INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
NAAC ACCREDITED WITH 'A' GRADE
Marching Beyond 25 Years Successfully

M.Sc., Mathematics

Curriculum and Syllabus

Regulations 2021

(Based on Choice Based Credit System (CBCS)

and

Learning Outcomes based Curriculum Framework (LOCF))

Effective from the Academic year

2021-2022

Department of Mathematics

School of Basic Sciences

VISION of the Department

To empower students with sound knowledge and investigate new methodologies for future applications. The department aims to be center of excellence in mathematics and computing and vigorously engaged in both teaching and research.

MISSION of the Department

- To make students aware of technology to explore mathematical concepts through activities and experimentation.
- To provide a foundation for critical thinking by developing skills in logic and problem solving
- To develop close mentoring relationships among faculty and students through small classes, student-faculty research projects and a drop-in study lab staffed by mathematics faculty.
- To inculcate in students the ability to apply mathematical and computational skills to model, formulate and solve real time applications.
- To produce post graduate students with strong foundation to join research or to serve in industry.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1	To equip students with knowledge, abilities and insight in mathematics and related fields.
PEO2	To enable them to work as a mathematical professional, or qualify for training as scientific researcher.
PEO3	To equip students with the ability to translate and synthesize their understanding towards nature, human and development.
PEO4	To develop the ability to utilize the mathematical problem-solving methods such as analysis, modeling, and programming and mathematical software applications in addressing the practical and heuristic issues.
PEO5	Use their mathematical knowledge to solve problems; and undertake further studies related to mathematics; and be able to solve mathematical problems using technology.

PROGRAM OUTCOME (PO)

PO1	**Critical thinker and problem solver:** Ability to employ critical thinking and efficient problem solving skills in all the basic areas of Mathematics.
PO2	**Skilled communicator:** Ability to transmit complex technical information relating all areas in Mathematics in a clear and concise manner in writing and oral ability to present complex and technical concepts in a simple language for better understanding.
PO3	**Disciplinary knowledge and skills:** Capable of demonstrating - good knowledge and understanding of major concepts, theoretical principles and findings in Mathematics and its different subfields and other related fields of study, including broader interdisciplinary subfields like Computer Science, Information Technology etc.
PO4	**Sense of inquiry:** Capability for asking relevant/appropriate questions relating to the issues and problems in the field of Mathematics, and planning, executing and reporting

	the results of a theoretical investigation.
PO5	**Digitally Efficient*:*** Capable of using computers for simulation studies in Mathematics and computation and appropriate software for numerical and statistical analysis of data, and employing modern e-library search tools like Inflibnet, various websites of the renowned Mathematics and evaluate Mathematics information.
PO6	**Skilled project manager:** Capable of identifying/mobilizing appropriate resources required for a project, and manage a project through to completion, while observing responsible and ethical scientific conduct; and safety and laboratory hygiene regulations and practices
PO7	**Life-long learners:** Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling in all areas of Mathematics.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO1	Graduates will be able to demonstrate the ability to use skills in Mathematics and its related fields of technology to formulate and address Mathematics related problems.
PSO2	Graduates will acquire methodological skills and can enroll in different disciplines such as Science and Engineering, Education, Business, Banking, Research and development, teaching and government/public service.

List of Board of Studies Members

S.No.	Name of the Member	Designation
1.	Dr. K.Selvakumari Professor & Head Department Of Mathematics VISTAS,Pallavaram, Chennai-117	Chair Person
2.	Dr. P.Sumathi Associate Professor & Head Department Of Mathematics C.Kandaswami Naidu College for men, Anna Nagar, Chennai-102	External Member
3.	Dr. A.Selvaraj Professor Department Of Mathematics VISTAS, Pallavaram, Chennai-117	Internal Member
4.	Dr. G.Jayalalitha Professor Department Of Mathematics VISTAS, Pallavarm, Chennai-117	Internal Member
5.	Dr.S.Meenakshi Associate Professor Department Of Mathematics VISTAS,Pallavarm, Chennai-117	Internal Member
6.	Dr.V.Maheswari Associate Professor Department Of Mathematics VISTAS Pallavarm, Chennai-117	Internal Member
7.	Mr.K.Srinivasan Assistant Professor Department of Mathematics VISTAS Pallavarm, Chennai-117	Internal Member
8.	Mr.S.Senthil Assistant Professor Department of Mathematics VISTAS, Pallavarm, Chennai-117	Internal Member
9.	Mr.V.Anandha Raghavan Software Project Manager Visteon Technical and Services centre, Chennai	Industry member
10.	Mrs. D.Deepa Lecturer Sindhi Arts & Science College Numdal, Chennai-77	Alumni Member

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES (VISTAS)

CHENNAI - 600 117

REGULATIONS 2021

CHOICE BASED CREDIT SYSTEM

Common to All Post Graduate Full-Time Programmes

DEGREE OF MATHEMATICS

1. DURATION OF THE PROGRAMME

1.1. Two years (Four semesters)

1.2. Each academic year shall be divided into two semesters. The odd semesters shall consist of the period from July to November of each year and the even semesters from January to May of each year.

1.3 There shall be not less than 90 working days for each semester.

2. ELIGIBILITY FOR ADMISSION

2.1. Candidates for admission to the first year of the Master Degree shall be required to pass UG degree Examination (Academic Stream) accepted as equivalent thereof by the Syndicate of the Vels Institute of Science, Technology and Advanced Studies.

3. CREDIT REQUIRMENTS AND ELIGIBILITY FOR AWARD OF DEGREE

3.1. A Candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study in the Institute for a period of not less than three academic years and passed the examinations of all the Four Semesters prescribed earning a minimum of 90 credits as per the distribution given in for Part I, II, III and also fulfilled such other conditions as have been prescribed thereof.

4. COURSE OF STUDY, CREDITS AND SCHEME OF EXAMINATION

4.1 The Course Components and Credit Distribution shall consist Part I, II & III:

(Minimum number of Credits to be obtained)

Credit Assignment Each course is assigned certain number of credits based on the following: Contact period per week CREDITS

1 Lecture Period - 1 Credit

1 Tutorial Period - 1 Credit

2 Practical Periods - 1 Credit

(Laboratory / Seminar / Project Work / etc.)

5. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER

5.1. Eligibility: Students shall be eligible to go to subsequent semester only if they earn sufficient attendance as prescribed therefor by the Board of Management from time to time.

5.2. Attendance: All Students must earn 60% and above of attendance for appearing for the University Examination. (Theory/Practical)

5.3. Condonation of shortage of attendance: If a Student fails to earn the minimum attendance (Percentage stipulated), the HODs shall condone the shortage of attendance up to a maximum limit of 10% (i.e. between 65% and above and less than 60%) after collecting the prescribed fee towards the condonation of shortage of attendance should be remitted to the University.

5.4. Non-eligibility for condonation of shortage of attendance: Students who have secured less than 65 % but more than 50 % of attendance are NOT ELIGIBLE for condonation of shortage of attendance and such Students will not be permitted to appear for the regular examination, but will be allowed to proceed to the next year/next semester of the program

5.5. Detained students for want of attendance: Students who have earned less than 50% of attendance shall be permitted to proceed to the next semester and to complete the Program of study. Such Students shall have to repeat the semester, which they have missed by rejoining after completion of final semester of the course, by paying the fee for the break of study as prescribed by the University from time to time.

5.6. Condonation of shortage of attendance for married women students: In respect of married women students undergoing UG programs, the minimum attendance for condonation (Theory/Practical) shall be relaxed and prescribed as 55% instead of 65% if they conceive during their academic career. Medical certificate from the Doctor together with the attendance details shall be forwarded to the university to consider the condonation of attendance mentioning the category.

5.7. Zero Percent (0%) Attendance: The Students, who have earned 0% of attendance, have to repeat the program (by rejoining) without proceeding to succeeding semester and they have to obtain prior permission from the University immediately to rejoin the program

6. EXAMINATION AND EVALUATION

6.1 **SCHEME OF EXAMINATION:**

Scheme of Examination shall be as given in APPENDIX – A

6.2. Register for all subjects: Students shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination. For this purpose, Students shall register for all the arrear subjects of earlier semesters along with the current (subsequent) Semester Subjects.

6.2. Marks for Internal and End Semester Examinations for PART I, II, III

6.2.1 There shall be no passing minimum for Internal.

6.2.2 For external examination, passing minimum shall be 40% [Forty Percentage] of the maximum marks prescribed for the paper for each Paper/Practical/Project and Viva-Voce.

6.2.3 In the aggregate [External/Internal] the passing minimum shall be of 50%.

6.2.4. He / She shall be declared to have passed the whole examination, if he/she passes in all the papers and practical wherever prescribed as per the scheme of the examinations by earning 90 CREDITS in Part I, II, III.

7. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMS TO QUALIFY FOR A DEGREE

7.1. A Student who for whatever reasons is not able to complete the programs within the normal period (N) or the Minimum duration prescribed for the programme, may be allowed two years period beyond the normal period to clear the backlog to be qualified for the degree. (Time Span = N + 2 years for the completion of programme)

8. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The University may from time-to-time revise, amend or change the Regulations, Curriculum, Syllabus and Scheme of examinations through the Academic Council with the approval of the Board of Management.

APPENDIX – A- PATTERN OF QUESTION PAPER

PART – A (50 words) Answer 10 questions without choice	10 X 3 = 30 marks
PART – B (200 words) Answer 5 questions out of 8 questions	5 X 8 = 40 marks
PART – C (500 words) Answer 2 questions out of 5 questions	2 X 15 = 30 marks
	Total = 100 marks

QUESTION PAPER FOR PRACTICALS

The External examiner will prepare a question paper on the spot from the syllabus prescribed and supplied by the Controller's Office.

VELS INSTITUTE OF SCIENCE AND TECHNOLOGY AND ADVANCED STUDIES (VISTAS)

M.SC., MATHEMATICS DEGREE

COURSES OF STUDY AND SCHEME OF ASSESSMENT

Total No of Credits: 90

M.Sc., Mathematics Course Components

Component	**I Sem**	**II Sem**	**III Sem**	**IV Sem**	**Total Credits**
Core Courses	12	16	12	14	54
Discipline Specific Elective (DSE) & Generic Elective(GEC)	10	4	10	4	28
Skill enhancement Course(SEC) & SI	2	2+2(SI)	2	-	8
Total Credits	**24**	**24**	**24**	**18**	**90**

Learning Outcomes-Based Curriculum Framework for Postgraduate education in Mathematics

1. Introduction

The learning outcomes-based curriculum framework (LOCF) for the postgraduate programs in M.Sc.,(Mathematics) is intended to provide a broad framework within which both the undergraduate programs in Mathematics help to create an academic base that responds to the need of the students to understand the basics of Mathematics and its ever evolving nature of applications in explaining all the observed natural phenomenon as well as predicting the future applications to the new phenomenon with a global perspective. The curriculum framework is designed and formulated in order to acquire and maintain standards of achievement in terms of knowledge, understanding and skills in Mathematics and their applications to the natural phenomenon as well as the development of scientific attitudes and values appropriate for rational reasoning, critical thinking and developing skills for problem solving and initiating research which are competitive globally and are on par in excellence with the standard Higher Education Institutions (HEI) in the advanced countries of America, Asia and Europe. The multicultural fabric of our nation requires that the institutions involved in implementing this curriculum framework also work hard towards providing an environment to create, develop and inculcate rational, ethical and moral attitudes and values to help the creation of knowledge society needed for scientific advancement of our nation.

The learning outcome based curriculum framework in Mathematics should also allow for the flexibility and innovation in the program design of the UG education, and its syllabi development, teaching learning process and the assessment procedures of the learning outcomes. The process of learning is defined by the following steps which should form the basis of final assessment of the achievement at the end of the program.

- The accumulation of facts of nature and the ability to link the facts to observe and discover the laws of nature i.e. develop an understanding and knowledge of the basic Mathematics.

- The ability to use this knowledge to analyze new situations and learn skills and tools like mathematics, engineering and technology to find the solution, interpret the results and make predictions for the future developments.
- The ability to synthesize the acquired knowledge, understanding and experience for a better

and improved comprehension of the physical problems in nature and to create new skills and tools for their possible solutions.

The conceptualization and formulation of the learning outcomes for an postrgraduate program in Mathematics is aimed to achieve (i) and (ii) above while the (iii) could be planned for the research programs in Mathematics in the Higher Education Institutions in India.

2. **Learning Outcomes based approach to Curriculum Planning: (LOCF)**

   Learning Outcome based approach to curriculum planning (LOCF) is almost a paradigm shift in the whole gamut of higher education such that it is based on first and foremost identifying the outcomes of the learning required for a particular subject of study, and then planning all components of higher education so as to achieve these outcomes. The learning outcomes are the focal point of the reference to which all planning and evaluation of the end learning is compared and further modifications are made to fully optimize the education of the individuals in a particular subject. For the subject of mathematics, the outcomes are defined in terms of the understanding and knowledge of the students in mathematics and computer application the students are required to have to be competitive mathematician. So, that they are able to play their role as mathematics.

3. **Postgraduate attributes in Basic science:**

   Broaden the outlook and attitude, develop the current skills and abilities, and learn

   - New one to do extremely well in studies and career, grow into responsible global citizens. Contour the academic career of the students, make them employable, enhance
   - To shape one's life and also that of colleagues and peers. Demonstrate behavioral attributes for the enhancement of soft skills, socialistic
   - Research insight and support the participation in co-curricular and extracurricular activities. Instill skills and abilities to develop a positive approach and be self-contained
   - Approach and leadership qualities for successful career and nurture responsible human being.

- Provide highly skilled and knowledgeable human resources for agricultural Sector, food industry, dairy industry, medical and paramedical field, pharmaceutical and research institutes

4. **Qualification Descriptors:**

The following may serve as the important qualification descriptors for a PG degree in Mathematics

- Demonstrate a fundamental/systematic or coherent understanding of the academic field of Mathematics, its different learning areas like Algebra, Trigonometry, Integral and Differential Calculus, Differential Equations, Analytical Geometry, Graph theory, Discrete Mathematics, Real Analysis, Complex Analysis, Mechanics, Numerical Analysis, Operations research, Statics, Number theory and cryptography and other related fields of study, including broader interdisciplinary subfields like Computer science, Information Technology etc.

  (i) procedural knowledge that creates different types of professionals related to different areas of study in Mathematics outlined above, including research and development, teaching and government and public service;

  (ii) skills in areas related to specialization area relating the subfields and current developments in the academic field of Mathematics.

- Use knowledge, understanding and skills required for identifying problems and issues relating to Mathematics, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources from various application, analysis and evaluation using methodologies as appropriate to Mathematics for formulating new theories and concepts.

- Communicate the results of studies undertaken accurately in a range of different contexts using the main concepts, constructs and techniques of Mathematics. Develop communication abilities to present these results in technical as well as popular science meetings organized in various universities and other private organizations.

- Apply one's knowledge of Mathematics and theoretical analyse problems and issues and solve complex problems in Mathematics and related areas with well-defined solutions.

- Demonstrate Mathematics-related technological skills that are relevant to Mathematics-related job trades and employment opportunities.

Objectives of the course:

The aim and objectives of the M.Sc. Mathematics course program essentially focus to develop skills of student for a successful career.

- The course structure emphasizes to put enough efforts in theory as well as laboratory work so as to gain thorough knowledge of the subject.
- The course includes project work that would develop and nourish the scientific approach and research attitude of the students.
- The course work is essentially framed to acquaint the students with all the recent advances in this field.
- It is compulsory & essential for the students to read research papers, publications and deliver seminars that would better help them to know the recent advances in the subject and also develop the communication skills.
- The program is designed in such a way that it is essential for the students to read original publications, put enough efforts in laboratory work for practical and project, be acquainted with all the recent advances in the field computer to develop all the skills for a successful career

5. Programme Learning Outcome

(i) An advanced and systematic or coherent understanding of the academic field of Science, its different learning areas and applications, and its linkages with related disciplinary areas/subjects.

(ii) The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This can be utilized in modeling and solving real life problems.

(iii) Procedural knowledge that creates different types of professionals related to the disciplinary including professionals engaged in research and development, teaching and government/public service

(iv) Skills in areas related to one's specialization area within the disciplinary and current and emerging developments in the field of Science

(v) Demonstrate relevant generic skills and global competencies such as (i) problem solving skills that are required to solve different types of problems with well-defined solutions, and tackle open-ended problems that may cross disciplinary-area boundaries;

(vi) Communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences

(vii) Analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language

(viii) ICT skills

(ix) Personal skills such as the ability to work both independently and in a group.

6. Teaching learning Process

The teaching-learning process should be aimed at systematic exposition of basic concepts so as to acquire knowledge of respective discipline in a canonical manner. Students have great freedom of choice of subjects which they can study. The various components of teaching learning process are summarized in the following.

1. The most common method of imparting knowledge is through lectures. There are diverse modes of delivering lectures such as through blackboard, power point presentation and other technology aided means. A judicious mix of these means is a key aspect of teaching-learning process.
2. Assimilating ideas, deepening understanding, and gaining mastery of new concepts all take time, commitment, and intelligent effort. To reinforce learning, to monitor progress, and to provide a regular pattern of study, tutorials are essential requirements. During these tutorials, difficulties faced by the students in understanding the lectures, are dealt with.
3. Necessary and sufficient infrastructural facilities for the, laboratories and libraries equipped with adequate modern and modular furniture and other requirements. Modern and updated laboratory equipments needed for the undergraduate laboratories and reference and text books for the libraries
4. Home assignments at regular intervals and project work involving applications of theory are necessary to assimilate basic concepts of the respective discipline. Hence, it is incumbent on the part of a learner to complete open-ended projects assigned by the teacher.
5. The teaching-learning process needs to be further supported by other activities devoted to subject-specific and interdisciplinary skills, summer and winter internships in their discipline.

During these internships it is expected that a learner will interact with experts and write a report on a topic provided to the learner.

6. Institute visit by a learner is also a part of learning process. During such visits a learner has access to knowledge by attending academic activities such as seminars, colloquia, library consultation and discussion with faculty members. These activities provide guidance and direction for further study.
7. Special attempts should be made by the institution to develop problem-solving skills and design of laboratory experiments for demonstration at the UG level. For this purpose, a mentor system may be evolved where 3-4 students may be assigned to each faculty member.

7. Assessment methods

A range of assessment methods which are appropriate to test the understanding of various concepts of mathematics will be used. Priority will be given to formative assessment. Various learning outcomes will be assessed using time-bound examinations, series of open and closed book tests with uniform distribution over time, problem solving, home assignments, individual and group project reports, seminar presentations, viva-voce examination, participation in mathematical quizzes/competitions at local, regional, national and international levels and participations in internship programs. For various courses in mathematics, the following assessment methods shall be adopted:

- Announced/unannounced quizzes
- Scheduled/unscheduled tests
- Problem solving sessions aligned with classroom lectures
- Practical assignments
- Regular chamber consultation with faculty members
- Periodic tests, mid semester examination and semester end comprehensive examination
- Seminar presentations
- Computer skill test and computer simulation of concepts learnt
- Awareness tests of historical development of mathematical ideas
- Awareness tests of recent advances in mathematics
- Awareness tests of various national/international prizes in mathematics including Fields Medal, Abel prize, Rolf Nevanlinna Prize, Srinivasa Ramanujan Medal etc. and the work of recipients of these prizes
- Awareness test of applications of mathematics in other branches of science, technology and other disciplines.

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES (VISTAS)

M.Sc. DEGREE COURSE - MATHEMATICS

COURSES OF STUDY AND SCHEME OF ASSESSMENT

Total number of Credits: 90

Code No.	Course	Hours/Week			Credits	Maximum Marks		
		Lecture	Tutorial	Practical		CA	SEE	Total
SEMESTER 1								
Core	Abstract Algebra	4	0	0	4	40	60	100
Core	Advanced Calculus	4	0	0	4	40	60	100
Core	Ordinary Differential Equation	4	0	0	4	40	60	100
DSE	Discipline Specific Elective – I	4	1	0	5	40	60	100
DSE	Discipline Specific Elective – II	4	1	0	5	40	60	100
SEC	Soft Skill 1/ Sector Skill Course	2	0	0	2	40	60	100
		22	**2**	0	**24**			
SEMESTER II								
Core	Linear Algebra	4	0	0	4	40	60	100
Core	Measure theory and Integration	4	0	0	4	40	60	100
Core	Partial Differential Equation	4	0	0	4	40	60	100
Core	Complex Analysis	4	0	0	4	40	60	100
DSE	Discipline Specific Elective – III	4	0	0	4	40	60	100
SI	Internship	0	0	4	2	40	60	100
SEC	Soft Skill 2/ Sector Skill Course	2	0	0	2	40	60	100
		22	**0**	**4**	**24**			
SEMESTER III								
Core	Functional Analysis	4	0	0	4	40	60	100
Core	Topology	4	0	0	4	40	60	100
Core	Differential Geometry	4	0	0	4	40	60	100
DSE	Discipline Specific Elective – IV	4	1	0	5	40	60	100
DSE	Discipline Specific	4	1	0	5	40	60	100

	Elective – V							
SEC	Soft Skill 3/ Sector Skill Course	2	0	0	2	40	60	100
		22	**2**	0	**24**			
SEMESTER IV								
Core	Operations Research	4	0	0	4	40	60	100
GE	Computer	4	0	0	4	40	60	100
Core	Project Work	0	0	20	10	40	60	100
		8	**0**	**20**	**18**			

CA - Continuous Assessment , SEE - Semester End Examination

List of Core

1. Abstract Algebra
2. Advanced Calculus
3. Ordinary Differential Equations
4. Linear Algebra
5. Measure theory and Integration
6. Partial Differential Equations
7. Complex Analysis
8. Functional Analysis
9. Topology
10. Differential Geometry
11. Operations Research
12. Project

List of Discipline Specific Elective (DSE)

1. Fluid Dynamics
2. Number theory
3. Calculation of variations
4. Mathematical Statistics
5. Graph theory
6. Mathematical modeling
7. Fuzzy sets and its Applications

List of Skill Enhancement Course (SEC)

1. Soft skill-I
2. Soft skill-II
3. Soft skill-III

SEMESTER-I

CORE	ABSTRACT ALGEBRA	L	T	P	Credits
		4	0	0	4

Course Objective

Abstract Algebra course introduce the basic ideas of counting principle, Sylow subgroups, Field theory and Galois theory. To apply Galois theory to Solvability of polynomial equations by radicals.

UNIT I Another counting principle

Another counting principle- Class equation for finite groups and its applications- Sylow's Theorems I part (first proof only), II part and III part- Internal Direct products. **12**

UNIT II Extension Fields

Extension Fields- finite extension-Algebraic element -Roots of polynomials. **12**

UNIT III Polynomial rings & Finite fields

Polynomial rings- The division algorithm-finite fields**.** **12**

UNIT IV The elements of Galois theory

The elements of Galois theory- Fixed field – Galois group – Normal extension – Fundamental theorem of Galois theory. **12**

UNIT V Solvability by radicals

Solvability by radicals- Solvable groups – Radical extension. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Understand important mathematical concepts in abstract algebra such as definition of group, finite group, abelian group

CO2: Create many mathematical concepts studied in abstract mathematics such as extension, Algebraic element and roots of polynomial.

CO3: Evaluate participation in the important concepts like finite fields and Division algorithm

CO4: Apply elements of Galois theory, Galois group and Fundamental theorem of Galois theory

CO5: Analyze Solvable group, Solvability by radicals and Radical extension.

TextBooks

I.N. Herstein. Topics in Algebra (II Edition) John Wiley& Sons, 2011.

Unit I :Chapter 2: Sections 2.11 and 2.12 (Omit Lemma2.12.1, Lemma 2.12.2,Lemma2.12.5) and 2.13

Unit II: Chapter 5: Sections 5.1 ,5.3

Unit III :Chapter3: 3.9 and Chapter7: 7.1

Unit IV: Chapter 5 : Sections 5.6

Unit V: Chapter 5 : Sections 5.7

2. K.Thirusangu ,A text book on Abstract Algebra by, KTM Publications, 2021

Reference Books

1. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra*

(II Edition) Cambridge University Press, 1997. (Indian Edition)

2. John B, Fraleigh , A first course in Abstract Algebra, 7 th Edition, Pearson. 2013

3. D.S.Dummit and R.M.Foote, *Abstract Algebra*, 2nd edition, Wiley, 2002.

4. N.Jacobson, *Basic Algebra*, Vol. I & II W.H.Freeman (1980); also published

by Hindustan Publishing Company, New Delhi.

Websites

https://nsufl.libguides.com/cnso-abstractalgebra/websites

Web Sources

http://www2.math.umd.edu/~jcohen/402/Pinter%20Algebra.pdf

CORE	ADVANCED CALCULUS	L	T	P	Credits
		4	0	0	4

Course Objective

To provide the student with the concept and the understanding in functions of bounded variation, Riemann-Stieiltjes integral and sequences of functions.

UNIT-I Metric spaces:

Continuous functions on metric spaces- Functions continuous at a point on the real line – Reformulation – functions continuous on a metric space – open sets – closed sets – Discontinuous functions on R1. (Sections 5.1 to 5.6). **12**

UNIT II Closed Sets

Closed sets – closure – Limit points – Dense sets – complete metric space – Cantor's intersection theorem – Baire's Category Theorem. **12**

UNIT III Continuous Functions on Metric Spaces

Functions - continuous at a point on the real line – Functions - Continuous – uniform continuous in a metric space – Discontinuous function of R. **12**

UNIT-IV Connectedness and Compactness

Connectedness – connected subset of R – connectedness and continuity – compact metric spaces – compact subset of R – Heine Borel theorem. **12**

UNIT-V Riemann Integral

Sets of measure zero – Existence of the Riemann integral – Derivatives – Rolle's theorem – Fundamental theorem of Calculus – Mean value theorem – Cauchy's mean value theorem – Taylor's theorem**.** **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

At the end of this course the students will be able to,

CO1: Prove basic concepts on Metric spaces and boudedness sets bounded sets with examples and Related

CO2: Solve Cantor's intersection theorem , Baires Category Theorem.

CO3: Prove uniform continuous in a metric space – Discontinuous function of R.

.

CO4: Definition of the Riemann integral – Existence of Riemann integrals – properties of Riemann integrals.

CO5: Apply the concept of the Riemann integral – Existence of Riemann integrals – properties of Riemann integrals.

Text Books: 1. Arumugam & Issac – Modern Analysis

2. Malic .S.C - Mathematical Analysis, Wiley Eastern Limited, New Delhi.

Books for Reference :

1. Tom .M. Apostal – Mathematical Analysis, II Edition, Narosa Publishing House, New Delhi (Unit I) (1997)

2. Goldberg .R – Methods of Real Analysis Oxford and IBH Publishing Co. New Delhi (200)

3. Viswanath Naik .K – Real Analysis, Emerald Publishers, Chennai.

4. Berberian .S.K – First course in Real Analysis, Springer Verlag, New York.

Websites

https://www.khanacademy.org/math/calculus-1

Web Sources

http://people.math.harvard.edu/~shlomo/docs/Advanced_Calculus.pdf

CORE	ORDINARY DIFFERENTIAL EQUATIONS	L	T	P	Credits
		4	0	0	4

Course Objectives

To understand the concept of well posed differential equation, Green's functions, Sturm-Liouville type problems and Exposure to solve system of ODE

UNIT-I Existence and uniqueness of solutions

Review of exact solutions of first order ODE, method of successive approximations, Lipschitz condition, convergence of successive approximations, existence and uniqueness of solutions of IVP, non-local existence of solutions, existence and uniqueness of solutions to systems, existence and uniqueness of solutions to linear systems, equations of order *n*. **12**

UNIT-II Second order equations

General solution of homogeneous equations, non-homogeneous equations, Wronskian, method of undetermined coefficients,method of variation of parameters. **12**

UNIT-III Boundary value problems

Sturm comparison theorem, Sturm separation theorem, boundary value problems **12**

UNIT-IV Series solutions

Series solution of second order linear equations: ordinary points, regular singular points, Sturm-Liouville problems, Green's functions, Legendre polynomials and properties, Bessel functions and properties. **12**

UNIT-V System of differential equations

Algebraic properties of solutions of linear systems, eigenvalue-eigenvector method of finding solutions, complex eigenvalues,equal eigenvalues. **12**

Total 60 Hours

Course Outcome

At the end of this course , the students will be able to,

CO1: Understand the basic concepts of linear homogeneous and non-homogeneous differential equations.

CO2: Create Legendre's equation and its solutions, generating function for the Legendre polynomials, special values of the Legendre polynomials and orthogonality properties of the Legendre polynomials.

CO3:Analyze the basic concepts of generating function for Bessel Functions, integral representations for Bessel functions and recurrence relations

CO4: Apply Lipschitz Condition, successive Approximation, Picard's theorem for Initial value problem strum-Liouville Problem, Green's Functions and Picard's Theorem for BVP.

CO5: Analyze about stability of quasi linear systems, stability of autonomous systems, stability of non-autonomous systems and a particular lyapunov function.

Textbooks

1.E. A. Coddington, An Introduction to Ordinary Differential Equations, PHI Learning 1999.

2.G. F. Simmons, Differential Equations with Applications and Historical Notes, 2nd Ed, McGraw- Hill, 1991.

3.R. P. Agarwal and D. O'Regan, An Introduction to Ordinary Differential Equations, Springer- Verlag, 2008.

- Unit-I: Chapter 2: Sec. 7-11 [Simmons]; Chapter 5 [Coddington], Chapter 6: Sec. 6-8 [Coddington]
- Unit-II: Chapter 3: Sec. 14-19 [Simmons]
- Unit-III: Chapter 4 [Simmons]
- Unit-IV: Chapter 5: Sec. 26-30, Chapter 7: Sec-43 [Simmons]; Lecture33 [Agarwal and O'Regan]Chapter 8: Sec. 44-47 [Simmons]
- Unit-V: Chapters 25, 26 [Agarwal and O'Regan]

Reference books

1. G. Birkhoff and G. -C. Rota, Ordinary Differential Equations, John Willey and Sons, 4th Ed., 1989.
2. R. P. Agarwal and R. C. Gupta, Essentials of Ordinary Differential Equations, McGraw-Hill, 1993.
3. M. Braun, Differential Equations and Their Applications, 3rd Ed., Springer-Verlag, 1983.
4. S. G. Deo, V. Raghavendra, R. Kar and V. Lakshmikantham, Textbook of Ordinary Differential Equations, McGraw HillEducation, 3rd Ed., 2015.
5. G. F. Simmons and S. G. Kantz, Differential Equations: Theory, Technique and Practice, Tata McGraw-Hill, 2007.

Websites

https://nsufl.libguides.com/cnso-diffeq/websites

Web Sources

https://users.math.msu.edu/users/gnagy/teaching/ode.pdf

SEMESTER-II

CORE	LINEAR ALGEBRA	L	T	P	Credits
		4	0	0	4

Course Objective

To study the generalized form of a vector space namely modules and various canonical form of linear transformation under certain conditions on finite dimensional vector spaces.

UNIT I Modules

Modules – Direct sum – Module homomorphism – Cyclic module- Finitely generated module.**12**

UNIT II Canonical forms

Canonical forms : Nil potent transformation – Canonical forms: Jordan Canonical form. **12**

UNIT III Rational Canonical form

Canonical forms: Rational Canonical form- Trace and Transpose. **12**

UNIT IV Determinants

Determinants – Properties of determinants- Cramer's Rule- Cayley Hamilton theorem. **12**

UNIT V Hermitian, Unitary and Normal transformation

Hermitian, Unitary and Normal transformation- positive definite transformation – Hermitian-adjoint of a transformation. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Understand the important mathematical concepts in Linear algebra such as Canonical form, Nil potent transformation

CO2: Create many mathematical concepts studied in Linear mathematics such as

Modules, Direct sum , Module homomorphism ,Cyclic module, Finitely generated module

CO3: Apply Active participation in the important concepts like Rational Canonical form- Trace and Transpose

CO4: Evaluate Determinants with its Properties of determinants, Cramer's Rule along with Cayley Hamilton theorem.

CO5: Analyze Solvable group, Solvability by radicals and Radical extension.

Text Books

I.N. Herstein. Topics in Algebra (II Edition) John Wiley 2011.

Unit I: *Chapter 4: Section 4.5*

Unit II: *Chapter 6: Sections 6.5 and 6.6*

Unit III: *Chapter 6 : Sections 6.7 and 6.8*

Unit IV: *Chapter6: Section 6.9*

Unit V: *Chapter 6: section 6.10*

Reference Books

1. Kenneth M Hoffman and Ray Kunze , Linear Algebra , 2 nd Edition, Prentice – Hall of India Pvt Ltd, New Delhi, 2013.

2. J.J Roman, Advanced Modern Algebra, 2 nd Edition, Graduate Studies in Mathematics, Vol 114,AMS, Providence, Rhode Island, 2010.

3. I.S.Luther and I.B.S.Passi, *Algebra*, Vol. I - Groups(1996); Vol. II Rings, (1999)

Narosa Publishing House , New Delhi.

4. N.Jacobson, *Basic Algebra*, Vol. I & II Hindustan Publishing Company, New Delhi.

Websites

https://www.khanacademy.org/math/linear-algebra

Web Sources

https://secure.math.ubc.ca/~carrell/NB.pdf

CORE	MEASURE THEORY AND INTEGRATION	L	T	P	Credits
		4	0	0	4

Course Objective

To provide a basic course in Lebesgue Measure and Integration and a study of inequalities and a study of inequalities and the L^p- spaces.To study signed measures and decomposition theorem.

UNIT I Measure on the Real Line

Introduction – Lebesgue Outer Measure – Measurable Sets – Borel Sets – Regular Measure – Measurable Functions – Borel and Lebesgue Measurable Functions. **12**

UNIT II Integration of Functions of a Real Variable

Integration of non-negative Functions – Lebesgue Integral – Fatou's Lemma – Lebesgue Monotone Convergence – The General Integral – Lebesgue Dominated Convergence Theorem – Integration of Series – Riemann and Lebegue Integrals. **12**

UNIT III Abstract Measure Spaces

Measures and outer Measures – Extension of Measures – Uniqueness of the Extension – Completion of a Measure – Measure Spaces Integration with respect to a Measure. **12**

UNIT IV Inequalities and the L^pspaces

L^pSpaces – Convex Functions – Jensen's Inequality – Inequalities of Holder and Minkowski – Convergence in Measure – Almost Uniform Convergence . **12**

UNIT V Signed Measures and their Derivatives

Signed Measures and Hahn Decomposition - The Jordan Decomposition – The Radon Nikodym Theorem – some Applications of the Radon Nikodym Theorem. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1 : Understand the basic concepts of Measure on the Real Line: Introduction, Lebesgue Outer Measure, Measurable Sets, Borel Sets, Regular Measure, Measurable Functions, Borel and Lebesgue Measurable Functions.

CO2: Analyze Integration of Functions of a Real Variable, Lebesgue Integral, Fatou's Lemma, Lebesgue Monotone Convergence, The General Integral, Lebesgue Dominated Convergence Theorem, Integration of Series and Riemann and Lebegue Integrals.

CO3: Evaluate the basic concepts of abstract Measure Spaces, Measures and outer Measures, Extension of Measures, Uniqueness of the Extension, Completion of a Measure, Measure Spaces Integration with respect to a Measure.

CO4: Apply Inequalities and the L^pSpaces - L^pSpaces – Convex Functions – Jensen's Ineqality – Inequalities of Holder and Minkowski – Convergence in Measure – Almost Uniform Convergence .

CO5: Understand the basic concepts of Signed Measures and their Derivatives: Signed Measures and Hahn Decomposition - The Jordan Decomposition – The Radon Nikodym Theorem – some Applications of the Radon Nikodym Theorem.

Text Books

1. G.de Barra, Measure Theory and Integration, Wiley Eastern Ltd, 1987.

   [Chapters 2.1 – 2.5, 3.1 - 3.4, 5.1 - 5.6, 6.1 - 6.4, 7.1 - 7.2, 8.1 – 8.4]

Reference Books

1. Munroe, M.E., Introduction to Measure and Integration , Addison Wesley, Mass, 1953.
2. Rudin, w., Principles of Mathematical Analysis, Macmillan, 1968.
3. Halmos, P.R, Measure Theory, Springer International Student Edition, 1987.
4. Rana, I.K., An Introduction to Measure and Integration, Narosa Publishing House, 1997.

Websites

https://ocw.mit.edu/courses/mathematics/18-125-measure-and-integration-fall-2003/lecture-notes/

Web Sources

https://people.math.ethz.ch/~salamon/PREPRINTS/measure.pdf

CORE	PARTIAL DIFFERENTIAL EQUATION	L	T	P	Credits
		4	0	0	4

Course Objective

Partial differential equations allow deterministic mathematical formulations of phenomena in physics and engineering as well as biological processes among many other scenarios. The objective of this course is to present the main results in the context of partial differential equations that allow learning about these models and to study numerical methods for the approximation of their solution.

UNIT I First Order Partial Differential Equations

Cauchy's problem for First Order Equations - Linear Equation of the First Order - Compatible system of First OrderEquations - Charpits Method. **12**

UNIT II Second Order Partial Differential Equations

Linear Partial Differential Equations of Second Order with constant coefficients – Classification of Second Order Partial Differential - Canonical Forms - characteristic equations. **12**

UNIT III Eliptic Partial Differential Equations

Derivation of the Laplace Partial Differential Equations - Boundary Value Problems – Separation of Variables – Dirichlet Problem for a rectangle - The Neumann Problem for a Rectangle .**Parabolic Partial Differential Equations :** Occurrence of the Diffusion Equation - Boundary Conditions - Elementary Solutions of the Diffusion Equations - Separation of Variables. **12**

UNIT IV Hyperbolic Partial Differential Equations

Occurrence of the Wave Equations - Derivation of the One Dimensional Wave Equation - Solution of One Dimensional Wave Equation by Canonical Reduction - The Initial Value Problems : D'Alembert's Method. **12**

UNIT V Laplace Transform Methods

Solutions of the Diffusion Equations - Solutions of the Wave Equations. Fourier Transform Methods: Solutions of the Diffusion Equations - Solutions of the Wave Equations - Solutions of the Laplace Equations. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Understand the basic concepts of Cauchy's problem for first order equations, linear equation of the first order, compatible system of first order equations and charpits method.

CO2: Analyze linear partial differential equations of second order with constant coefficient, classification of second order partial differential, canonical forms and characteristic equations.

CO3: Apply the basic concepts of elliptic partial differential equations and parabolic partial differential equations.

CO4: Evaluate one dimensional wave equation by Canonical Reduction and D'Alembert's Method.

CO5: Analyze Laplace Transform Methods and Fourier Transform Methods.

Text Books

1.Chapter 2 :2.3 – 2.6, 2.9 & 2.10 Ian N Sneddon

2. Chapter 2 : 2.11 & 2.13 Ian N Sneddon & Chapter 1 : 1.2 & 1.3 K. SankaraRao

3.Chapter 2 :2.1, 2.2 , 2.5 – 2.7; Chapter 3: 3.1 – 3.3, 3.5; K. SankaraRao

4. Chapter 4: 4.1 – 4.4 K. SankaraRao

5.Chapter 6 :6.13 ; Chapter 7: 7.11 – 7.13 K. SankaraRao

Reference Books:

1. Ian N Snedon, Elements of Partial Differential Equations, Mcgraw Hill International

Book Company, 1957.

2. K. Sankara Rao, Introduction to Partial Differential Equations, Prentice Hall of India,

2007.

3. C.R. Chester, Techniques in Partial Differential Equations, Mcgraw Hill, 1970.

Websites

https://mathworld.wolfram.com/PartialDifferentialEquation.html

Web Sources

https://www.math.uni-leipzig.de/~miersemann/pdebook.pdf

CORE	COMPLEX ANALYSIS	L	T	P	Credits
		4	0	0	4

Course Objective

The course studies complex integration, conformal maps, harmonic and sub harmonic functions, Dirichlets problem, series and product expansions, elliptic functions, and analytical continuation.

UNIT I Complex integration

Complex integration: Zeros of an analytic function- the index of a closed curve – Cauchy's theorem and integral formula – the homotopic version of Cauchy's Theorem and simple connectivity – Counting zeros & open mapping theorem – Goursat's theorem. **12**

UNIT II Singularities

Singularities: Classification of Singularities –residues-the Argument principle.
The Maximum Modulus theorem : The Maximum Principle – Schwarz 's lemma. **12**

UNIT III Compactness and Convergence

Compactness and convergence in the space of analytic functions: The Riemann mapping theorem –Weierstrass Factorization theorem – Factorization of the sine function - The gamma function - The Riemann – zeta function. **12**

UNIT IV Harmonic functions

Harmonic functions : Basic properties of Harmonic function – Harmonic functions on a disk- Sub harmonic and super harmonic function – The Dirichlet problem – Green's functions. **12**

UNIT V Entire Functions

Entire Functions: Jensens formula – The genus and order of an entire function –Hadamard Factorization theorem. The Range of an Analytic function: Bloch's theorem –The Little Picard theorem –Schottky'stheorem . **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Understand the basic concepts complex integration, zeros of an analytic function, Cauchy's theorem and integral formula counting zeros & open mapping theorem – goursat's theorem.

CO2: Analyze singularities, classification of singularities, residues-the argument principle, the maximum modulus theorem, the maximum principle and Schwarz ‘s lemma

CO3: Understand the basic concepts of compactness and convergence in the space of analytic functions, the Riemann mapping theorem, Weierstrass factorization theorem, the gamma function the Riemann and zeta function.

CO4: Analyze harmonic functions , basic properties of harmonic function , harmonic functions on a disk, sub harmonic and super harmonic function, The Dirichlet problem – Green’s functions.

CO5: Apply Jensens formula , the genus and order of an entire function, Hadamard Factorization theorem, the Range of an Analytic function, Bloch’s theorem, the Little Picard theorem and Schottky’stheorem .

Text Books

John B. Conway , Functions of one complex variable, springer – Verlag,international student edition,Narosa publishing co.

Reference Books

1 .Lars V. Ahlfors, Complex Analysis, (3rd edition) McGraw Hill Co., New York, 1979

2. H.A.Prestly, Introduction to complex Analysis, clarendon Press Oxford 1990.

3. E.Hille, Analytic function Theory (2 vols), Gonm& co, 1959

4. M.Heins, Complex function Theory, Academic press, New York 1968

Websites

https://www.math.ttu.edu/~pearce/complex.shtml

Web Sources

https://www.oulu.fi/sites/default/files/151/complex_book.pdf

SEMESTER-III

CORE	FUNCTIONAL ANALYSIS	L	T	P	Credits
		4	0	0	4

Course Objective:

The objectives of the course are the study of the main properties of bounded operators between Banach and Hilbert spaces, the basic results associated to different types of convergences in normed spaces and the spectral theorem and some of its applications.

UNIT-I Preliminary on Banach spaces

Definition and examples – Continuous linear transformations – The Hahn Banach theorem. **12**

UNIT-II Banach spaces

The natural imbedding – Open mapping theorem – The conjugate of an operator. **12**

UNIT-III Hilbert spaces

Definition and simple properties – Orthogonal complements – Orthonormal sets– Conjugate space. **12**

UNIT-IV Banach spaces and Hilbert spaces

The adjoint of an operator-Self –adjoint operators-Normal and unitary operators-Projections. **12**

UNIT-V Algebras of Operators

General Preliminaries on Banach Algebras: The definitions and some examples-Regular and singular elements-Topological divisors of zero-The spectrum-The formula for the spectral radius. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Understand the basic concepts of definition and examples, continuous linear transformations and the Hahn Banach theorem.

CO2: Analyze the natural imbedding, open mapping theorem, the conjugate of an operator.

CO3: Understand the definition and simple properties, orthogonal complements, orthonormal sets and conjugate space.

CO4: Evaluat the adjoint of an operator, self-adjoint operators, normal and unitary operators-Projections

CO5: Analyze about general preliminaries on Banach Algebras and topological divisors of zero-the spectrum.

Text Book

G.F. Simmons,"Introduction to Topology and Modern Analysis"**,** McGraw-Hill, New York, 1963

Reference Books

1. J. B. Conway ,"A Course in Functional Analysis", Springer, New York,1990.
2. C. Goffman& G. Pedrick ,"First Course in Functional Analysis", Prentice-Hall of India, New Delhi,2002.
3. L. A. Lusternik& V. J. Sobolev ,"Elements of Functional Analysis" Hindustan Publishing Co, New Delhi,1985.
4. A. E. Taylor, John Wiley ,"Introduction to Functional Analysis", New York,1958.

Websites

https://www.britannica.com/science/functional-analysis-mathematics

Web Sources

https://www.mat.univie.ac.at/~gerald/ftp/book-fa/fa.pdf

CORE	TOPOLOGY	L	T	P	Credits
		4	0	0	4

Course Objective

This course will enable the students to understand about the topological spaces and continuous functions. To have a clear picture of connectedness and local connectedness. To get knowledge on compact spaces and Hausdorff spaces.

UNIT I Topological Spaces and Continuous Functions

Topological Spaces and Continuous Functions : Topological spaces, Basis for a topology, The order Topology, The product Topology on X x Y, The subspace Topology. **12**

UNIT II Connectedness and Compactness

Connectedness and Compactness :Connected spaces and Connected subspaces of the Real line, Components and Local Connectedness. **12**

UNIT III Compactness and Limit Point Compactness

Connectedness and Compactness (Contd.):Compact spaces, Compact subspaces of the Real line and Limit point Compactness, Local Compactness. **12**

UNIT IV Countability and Separation

Countability and Separation:The Countability Axioms, The separation Axioms, Normal spaces.

12

UNIT V Countability and Separation Axioms

Countability and Separation Axioms (Contd.): The Urysohn Lemma, The Urysohn MetrizationTheorem, The Tietze ExtensionTheorem. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Understand Outline terms, definitions and theorems related to topology.

CO2: Apply continuous functions and homeomorphisms to understand connectedness and local connectedness

CO3: Demonstrate knowledge and understanding of compact spaces and Hausdorff spaces

CO4: Analyze the concepts of the countability and separation axioms

CO5: Analyze a selection of theorems concerning normal and metrizable spaces

Text Books

James R. Munkres, Topology, Second Edition, 2002.

Reference books

1. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill International Book Company, New York, 1963
2 .W. Rudin, Functional Analysis, Tata McGraw-Hill Publishing Company, New Delhi, 1973.
3. G. Bachman and L. Narici, Functional Analysis Academic Press, New York,1966.
4. H.C. Goffman and G. Fedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi,1987.
5. E. Kreyszig, Introductory Functional Analysis with Application, John Wiley &Sons, New York,1978.

Websites

https://www.lehigh.edu/~dmd1/othersites.html

Web Sources

https://www.maths.ed.ac.uk/~v1ranick/papers/seifthreng.pdf

CORE	DIFFERENTIAL GEOMETRY	L	T	P	Credits
		4	0	0	4

Course Objective

To be able to understand the fundamental theorem for plane curves. Involutes and evolutes of space curves with the help of examples. To be able to compute the curvature and torsion of space curves. Coefficients and their derivatives.

UNIT I Tangents and normals

Space Curves – Definition of a space Curve – Arc length – tangent – normal and binormal – Curvature and Torsion – Contact between Curves and Surfaces – tangent surface – Involutes and evolutes – Intrinsic equations – Fundamental Existence Theorem for space Curves - Helices.**12**

UNIT II Surface of revolution

Intrinsic Properties of a Surface – Definition of a Surface – Curves on a Surface – Surface of revolution – Helicoids – Metric – Direction Coefficients – families of Curves – Isometric Correspondence – Intrinsic properties. **12**

UNIT III Geodesics

Geodesics – Canonical geodesic equations – Normal property of geodesics – Existence Theorems – Geodesic Parallels. **12**

UNIT IV Curvature

Geodesic Curvature – Gaurs – Bonnet Theorem – Gaussian Curvature – Surface of Constant Curvature. **12**

UNIT V Space curve and surface

Non-Intrinsic Properties of a Surface – The second fundamental form – Principal Curvature – Lines of Curvature – Developable – Developable associated with space curves and with curves on surfaces. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1 :Understand the basic concepts of space curves, definition of a space curve, arc, normal and binormal, curvature and torsion , fundamental existence theorem for space curves and helices.

CO2: Analyze intrinsic properties of a surface, definition of a helicoids, metric, families of curves, isometric correspondence and intrinsic properties

CO3:Understand the basic concepts of geodesics, canonical geodesic equations, normal property of geodesics, existence theorems and geodesic parallels.

CO4: Apply geodesic curvature, gaurs, bonnet theorem, gaussian curvature and surface of constant curvature.

CO5: Analyze the second fundamental form, principal curvature, lines of curvature and developable associated with space curves and with curves on surfaces.

Text Books

T.J.Willmore, An Introduction to Differential Geometry, Oxford University Press (17^{th} Impression) New Delhi 2002 (Indian Print)

Chapter I : Sections 1 to 9

Chapter II : Sections 1 to 9

Chapter II : Sections 10 to 14

Chapter II : Sections 15 to 18

Chapter III : Sections 1 to 6

Reference Books

1. D.Somasundaram, Differential Geometry, A First Course, Narosa Publishing House, Chennai, 2005.
2. D.J.Struik, Classical Differential Geometry, Addison Wesley Publishing Company INC, Massachusetts, 1961.

Websites

https://ocw.mit.edu/courses/mathematics/18-950-differential-geometry-fall-2008/

Web Sources

http://www.gbv.de/dms/goettingen/482242930.pdf

SEMESTER-IV

CORE	OPERATIONS RESEARCH	L	T	P	Credits
		4	0	0	4

Course Objective

In this course basic concepts of Operations Research such as Decision theory, Network Models Inventory Control Models and Queuing theory are introduced.

UNIT-I : Decision Theory

Steps in Decision theory Approach – Types of Decision- Making Environments – Decision Making Under Uncertainty – Decision Making under Risk– Posterior Probabilities and Bayesian Analysis – Decision Tree Analysis – Decision Making with Utilities. **12**

UNIT-II : Network Models

Scope of Network Applications – Network Definition – Minimal spanning true Algorithm – Shortest Route problem – Maximum flow model – Minimum cost capacitated flow problem - Network representation – Linear Programming formulation – Capacitated Network simplex Algorithm. **12**

UNIT-III : Deterministic Inventory Control Models

Meaning of Inventory Control – Functional Classification – Advantage of Carrying Inventory – Features of Inventory System– Inventory Model building - Deterministic Inventory Models with no shortage – Deterministic Inventory with Shortages. **12**

Probabilistic Inventory Control Models:

Single Period Probabilistic Models without Setup cost – Single Period Probabilities Model with Setup cost. **12**

UNIT-IV Queueing Theory

Essential Features of Queueing System – Operating Characteristic of Queueing System – Probabilistic Distribution in Queueing Systems – Classification of Queueing Models – Solution of Queueing Models – Probability Distribution of Arrivals and Departures – Erlangian Service times Distribution with k-Phases. **12**

UNIT-V Replacement and Maintenance Models

Failure Mechanism of items – Replacement of Items that deteriorate with time – Replacement of items that fail completely– other Replacement Problems. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Identify the goals and objectives of Decision theory

CO2: Identify and develop operational research models from the verbal description of the real system.
CO3 : Understand the various selective inventory control techniques and its applications.

CO4 : Understand the mathematical modeling of queuing systems.

CO5 : Apply various item of replacement models.

Text Books

1. P. K. Gupta, Man Mohan, KantiSwarup: "Operations Research", Sultan Chand, 2008.

2. V. K. Kapoor: "Operations Research", Sultan Chand & Sons, 2006

3. J. K. Sharma: Operations Research Theory & Applications, Macmillan India

Limited, fifth edition.2013

Reference Books

1. Hamdy Taha, Operations Research, 8th Edition, Pearson Education, 2009.

2. Sharma J.K, Operations Research, 3rd Edition, Macmillan Business Books, 2009.

3. Sundaresan V, Ganapathy K.S, Ganesan K, Resource Management Technique- Lakshmi Publications, 2003.

4. Kanti swaroop, Gupta P. K, Man Mohan, Operations Research, 14th Edition, Sultan Chand & Sons, 2008.

5. Kalavathy S, Operations Research, 2nd Edition, Vikas Publications, 2009.

Websites

https://cbom.atozmath.com/Menu/CBomMenu.aspx

Web Sources

https://www.bbau.ac.in/dept/UIET/EME-601%20Operation%20Research.pdf

DISCIPLINE SPECIFIC ELECTIVE

(DSE)

DSE	FLUID DYNAMICS	L	T	P	Credits
		4	0	0	4

Course Objective

To introduce and explain fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc. To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

UNIT-I: Kinematics of Fluids in motion

Kinematics of Fluids in motion. Real fluids and Ideal fluids- Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential – The vorticity vector- Local and particle rates of changes - Equations of continuity – Worked examples - Acceleration of a fluid - Conditions at a rigid boundary. **12**

UNIT-II Equations of motion of a fluid

Pressure at a point in a fluid at rest.- Pressure at a point in a moving fluid - Conditions at a boundary of two inviscid immiscible fluids- Euler's equation of motion - Discussion of the case of steady motion under conservative body forces. **12**

UNIT-III Some three dimensional flows

Introduction- Sources, sinks and doublets -Images in a rigid infinite plane - Axi symmetric flows - Stoke's stream function. **12**

UNIT-IV Some two dimensional flows

Meaning of two dimensional flow - Use of Cylindrical polar coordinate - The stream function - The complex potential for two dimensional , irrotational in compressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompson circle Theorem. **12**

UNIT-V Viscous flows

Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid elements - The rate of strain quadric and principle stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain- The coefficient of viscosity and Laminar flow - The Navier – Stoke's equations of motion of a Viscous fluid. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Understand the basic concepts of kinematics of fluids in motion, real fluids and ideal fluids- velocity of a fluid at a point, stream lines, path lines, steady and unsteady flows.

CO2: Analyze equations of motion of a fluid.

CO3: Apply the concept of sources, sinks and doublets, images in a rigid infinite plane, axi symmetric flows and stoke's stream function

CO4: Analyze some two-dimensional flows.

CO5: Analyze about Viscous flows.

Text Books

1. R.W. Fox and A.T. McDonald.Introduction to Fluid Mechanics, Wiley, 1985.

2. E. Krause, Fluid Mechanics with Problems and Solutions, Springer, 2005.

ReferenceBooks

1. B.S. Massey, J.W. Smith and A.J.W. Smith, Mechanics of Fluids, Taylor and Francis, New York, 2005

2 P. Orlandi, Fluid Flow Phenomena, Kluwer, New Yor, 2002.

3. T. Petrila, Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics, Springer, berlin, 2004.

4. F. Chorlton, Fluid Dynamics , CBS Publications. Delhi ,1985

Chapter 2. Sec 2.1 to 2.10

Chapter 3. Sec 3.1 to 3.7

Chapter 4 Sec 4.1, 4.2, 4.3, 4.5.

Chapter 5. Sec 5.1 to 5.8

Chapter 8. Sec 8.1 to 8.9

Websites

https://fyfluiddynamics.com/links/

Web Sources

http://web.engr.uky.edu/~acfd/me330-lctrs.pdf

DSE	NUMBER THEORY	L	T	P	Credits
		4	0	0	4

Course Objective

Number theory is one of the oldest branches of Mathematics. In this course we introduce the basic concepts of Number theory such as Divisibility, Congruences, Congruences with Prime Modulus, Quadratic reciprocity and some functions of Number Theory

UNIT I Divisibility

Divisibility :Divisibility- primes **12**

UNIT II Congruences

Congruences - Solutions of Congruences - Congruences of Degree I - The Function $\varphi(n)$- Congruences of Higher Degree - Prime Power Moduli. **12**

UNIT III Congruences with Prime Modulus

Prime Modulus - Congruences of Degree Two, Prime Modulus - Power Residues - Number Theory from an Algebraic Viewpoint - Multiplicative Groups, Rings and Fields. **12**

UNIT IV Quadratic Reciprocity

Quadratic residues-Quadratic reciprocity-The Jacobi Symbol -Quadratic forms, Sums of two squares. **12**

UNIT V Some Functions of Number Theory

Greatest Integer Function - Arithmetic Functions - The Mobius Inversion Formula - The Multiplication of Arithmetic Functions - Recurrence Functions. **12**

Total 60 Hours

Course outcome

At the end of this course the students will be able to,

CO1: Understand the concepts of divisibility and Primes.

CO2: Evaluate the Congruences

CO3: Describe power residue, multiplicative groups.

CO4: Apply Quadratic Residues and Reciprocity

CO5: Analyze Study greatest integer function and recurrence functions.

Text Book

I. Niven and H.S. Zuckerman, An Introduction to the Theory of Numbers, Wiley Eastern Limited, New Delhi, 1976.

Contents : Unit I: Chapter 1, Sections 1.1 to 1.3

Unit II: Chapter 2, Sections 2.1 to 2.6

Unit III: Chapter 2, Sections 2.7 to 2.11

Unit IV: Chapter 3, Sections 3.1 to 3.3

Unit V: Chapter 4, Sections 4.1 to 4.5

Reference books

1. Tom M. Apostol, Introduction to Analytic Number Theory, Springer Science & Business Media,1998.
2. David M. Burton, Elementary Number Theory, Tata McGraw-Hill Education, 2006.

3.Victor Soup, A Computational Introduction to Number Theory and Algebra, Cambridge University Press, 2008.

4. Andrew Weil, Number Theory for Beginners, Springer, 1979.

Websites

http://www.numbertheory.org/

Web Sources

http://joshua.smcvt.edu/numbertheory/book.pdf

DSE	CALCULUS OF VARIATIONS	L	T	P	Credits
		4	0	0	4

Course Objective

Give an account of the foundations of calculus of variations and of its applications in mathematics and physics; describe the brachistochrone problem mathematically and solve it; solve isoperimetric problems of standard type; solve simple initial and boundary value problems by using several variable calculus; formulate important results and theorems covered by the course; use the theory, methods and techniques of the course to solve problems; present mathematical arguments to others.

UNIT I: Functionals

Variations of a functional -Euler-Lagrange Equation - Necessary and sufficient conditions for extrema. **12**

UNIT II Boundry value problems

Variational Methods for boundary value problems in Ordinary and Partial differential equations. **12**

UNIT III Integral equations

Linear Integral equations of the first and second kind of Fredholm and Volterra type - Solutions with seperable kinds. **12**

UNIT IV Eigen functions

Characteristic numbers and eigen functions, resolvent kernal. **12**

UNIT V Singular integral equations

Symmetric Kernals and Singular integral equations. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Understand the basic concepts of variations of a functional, Euler-Lagrange equation and necessary and sufficient conditions for extrema.

CO2: Discuss about of variational methods for boundary value problems in ordinary and partial differential equations.

CO3:Apply the concept of linear integral equations of the first and second kind of Fredholm and Volterra type and Solutions with seperable kinds.

CO4: Analyze characteristic numbers and eigen functions, resolvent kernal.

CO5: Evaluate symmetric Kernals and singular integral equations.

Text Book

1.A.S. Gupta, Calculus of Variations with Applications Prentice. Hall of India, New Delhi, 1997.

Reference Books

1. L. Elsgolts, Differential Equations and the Calculus of Variations Mir Publishers, Moscow,1973
2. Ram P. Kanwal, Linear Integral Equations. Academic Press, New York,1971

Websites

https://mathworld.wolfram.com/CalculusofVariations.html

Web Sources

http://www.math.uni-leipzig.de/~miersemann/variabook.pdf

DSE	MATHEMATICAL STATISTICS	L	T	P	Credits
		4	1	0	5

Course Objective

Mathematics and statistics open doors in engineering, business, finance, computing, data sciences, health sciences, environmental sciences and public policy. They are also fascinating in their own right. Recent discoveries in the mathematical sciences have played an essential role in internet search algorithms, disease control, communications technology, climate modeling and much more. Mathematics and Statistics are among the most important disciplines in today's complex world, in part because they serve as the common language of science.

UNIT-I : Sample moments and their functions

Notion of a sample and a statistic - distribution of the arithmetic mean of independent mormally distributed random variables – The chi-square – distribution – The distribution of the statistics ($\bar{X}$,S) – Student's t – distribution – Fisher's Z – distribution – Snedecor's F – distribution – Distribution of sample mean from non-normal populations. **15**

UNIT-II: Significance Test

Kolmogorov Theorem – Smirnov Theorem – Concept of a statistical test - Parametric tests for small samples and large samples – Chi-square tests – Tests of Kolmogorov and Smirnov type – The Wald – Wilcoxon –Mann-Whitney tests – Independence Tests by contingency tables. **15**

.**UNIT-III : Estimation**

Preliminary notion – consistent estimation – Unbiased estimates – Sufficiency of an estimate – Efficiency of an estimate – Asymptotically most efficient estimates – methods of finding estimates – confidence Interval. **15**

UNIT-IV : Analysis Of Variance

One way of classification and two-way classification. Hypotheses Testing**:** The Power functions and OC function – Most Powerful test – Uniformly most powerful test - Unbiased test. **15**

UNIT-V: Sequential Analysis

SPRT – Auxiliary Theorem – Wald's fundamental identity – OC function and SPRT – The expected value of E(n) – Determination of A and B – Testing a hypothesis concerning the expected value m of a normal population. **15**

Total 75 Hours

Course Outcome

At the end of this course the students will be able to,

CO1 : Understand the basic concepts of notion of a sample and a statistic, distribution of the arithmetic mean of independent normally distributed random variables, the chi-square, distribution, the distribution of the statistics ($\bar{X}$,S) – Student's t – distribution, Fisher's Z – distribution, Snedecor's F- distribution and distribution of sample mean from non-normal populations.

CO2: Analyze Kolmogorov Theorem, Smirnov Theorem, concept of a statistical, Chi-square tests, tests of Kolmogorov and Smirnov type, the Wald, Wilcoxon, Mann-Whitney tests and Independence Tests by contingency tables.

CO3:Evaluate the concepts of preliminary notion, consistent estimation, unbiased estimates, sufficiency of an estimate, efficiency of an estimate, asymptotically most efficient estimates, methods of finding estimates and confidence Interval.

CO4: Analyze One way of classification and two-way classification, the power functions and OC function, most powerful test, uniformly most powerful test and unbiased test.

CO5: Analyze about SPRT, auxiliary theorem , Wald's fundamental identity, OC function and SPRT, the expected value of E(n), determination of A and B, testing a hypothesis concerning the expected value m of a normal population.

Text Books

M. Fisz , Probability Theory and Mathematical Statistics, John Wiley and New York,1963.

Chapter 9 :Sections 9.1 to 9.8

Chapter 10 :Section 10.11; Chapter 12 :Sections 12.1 to 12.7

Chapter 13 : Sections 13.1 to 13.8

Chapter 15 :Section 15.1 and 15.2

Chapter 16 : Sections 16.1 to 16.5

Chapter 17 :Sections 17.1 to 17.9

Reference Books

1. E.J. Dudewicz and S.N.Mishra , Modern Mathematical Statistics , John Wiley and Sons, New York, 1988
2. V.K. RohatgiAn Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern New Delhi, 1988(3rd Edn).
3. G.G. Roussas, A First Course in Mathematical Statistics, Addison Wesley Publishing Company, 1973
4. B.L. Vander Waerden, Mathematical Statistics, G. Allen &Unwin Ltd., London, 1968.

Websites

https://libguides.reading.ac.uk/mathematics/websites

Web Sources

http://www.ru.ac.bd/wp-content/uploads/sites/25/2019/03/201_04_01_Bijma-An-Introduction-to-Mathematical-Statistics-2017.pdf

DSE	GRAPH THEORY	L	T	P	Credits
		4	1	0	5

Course Objective

The objective of the course is to introduce students with the concepts in graph Theory, with a sense of some its modern applications. They will be able to use these methods in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.

UNIT -I: Graphs, Sub graphs and Trees

Graphs and simple graphs – Graph Isomorphism- The Incidence and Adjacency Matrices- Sub graphs- Vertex Degrees- Path and Connection – Cycles- Trees- Cut edges and Bonds – Cut vertices. **15**

UNIT -II: Euler tours and Hamilton Cycles

Introduction - Euler tours and Hamilton Cycles **15**

UNIT -III: Matchings, Edge Colorings:

Matchings and Coverings in Bipartite graphs- Edge Chromatic number – Vizing's theorem.**15**

UNIT –IV Independent sets and Cliques, Vertex Colorings

Independent sets- Ramsey's theorem- Chromatic number- Brooks' theorem- Chromatic polynomials. **15**

UNIT V Colorability

Introduction-Chromatic Number and Chromatic Index-The five color theorem-four color Problem-Chromatic Polynomials **15**

Total 75 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Understand concepts of graphs, sub graphs and graph Isomorphism, Adjacency, Incidence matrix, cycles, trees, cut edges, cut vertices.
CO2: Analyze the Euler tour, Hamiltonian Cycles.
CO3: Evaluate the Matching and Edge coloring of graphs.

CO4: Create the concept of Independent sets, Ramsey's theorem, Brooks theorem with applications.

CO5: Create the concept of finding Chromatic Number and Chromatic Index, The Four, Five color theorem with its applications.

Text Book

Graph Theory and Applications. J.A. Bondy and U.S.R. Murthy, Macmillan, London,1976.

Reference Books

1. R. Balakrishnan & K. Ranganathan (2012). A Textbook of Graph Theory. Springer.

2. Narsingh Deo (2016). Graph Theory with Applications to Engineering and Computer Science. Dover Publications.

3. Reinhard Diestel (2017). Graph Theory (5th edition). Springer.

4. Edgar G. Goodaire & Michael M. Parmenter (2018). Discrete Mathematics with Graph Theory (3rd edition). Pearson.

5. Douglas West (2017). Introduction to Graph Theory (2nd edition). Pearson

Websites

https://medium.com/basecs/a-gentle-introduction-to-graph-theory-77969829ead8

Web Sources

https://www.maths.ed.ac.uk/~v1ranick/papers/wilsongraph.pdf

DSE	MATHEMATICAL MODELING	L	T	P	Credits
		4	0	0	4

Course Objective

A primary purpose of any modeling course should be to develop students' capacity to solve problems through the use of mathematical models as a transferable process that will equip them to address novel problems in the future.

UNIT I Introduction to Mathematical Modeling

Introduction: Need, Techniques, Classifications and Characteristics of Mathematical Modeling – Mathematical Modeling through Geometry, Algebra, Trigonometry and Calculus. **12**

UNIT II Mathematical modeling through Ordinary differential equations of first order

Linear Growth and Decay Models – Non – Linear Growth and Decay models – Compartment models – Population Dynamics, Epidemics. **12**

UNIT III Mathematical modeling through Ordinary differential equations of second order

Planetary motions – Circular motion and motion of Satellites – Rectilinear motion – Electrical Circuits – Phillip's Stabilization model for a Closed Economy – The Catenary – A Curve of Pursuit. **12**

UNIT IV Mathematical modeling through difference equations

Simple models – Basic theory of linear difference equations with constant coefficients – Economics and Finance – Population Dynamics and Genetics – Probability theory. **12**

UNIT V Mathematical modeling through graphs

Problems that can be modeled through graphs– directed graphs – Signed graphs – weighted digraphs – unoriented graphs. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1: Understand the basic concepts of Need, Techniques, Classifications and Characteristics of mathematical modeling, mathematical modeling through geometry, algebra, trigonometry and Calculus.

CO2: Analyze mathematical modelling through ordinary differential equations of first order.

CO3:Apply the concept of mathematical modelling through ordinary differential equations of second order.

CO4: Create mathematical modelling through difference equations.

CO5: Analyze Mathematical modelling through graphs, directed graphs, signed graphs, weighted digraphs and in oriented graphs.

Text Book

J.N. Kapur, Mathematical Modeling, New Age International (P) Limited, Publishers,1998.

UNIT I : Chapter 1 –Section 1.1 to1.9

UNIT II : Chapter 2 – Section 2.1 to2.4

Chapter 3 – Section 3.1, 3.2

UNIT III : Chapter 4 – Section 4.1 to 4.4

UNIT IV : Chapter 5 – Section 5.1 to 5.6

UNIT V : Chapter 7 – Section 7.1 to 7.5

Reference books

J.N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East – West Press Pvt Limited, New Delhi,1981.

2. I.S.Luther and I.B.S.Passi, Algebra, Vol. I – Groups (1996); Vol. II Rings, (1999)

Narosa Publishing House , New Delhi.

3. N.Jacobson, *Basic Algebra*, Vol. I & II Hindustan Publishing Company, New Delhi.

Websites

https://www.mathworks.com/solutions/mathematical-modeling.html

Web Sources

https://www.math.colostate.edu/~gerhard/MATH331/331book.pdf

DSE	FUZZY SETS AND ITS APPLICATIONS	L	T	P	Credits
		4	0	0	4

Course Objective

Provide an understanding of the basic mathematical elements of the theory of fuzzy sets and an emphasis on the differences and similarities between fuzzy sets and classical sets theories. Explain the concepts of neural networks, fuzzy logic, and genetic algorithms.Enable students to Solve problems that are appropriately solved by neural networks, fuzzy logic, and genetic algorithms.

UNIT-I Crisp Sets

Basic Definitions - Operations on crisp sets – Properties of crisp set – Crisp relations- Operations on crisp relations – Properties of Crisp relations – Composition of Crisp relations - Characteristic Function-Exercises. **12**

UNIT – II Fuzzy Sets

Definition of Fuzzy sets - examples - Fuzzy numbers- Characteristics of a Fuzzy Set- Basic operations on fuzzy sets- Properties of Fuzzy sets- Membership functions-Algebraic product and Sum of Fuzzy Sets – Power and related operations on Fuzzy Sets – The extension Principle- Exercise. **12**

UNIT-III Fuzzy Relations

Definition of Fuzzy relation – Basic operations on Fuzzy relations – Direct product – Projections of a Fuzzy relation – Max-Min and Min-Max compositions – Fuzzy relations and approximate Reasoning – Exercise- Fuzzy relational equation-Problem partitioning – Solution method – Use of Neural network in Fuzzy relation. **12**

UNIT-IV Fuzzy control systems

Introduction – Fuzzy control structure - Modelling and control parameters – If….and….then rules – Rule evaluation – Conflict resolution – Defuzzification – Fuzzy controller with matrix Representation - Exercises. **12**

UNIT-V Applications

Fuzzy Control in Washing Machine – Fuzzy Decision making in forecasting – Fuzzy decision Making in industrial problems – Fuzzy control in traffic control – Fuzzy relational equation in medicine. **12**

Total 60 Hours

Course Outcome

At the end of this course the students will be able to,

CO1 :Understand the basic concepts of operations on crisp sets, properties of crisp set, Crisp relations, operations on crisp relations, properties of Crisp relations, composition of Crisp relations and characteristic Function-Exercises.

CO2: Understand definition of fuzzy, basic operations on fuzzy sets- properties of fuzzy sets, membership functions-algebraic product and sum of fuzzy sets, power and related operations on fuzzy sets and the extension principle- exercise

CO3:Analyze the concept of definition of fuzzy relation, projections of a fuzzy, fuzzy relations and approximate reasoning and use of neural network in fuzzy relation

CO4: Apply fuzzy control structure, modelling and control, conflict resolution, defuzzification and fuzzy controller with matrix representation.

CO5: Create fuzzy Control in a shing machine, fuzzy decision making in forecasting, fuzzy decision making in industrial problems, fuzzy control in traffic control and fuzzy relational equation in medicine.

Text Books

1. George J. Klir/Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India(2000).
2. George Bojadziev and Maria Bojadziev, Fuzzy Sets, Fuzzy Logic, Applications, World Scientific Publishing Co.Pte.Ltd, Singapore,1996.

Reference Books

1. George J. Klir and Tina A. Folger, Fuzzy Sets, Uncertainty and Information, Prentice-Hall of India1993.
2. Witold Pedrycz& Fernando Gomide, An introduction to Fuzzy Set, Prentice-Hall of India, NewDelhi.2005.
3. James J. Buckely, EsfandiarEslami, An introduction to Fuzzy Logic and Fuzzy Sets, Springer2002.
4. Abraham Kandel and Gideon Langholz, Fuzzy Control Systems, CRC Press, USA

Websites

https://www.springer.com/gp/book/9780792374350

Web Sources

https://cours.etsmtl.ca/sys843/REFS/Books/ZimmermannFuzzySetTheory2001.pdf

SKILL ENCHANCEMENT COURSE (SEC)

SEC	SOFTSKILLS – I	L	T	P	Credits
		2	0	0	2

Course Objective:

- To enable participants Business Communication Skills
- To enhance participants E-mail writing skills
- To impart Leadership and Team Bonding skills

1. READING COMPREHENSION AND VOCABULARY **06**

Filling the blanks – Cloze Exercise – Vocabulary building – Reading and answering Questions.

2. LISTENING AND ANSWERING QUESTIONS. **06**

Listening and writing – Listening and sequencing sentences – Filling in the blanks – Listening and answering questions.

3. GROUP DISCUSSIONS **06**

Why GD part of a selection process – Structure of a GD – strategies in GD – Team Work – Body Language

4. CONVERSATION. **06**

Face to face Conversation and Telephone conversation.

5. SELF- INTRODUCTION AND ROLE PLAY **06**

Total **30 Hours**

Course Outcome

At the end of this course the students will be able to,

CO 1 Prioritize power of understanding and aids assimilation of vocables. Vocabulary to charge communication with educated words

CO 2 Develop comprehensive knowledge through listening leading to answering questions

CO 3 Build observation power and infuse self-confidence through group discussions

CO 4 Identify methodology for befitting constructional ability

CO 5 Experiments with inward looking and visualization of the ‘otherness’ of situations

Books Recommended

- Barun K. Mitra. Personality Development and Soft Skills. Oxford University Press. New Delhi.2011.
- S.P. Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009.
- Tiko, Champa & Jaya Sasikumar. Writing with a Purpose.OUP. New Delhi. 1979

Web Source:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://blog.smarp.com/top-5-communication-skills-and-how-to-improve-them
- https://blog.hubspot.com/service/phone-etiquette

SEC	SOFTSKILLS – II	L	T	P	Credits
		2	0	0	2

Course Objective:

- To enable students to develop their communication skills effectively
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence through communication

1. PRESENTATION SKILLS **06**

Elements of an effective presentation – structure of presentation – voice modulation – Audience analysis – Body language

2. SOFT SKILLS **06**

Time Management – Articulateness – Assertiveness – Stress management

3. RESUME / REPORT PREPARATION / LETTER WRITING **06**

Structuring the resume / Report – Business letters – E-Mail Communication

4. INTERVIEW SKILLS **06**

Kinds of Interviews – Required by Skills – Corporate Culture – Mock Interviews

5. 30 FREQUENTLY ASKED QUESTIONS **06**

Total **30 Hours**

Course Outcome

At the end of this course the students will be able to,

CO1 Illustrate the essential of presentation skills, thoughts, structure, voice modulation, audience analysis and body language

CO2 Utilize the psychological skills pertaining to time management, articulation, assertion and stress management

CO3 Construct methodology for preparation of resume, reports, business letters and email communication

CO4 Appraise learners with varied skills needed for expose to interviews

CO5 Categorize the nature of questions asked usually in interviews

Books Recommended

- Barun K.Mitra. Personality Development and soft skills. Oxford University Press. New Delhi. 2011.
- S P Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.
- Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009.

Web Sources:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://www.businessnewsdaily.com/5836-top-interviewing-skills.html
- https://gdpi.hitbullseye.com/Group-Discussion.php

SEC	SOFTSKILLS – III	L	T	P	Credits
		2	0	0	2

Course Objective:

- To enable students to develop their soft skills and Body Language
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence to excel at Interviews

UNIT–I **06**

Powerful Presentation

UNIT–II **06**

Reinforcement

UNIT–III **06**

Using visual aids

UNIT–IV **06**

Types and Methods of Presentations

UNIT–V **06**

Obstacles to Presentation

Total **30 Hours**

Course Outcome:

CO1 To develop participants social and professional skills
CO2 To help participants manage time effectively
CO3 To build a strong resume to suit corporate requirements
CO4 To face interviews confidently
CO5 To enhance their aptitude abilities

Books Recommended:

- Roz Townsend: Presentation Skills for the Upwardly Mobile, Emerald, Chennai.
- Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Publishing Company Limited, 2001.
- Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

Web Sources:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://venngage.com/blog/presentation-skills/
- https://gdpi.hitbullseye.com/Group-Discussion.php