dice, Analytical Reasoning. **14 Hours**

Reference Books:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan, Pratogita prakasan, Kic X, Kiran Prakasan publishers.
4. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill publications.

Open Elective

(For Students of all Streams)

Basics of Number Theory	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSD850**

Course Learning Outcomes: This course will enable the students to

- Know the expansion of sum of two numbers with positive integral powers.
- General method of proving the statement.
- Learn the concept of Divisibility.
- Learn about prime and composite numbers.
- Learn the concept of congruences and its applications.

Unit I:

Binomial Theorem, Mathematical Induction. **14 Hours**

Unit II: Number System

Test for Divisibility, Number of divisors and Sum of divisors of a number, Greatest Common Divisor (GCD), Least Common Multiplie (LCM), Relation between GCD and LCM, Representation of a GCD as a linear combination of given two numbers. **14 Hours**

Unit III: Congruence

Basic properties of congruence, Binary and Decimal representations of integers, Linear Congruences and the Chinese Remainder Theorem. **14 Hours**

References:

1. An Introduction to the Theory of Numbers by Ivan Niven, Herbert S. Zuckerman, Hugh L. Montgomery.
2. Elementary Number Theory by David M. Burton.

SEMESTE-V

Real Analysis-II and Complex Analysis	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60Hours	**Max. Marks: 100 (S.A.-60+I.A.–40)**
Course Code	**FSE43032 / FSE43034**

Course Learning Outcomes:

The overall expectation from this course is that the student builds a basic understanding on Riemann integration and elementary complex analysis. The broader course outcomes are listed as follow. At the end of this course, the student will be able to:

1. Carry out certain computations such as computing upper and lower Riemann sums as well integrals.
2. Describe various criteria for Integrability of functions.
3. Exhibit certain properties of mathematical objects such as integrable functions, analytic functions, harmonic functions and so on.
4. Prove some statements related to Riemann integration as well as in complex analysis.
5. Carry out the existing algorithms to construct mathematical structures such as analytic functions.
6. Applies the gained knowledge to solve various other problems.

Unit–I: Riemann Integration-I

Definition & examples for partition of an interval, Refinement and Common refinement of a partition. Lower and Upper Riemann (Darboux) sums – definition, properties & problems.Riemann Integral– Lower and Upper integrals (definition & problems), Darboux's theorem and Criterion for Integrability, Integrability of sum, difference, product, quotient and modulus of integrable functions. Integral as a limit of sum (Riemannsum) –Problems. Some integrable functions –Integrability of continuous functions, monotonic functions, bounded function with finite number of discontinuity. Fundamental theorem of Calculus–related problems, change of variables, integration by parts, first and second mean value theorems of integral calculus. **15 Hours**

Unit–II: Complex number

Cartesian and Polar form (Definitions, properties and problems)- Geometrical representation of complex plane (z-plane); Euler's formula, $e^{i\theta}$ = cosθ + isinθ .Separate the real and imaginary parts of some standard functions (e^z, ,sinz, cosz, logz etc). Dot and vector product of z1 and z2 . Equation of a straight line and circle in a complex form and represent graphically (locus of a point). Functions of a complex variable - Limit of a function, Continuity and differentiability, Analytic functions, Singular points (definitions and related problems); Cauchy-Riemann equations – Cartesian and Polar forms – Proof & Problems, Necessary and sufficient condition for a function to be analytic (Statement only); Harmonic functions– Definition and problems; Properties of analytic functions - Various properties withproofs; Construction of analytic functions: i)Milne Thomson Method (Only problems) ii)Using the concept of harmonic function.

15 Hours

Unit–III: Complex integration

Complex integration– definition, Line integral, properties and problems. Cauchy's Integral theorem- proof using Green's theorem- direct consequences. Cauchy's Integral formula with proof-Cauchy's generalized formula for the derivatives with proof and applications for evaluation of simple line integrals. Cauchy's inequality- Proof, Livouville's theorem- Proof.

15 Hours

Unit-IV: Transformations

Definition, Jacobian of a transformation- Identity transformation- Reflection- Translation- Rotation and Magnification- Inversion- Inverse points- Linear transformation- Definitions- Bilinear transformations- Cross- ratio of four points- Cross-ratio preserving property- Preservation of the family of straight lines and circles- Conformal mappings- Discussion of the transformations

w = z^2 , w= sin z, w= cos z, w= e^z, w = $\frac{1}{2}\left(z+\frac{1}{z}\right)$ etc.

15 Hours

Reference Books:

1. Ajit Kumr and S. Kumaresan - A Basic Course in Real Analysis,Taylor and Francis Group.
2. Bruce P.Palka, Introduction to the Theory of Function of a Complex Variable, Springer
3. L.V.Ahlfors, Complex Analysis, 3rdEdition, Mc Graw Hill Education
4. Richard R Goldberg, Methods of Real Analysis, Oxford and IBH Publishing
5. R.V.Churchil & J.W.Brown, Complex Variables and Applications, 5th ed, Mc Graw Hill Companies.
6. Shanthinarayan, Theory of Functions of a Complex Variable, S. Chand Publishers.
7. Serge Lang, Complex Analysis, Springer
8. S.C.Malik and Savita Arora, Mathematical Analysis, 5thed.NewDelhi, India: New Age international(P)Ltd., 2017.
9. S.C.Malik, Principles of Real Analysis, New Age International (India) Pvt.Ltd., 4thEdition, 2018.
10. S.Ponnuswamy, Foundations of Complex Analysis, 2ndEdition, Alpha Science International Limited.

Real Analysis-II and Complex Analysis Practical	
Teaching Hours: 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 60Hours	**Max. Marks: 50 (S.A.-25+I.A.–25)**
Course Code	**FSE431P32 / FSE431P34**

Course Learning Outcomes: This course will enable the students to

1. Learn Free and Open Source Software(FOSS) tools for computer programming.
2. Solve problem on Real Analysis and Complex Analysis studied in **FSE431P32/FSE431P34** by using FOSS software's.
3. Acquire knowledge of applications of Real Analysis and Complex Analysis through FOSS.

Practical/LabWork to be performed in Computer Lab (FOSS) Suggested Software's: Maxima/Scilab/Python/R.

Suggested Programs:

1. Program to check whether a given set of real numbers attains supremum or infimum.
2. Program to find upper and lower Riemann sums with respect to given partition.
3. Program to test Riemann Integrability.
4. Program to evaluate Riemann integral as a limit of sum.
5. Program on verification of Cauchy –Riemann equations (Cartesian form) or test for analyticity.
6. Program on verification of Cauchy –Riemann equations (Polar form) or test for analyticity.
7. Program to check whether a function is harmonic or not.
8. Program to construct analytic functions (through Milne–Thompson method)
9. Program to find Cross ratio of points and related aspects.
10. Program to find fixed points of bilinear transformations.
11. Program to verify De-Moivre's theorem.

Advanced Algebra and Discrete Mathematics	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60+I.A.–40)**
Course Code	**FSE43232 / FSE43234**

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

1. Identify and analyze different algebraic structures such as rings, fields, domains and so on.
2. Explore the properties of the above mentioned algebraic structures.
3. Carry out the prescribed algorithm to compute the GCD of polynomials, irreducibility of polynomials and so on.
4. Prove various statements related to algebraic structures.
5. Apply the gained knowledge to solve various other problems.

Unit I : Rings and Fields

Rings – definition and properties of rings- integral domains- Fields-theorems and problems, Sub rings- Criterion for sub rings- theorems and problems on sub rings, Ideals –Algebra of Ideals-theorems- Principal ideals - examples and standard properties following the definition, Divisibility in an integral domain-theorems and problems, Units and Associates- theorems and problems. Quotient rings– examples and theorems- The field of quotients- theorems and problems.

15 Hours

Unit II : Polynomial rings and Homomorphism

Homomorphism- Definitions and example, Kernel of a homomorphism- examples and related theorems. Isomorphism of a ring- examples and related theorems. Automorphism- problems. Fundamental Theorem of Homomorphism of Rings, Prime and Maximal idealsin a commutative ring – definition and examples. Polynomials over rings and fields (some standard properties), division algorithm (proof and problems), Greatest common divisor – Euclidian algorithm (problems); reducible and irreducible polynomials over fields (definition and problems); Eisenstein's criteria for reducibility – problems; Rational roots of a polynomial – Test - problems;

15 Hours

Unit III: Vector algebra

Vectors – Scalars – Vector Field – Scalar field (definition and problems); – Vector differentiation – The vector differential operator Gradient – Divergence – Curl – Standard derivations –vector integration Green's theorem in plane (definition and problems). **15 Hours**

Unit IV: Basics of Graph theory

Basic definitions, Isomorphism, Subgraphs, Operations on graphs, Walks, Paths, Circuits, Connected and disconnected graphs, Euler graphs, Hamiltonian graphs, Some applications, Trees - basic properties, Distance, Eccentricity, center, Spanning trees, Minimal spanning tree.

15 Hours

Reference Books

1. C.L. Liu (200), Elements of Discrete Mathematics,Tata McGraw-Hill.
2. Frank Harary(1969), GraphTheory, Addison-Wesley Pub.Company.
3. Hari Kishan and Shiv Raj Pundir (2015), Discrete Mathematics, Pragathi Prakashan, 10thed.
4. I N Herstein (1990), Topics in Algebra, 2nd Edition,Wiley Eastern Ltd., New Delhi.
5. Joseph A, Gallian (2021), Contemporary Abstract Algebra, 10thed., Taylor and Francis Group.
6. Kenneth H.Rossen, Discrete Mathematics and its Applications, Mc-GrawHill, 8th ed., 2021.
7. Michael Artin (2015), Algebra, 2nded., Pearson.
8. Murray R Spiegel – Theory and problems of vector calculus.
9. N. Deo(1990), Graph Theory: Prentice, Hall of India Pvt.Ltd. New Delhi.
10. Shanthinarayan and J N Kapur – A text book of Vector calculus.
11. Vijay K Khanna and SK Bhambri (1998), A Course in Abstract Algebra,Vikas Publications.
12. W D Wallis (2017), A Beginner's Guide to Discrete Mathematics for Computer Science,Wiley Publishers.

Advanced Algebra and Discrete Mathematics Practical	
Teaching Hours: 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 60 Hours	**Max. Marks: 50** **(S.A.-25+I.A.–25)**
Course Code	**FSE433P32 / FSE433P34**

Course Learning Outcomes: This course will enable the students to

1. Learn Free and Open Source Software(FOSS) tools for computer programming.
2. Solve problem on Advanced Algebra and Discrete Mathematics studied in **FSE433P32/FSE433P34** by using FOSS software's.
3. Acquire knowledge of applications of Advanced Algebra and Discrete Mathematics through FOSS.

Practical/LabWork to be performed in Computer Lab (FOSS) Suggested Software's: Maxima/Scilab/Python/R.

Suggested Programs:

1. (i) To Verify the given Ring is Commutative or not.

   (ii) To check the Presence of the Unity element in the Ring.
2. (i) To Verify the given Ring is a Field /Integral Domain or not.

   (ii) To Verify given set is a Sub ring of a Ring or not.
3. To Verify given function is a homomorphism or not.
4. (i) To verify the given polynomial is reducible or irreducible.

   (ii) To find the zeros of the given polynomial.
5. To find the G.C.D of any two polynomials.

6. (i) To find the Units of the given ring.

   (ii) To verify the given elements are Associates or not.

7. Graph Theory

8. Maxima program to obtain some standard graphs

9. Create a graph of your choice

10. Obtain Induced sub graph

11. Obtain random graph

12. To check the given are graphs are isomorphic or not

13. Obtain degree of each vertex

14. Obtain distance between vertices

15. Obtain eccentricity of vertices

16. Operation on graphs: Product of graphs

17. Maximum/Minimum degree vertices of the graph G and a vertex of maximum/minimum degree

18. Obtain radius and diameter of the graph

19. Obtain Edge connectivity and Vertex connectivity

20. Obtain minimum spanning tree

21. Obtain Adjacency matrix of the graph

SEMESTE-VI

Linear Algebra	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60Hours	**Max. Marks: 100 (S.A.-60+I.A.–40)**
Course Code	**FSF43032 / FSF43034**

Course Learning Outcomes:

The overall expectation from this course is that the student will build a basic understanding in few areas of linear algebra such as vector spaces, linear transformations and inner product spaces. Some broader course outcomes are listed as follows. At the end of this course, the student will be able to

1. Understand the concepts of Vector spaces, subspaces, bases dimension and their properties.
2. Become familiar with the concepts Eigen values and Eigen vectors, minimal polynomials, linear transformations etc.
3. Learn properties of inner product spaces and determine orthogonality in inner product spaces.
4. Prove various statements in the context of vector spaces.
5. Realize importance of adjoint of a linear transformation and its canonical form.

Unit–I:Vector spaces

Vector spaces - Definition, examples and properties; Subspaces - Examples, criterion for a subspace and some properties; Linear Combination - Linear span, Linear dependence and Linear independence, basic properties of linear dependence and independence, techniques of determining linear dependence and independence in various vector spaces and related problems; Basis and dimension - Co-ordinates, ordered basis, some basic properties of basis and dimension and subspaces panned by given set of vectors; Quotient space- theorems and examples.

15 Hours

Unit–II:Linear Transformations

Linear transformation - Definition, examples, equivalent criteria, some basic properties and matrix representation, change of basis and effect on associated matrix, similar matrices; Rank - Nullity theorem -Null space, Range space, proof of rank nullity theorem and related problems. **15 Hours**

Unit–III: Isomorphism, Eigen values and Diagonalization

Homomorphism, Isomorphism and automorphism-Examples, order of automorphism and Fundamental theorem of homomorphism; Eigen values and Eigen vectors-Computation of Eigen values, algebraic multiplicity, some basic properties of eigen values, determination of eigen vectors and eigen space and geometric multiplicity. Diagonalizability of linear transformation - Meaning, condition based on algebraic and geometric multiplicity (mentioning) and related problems (Only verification of diagonalizability). **15 Hours**

Unit–IV:Invertible Transformation and Inner product spaces

Invertible transformation - some basic properties of Invertible, singular and non-singular transformations and conditions for existence of inverses; Minimal polynomial of a transformation. Relation between characteristic and minimal polynomials and related problems.Inner product and normed linear spaces- Definitions, examples, Cauchy-Schwartz inequality (withproof) and related problems; Gram-Schmidt orthogonalization- Orthogonalvectors, orthonormal basis, Gram-Schmidt orthogonalization process: both proof and problems. **15 Hours**

Reference Books:

1. F.M.Stewart, Introduction to Linear Algebra, Dover Publications.
2. Gilbert.Strang (2015), Linear Algebra and its applications, (2ndEdition), Elsevier.
3. I. N. Herstein, Topics in Algebra, 2nd Edition,Wiley.
4. Kenneth Hoffman & Ray Kunze (2015), Linear Algebra, (2ndEdition), Prentice Hall India Leaning Private Limited.
5. Serge Lang (2005), Introduction to Linear Algebra (2ndEdition), SpringerIndia.
6. S.Kumaresan, Linear Algebra, Prentice Hall India Learning Private Limited.
7. Stephen H. Friedberg, ArnoldJ.Insel & Lawrence E.Spence (2003), Linear Algebra (4thEdition), Printice-Hall of India Pvt.Ltd.
8. T.K.Manicavasagam Pillai and K S Narayanan, Modern Algebra Volume2.
9. VivekSahai &VikasBist (2013), Linear Algebra (2ndEdition) Narosa Publishing.

Linear Algebra Practical	
Teaching Hours: 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 60 Hours	**Max. Marks: 50 (S.A.-25+I.A.–25)**
Course Code	**FSF431P32 / FSF431P34**

Course Learning Outcomes: This course will enable the students to

1. Learn Free and Open Source Software (FOSS) tools for computer programming
2. Solve problem on Linear Algebra studied in **FSF431P32/FSF431P34** by using FOSS software's.
3. Acquire knowledge of applications of Linear Algebra through FOSS. Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's: Maxima/Scilab/Python/R.

Suggested Programs:

a. Program on linear combination of vectors.

b. Program to verify linear dependence and independence.

c. Program to find basis and dimension of the subspaces.

d. Program to verify the function is linear transformation or not.

e. Program to find the matrix of linear transformation.

f. Program to find the Eigen values and Eigen vectors of a given linear transformation.

g. Program on Rank–nullity theorem.

h. Program to verify if the given linear transformation is singular/non-singular.

i. Program to find the minimal polynomial of given transformation.

j. Program to find the algebraic multiplicity of the Eigen values of the given linear transformation.

k. Program on diagonalization

Numerical Analysis	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60+I.A.–40)**
Course Code	**FSF43232 / FSF43234**

Course Learning Outcomes:

The overall expectation from this course is that the student will get equipped with certain numerical techniques for various computations such as finding roots, finding the integrals and derivatives, and finding solutions to differential equations. Some broader course outcomes are listed as follows. At the end of this course, the student will be able to

i. Describe various operators arising in numerical analysis such as difference operators, shift operators and so on.

ii. Articulate the rationale behind various techniques of numerical analysis such as in finding roots, integrals and derivatives.

iii. Reproduce the existing algorithms for various tasks as mentioned previously in numerical analysis.

iv. Apply the rules of calculus and other areas of mathematics in justifying the techniques of numerical analysis.

v. Solve problems using suitable numerical technique.

vi. Appreciate the profound applicability of techniques of numerical analysis in solving real life problems and also appreciate the way the techniques are modified to improve the accuracy.

Unit–I: Algebraic and Transcendental Equations

Errors- Significant digits, absolute, relative, percentage errors, rounding off and truncation errors (meanings and related problems), general error formula (derivation of formula and problems based on it), error in series approximation: Taylor series approximations (problems only), Solutions to algebraic and transcendental equations - Bisection method, Regula-Falsi method, iterative method Newton-Raphson method and secant method (Plain discussion of the rationale behind techniques and problems on their applications). **15 Hours**

Unit–II: System of LinearAlgebraicEquations

Direct Methods– Gauss elimination method, Gauss-Jordan elimination method and Tringularization method; Iterative methods – Jacobi method, Gauss-Jacobi method, Gauss- Seidal method,Successive- Over Relaxation method(SOR) method. **15 Hours**

Unit–III:Polynomial Interpolations

Finite differences. Forward, backward and central differences and shift operators: definitions, properties and problems; Polynomial interpolation - Newton-Gregory forward and backward interpolation formulas, Gauss's Forward and backward interpolation formulas, Lagrange interpolation polynomial, Newton's divided differences and Newton's general interpolation formula (Discussion on setting up the polynomials, differences between them and problems on their applications). **15 Hours**

Unit-IV:Numerical Differentiation and Integration

Formula for derivatives (till second order) based on Newton-Gregory forward and backward interpolations (Derivations and problems based on them). Numerical Integration- General quadrature formula, Trapezoidal rule, Simpson's1/3rule, Simpson's 3/8 rule and Weddell's rule (derivations for only general quadrature formula, trapezoidal rule and Simpson's 1/3rd rule and problems on the applications of all formulas). **15 Hours**

Reference Books:

1. E.Isaacson and H.B.Keller, Analysis of Numerical methods, Dover Publications.
2. S.S. Sastry, Introductory methods of Numerical Analysis, 5thEdition, PHI Learning Private Limited.
3. E Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt.Limited
4. B.S. Grewal, Numerical Methods for Scientists and Engineers, Khanna Publishers.
5. M.K.Jain, S.R.K. Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering computation, 4thEdition, New Age International
6. H.C.Saxena, Finite Difference and Numerical Analysis, S.Chand Publishers
7. B.D.Gupta, Numerical Analysis, Konark Publishers Pvt.Ltd.

Numerical Analysis Practical	
Teaching Hours: 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 60 Hours	**Max. Marks: 50 (S.A.-25+I.A.–25)**
Course Code	**FSF433P32 / FSF433P34**

Course Learning Outcomes: This course will enable the students to

1. Learn Free and Open Source Software(FOSS) tools for computer programming.
2. Solve problem on numerical Analysi studied in **FSF433P32/FSF433P34** by using FOSS software's.
3. Acquire knowledge of applications of Numerical Analysis through FOSS. **Practical/Lab Work to be performed in Computer Lab(FOSS) Suggested Software's: Maxima/Scilab/Python/R.**

Suggested Programs:

1. Program to find root of an equation using bisection and Regula-Falsi methods.
2. Program to find root of an equation using Newton-Raphson and Secant methods.
3. Program to solve system of algebraic equations using Gauss-elimination method.
4. Program to solve system of algebraic equations using Gauss-Jordan method.
5. Program to solve system of algebraic equation using Gauss-Jacobi method.
6. Program to solve system of algebraic equation using Gauss-Seidel method.
7. Program to solve the system of algebraic equations using SOR method
8. Program to evaluate integral using Simpson's 1/3 and 3/8 rules.
9. Program to evaluate integral using Trapezoidal and Weddle rules.
10. Program to find the sums of powers of successive natural numbers using Newton–Gregory technique.
11. Program to find differentiation at specified point using Newton-Gregory interpolation method.
12. Program to find the missing value of table using Lagrange method.

Question Paper Pattern

(For Discipline Course Papers)

MATHEMATICS

Time: 2.30 Hours **Max. Marks: 60**

1. Answer any three questions. **5X3=15**

a.

b.

c.

d.

e

2. Answer any three questions. **5X3=15**

a.

b.

c.

d.

e.

3. Answer any three questions. **5X3=15**

a.

b.

c.

d

e.

4. Answer any three questions. **5X3=15**

a.

b.

c.

d.

e.

Question Paper Pattern

(For Open Elective Papers)

MATHEMATICS

Time: 2.30 Hours **Max. Marks: 60**

1. Answer any four questions. **5X4=20**

a.

b.

c.

d.

e

f.

2. Answer any four questions. **5X4=20**

a.

b.

c.

d.

e.

f.

3. Answer any four questions. **5X4=20**

a.

b.

c.

d

e.

f.