MANONMANIAM SUNDARANAR UNIVERSITY

Tirunelveli 627012, INDIA

DEPARTMENT OF MATHEMATICS

Vision of the University

To provide quality education to reach the un-reached

Mission of the University

- *To conduct research, teaching and outreach programmes to improve conditions of human living*
- *To create an academic environment that honours women and men of all races, caste, creed, cultures an atmosphere that values intellectual curiosity, pursuit of knowledge, academic freedom and integrity*
- *To offer a wide variety of off-campus educational and training programs, includingthe use of information technology, to individuals and groups.*
- *To develop partnership with industries and government so as to improve the quality of the workplace and to serve as catalyst for economic and cultural development*
- *To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressedand differently abled.*

Vision of the Department

To attain academic excellence at the international level at par with leading research institutions

Mission of the Department

To develop mathematical skills, knowledge and critical thinking in the minds of young students

Five Year Integrated M. Sc. Mathematics

Syllabus

For 2023-2024 onwards

CONTENTS

1. Introduction
2. Value Additions to the revamped curriculum
3. Curriculum Design & Structure of Course
4. Learning and Teaching Activities
5. Template for UG Programme in Mathematics
6. Illustrative Template Semester wise
7. Different Types of Courses
   - 7.1 Core Courses
   - 7.2 Elective Courses (Generic / Discipline Centric)
   - 7.3 Skill Development Courses
   - 7.4 Institution-Industry-Interaction
8. Core Component Model Syllabus

Introduction

Integrated M. Sc Mathematics: Programme Outcome, Programme Specific Outcome and Course Outcome

Mathematics is the study of quantity, structure, space and change, focusing on problem solving, with wider scope of application in science, engineering, technology, social sciences etc. The key core areas of study in Mathematics include Algebra, Analysis (Real & Complex), Differential Equations, Geometry, and Mechanics. The Master's Degree Integrated M.Sc. Mathematics is awarded to the students on the basis of knowledge, understanding, skills, attitudes, values and academic achievements expected to be acquired by learners at the end of the Programme. Learning outcomes of Mathematics are aimed at facilitating the learners to acquire these attributes, keeping in view of their preferences and aspirations for gaining knowledge of Mathematics.

Master's degree in Mathematics is the culmination of in-depth knowledge of algebra, calculus, geometry, differential equations and several other branches of Mathematics. This also leads to study of related areas like Computer science, Financial Mathematics, Statistics and many more. Thus, this programme helps learners in building a solid foundation for higher studies in Mathematics. The skills and knowledge gained have intrinsic aesthetics leading to proficiency in analytical reasoning. This can be utilised in Mathematical modelling and solving real life problems.

Students completing this programme will be able to present Mathematics clearly and precisely, make abstract ideas precise by formulating them in the language of Mathematics, describe Mathematical ideas from multiple perspectives and explain fundamental concepts of Mathematics to non-Mathematicians.

Completion of this programme will also enable the learners to join teaching profession, enhance their employability for government jobs, jobs in banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises. Those who seek admission to Integrated M.Sc. Mathematics Degree programme must have passed the Higher Secondary Examinations (+ 2) conducted by the Board of Higher Secondary Examination, Tamil Nadu with the subjects Mathematics, Physics and Chemistry or an equivalent programme of study with 60% of marks in Mathematics (55% for SC/ST/SCA applicants).

The syllabus for fourth and fifth years is same as that of two year M.Sc. Mathematics programme of the Department of Mathematics, Manonmaniam Sundaranar University.

Integrated M. Sc Mathematics

Programme Outcomes:

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO3: Problem Solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's earning to real life situations.

PO4: Analytical Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

PO5: Scientific Reasoning: Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open minded and reasoned perspective.

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

Integrated M. Sc Mathematics

Programme Specific Outcomes:

PSO1: Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics.

PSO2: Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.

PSO3: To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions. To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)can be carried out accordingly, assigning the appropriate level in the grids:

	POs							PSOs		
	1	2	3	4	5	6	…	1	2	…
CLO1										
CLO2										
CLO3										
CLO4										
CLO5										

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising mathematical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced mathematical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Mathematics based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Industrial Statistics course is newly introduced in the fourth semester, to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest - Artificial Intelligence.

1. **Value additions in the Revamped Curriculum:**

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Mathematics and simulating mathematical concepts to real world.	• Instil confidence among students • Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects
		• Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Training to girls leads to women empowerment
		• Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT tools
III, IV, V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domain knowledge • Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature • Students are exposed to Latest topics on Computer Science / IT, that require strong mathematical background • Emerging topics in higher education / industry / communication network / health sector etc. are introduced with hands-on-training, facilitates designing of mathematical models in the respective

		sectors
IV	Industrial Statistics	• Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
II year Vacation activity	Internship / Industrial Training	• Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	Project with Viva – voce	• Self-learning is enhanced • Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; 'Mathematics for Advanced Explain' component will comprise of advanced topics in Mathematics and allied fields, for those in the peer group / aspiring researchers; • 'Training for Competitive Examinations' –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: **For Advanced Learners / Honours degree**		• To cater to the needs of peer learners / research aspirants

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

2. Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credit and Hours Distribution System for Integrated M.Sc. Mathematics including Lab Hours

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	5
Part-2	English	3	5
Part-3	Core Courses & Elective Courses [in Total]	13	16
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	5
Part-2	English	3	5
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	16
Part-4	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		23	**30**

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	5
Part-2	English	3	5
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	16
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	1	1
		23	**30**

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	5
Part-2	English	3	5
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	16
Part-4	Skill Enhancement Course -SEC-6	1	1
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	E.V.S	1	1
		23	**30**

Third Year Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based	22	28
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	--
		26	**30**

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	18	25
Part -4	Professional Competency Skill	2	3
Part- 5	Extension Activity	2	2
		22	**30**

4. Credit Distribution for the first three years of Integrated M.Sc in Mathematics

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	5	Part..1. Language – Tamil	3	5	Part..1. Language – Tamil	3	5	Part..1. Language – Tamil	3	5	5.1 Core Course – \CC IX	4	5	6.1 Core Course – CC XIII	4	5
Part.2 English	3	5	Part..2 English	3	5	Part..2 English	3	5	Part..2 English	3	5	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	5
1.3 Core Course – CC I	4	5	2..3 Core Course – CC III	4	5	3.3 Core Course – CC V	4	5	4.3 Core Course – CC VII Core Industry Module	4	5	5. 3.Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	5
1.4 Core Course – CC II	4	5	2.4 Core Course – CC IV	4	5	3.4 Core Course – CC VI	4	5	4.4 Core Course – CC VIII	4	5	5. 4.Core Course –/ Project with viva-voce CC -XII	4	5	6.4 Elective - VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic/ Discipline Specific	5	6	2.5 Elective II Generic/ Discipline Specific	5	6	3.5 Elective III Generic/ Discipline Specific	5	6	4.5 Elective IV Generic/ Discipline Specific	5	6	5.5 Elective V Generic/ Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	1	4.6 Skill Enhancement Course SEC-6	1	1	5.6 Elective VI Generic/ Discipline Specific	3	4	6.6 Professional Competency Skill	2	3
1.7 Skill Enhancement - (Foundation Course)	2	2	2.7 Skill Enhancement Course –SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Extension Activity	2	2
						3.8 E.V.S.	1	1	4.8 E.V.S	1	1	5.8 Summer Internship /Industrial Training	2				
	23	**30**		**23**	**30**		**23**	**30**		**23**	**30**		**26**	**30**		**22**	**30**

1. Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	22	18	92
Part IV	4	4	4	4	4	2	22
Part V	-	-		-	-	2	2
Total	23	23	23	23	26	22	**140**

***Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

2. Integrated MSc Mathematics Curriculum Design for the first three years

First Year Semester-I

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	1.1 Language – **Tamil**	3	5
Part-II	1.2 Language – **English**	3	5
Part-III	1.3 Core Course – CCI **Algebra &Trigonometry**	4	5
	1.4 Core Course – CCII **Differential Calculus**	4	5
	1.5 Elective I – **Allied Physics with Practical**	T – 3 P - 2	T-3 P- 3
Part-IV	1.6 Skill Enhancement Course – SEC I **Mathematics for Competitive Examination-I**	2	2
	1.7 Foundation Course FC – **Bridge Mathematics**	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	2.1 Language - **Tamil**	3	5
Part-II	2.2 Language - **English**	3	5
Part-III	2.3 Core Course – CCIII **Analytical Geometry (2D & 3D)**	4	5
	2.4 Core Course – CCIV **Integral Calculus**	4	5
	2.5 Elective II - **Allied Physics with practical**	T – 3 P – 2	T-3 P- 3
Part-IV	2.6 Skill Enhancement Course – SEC II- **Computing skills (Office Automation)**	2	2
	2.7 Skill Enhancement Course – SEC III- **Web Application Development**	2	2
		23	**30**

Second Year Semester-III

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	3.1 Language **Tamil**	3	5
Part-II	3.2 Language **English**	3	5
Part-III	3.3 Core Course – CCV **Vector Calculus and Applications**	4	5
	3.4 Core Course – CCVI **Differential Equations and Applications**	4	5
	3.5 Elective III - **Programming in C with practical**	T – 2 P - 2	T-3 P- 2
Part-IV	3.6 Skill Enhancement Course (Entrepreneurial Based) SEC IV – **LaTex**	2	2
	3.7 Skill Enhancement Course – SECV - **Computational Mathematics**	2	2
	3.8 **Environmental Studies**	1	1
		23	**30**

Semester-IV

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	4.1 Language **Tamil**	3	5
Part-II	4.2 Language **English**	3	5
Part-III	4.3 Core Course – CCVII-**Industry Module – Industrial Statistics**	4	5
	4.4 Core Course – CCVIII - **Elements of Mathematical Analysis**	4	5
	4.5 Elective IV- **Programming in MATLAB with practical**	T – 2 P - 2	T-3 P- 2
Part-IV	4.6 Skill Enhancement Course –SEC VI- **Programming with SageMath**	2	2
	4.7 Skill Enhancement Course – SEC VII – **Mathematics for Competitive Examinations II**	2	2
	4.8 **Environmental Studies**	1	1
		23	**30**

Third Year Semester-V

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	5.1 Core Course CCIX - **Abstract Algebra**	4	5
	5.2 Core Course X - **Real Analysis**	4	5
	5.3 Core Course XI- **Mathematical Modelling**	4	5
	5.4 Core Course XII - **Project with Viva voce**	4	5
	5.5 Elective V – **Elementary Number Theory**	3	4
	5.6 Elective VI - **Mathematical Statistics**	3	4
Part-IV	5.7 **Value Education**	2	2
	5.8 Internship / Industrial Training (Summer vacation at the end of IV semester activity)	2	--
		26	**30**

Semester-VI

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	6.1 Core Course XIII - **Linear Algebra**	4	5
	6.2 Core Course XIV - **Complex Analysis**	4	5
	6.3 Core Course XV – **Mechanics**	4	5
	6.4 Elective VII – **Graph Theory & Applications**	3	5
	6.5 Elective VIII – **Optimization Techniques**	3	5
Part-IV	6.6 Professional Competency Skill (**Training in the following subjects for Competitive Examinations: Algebra and Linear Algebra, Real and Complex Analysis, Differential Equations, Sequence and Series)**	2	3
Part -V	6.7 Extension Activity	2	2
		22	**30**

Total Credits : 140

7.1 Topics in Core Component

- **Foundation Course FC – Bridge Mathematics**
- **Algebra & Trigonometry**
- **Differential Calculus**
- **Integral Calculus**
- **Analytical Geometry (2D & 3D)**
- **Vector Calculus and Applications**
- Differential Equations **and Applications**
- **Industry Module – Industrial Statistics**
- **Elements of Mathematical Analysis**
- Abstract Algebra
- Real Analysis
- Mathematical Modelling
- Project with Viva voce
- Linear Algebra
- Complex Analysis
- Mechanics

7.2 Group I -- Elective Courses (Generic)

- Allied Physics with Practical
- Allied Chemistry with Practical
- Programming in C with practical
- Matlab Programming with Practical
- Programming in C++ with practical
- Financial Mathematics
- Bio Statistics
- Data structures & Algorithms

Group II – Elective Courses (Discipline-centric)

- Elementary Number Theory
- Mathematical Statistics
- Graph Theory with Applications
- Optimization Techniques
- Numerical Methods with Applications
- Sampling Theory
- Special Functions with Applications
- Integral Transforms with Applications
- Discrete Mathematics
- Combinatorial Mathematics
- Astronomy
- Formal Languages & Automata Theory

7.3 Group III - Skill Enhancement Courses (SEC)

- Mathematics for Competitive examinations I
- Office Automation
- Web Application Development
- LaTeX
- Programming with SageMath
- Computational Mathematics
- Mathematics for Competitive examinations II
- R Programming
- Advanced Excel
- E- Commerce & Tally
- Android App Development

Integrated M.Sc. Mathematics
Core Component Model Syllabus

8. Syllabus for different Courses of Integrated M.Sc Mathematics

<table>
<tr><td>Title of the Course</td><td colspan="8">Foundation course - Bridge Mathematics</td></tr>
<tr><td>Paper Number</td><td colspan="8">FOUNDATION 1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">FC</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2">2</td><td colspan="2">-</td><td colspan="2">--</td><td colspan="2">2</td></tr>
<tr><td>Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td>Objectives of the Course</td><td colspan="8">To bridge the gap and facilitate transition from higher secondary to tertiary education;
To instil confidence among stakeholders and inculcate interest for Mathematics;</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="8">UNIT-I: Algebra: Binomial theorem, General term, middle term, problems based on these concepts</td></tr>
<tr><td colspan="8">Unit II: Sequences and series (Progressions). Fundamental principle of counting. Factorial n.</td></tr>
<tr><td colspan="8">Unit III: Permutations and combinations, Derivation of formulae and their connections, simple applications, combinations with repetitions, arrangements within groups, formation of groups.</td></tr>
<tr><td colspan="8">Unit IV: Trigonometry: Introduction to trigonometric ratios, proof of sin(A+B), cos(A+B), tan(A+B) formulae, multiple and sub multiple angles, sin(2A), cos(2A), tan(2A) etc., transformations sum into product and product into sum formulae, inverse trigonometric functions, sine rule and cosine rule</td></tr>
<tr><td colspan="8">Unit V: Calculus: Limits, standard formulae and problems, differentiation, first principle, uv rule, u/v rule, methods of differentiation, application of derivatives, integration - product rule and substitution method.</td></tr>
<tr><td>Recommended Text</td><td colspan="8">1. NCERT class XI and XII text books.
2. Any State Board Mathematics text books of class XI and XII</td></tr>
<tr><td>Website and e-Learning Source</td><td colspan="8">https://nptel.ac.in</td></tr>
</table>

Course Learning Outcome

After completion of this course successfully, the students will be able to

CLO 1: Prove the binomial theorem and apply it to find the expansions of any $(x + y)^n$ and also, solve the related problems

CLO 2: Find the various sequences and series and solve the problems related to them. Explain the principle of counting.

CLO 3: Find the number of permutations and combinations in different cases. Apply the principle of counting to solve the problems on permutations and combinations

CLO 4: Explain various trigonometric ratios and find them for different angles, including sum of the angles, multiple and submultiple angles, etc. Also, they can solve the problems using the transformations.

CLO 5: Find the limit and derivative of a function at a point, the definite and indefinite integral of a function. Find the points of min/max of a function.

Mapping of Course Learning Outcomes (CLOs) with Programme Learning Outcomes (PLOs) and Programme Specific Outcomes (PSOs)

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	1	1	1	1	1	1	1	1	1
CLO2	2	1	1	2	2	1	2	1	1
CLO3	2	1	1	2	2	1	2	1	1
CLO4	1	1	1	1	1	1	2	1	1
CLO5	1	1	1	1	1	1	2	1	1

Title of the Course	ALGEBRA & TRIGONOMETRY							
Paper Number	CORE 1							
Category: Core	Year: I		Credits: 4		Course Code			
	Semester: I							
Instructional Hours per week	Lecture		Tutorial		Lab Practice		Total	
	4		1		--		5	
Pre-requisite	12^{th} Standard Mathematics							
Objectives of the Course	1. Basic ideas on the Theory of Equations, Matrices and Number Theor 2. Knowledge to find expansions of trigonometry functions, sol theoretical and applied problems.							
Course Outline	**Unit I:** Reciprocal Equations-Standard form–Increasing or decreasing the roots of a given equation- Removal of terms, Approximate solutions of roots of polynomials by Horner's method – related problems.							
	Unit II: Summation of Series: Binomial– Exponential –Logarithmic series (Theorems without proof) – Approximations - related problems.							
	Unit III: Characteristic equation – Eigen values and Eigen Vectors-Similar matrices - Cayley – Hamilton Theorem (Statement only) - Finding powers of square matrix, Inverse of a square matrix up to order 3, Diagonalization of square matrices - related problems.							
	Unit IV: Expansions of $\sin n\theta$, $\cos n\theta$ in powers of $\sin\theta$, $\cos\theta$ - Expansion of $\tan n\theta$ in terms of $\tan\theta$, Expansions of $\cos^n\theta$, $\sin^n\theta$, $\cos^m\theta\sin^n\theta$ –Expansions of $\tan(\theta_1+\theta_2+,\ldots,+\theta_n)$-Expansions of $\sin\theta$, $\cos\theta$ and $\tan\theta$ in terms of θ - related problems.							
	Unit V: Hyperbolic functions – Relation between circular and hyperbolic functions Inverse hyperbolic functions, Logarithm of complex quantities, Summation of trigonometric series - related problems.							
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)							

Skills acquired from this course	Knowledge, problem solving, analytical ability, professional competency, professional communication and transferable skill.
Recommended Text	1. S. Burnstine and A.W. Panton, Theory of equations 2. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007 3. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005 4. C. V. Durell and A. Robson, Advanced Trigonometry, Courier Corporation, 2003 5. J . Stewart, L. Redlin, and S. Watson, Algebra and Trigonometry, Cengage Learning, 2012. 6. Calculus and Analytical Geometry, G.B. Thomas and R. L. Finny, Pearson Publication, 9th Edition, 2010.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs) Students will be able to

CLO 1: Classify and Solve reciprocal equations

CLO 2: Find the sum of binomial, exponential and logarithmic series

CLO 3: Find Eigen values, eigen vectors, verify Cayley – Hamilton theorem and diagonalize a given matrix

CLO 4: Expand the powers and multiples of trigonometric functions in terms of sine and cosine

CLO 5: Determine relationship between circular and hyperbolic functions and the summation of trigonometric series

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	-	-	-	3	2	1
CLO2	2	1	3	1	-	-	3	2	1
CLO3	3	1	3	1	-	-	3	2	1
CLO4	3	1	3	-	-	-	3	2	1
CLO5	3	1	3	-	-	-	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">DIFFERENTIAL CALCULUS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE M2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
4</td><td colspan="2">Tutorial
1</td><td colspan="2">Lab Practice
--</td><td>Total
5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">The basic skills of differentiation, successive differentiation, and their applications.
Basic knowledge on the notions of curvature, evolutes, involutes and polar co-ordinates and in solving related problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Successive Differentiation: Introduction (Review of basic concepts) – The n^{th} derivative – Standard results – Fractional expressions – Trigonometrical transformation – Formation of equations involving derivatives – Leibnitz formula for the n^{th} derivative of a product – Feynman's method of differentiation.</td></tr>
<tr><td colspan="7">UNIT-II: Partial Differentiation: Partial derivatives – Successive partial derivatives – Function of a function rule – Total differential coefficient – A special case – Implicit Functions.</td></tr>
<tr><td colspan="7">UNIT-III: Partial Differentiation (Continued): Homogeneous functions – Partial derivatives of a function of two variables – Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers.</td></tr>
<tr><td colspan="7">UNIT-IV: Envelope: Method of finding the envelope – Another definition of envelope – Envelope of family of curves which are quadratic in the parameter.</td></tr>
<tr><td colspan="7">UNIT-V: Curvature: Definition of Curvature – Circle, Radius and Centre of Curvature – Evolutes and Involutes – Radius of Curvature in Polar Co-ordinates.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002. 2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2010. 3. J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
Reference Books	1. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer- Verlag, New York, Inc., 1989. 2. Apostol, Calculus, Volumes I and II. Goldberg, Calculus and mathematical analysis.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with PLOs and PSOs) Students will be able to

CLO 1: Find the nth derivative, form equations involving derivatives and apply Leibnitz formula

CLO 2: Find the partial derivative and total derivative coefficient

CLO 3: Determine maxima and minima of functions of two variables and to use the Lagrange's method of undetermined multipliers

CLO 4: Find the envelope of a given family of curves

CLO 5: Find the evolutes and involutes and to find the radius of curvature using polar co-ordinates

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	-	-	-	3	2	1
CLO2	2	1	3	-	-	-	3	2	1
CLO3	3	2	3	2	-	-	3	2	1
CLO4	3	2	3	2	1	-	3	2	1
CLO5	3	2	3	2	1	-	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ANALYTICAL GEOMETRY (Two & Three Dimensions)</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE M3</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Necessary skills to analyze characteristics and properties of two- and three-dimensional geometric shapes.
• To present mathematical arguments about geometric relationships.
• To solve real world problems on geometry and its applications.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I: Pole, Polar - conjugate points and conjugate lines – diameters – conjugate diameters of an ellipse - semi diameters- conjugate diameters of hyperbola.</td></tr>
<tr><td colspan="6">UNIT-II: Polar coordinates: General polar equation of straight line – Polar equation of a circle given a diameter, Equation of a straight line, circle, conic – Equation of chord, tangent, normal. Equations of the asymptotes of a hyperbola.</td></tr>
<tr><td colspan="6">UNIT-III: System of Planes-Length of the perpendicular–Orthogonal projection.</td></tr>
<tr><td colspan="6">UNIT-IV: Representation of line–angle between a line and a plane – co – planar lines–shortest distance between two skew lines –length of the perpendicular–intersection of three planes.</td></tr>
<tr><td colspan="6">UNIT-V: Equation of a sphere-general equation-section of a sphere by a plane-equation of the circle- tangent plane- angle of intersection of two spheres- condition for the orthogonality- radical plane.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	1. S. L. Loney, Co-ordinate Geometry. 2. Robert J. T. Bell, Co-ordinate Geometry of Three Dimensions. 3. William F. Osgood and William C. Graustein, Plane and Solid Analytic Geometry, Macmillan Company, New York, 2016.
Reference Books	1. Calculus and Analytical Geometry, G.B. Thomas and R. L. Finny, Pearson Publication, 9th Edition, 2010. 2. Robert C. Yates, Analytic Geometry with Calculus, Prentice Hall, Inc., New York, 1961. 3. Earl W. Swokowski and Jeffery A. Cole, Algebra and Trigonometry with Analytic Geometry, Twelfth Edition, Brooks/Cole, Cengage Learning, CA, USA, 2010. 4. William H. McCrea, Analytical Geometry of Three Dimensions, Dover Publications, Inc, New York, 2006.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs) Students will be able to

CLO 1: Find pole, polar for conics, diameters, conjugate diameters for ellipse and hyperbola

CLO 2: Find the polar equations of straight line and circle, equations of chord, tangent and normal and to find the asymptotes of hyperbola

CLO 3: Explain in detail the system of Planes

CLO 4: Explain in detail the system of Straight lines

CLO 5: Explain in detail the system of Spheres

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	2	2	2	1	-	-	3	2	1
CLO2	2	2	2	1	-	-	3	2	1
CLO3	3	2	2	1	-	-	3	2	1
CLO4	3	2	3	1	-	-	3	2	1
CLO5	3	2	3	1	-	-	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">INTEGRAL CALCULUS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE M4</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
4</td><td colspan="2">Tutorial
1</td><td>Lab Practice
--</td><td>Total
5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Knowledge on integration and its geometrical applications, double, triple integrals and improper integrals.
• Knowledge about Beta and Gamma functions and their applications.
• Skills to Determine Fourier series expansions.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I: Reduction formulae -Types, integration of product of powers of algebraic and trigonometric functions, integration of product of powers of algebraic and logarithmic functions - Bernoulli’s formula, Feyman’s technique of integration.</td></tr>
<tr><td colspan="6">UNIT-II: Multiple Integrals - definition of double integrals - evaluation of double integrals – double integrals in polar coordinates - Change of order of integration.</td></tr>
<tr><td colspan="6">UNIT-III: Triple integrals –applications of multiple integrals - volumes of solids of revolution - areas of curved surfaces–change of variables - Jacobian.</td></tr>
<tr><td colspan="6">UNIT-IV: Beta and Gamma functions – infinite integral - definitions–recurrence formula of Gamma functions – properties of Beta and Gamma functions- relation between Beta and Gamma functions - Applications.</td></tr>
<tr><td colspan="6">UNIT-V: Geometric and Physical Applications of Integral calculus.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002. 2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007. 3. D. Chatterjee, Integral Calculus and Differential Equations, Tata-McGraw Hill Publishing Company Ltd.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs) Students will be able to

CLO 1: Determine the integrals of algebraic, trigonometric and logarithmic functions and to find the reduction formulae

CLO 2: Evaluate double and triple integrals and problems using change of order of integration

CLO 3: Solve multiple integrals and to find the areas of curved surfaces and volumes of solids of revolution

CLO 4: Explain beta and gamma functions and to use them in solving problems of integration

CLO 5: Explain Geometric and Physical applications of integral calculus

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	-	-	-	3	2	1
CLO2	3	1	3	-	-	-	3	2	1
CLO3	3	1	3	-	-	-	3	2	1
CLO4	3	1	3	-	-	-	3	2	1
CLO5	3	1	3	-	2	1	3	2	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">VECTOR CALCULUS AND ITS APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE M5</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
4</td><td colspan="2">Tutorial
1</td><td>Lab Practice
--</td><td>Total
5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Knowledge about differentiation of vectors and on differential operators. Knowledge about derivatives of vector functions.
• Skills in evaluating line, surface and volume integrals.
• The ability to analyze the physical applications of derivatives of vectors.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I: Vector point function - Scalar point function - Derivative of a vector and derivative of a sum of vectors - Derivative of a product of a scalar and a vector point function - Derivative of a scalar product and vector product.</td></tr>
<tr><td colspan="6">UNIT-II: The vector operator ‘del’, The gradient of a scalar point function - Divergence of a vector - Curl of a vector - solenoidal and irrotational vectors – simple applications.</td></tr>
<tr><td colspan="6">UNIT-III: Laplacian operator, Vector identities - Line integral - simple problems.</td></tr>
<tr><td colspan="6">UNIT-IV: Surface integral - Volume integral – Applications.</td></tr>
<tr><td colspan="6">UNIT-V: Gauss divergence Theorem, Stoke’s Theorem, Green’s Theorem in two dimensions – Applications to real life situations.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. J.C. Susan ,Vector Calculus, , (4th Edn.) Pearson Education, Boston, 2012.
2. A. Gorguis, Vector Calculus for College Students, Xilbius Corporation, 2014.
3. J.E. Marsden and A. Tromba ,Vector Calculus, , (5thedn.) W.H. Freeman, New York, 1988.</td></tr>
</table>

Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs) Students will be able to

CLO 1: Find the derivative of vector and sum of vectors, product of scalar and vector point function and to Determine derivatives of scalar and vector products

CLO 2: Applications of the operator 'del' and to Explain soleonidal and ir-rotational vectors

CLO 3: Solve simple line integrals

CLO 4: Solve surface integrals and volume integrals

CLO 5: Verify the theorems of Gauss, Stoke's and Green's(Two Dimension)

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	1	-	-	3	2	1
CLO2	3	2	3	1	2	-	3	2	1
CLO3	3	3	3	3	-	-	3	3	1
CLO4	3	3	3	3	-	-	3	3	1
CLO5	3	3	3	3	2	-	3	3	1

Title of the Course	**DIFFERENTIAL EQUATIONS AND APPLICATIONS**							
Paper Number	**CORE M6**							
Category	Core	**Year**	II	**Credits**	4	**Course Code**		
		Semester	III					
Instructional Hours per week	**Lecture**		**Tutorial**		**Lab Practice**		**Total**	
	4		1		--		5	
Pre-requisite	12^{th} Standard Mathematics							
Objectives of the Course	• Knowledge about the methods of solving Ordinary and Partial Differential Equations. • The understanding of how Differential Equations can be used as a powerful tool in solving problems in science.							
Course Outline	**UNIT-I:** Ordinary Differential Equations: Variable separable - Homogeneous Equation-Non-Homogeneous Equations of first degree in two variables -Linear Equation - Bernoulli's Equation-Exact differential equations.							

	UNIT-II: Equation of first order but not of higher degree: Equation solvable for dy/dx- Equation solvable for y-Equation solvable for x-Clairauts' form - Linear Equations with constant coefficients-Particular integrals of algebraic, exponential, trigonometric functions and their products.
	UNIT-III: Simultaneous linear differential equations- Linear Equations of the Second Order -Complete solution in terms of a known integrals-Reduction to the Normal form-Change of the Independent Variable-Method of Variation of Parameters.
	UNIT-IV: Partial differential equation: Formation of PDE by Eliminating arbitrary constants and arbitrary functions – complete integral – singular integral-General integral-Lagrange's Linear Equations –Simple Applications.
	UNIT-V: Special methods – Standard forms-Charpit's Methods – Simple Applications
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984. 2. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967. 3. G.F. Simmons, Differential equations with applications and historical notes, 2nd Ed, Tata Mcgraw Hill Publications, 1991.
Reference Books	1. D.A. Murray, Introductory course in Differential Equations, Orient and Longman 2. H.T. H. Piaggio, Elementary Treaties on Differential Equations and their applications, C.B.S Publisher & Distributors, Delhi,1985. 3. Horst R. Beyer, Calculus and Analysis, Wiley, 2010. 4. Braun, M. Differential Equations and their Applications. (3rd Edn.), Springer- Verlag, New York. 1983.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs) Students will be able to

CLO 1: Determine solutions of homogeneous equations, non-homogeneous equations of degree

one in two variables, solve Bernoulli's equations and exact differential equations

CLO 2: Find the solutions of equations of first order but not of higher degree and to Determine particular integrals of algebraic, exponential, trigonometric functions and their products

CLO 3: Find solutions of simultaneous linear differential equations, linear equations of second order and to find solutions using the method of variations of parameters

CLO 4: Form a PDE by eliminating arbitrary constants and arbitrary functions, find complete, singular and general integrals, to solve Lagrange's equations

CLO 5: Explain standard forms and Solve Differential equations using Charpit's method

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	1	-	3	2	1
CLO2	3	1	3	2	1	-	3	2	1
CLO3	3	1	3	2	1	-	3	3	1
CLO4	3	1	3	2	2	1	3	3	1
CLO5	3	1	3	2	2	1	3	3	1

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">INDUSTRIAL MATHEMATICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE M7</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="2">--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To bridge the gap between industry academia interface – to apply the theory learnt to industrial applications</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Core Industry Module / Industrial Mathematics can be designed as per HEI’s need.</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication, Transferrable Skill and designing mathematical models towards solving mathematical applications</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Papoulis A. Probability, Random Variables and Stochastic process, Tata McGraw Hill Education Pvt. Ltd., New Delhi
2. Baisnab A., Jas M., Elements of Probability and Statistics, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 1993
3. Fruend John E, Mathematical Statistics, Prentice Hall of India, New Delhi</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="6">https://nptel.ac.in</td></tr>
</table>

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ELEMENTS OF MATHEMATICAL ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE M8</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Identify and characterize sets and functions and Understand, test and analyze the convergence and divergence of sequences, series.
• Understand metric spaces with suitable examples</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I: Sets and Functions: Sets and elements- Operations on sets- functions- real valued functions- equivalence-countability- real numbers- least upper bounds.</td></tr>
<tr><td colspan="6">UNIT-II: Sequences of Real Numbers: Definition of a sequence and subsequence-limit of a sequence – convergent sequences–divergent sequences- bounded sequences-monotone sequences</td></tr>
<tr><td colspan="6">UNIT-III: Operations on convergent sequences – operations on divergent sequences – limit superior and limit inferior-Cauchy sequences.</td></tr>
<tr><td colspan="6">UNIT-IV: Series of Real Numbers: Convergence and divergence – series with non –negative terms-alternating series-conditional convergence and absolute convergence- tests for absolute convergence.</td></tr>
<tr><td colspan="6">UNIT-V: Limits and Metric Spaces: Limit of a function on a real line - Metric spaces - Limits in metric spaces – Continuous Functions on Metric Spaces: Function continuous at a point on there a line-Function continuous on a metric space.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	1. Richard R. Goldberg, Methods of Real Analysis: Oxford and IBH Publishing, (1 January 2020). 2. Ethan D. Bloch, The Real Numbers and Real Analysis, Springer, 2011. 3. G.M. The fundamentals of Mathematical Analysis, vol I. Pergamon Press, New York, 1965.
Reference Books	1. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002. 2. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd., 2000. 3. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983. 4. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Explain in detail about sets and functions, equivalence and countability and the LUB axiom

CLO 2: Explain Sequence and Subsequence of real numbers and to find the limit of sequence to test for convergent, divergent, bounded and monotone sequences

CLO 3: Explain the operations on convergent and divergent sequences and to Explain the concepts of limit superior and limit inferior and the notion of Cauchy sequences

CLO 4: Classify the series of real numbers and the alternating series and their convergence and divergence, the conditional convergence and absolute convergence and solve problems on convergence of the sequences

CLO 5: Explain about the metric spaces and functions continuous on a Metric space

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	2	3	2	-	3	2	1
CLO2	3	3	2	3	2	-	3	2	1
CLO3	3	3	3	3	2	-	3	2	1
CLO4	3	3	3	3	2	-	3	2	1
CLO5	3	3	2	3	2	-	3	2	1

<table>
<tr><td>Title of the Course</td><td colspan="6">ABSTRACT ALGEBRA</td></tr>
<tr><td>Paper Number</td><td colspan="6">CORE M9</td></tr>
<tr><td rowspan="2">Category Core</td><td>Year</td><td>III</td><td>Credits</td><td>4</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>V</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td>Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">• Concepts of Sets, Groups and Rings.
• Construction, characteristics and applications of the abstract algebraic structures</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="6">UNIT-I: Introduction to groups- Subgroups- cyclic groups and properties of cyclic groups- Lagrange’s Theorem-A counting principle – Examples</td></tr>
<tr><td colspan="6">UNIT-II: Normal subgroups and Quotient group- Homomorphism-Automorphism -Examples.</td></tr>
<tr><td colspan="6">UNIT-III: Cayley’s Theorem-Permutation groups - Examples</td></tr>
<tr><td colspan="6">UNIT-IV: Definition and examples of ring- Some special classes of rings- homomorphism of rings- Ideals and quotient rings- More ideals and quotient rings.</td></tr>
<tr><td colspan="6">UNIT-V: The field of quotients of an integral domain-Euclidean Rings - The particular Euclidean Ring – Examples</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td>Recommended Text</td><td colspan="6">Topics in Algebra–I.N.Herstein, Wiley Eastern Ltd. Second Edition (1st January 2006)</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.</td></tr>
<tr><td>Website and e-Learning Source</td><td colspan="6">https://nptel.ac.in</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Explain groups, subgroups and cyclic groups

CLO 2: Explain about Normal subgroup, Quotient groups, Homomorphisms and Automorphisms and verify the functions for homomorphism and automorphism properties

CLO 3: Explain Permutation groups and apply Cayley's theorem to problems

CLO 4: Explain Rings, Ideals and Quotient Rings and examine their structure

CLO 5: Discuss about the field of quotient of an integral domain and to Explain in detail about Euclidean Rings

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	2	3	1	-	3	3	1
CLO2	3	3	2	3	1	-	3	3	1
CLO3	3	3	2	3	2	-	3	3	1
CLO4	3	3	2	3	1	-	3	3	1
CLO5	3	3	2	3	2	-	3	3	1

Title of the Course	**REAL ANALYSIS**					
Paper Number	**CORE M10**					
Category Core	**Year**	II	**Credits**	4	**Course Code**	
	Semester	IV				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	1	--	5

Pre-requisite	12th Standard Mathematics
Objectives of the Course	• Real Numbers and properties of Real–valued functions. • Connectedness, Compactness, Completeness of Metric spaces. • Convergence of sequences of functions, Examples and counter examples
Course Outline	**UNIT-I:** Continuous Functions on Metric Spaces: Open sets– closed sets–Discontinuous function on R^1. Connectedness, Completeness and Compactness: More about open sets-Connected sets.
	UNIT-II: Bounded sets and totally bounded sets: Complete metric spaces- compact metric spaces, continuous functions on a compact metric space, continuity of inverse functions, uniform continuity.
	UNIT-III: Calculus: Sets of measure zero, definition of the Riemann integral, existence of the Riemann integral-properties of Riemann integral.
	UNIT-IV: Derivatives-Rolle's theorem, Law of mean, Fundamental theorems of calculus.

	UNIT-V: Taylor's theorem-Point wise convergence of sequences of functions, uniform convergence of sequences of functions.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Methods of Real Analysis-Richard R.Goldberg (John Wiley & sons, 2nd edition) (Indian edition –Oxford and IBH Publishing Co, New Delhi, 1st January 2020)
Reference Books	Principles of Mathematical Analysis by Walter Rudin, Tata McGraw Hill Education, Third edition (1 July 2017). Mathematical Analysis Tom M A postal, Narosa Publishing House, 2nd edition (1974), Addison-Wesley publishing company, New Delhi.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs) Students will be able to

CLO 1: Explain the concepts of Continuous and Discontinuous functions, open and close sets, Connectedness, Completeness and Compactness

CLO 2: Explain the concepts of bounded and totally bounded sets, continuity of inverse functions and Uniform continuity

CLO 3: Define the sets of measure zero, to Explain about the existence and properties of Riemann integral

CLO 4: Explain the concept of differentiability and to Explain Rolle's theorem, Law of mean, and Fundamental theorem of calculus

CLO 5: Explain the point wise and uniform convergence of sequence of function and to derive the Taylor's theorem

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	1	3	1	-	3	1	1
CLO2	3	3	1	3	1	-	3	1	1
CLO3	3	3	1	3	1	-	3	1	1
CLO4	3	3	1	3	1	-	3	1	1
CLO5	3	3	1	3	1	-	3	1	1

Title of the Course		**MATHEMATICAL MODELLING**						
Paper Number		**CORE M11**						
Category	Core	**Year**	II	**Credits**	4	**Course Code**		
		Semester	IV					
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**		**Total**
		4		1		--		5

Pre-requisite	12th Standard Mathematics
Objectives of the Course	Construction and Analysis of Mathematical models found in real life problems. Modelling through differential and difference equations
Course Outline	**UNIT-I:** Mathematical Modelling: Simple situations requiring mathematical modelling, characteristics of mathematical models.
	UNIT-II: Mathematical Modelling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.
	UNIT-III: Mathematical Modelling, through system of Ordinary differential equations of first order: Prey-predator models, Competition models, Model with removal and model with immigrations. Epidemics: simple epidemic model, Susceptible-infected- susceptible (SIS) model, SIS model with constant number of carriers. Medicine: Model for Diabetes Mellitus.
	UNIT – IV: Introduction to difference equations.
	UNIT-V: Mathematical Modelling through difference equations: Harrod Model, cob web model application to Actuarial Science
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	J N Kapur, Mathematical Modeling, New Age International publishers (2009).
Reference Books	1. Mathematical Modeling by Bimalk. Mishra and Dipak K.Satpathi. Ane Books Pvt. Ltd(1 Januuary 2009) 2. Mathematical Modeling Models, Analysis and Applications, by Sandip Banerjee, CRC Press, Taylor & Francis group, 2014 3. Mathematical Modeling applications with Geogebra by Jonas Hall & Thomas Ligefjard, John Wiley & Sons, 2017
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs) Students will be able to

CLO 1: Explain simple situations requiring Mathematical Modelling and to Determine the characteristics of such models
CLO 2: Model using differential equations in-terms of linear growth and Decay models
CLO 3: Model using systems of ordinary differential equations of first order, to discuss about various models under the categories 'Epidemics' and 'Medicine'
CLO 4: Explain in detail about difference equations
CLO 5: Model using difference equations

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	2	3	3	3	2	2	2	3	2
CLO2	2	3	3	3	2	2	2	3	2
CLO3	2	3	3	3	2	2	2	3	2
CLO4	3	2	2	2	-	1	2	3	2
CLO5	2	3	3	3	2	2	2	3	2

Title of the Course	**PROJECT WITH VIVA VOCE**					
Paper Number	**CORE M12**					
Category Core	**Year** III	**Credits**	4	**Course Code**		
	Semester V					
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
	4	-	--	4		

Title of the Course	**LINEAR ALGEBRA**					
Paper Number	**CORE M13**					
Category Core	**Year** II	**Credits**	4	**Course Code**		
	Semester IV					
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
	4	1	--	5		
Pre-requisite	12^{th} Standard Mathematics					
Objectives of the Course	• Vector Spaces, linear dependence and independence of vectors . Dual spaces, Inner product and norm – orthogonalization process. • Linear transformations. Various operators on vector spaces					
Course Outline	**UNIT-I:** Vector spaces – Subspaces – Linear Combinations and linear span - Systems of Linear equations – Homogenous Equations – Non-homogenous Equations – Elementary Matrices – Row reduced - Echelon form.					
	UNIT-II: Linear Dependence and Linear independence – Bases – Dimensions					

	UNIT-III: Linear transformations, null spaces and ranges – Matrix representation of a linear transformation –invertibility and isomorphisms – dual spaces
	UNIT – IV: Eigen values, eigen vectors, diagonalizability – invariant subspaces – Cayley– Hamilton theorem
	UNIT-V: Inner products and norms – Gram Schmidt Orthogonalization Process - Orthogonal complements
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Linear Algebra - Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5th edition (2018) Pearson
Reference Books	I.N.Herstein, Topics in Algebra, Wiley EasternLtd. Second Edition, 2006. N.S.Gopalakrishnan, University Algebra, New Age International Publications, Wiley Eastern Ltd. John B.Fraleigh, First course in Algebra, Addison Wesley. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs) Students will be able to
CLO 1: Acquire a detailed knowledge about vector spaces and subspaces
CLO 2: Explain the concepts of Linear Dependence, Linear Independence, Bases and Dimension of basis
CLO 3: Explain the concept of Linear Transformations, their Matrix representation and the notion of dual spaces
CLO 4: Find the Eigen values and Eigen vectors, to apply the concepts for diagonalisation
CLO5: Explain about Inner product and norms and to apply Gram Schmidt Orthogonalization Process to problems on inner product spaces

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	2	3	-	-	3	3	1
CLO2	3	3	3	3	-	-	3	3	1
CLO3	3	3	2	3	1	-	3	3	1

CLO4	3	3	3	3	-	-	3	3	1
CLO5	3	3	3	3	1	-	3	3	1

Title of the Course	**COMPLEX ANALYSIS**						
Paper Number	**CORE M14**						
Category Core	**Year** II		**Credits** 4		**Course Code**		
	Semester IV						
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**			
	4	1	--	5			
Pre-requisite	**12th Standard Mathematics**						
Objectives of the Course	• Apply concept and consequences of analyticity and C-R equations. • Understand the concept of mappings and transformations. • Compute complex contour integrals and applying Cauchy's integral in various versions. • Understand zeros and singularities of an analytic function, apply their properties in the evaluation of definite integral.						
Course Outline	**UNIT-I: Analytic functions**: Functions of a Complex variable –Limits –Theorem on limits –Continuity – Derivatives – Differentiation formulas – Cauchy Riemann equation – conditions for differentiability – Polar coordinates– Analytic functions– Harmonic functions.						
	UNIT-II: Conformal mapping: Mappings – Mapping by exponential function – Linear transformation – The transformation $w=\frac{1}{z}$– Mappings by $\frac{1}{z}$ – Linear fractional transformations (bilinear)						
	UNIT-III: Complex Integration: Contour integrals– Some examples – Simply and Multiply connected domains– Cauchy integral formula – Formula for derivatives– Liouville's theorem –Fundamental theorem of Algebra– Maximum modulus principle.						
	UNIT – IV: Sequences and Series: Convergence of sequences – Convergence of series– Taylor's series – Laurent series– Absolute and uniform convergence of power Series – Continuity of sums of power series–Integration & differentiation of power series						
	UNIT-V: Residues and Poles: Isolated singular points – Residues – Cauchy Residue theorem – Residue at infinity – The three types of isolated singular points – Residues at poles – Zeros of analytical functions – Zeros and poles – Evaluation of real improper integrals (excluding poles on the real axis).						
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)						
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill						

Recommended Text	Complex variables and application, Seventh Edition by James Ward Brown and Ruel V. Churchill, Mc-Graw Hill Book Co., International Edition, 2009.
Reference Books	Theodore W. Gamelan, Complex Analysis, Springer Verlag, 2008 Joseph Bak and Donald J. Newman, Complex analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997. Richard A. Silverman, Introductory Complex Analysis. Dover Publications, 1972. S. Ponnusamy and H. Silverman, Complex variables with applications, Birkhauser, 2006.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs) Students will be able to

CLO 1: Explain about analytic functions, their differentiation and continuity and to verify the Harmonic functions using analyticity conditions

CLO 2: Explain the concept of Conformal mappings and mappings by linear transformations and linear fractional transformations

CLO 3: Explain about the integrations of functions over simply and multiply connected domains and to derive the Cauchy integral formula, Liouvlle's theorem, Fundamental theorem of Algebra and Maximum Module Principle

CLO 4: Find the convergence the sequences and series, to derive Taylor's and Laurent's series

CLO 5: Find the nature of singularities, to find the residue of a given function at a given singular point, to Explain about zeros and poles and to evaluate real improper integrals (Excluding poles on the real axis)

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	2	1	-	3	3	2
CLO2	3	3	3	2	1	-	3	3	2
CLO3	3	3	3	2	1	-	3	3	2
CLO4	3	3	3	2	1	-	3	3	2
CLO5	3	3	3	2	1	-	3	3	2

Title of the Course	**MECHANICS**					
Paper Number	**CORE M15**					
Category Core	**Year** II	**Credits** 4	**Course Code**			
	Semester IV					
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
	4	1	--	5		
Pre-requisite	12th Standard Mathematics					

Objectives of the Course	Equilibrium of a particle under the action of given forces Simple Harmonic Motion Projectiles
Course Outline	**UNIT-I:** Force: Newton's laws of motion – Resultant of two forces on a particle - Equilibrium of a Particle: Equilibrium of a particle – Limiting equilibrium of a particle on an inclined plane.
	UNIT-II: Forces on a Rigid Body: Moment of a Force – General motion of a body – Equivalent systems of forces- Parallel Forces – Forces acting along a Triangle - A specific reduction of Forces: Reduction of coplanar forces into a force and couple – Problems involving frictional forces.
	UNIT-III: Work, Energy and Power: Work – Conservative field of force – Power -Rectilinear Motion under Varying Force: Simple Harmonic Motion - along a horizontal line – along a vertical line.
	UNIT – IV: Projectiles: Forces on a projectile – Projectile projected on an inclined plane
	UNIT-V: Central Orbits**:** General orbits – Central orbit – Conic as a centered orbit
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	A. Ruina and R. Pratap, Introduction to Statics and Dynamics, , Oxford University Press, 2014. S.L. Loney, The Elements of Statics and Dynamics, Cambridge University Press, 1904.
Reference Books	J.L. Meriam and L. G. Kraige, Engineering Mechanics: Statics, Seventh Edition,Wiley and sons Pvt ltd., New York, 2012. J.L. Meriam, L. G. Kraige, and J.N. Bolton, Engineering Mechanics: Dynamics, 8thedn, Wiley and sons Pvt ltd., New York, 2015. A. K. Dhiman, P.Dhinam and D. Kulshreshtha, Engineering Mechanics (Statics and Dynamics) ,McGraw Hill Education(India) Private Limited, New Delhi, 2015.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs) Students will able to

CLO 1: Define Resultant, Component of a Force, Coplanar forces, like and unlike parallel forces, Equilibrium of a Particle, Limiting equilibrium of a particle on an inclined plane.

CLO 2: Define Moment of a force and Couple with examples. Define Parallel Forces and Forces acting along a Triangle, Solve problems on frictional forces

CLO 3: Define work, energy, power, rectilinear motions under varying forces. Define Simple Harmonic Motion and find its Geometrical representation.

CLO 4: Define Projectile, impulse, impact and laws of impact. Prove that the path of a projectile is a parabola. Find the direct and oblique impact of smooth elastic spheres

CLO 5: Define central orbits, explain conic as centered orbits and solve problems related to central orbits

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	1	1	3	3	2
CLO2	3	2	3	2	1	1	3	3	2
CLO3	3	2	3	2	1	1	3	3	2
CLO4	3	2	3	2	1	1	3	3	2
CLO5	3	2	3	2	1	1	3	3	2

Group I: Elective Courses (Generic)

- **Allied Physics with Practical**
- **Allied Chemistry with Practical**
- **Programming in C with Practical**
- **Matlab Programming with Practical**
- **Programming in C++ with Practical**
- **Financial Mathematics**
- **Bio Statistics**
- **Data Structures & Algorithms**

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		PROGRAMMING IN C WITH PRACTICAL	**Generic Elective**	**4**	**3**	**-**	**2**	**4**

Course Objectives:

The course is designed to provide complete knowledge of C language with practicals in the computer Lab.

It imparts adequate knowledge on the need of programming languages and problem solving techniques

It makes the students get acquainted with the concept of structures and pointers in C.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	KnowledgeLevel Upto
CO1	remember the importance and functioning of C programming	**K1**
CO2	classify decision making and looping classes and apply the min programming	**K2, K3**
CO3	Implement the concept of arrays, pointers and structures with ethical coding standards	**K3**
CO4	develop an in-depth understanding of functional and logical concepts of C Programming	**K2**
CO5	choose the right data representation formats based on the requirements of the problem	**K4, K6**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : Constants - variables - Data types - operations and Expressions - managing input and output operations

Unit II : Decision making and branching - Decision making and looping

Unit III : Arrays - Handling of character strings

Unit IV: Structures and unions

Unit V : Pointers

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	3	2	1	-	3	3	2
CLO2	3	3	3	2	1	-	3	3	2
CLO3	3	3	3	2	1	-	3	3	2
CLO4	3	3	3	2	1	-	3	3	2
CLO5	3	3	3	2	1	-	3	3	2

Mean Overall Score: **2.10 High**

Level of correlation: **3**-High, **2**-Medium, **1**-Low

Recommended Text : Content and treatment as in
E. Balagurusamy, Programming in ANSI C, IV Edition, TMH Publishing Company, Ltd., 2008.
Unit I to V: Chapters 2 to 7 and 9 to 11.

Reference Books :

2. Y. P. Kanetkar, *Let Us C,* 15th Edition, BPB Publications, 2012.
3. B.Gottfried and J. Chhabra, Programming with C, 3rd Edition, Tata McGraw-Hill, 2010.
4. H. M.Deitel and P. J.Deitel, C - How to Program, 7th Edition, Prentice-Hall, 2012.

Webliography:

1. https://nptel.ac.in/courses/106/104/106104128/
2. https://nptel.ac.in/courses/106/105/106105171/

List of Practical

1. Solving the quadratic equation $ax^2+bx+c=0$.
2. Reading two matrices and printing their product.
3. Computing the sum of the digits and reverse the digits of an integer reading from the keyboard.
4. Finding the values of ***sin x,cos x,*** e^x to 0.0001% accuracy, using at least two user-defined functions.
5. Checking whether a given number is prime or not, using at least two user-defined functions.
6. Sorting a list of names in alphabetical order and sorting an array of numbers, using at least two user-defined functions
7. Calculating the standard deviation of an array of values, using at least two user-defined functions.
8. Defining a structure **mark** containing six subjects in a semester examination of a degree class and then calculating students- vice total and percentage of marks of students of the class.
9. Program which illustrates the method of sending an entire structure as a parameter to a function.
10. Reading a sorted array of integers and an integer value, and then inserting the value in its correct place, using pointers.

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
IV		MATLAB PROGRAMMING WITH PRACTICAL	**Generic Elective**	**5**	**3**	**-**	**2**	**4**

Course Objective

1. To develop deep knowledge on computing the numerical solutions of the abstract Mathematical problems.
2. To prepare students to write MatLab programming to find solutions for algebraic, transcendental and matrix equations.
3. To assist students to visualize the graph, surface of the given function.

Course Outcome

On completion of this course, the Students will be able to

Course Outcome No.	Course Outcome Details	Knowledge Level Upto
CO1	Develop MatLab program for the given abstract Mathematical problems.	K6
CO2	Compute the numerical solutions for the equations involving Matrices.	K3
CO3	Develop various techniques to solve polynomial and transcendental equations, numerically.	K3
CO4	Establish numerical methodology to compute derivatives and integrations.	K3
CO5	Apply MatLab to visualize the graphs (2D) and surfaces(3D) of the given function	K3
K1=Remember,K2=Understand, K3=Apply,K4=Analyze,K5=Evaluate,K6= Create		

Course Outline:

Unit I	Introduction to MatLab – Buildin Functions – Script Files – Programming Structure –Input and Output – Branching and Looping.
Unit II	Working with Matrices – Solving System of Linear Equations – Finding Eigen Values and Eigen Vectors of square matrices
Unit III	Solving Polynomial Equations – Transcendental Equations – Bisection Method – Newton Raphson Method
Unit IV	Differentiation and Integration
Unit V	Curves Plotting and Surface Plotting

Text Books

Rudra Pratap, *Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers*, Oxford University Press, 2010

References

1. Amos Gilat, MATLAB : An Introduction with Applications, Wiley Publications, 2008
2. B.R. Hunt, R.L. Lipsman, J. M. Rosenberg, A Guide to MatLab, Cambridge University Press, 2001
3. D.M. Etter, Introduction to MATLAB,Pearson Education India, 2014

Web-References

1. https://nptel.ac.in/courses/103106118

List of Practical

1.To find the roots of the quadratic polynomial.
2. To find the reciprocal roots of the polynomial.
3. To find the roots of the symmetric function.
4. To find the eigen value of the square matrix.
5. To find the eigen vector of the square matrix.
6. Solve the first order differential equation using MATLAB.
7. Solve the second order differential equation using MATLAB.
8. To find integration when limits are not given.
9. To find integration when limits are given.
10. Simple 2-D, 3-D plots by using MATLAB.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	-	-	-	3	2	1
CLO2	2	1	3	1	-	-	3	2	1
CLO3	3	1	3	1	-	-	3	2	1
CLO4	3	1	3	-	-	-	3	2	1
CLO5	3	1	3	-	-	-	3	2	1

Level of correlation: 3-High, **2**-Medium, **1**-Low

Course Code	**PROGRAMMING IN C++ WITH PRACTICAL**		**Credits 4**
Lecture Hours: (L) per week 3	**Tutorial Hours : (T) per week**	**Lab Practice 2 Hours: (P)per week**	**Total: (L+T+P) per week 5**
Course Category : Generic Elective	**Year & Semester:**		

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To engender an appreciation for the need and characteristics of Object-orientation.
- To impart knowledge of the C++ language grammar in order to design and implement programming solutions to simple problems by applying Object-oriented thinking.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Explain the various basic concepts of Object-orientation.

CO2: Write programs to implement static binding

CO3: Write programs to implement inheritance and dynamic binding

CO4: Write programs to implement templates and exception handling and learn how to use STL class library.

CO5: Write programs implementing File and Stream I/O.

Conceptualize a given simple problem in an Object-oriented way, design classes and write a program to solve the problem by applying the concepts of Object-orientation and features of C++. Find and fix bugs in a given program snippet. Determine the output of a given program snippet.

Recap: (not for examination) Motivation/previous lecture/ relevant portions required for the course) [This is done during 2 Tutorial hours)

Course Outline:

Unit I: Functions in C++.
Unit II: Classes and Objects.
Unit III: Constructors and Destructors- Operator overloading
Unit IV: Type conversions. Inheritance: Extending classes
Unit V: Pointers, \virtual Functions and Polymorphism.

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Learning Resources:

Recommended Texts

Objected Oriented Programming with C++ by E. Balagurusamy (Third Edition)

Reference Books

1. Bjarne Strousstrup, *The C++ Programming Language*, Addison Wesley, 2000.
2. J. P. Cohoon and J. W. Davidson, *C++ Program Design – An Introduction to Programming and Object-Oriented Design*, Second Edition, McGraw Hill, 1999.
3. C. J. Lippman, *C++ Primer*, Third Edition, Addison Wesley, 2000.

Web resources

List of Practical

1. Macro that obtains largest of three numbers.

2. Define a class of students and prepare a statement containing name, total marks of ranks (using functions).
3. Program to check whether a number/ string is a palindrome without using the corresponding standard function.
4. Define a class string and exhibit the use of string manipulations.
5. Create a class FLOAT that contains one float data. Overload all the four arithmetic operators so that they operate on the objects of FLOAT.
6. Define a class String. Use overload = = operator to compare two strings.
7. Program to illustrate interpolation of constructors when the classes are inherited.
8. Program to illustrate multilevel and multiple inheritance.
9. Program using array of functions.
10. Program using pointers to objects

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	-	-	-	3	2	1
CLO2	2	1	3	-	-	-	3	2	1
CLO3	3	2	3	2	-	-	3	2	1
CLO4	3	2	3	2	1	-	3	2	1
CLO5	3	2	3	2	1	-	3	2	1

Level of correlation: **3**-High, **2**-Medium, **1**-Low

Semester	Course Code	Title of the Course	Category	Hours /Week	L	T	P	C
		FINANCIAL MATHEMATICS	**Generic Elective**	**5**	**3**		**2**	**4**

Course Objective

1. To recall fundamentals of Probability theory and understand the geometric Brownian motion
2. To understand the Arbitration Theorem and the Black-Schole's Theorem in detail.

Course Outcomes (Cos)

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Understanding probability theory and analyze the Geometric Brownian Motion	**K2, K4**

CO2	Knowledge of Interest Rate and making fair present value analysis	**K4**
CO3	Examine pricing contracts by understanding and using Arbitrage	**K4**
CO4	Understanding Arbitrage theorem with various examples	**K3, K4**
CO5	Derive the Black-Schole's formula	**K3**
K1=Remember,K2=Understand, K3=Apply,K4=Analyze,K5=Evaluate,K6= Create		

Course Outline:	
Unit I	Basic Probability Theory – Geometric Brownian Motion
Unit II	Interest Rate and Present Value Analysis
Unit III	Pricing Contracts via Arbitrage
Unit IV	The Arbitrage Theorem
Unit V	The Black-Scholes Formula

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	1	-	-	3	2	1
CLO2	3	2	3	1	2	-	3	2	1
CLO3	3	3	3	3	-	-	3	3	1
CLO4	3	3	3	3	-	-	3	3	1
CLO5	3	3	3	3	2	-	3	3	1

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Books :

1. Sheldon M. Ross, An Introduction to Mathematical Finance : Options and Other Topics, Cambridge University Press, 1999

Further Readings :

1. Sheldon M. Ross, An Elementary Introduction to Mathematical Finance, Cambridge University Press, 2011
2. I. Karatzas and S.E.Shreve, Methods of Mathematical Finance, Springer, 1998

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		BIO STATISTICS	**Generic Elective**	**5**	**3**	**-**	**2**	**4**

Course Objectives:

To teach students the basic principles of statistics, data types, and collection of data.

To make students understand the various methods of data presentation and measures of central tendency.

To make students understand the basic concepts of probability and Probability distribution.

Course Outcomes (COs): On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Remember and understand the basic principles of statistics, data types, and collection of data	K1&K2
CO2	Analyze and apply various methods of data presentation.	K3&K4
CO3	Understand and appraise the measures of central tendency and dispersion.	K2,K4&K5
CO4	Analyze and evaluate probabilityandprobabilitydistribution.	K4&K5
CO5	Design and develop the testing of the hypothesis and its applications.	K6
CO6	Develop statistical tools to validatetheresearchdata	K6
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

UNITI:

Data types and collection: Types of data, collection of data; primary and secondary data; classification and graphical representation of statistical data; methods ofclassificationofdata;datacollectionmethodsandsource;samplingmethods;types,size,anddetermination ofsample size.

UNITII:

Presentation of data: Data organization: Classes, class intervals, class limits, mid-value, inclusive and exclusive method; data-types of graph: line frequency graph, histogram, frequency polygon, kite diagram, Frequency curves, cumulative frequencycurve,scatterdiagram;diagrammaticpresentationofdata:bargraphandpiediagram.

UNITIII:

Measuresofcentraltendencyanddispersion:Arithmeticmean,median,mode;range, coefficient of range; mean deviation, standard deviation; variance, coefficient of variance; degree of freedom; measures of skewness moments and kurtosis.

UNITIV:

Probability and Probability distribution: Definition of probability, simple event, mutually exclusive event, non-mutually exclusive event; theorems of probability :additive and multiplicative rule; permutation and combination; compound probability;Bayestheorem,elementaryideasofbinomial,Poisson,andnormaldistributionsassumption,meanandstandarddeviationforalldistribution.

UNITV:

Test of hypothesis: Methods of sampling; confidence level, critical region, testing of hypothesis and standard error; large sample test and small sample test; problems on the test of significance; t-test; chi-square test for goodness of fit and analysis of variance(ANOVA).

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	1	-	3	2	1
CLO2	3	1	3	2	1	-	3	2	1
CLO3	3	1	3	2	1	-	3	3	1
CLO4	3	1	3	2	2	1	3	3	1
CLO5	3	1	3	2	2	1	3	3	1

Level of correlation: 3-High, **2**-Medium, **1**-Low

Recommended Textbooks

1. Bernard Rosner. Fundamentals of Biostatistics, Seventh Edition, CengageL earning, 2010.
2. Veer Bala Rastogi, Fundamentals of Biostatistics, Second Edition, Ane Books. Pvt. Ltd, 2010.

Web Resources

MOOC, SWAYAM, NPTEL, online and e-resources

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3469943/

Course Code:	**DATA STRUCTURES & ALGORITHMS**		**Credits: 4**
Lecture Hours: (L) per week: 3	**Tutorial Hours : (T) per week**	**Lab Practice 2 Hours: (P)per week**	**Total: (L+T+P) per week: 5**
Course Category : Generic Elective	**Year & Semester:**		
Pre-requisite	Basic knowledge in data and representations		
Links to other Courses			

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To impart the basic concepts of data structures and algorithms.
- To acquaint the student with the basics of the various data structures and make the students knowledgeable in the area of data structures.
- This course also gives insight into the various algorithm design techniques

Course Outcomes: (for students: To know what they are going to learn)

CO1: To introduce the concepts of Data structures and to understand simple linear data structures.

CO2: Learn the basics of stack data structure, its implementation and application

CO3: Use the appropriate data structure in context of solution of given problem and demonstrate a familiarity with major data structures.

CO4: To introduce the basic concepts of algorithms

CO5: To give clear idea on algorithmic design paradigms like Dynamic Programming, Backtracking, Branch and Bound

Recap: (not for examination) Motivation/previous lecture/ relevant portions required for the course) [This is done during 2 Tutorial hours)

Course Outline:

UNIT I: Data Structures: Definition- Time & Space Complexity, arrays, sparse matrix and its representation, Arrays: Representation of arrays, Applications of Linear list: Singly linked list implementation, insertion, deletion and searching operations on linear list Circular linked list: implementation, Double linked list implementation, insertion, deletion and searching operations. Applications of linked lists- Dynamic Storage management.

UNIT II: Operations, array and linked representations of stack, stack applications, infix to postfix conversion, postfix expression evaluation, recursion implementation

UNIT III: Queues: operations on queues, array and linked representations. **Circular Queue:** operations,, applications of queues. **Trees:** Definitions and Concepts- Representation of binary tree, Binary tree traversals (Inorder, Postorder , preorder), Binary search trees, **Graphs** : Representation of Graphs- Types of graphs -Breadth first traversal – Depth first traversal- -Applications of graphs –

UNIT IV: Definition of Algorithms- Overview and importance of algorithms- pseudocode conventions, Asymptotic notations, practical complexities.**Divide-and-Conquer:** : General Method – Binary Search- Quick Sort- Merge Sort.**Greedy Method:** General method- Knapsack problem- Tree vertex splitting- Job sequencing with deadlines

UNIT V: Dynamic programming: General method, Multistage Graphs, All pairs shortest path, Single source shortest path. **Backtracking:** General method, 8 Queens, Graph coloring, Hamiltonian cycle. **Branch & Bound**: General method, Travelling salesperson problem.

Extended Professional Component	Questions related to the above topics, from variouscompetitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from the Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication andTransferrable Skill

Learning Resources:

Recommended Texts

1. Ellis Horowitz , Sartaj Sahni, Susan Anderson Freed, Second Edition , Fundamentals of Data in C, Universities Press.
2. E. Horowitz, S. Sahni and S. Rajasekaran, Second Edition , Fundamentals of Computer Algorithms, Universities Press.

Reference Books

1. Seymour Lipschutz ,Data Structures with C, First Edition, Schaum's outline series in computers, Tata McGraw Hill.
2. R.Krishnamoorthy and G.Indirani Kumaravel, Data Structures using C, Tata McGrawHill, 2008.
3. A.K.Sharma, Data Structures using C , Pearson Education India,2011.
4. G. Brassard and P. Bratley, "Fundamentals of Algorithms", PHI, New Delhi, 1997.
5. A.V. Aho, J.E. Hopcroft, J.D. Ullmann,, "The design and analysis of Computer
6. Algorithms", Addison Wesley, Boston, 1974.

Web resources: Web resources from NDL Library, E-content from open source libraries

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	2	3	2	-	3	2	1
CLO2	3	3	2	3	2	-	3	2	1
CLO3	3	3	3	3	2	-	3	2	1
CLO4	3	3	3	3	2	-	3	2	1
CLO5	3	3	2	3	2	-	3	2	1

Level of correlation: 3-High, **2**-Medium, **1**-Low

Group II – Elective Courses (Discipline-centric)

- **Elementary Number Theory**
- **Mathematical Statistics**
- **Graph Theory with Applications**
- **Optimization Techniques**
- **Numerical Methods with Applications**
- **Sampling Theory**
- **Special Functions with Applications**
- **Integral Transforms with Applications**
- **Discrete Mathematics**
- **Combinatorial Mathematics**
- **Astronomy**
- **Formal Languages & Automata Theory**

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		ELEMENTARY NUMBER THEORY	**Elective**	**4**	**4**	**-**	**-**	**3**

Course Objectives:

1. This course was studied for its long and rich history.
2. It is well known for its wealth of easily accessible and fascinating questions, and its intellectual appeal.
3. In recent years it has been studied for the reason that it has become essential for Cryptology.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	define, interpret and apply the concepts and principles of number theory to perform numerical and symbolic computations	**K1, K6**
CO2	apply different types of proof writing techniques in number theory to related situations	**K2, K5**
CO3	develop an in-depth understanding of number theoretic functions	**K1**
CO4	communicate the number theory concepts, techniques and principles effectively in both written and oral form	**K2, K4**
CO5	understand the concept of congruence and apply it to various results	**K3**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : Divisibility Theory in the Integers: Early number theory-the division algorithm-the greatest common divisor-the Euclidean algorithm **(9 hrs)**

Unit II : The Diophantine equation - Primes and their distribution: The fundamental theorem of Arithematics-the Sieve of Eraosthenes - the Goldbach conjecture. **(9 hrs)**

Unit III : The theory of congruences: basis properties of congruences - binary and decimal representations of integers - linear congruences and the Chinese remainder theorem. **(9 hrs)**

Unit IV: Fermat's theorem: Fermat's Little theorem and Pesudoprimes - Wilson theorem - The Fermat-Kraitchik factorization method. **(9 hrs)**

Unit V : Number theoretic functions: the sum and number of divisors - the Mobius inversion function - the greatest integer function. **(9 hrs)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	1	3	1	-	3	1	1
CLO2	3	3	1	3	1	-	3	1	1
CLO3	3	3	1	3	1	-	3	1	1
CLO4	3	3	1	3	1	-	3	1	1
CLO5	3	3	1	3	1	-	3	1	1

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

David M. Burton, Elementary number theory, Seventh Editions, Tata McGraw-Hill, New Delhi (2012).

Unit I to Unit V: Sections: 2.1 to 2.5, 3.1 to 3.3, 4.2 to 4.4, 5.2 to 5.4, 6.1 to 6.3

Reference Books:

1. K. Ireland and M. Rosen, A Classical Introduction to Modern Number Theory, 2nd ed., New York: Springer-Verlag, 2010.
2. G. A. Jones And J. Mary Jones, Elementary Number Theory, Springer (India) Pvt. Ltd., 1999.
3. J. H. Silverman, A Friendly Introduction To Number Theory, Pearson Prentice Hall, 2006.

Webliography: https://nptel.ac.in/courses/111/101/111101137/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		MATHEMATICAL STATISTICS	**Elective**	**4**	**4**	**-**	**-**	**3**

Course Objectives:

1. To enable the student to understand the basic concepts and terminology in statistics.

2. To administer the students the knowledge of frequency distributions and how they are used in statistical analysis.
3. To help them identify the proper measure of central tendency to use for each level of measurement.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	memorize formulas for central tendencies and measures of dispersion	**K1**
CO2	Estimate moments, skewness and kurtosis and able to fit any given curve	**K2**
CO3	Administer knowledge of correlation and regression and their properties	**K3**
CO4	Appraise knowledge of discrete probability distributions	**K5**
CO5	Appraise knowledge of continuous probability distributions	**K5**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Central tendencies - arithmetic mean - partition values - mode - geometric mean and harmonic mean - measures of dispersion **(9 hours)**

Unit II: Moments, Skewness and Kurtosis - Curve fitting - Method of least squares -Fitting lines - Parabolic, Exponential and logarithmic curves. **(9 hours)**

Unit III: Correlation and regression - Scatter diagram - Karl Pearson's coefficient of correlation - Properties - Lines of regression, Regression coefficient and properties - Rank correlation. **(9 hours)**

Unit IV: Discrete Probability Distributions: Geometric, Binomial and Poisson distributions - Their moment generating function, Characteristic function, Properties and simple application. **(9 hours)**

Unit V: Continuous Probability Distributions: Beta and Gamma Distributions, Normal distribution - Standard normal distribution - Their properties - Simple Problems - Importance of normal distribution. **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	1	3	1	-	3	1	1
CLO2	3	2	1	3	1	-	3	1	1
CLO3	3	2	1	3	1	-	3	1	1
CLO4	3	2	1	3	1	-	3	1	1
CLO5	3	2	1	3	1	-	3	1	1

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Arumugam and A. Thangapandi Isaac, *Statistics* - New gamma publishing house, June 2007

Unit I to V: Chapters 2 (2.1 - 2.4) Chapter 3 (3.1), 4, 5, 6, 8 and 13.

Reference Books:

1. Irwin Miller &Marylees Miller, John E. Freund's Mathematical Statistics with Applications (8th edition). Pearson. Dorling Kindersley Pvt. Ltd. India, 2014.
2. Jim Pitman, Probability, Springer-Verlag, 1993.
3. Sheldon M. Ross, Introduction to Probability Models (11th edition). Elsevier 2014.

Webliography: https://seamk.libguides.com>eresources>mobileaccess

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
VI		**GRAPH THEORY WITH APPLICATIONS**	**Core**	**4**	**4**	**-**	**-**	**3**

Course Objectives:

1. This course is a new branch of Mathematics which got its due recognition because of its diverse applications in computer science, chemistry, sociology.
2. It is a part of Discrete Mathematics which deals with a finite set of objects.
3. Upon successful completion of this course, the students will able to use graph theory as a modelling to solve real life problems.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	understand fundamental concepts of graphs, graph operations and related results	**K2**
CO2	familiarized with the concepts and results on Eulerian graphs and Hamiltonian graphs	**K1**
CO3	Write precise and accurate mathematical definitions of basic concepts in graph theory	**K3**
CO4	gain knowledge in the concepts of trees and spanning trees	**K1, K2**
CO5	Infer the results on planar graphs and their properties	**K1, K2**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : Definition and Examples of Graphs - Degrees - subgraphs - isomorphism - independent sets and coverings - intersection graphs and line graphs - matrices - operation on graphs (12 hrs)

Unit II : Degree sequences - Graphic sequences - Walks - Trials and Paths - connectedness and components - connectivity. (12 hrs)

Unit III : Eulerian graphs - Hamiltonian graphs - characterization of trees - centre of a tree - Matchings (12 hrs)

Unit IV: Definition and Properties of planar graphs - characterization of planar graphs - chromatic number and chromatic index. (12 hrs)

Unit V : Chromatic polynomials - definition and basic properties of digraphs - paths and connectedness in digraphs - digraphs and matrices (12 hrs)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	1	3	1	1	3	-	1
CLO2	3	3	1	3	1	1	3	-	1
CLO3	2	3	1	3	1	1	3	-	2
CLO4	2	3	1	3	1	1	3	-	2

CLO5	2	3	1	3	3	2	3	1	3

Level of correlation: 3-High, **2**-Medium, **1**-Low

Recommended Text Book:

S. Arumugam and S. Ramachandran, Invitation to Graph Theory, Sci-Tech Publications Pvt. Ltd., 2001. Unit I – V: Chapters 2 to 10.

Reference Books:

1. R. Balakrishnan and K. Ranganathan, A Textbook of Graph Theory, New Delhi: Springer, 2008.
2. G. Chartrand and P. Chang, Introduction to Graph Theory, New Delhi: Tata McGraw-Hill, 2006.
3. F. Harary, Graph Theory, New Delhi: Narosa, 2001.

Webliography: https://nptel.ac.in/courses/111/106/111106102/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		OPTIMIZATION TECHNIQUE	**Elective**	**4**	**4**	**-**	**-**	**3**

Course Objectives:

1. The aim of this course is to introduce students to linear optimization theory and its applications. The field of linear programming provides the appropriate methods for the efficient computation of optimal solutions of a problem which is modelled by a linear objective function and a set of linear constraints.
2. To appropriately formulate Linear Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these LP problems.
3. To appropriately formulate Integer Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these IP problems

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto

CO1	Formulate a given simplified description of a suitable real-world problem as a linear programming model in general, standard and canonical forms	**K6**
CO2	Use the simplex method to solve small linear programming models by hand, given a basic feasible point.	**K3**
CO3	Distinguish simple method and dual simplex method.	**K4**
CO4	Formulate and solve the transportation problems using both manual methods and the Excel Solver, and interpret the solutions.	**K6**
CO5	Understand the theory of valid inequalities and how it applies to the solution of integer programs.	**K2**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Definition - examples - Mathematical formulation - Standard form - Theorems (statements only) - Graphical solution - simplex method. **(9 hours)**

Unit II: The Big-M method - Two phase simplex method **(9 hours)**

Unit III: Duality - The dual of the dual is the primal - Duality theorems (Statements only) - Dual simplex method. **(9 hours)**

Unit IV: Transportation problem - Mathematical formulation - North west corner rule - method of matrix minima - Vogel's Approximation method - MODI optimality test - Assignment problem. **(9 hours)**

Unit V: Integer Programming: Gomory's cutting plane method - Branch and bound method. **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	1	3	-	3	3	1	3	1	1
CLO2	1	3	-	3	3	1	3	1	1
CLO3	1	3	-	3	2	1	3	1	1
CLO4	1	3	2	3	2	1	2	1	1
CLO5	1	3	2	3	3	1	2	1	1

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, 2014.

Unit I to V: Relevant Sections from Chapters 2, 3, 4, 6, 7 and 14.

Reference Books:

1. J K Sharma, Operations Research, Theory and Applications, Third Edition, Macmillan Publications India, 2007.
2. Frederick S. Hillier, Gerald J. Lieberman, Bodhibrata Nag, PreetamBasu, Introduction to Operational Research, Tama McGraw Hill Ltd., New Delhi, 2012.

   S. D. Sharma, Operations Research - Theory, Methods and Applications, Kedar Nath Ram Nath, 2014.

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		NUMERICAL METHODS WITH APPLICATIONS	**Elective**	**4**	**4**	**-**	**-**	**3**

Course Objectives:

1. The aim of this course is to develop the skills in solving algebraic, transcendental, differential and integral equations numerically prerequisite.
2. To perform an error analysis for various numerical methods and derive appropriate numerical methods to solve definite integrals.
3. The outcome of the course is enabling the students to get numerical (approximate) solutions wherever analytic (exact) solutions are not possible.

Course Outcomes (COs): On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Solve algebraic and transcendental equations using appropriate numerical methods and approximate a function using appropriate numerical methods.	**K2**
CO2	Derive numerical methods for various mathematical operations and tasks such as interpolation, differentiation, integration and the solution of linear and nonlinear equations	**K3**
CO3	Analyze and evaluate the accuracy of common numerical methods.	**K4**
CO4	Evaluate and interpret results on real life problems using appropriate numerical techniques.	**K5**
CO5	Solve algebraic and transcendental equations using appropriate numerical methods and approximate a function using appropriate numerical methods.	**K2**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Errors in Numerical Calculations: Errors and their computations - A general error formula - Error in a series. Approximation Solution of Algebraic and Transcendental equations:

The Bisection method - The Method of False position - Iteration method - Newton - Raphson method. **(9 hours)**

Unit II: Interpolation: Finite differences - Forward Differences - Backward Differences - Central Differences - Symbolic Relations and Separation of Symbols. Newton‘s Formulae for Interpolation - Gauss‘s central difference formulae - Stirling‘s formula - Interpolation with unevenly spaced points: Lagrange‘s interpolation formula - Inverse Interpolation. **(9 hours)**

Unit III: Numerical Differentiation: Derivatives using Newton‘s Forward Difference Formula - Derivatives using Newton‘s Backward Difference Formula - Derivatives using Stirling‘s Formula - Maxima and Minima of Tabulated Function. **(9 hours)**

Unit IV: Numerical Integration: General Quadrature Formula - Trapezoidal Rule - Simpson‘s 1/3 Rule - Simpson‘s 3/8 Rule. **(9 hours)**

Unit V: Numerical Solutions of System of Linear Equations: Gauss elimination method - Gauss - Jordan method - Jacobi‘s method - Gauss - Seidel method. **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	1	3	2	1	2	1	-
CLO2	3	2	1	3	2	1	2	1	-
CLO3	3	2	1	3	2	1	2	1	-
CLO4	3	2	1	3	2	1	2	3	-
CLO5	3	2	1	3	2	1	2	3	-

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. S. Sastry, Introductory Methods of Numerical Analysis, Fourth Edition, Prentice Hall of India, Pvt. Ltd., New Delhi, 2005.

Reference Books:

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Methods for Scientific and Engineering Computation, Second Edition, Wiley Eastern Ltd, New Delhi.
2. D. Vaughan Griffiths, I. M. Smith, Numerical Methods for Engineers, Chapman &Hall, CRC, 2006.
3. V. N. Vedamurthy, S. N. Iyengar Numerical Methods, Vikas Publishing house PVT. Ltd 1998.

Webliography:

1. https://nptel.ac.in/courses/111/107/111107105/
2. https://nptel.ac.in/courses/127/106/127106019/
3. https://nptel.ac.in/courses/111/107/111107062/

3.

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		SAMPLING THEORY	**Elective**	**4**	**4**	**-**	**-**	**3**

Course Objectives:

1. To familiarize students to design and analyse survey samples for finite populations.
2. To train the students to test or analyze their sample data with the help of several tests
3. To develop the skill to administer ANOVA tables.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Explain tests of significance and errors in testing of hypothesis	**K2**
CO2	Explain tests of significance and errors in testing of hypothesis using t-test	**K2**
CO3	Elucidate test based on chi square distribution	**K3**
CO4	Analyze time series and its components	**K4**
CO5	Formulate analysis of variance	**K6**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Tests of Significance (Large samples): Sampling distribution - Testing of Hypothesis - Type I and Type II errors - Critical region, level of significance - Test of significance for large samples - Testing a single proportion - Difference of proportions - testing a single mean - Difference of means. **(9 hours)**

Unit II: Tests of Significance (Large samples): Tests based on t - distribution - Single mean - Difference of means - Tests based on F - distribution. **(9 hours)**

Unit III: Test based on chi square distribution - Goodness of fit - Independence of attributes. **(9 hours)**

Unit IV: Analysis of time series: Time series - Components of a time series - measurement of trends. **(9 hours)**

Unit V: Analysis of Variance - One criterion of classification - Two criteria of classification - Three criteria of classification. **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	-	1	2	2	2	2	1	-
CLO2	3	-	1	2	2	2	2	1	-
CLO3	3	-	1	2	2	2	2	1	-
CLO4	3	-	1	2	2	2	2	1	-
CLO5	3	-	1	2	2	2	2	1	-

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Arumugam and A. Thangapandi Isaac, *Statistics* - New gamma publishing House, June 2007

(For Unit I - III - Chapters 14, 15 and 16, For Unit IV - Chapter 10, For Unit V - Chapter 17).

Reference Books:

1. Irwin Miller &Marylees Miller, John E. Freund's Mathematical Statistics with Applications (8th edition), Pearson, Dorling Kindersley Pvt. Ltd. India, 2014.
2. Jim Pitman, Probability, Springer-Verlag, 1993.
3. Sheldon M. Ross Introduction to Probability Models (11th edition). Elsevier, (2014).

Webliography:

https://seamk.libguides.com>eresources>mobileaccess

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		SPECIAL FUNCTIONS WITH APPLICATIONS	**Elective**	**4**	**4**	**-**	**-**	**3**

Course Objectives:

1. To invent knowledge of some special functions.
2. To familiarize with the properties of these functions.
3. To discover applications of these functions.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Visualize exponential, logarithmic and trigonometric functions	**K1**
CO2	Appraise knowledge of beta and gamma functions	**K5**
CO3	Discover applications of gamma functions to multiple integrals	**K2**
CO4	Adapt knowledge of Legendre's equation and their orthogonal properties	**K6**
CO5	Examine Bessel's equation and their solution	**K3**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: The exponential function - the logarithmic function - definition of x^a – the trigonometric functions. **(9 hours)**

Unit II: Beta and gamma functions. **(9 hours)**

Unit III: Applications of Gamma functions to multiple integrals. **(9 hours)**

Unit IV: Legendre 's equation - solution - Legendre's function of the first and second kinds - Orthogonal properties of Legendre's Polynomial. **(9 hours)**

Unit V: Bessel's equations and Bessel's functions - Definition and solution - Bessel's function of the first kind of order n - generating function- some trigonometric expansions involving Bessel's functions. **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	1	2	-	2	2	2	1
CLO2	3	2	1	2	-	2	2	2	1
CLO3	3	2	1	2	-	2	2	2	1
CLO4	3	2	1	2	-	2	2	2	1

CLO5	3	2	1	2	-	2	2	2	1

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

1. R.R.Goldberg, Methods of Real analysis, Oxford and IBH Publishing, 1963
   (For Unit I - Chapter 8 -Sections 8.2 to 8.4)
2. S. Narayanan and T. K. Manicavachagom Pillay, Calculus - Volume II - S. Viswanathan (Printers and Publishers) Pvt. Ltd. 2008.
   (For Unit II - Chapter 7 - Sections 1 to 5: For Unit III Chapter 7 - Section 6).
3. U.P. Singh, R.Y. Denis , S. K.D. Dubey and K.N.Singh, Differential Equations and Integral transforms, (2005) Dominant Publishers and Distributors.
   (For Unit IV - 4.1 and for Unit V - 4.2).

Reference Books:

1. George Andrews, Special functions, 1999
2. IU.A Brychkov, Handbook of special functions, 2008
3. Larry Andrews, Special functions of Mathematics for Engineers,1992

Webliography: https://web.mst.edu>lmhall>SPFNS>spfns

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		INTEGRAL TRANSFORMS WITH APPLICATIONS	**Elective**	**4**	**4**	**-**	**-**	**3**

Course Objectives:

1. This course introduces the basic concepts of Integral transforms and Fourier series.
2. For many years, it has been studied for its essential in applied mathematics, and especially in the field of physics and electronics.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	acquire problem solving skills on Fourier Series, Fourier Transforms and Laplace Transforms	**K1, K6**

CO2	gain familiarity in fundamental theories on Fourier Series, Fourier Transforms and Laplace Transforms	**K2, K5**
CO3	evaluate some standard integrals by using Fourier Integrals	**K1**
CO4	understand different types of Fourier integrals.	**K2, K4**
CO5	apply Laplace transforms in solving ordinary differential equations.	**K3**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : The Laplace transforms: Definition - sufficient conditions for the existence of the Laplace transform - Laplace transform of periodic functions - some general theorems **(9 hrs)**

Unit II : The inverse transforms. **(9 hrs)**

Unit III : Applications to differential equations - solving simultaneous equations and differential equations with variable coefficients. **(9 hrs)**

Unit IV: Fourier series - even and odd functions - half - range Fourier series. **(9 hrs)**

Unit V : Fourier Transform – Complex form of Fourier integral formula - Fourier integral theorem – properties of Fourier transform – Fourier cosine and Fourier sine transforms and their properties. **(9 hrs)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	2	2	-	2	1
CLO2	3	2	3	2	2	2	-	2	1
CLO3	3	2	3	2	2	2	-	2	1
CLO4	3	2	3	2	2	2	-	2	1
CLO5	3	2	3	2	2	2	-	2	1

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Narayanan and T. K. Manicavachagom Pillay, Calculus - Volume III, S. Viswanathan (Printers and Publishers) Pvt. Ltd.2008.

Unit I to Unit V: Chapters 5 and 6 (Sections 1 to 4 & 9 to 12)

Reference Books:

1. B. Davis, Integral transforms and their Applications, 2nd ed., Springer Science and Business Media, 2013.
2. M.D. Raisinghania, Advanced Differential Equations, S Chand and Company Ltd., 2018.
3. E Kreyszig, Advanced Engineering Mathematics, Eighth Edition, New Delhi, India: Wiley India Pvt. Ltd., 2010.

Webliography: https://nptel.ac.in/courses/111/102/111102129/

1.

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
IV		DISCRETE MATHEMATICS	Core	4	4	-	-	3

Course Objectives:

1. This course makes the learners acquire intense knowledge of mathematical logic, set theory, relations and functions.
2. It apply rules of inference, tests for validity, and methods of proof including direct and indirect proof forms, proof by contradiction, proof by cases, and mathematical induction and write proofs using symbolic logic.
3. It simplifies and evaluates basic logic statements including compound statements, implications, inverses, converses, and contra positives using truth tables and the properties of logic.

Course Outcomes (COs): On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	remember the fundamental ideas and notation of discrete mathematics with examples.	K1
CO2	understand and apply knowledge to analyze and solve problems using models of Discrete Mathematics	K2
CO3	show a binary relation on a set is an equivalence relation, or give a counterexample to show that it is not.	K5
CO4	understand and use the terms cardinality, finite, countably infinite, and uncountably infinite, and determine which of these characteristics is associated with a given set.	K2, K5
CO5	describe the connection between bijective functions, inverses and find the inverse of an invertible function.	K1, K5

K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create

Course Outline:

Unit I : Mathematical logic: Logical statement or proposition- type of propositions- the propositional calculus - the negation of a proposition- disjunction- conjunction- tautologies and contradictions- logical equivalence - the algebra of propositions- conditional propositions - converse inverse and contrapositive propositions - the negation of a conditional proposition - biconditional propositions - arguments. (10 hrs)

Unit II : Set theory: Set- set designation- null sets and unit sets- special sets of numbers- universal set- subsets, proper subsets and equal sets- set operations- union operations- properties of union operation- intersection- properties of intersection operation. (10 hrs)

Unit III : Distributive properties - complementation- relative complement - properties of complement - properties of difference - symmetric difference- power set- Cartesian products. (9 hrs)

Unit IV: Relation and functions: Relation- equivalence relation- partition- partial order relation. (8 hrs)

Unit V : Function - inverse mapping- composition mappings - binary operations- countable and uncountable sets. (8 hrs)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	2	3	3	1	2	2	-	2	3
CLO2	2	3	3	1	2	2	-	2	3
CLO3	2	3	3	1	2	2	-	2	3
CLO4	2	2	3	1	2	2	-	2	2
CLO5	2	2	3	1	2	2	-	2	2

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book: Content and treatment as in

B.S. Vatssa, Discrete Mathematics - 3rdEdition, Wishwa Prakashan, 2009.

Unit I to V: Chapters 1, 2 (except 2.20) and 3.

Reference Books:

1. M.K. Venkataraman, N. Sridharan and N. Chandrasekaran, Discrete Mathematics, The National Publishing Company, Chennai, 2017.
2. J. P. Tremblay and R. Manohar, Discrete mathematical structures with applications to computer science, Tata McGraw-Hill Education, 2001.
3. R. P. Grimaldi, Discrete and Combinatorial Mathematics – An applied introduction, Pearson Addison Wesley, 5th Edition, 2004.

Webliography:

1. https://nptel.ac.in/courses/111/106/111106086/
2. https://nptel.ac.in/courses/111/104/111104026/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		COMBINATORIAL MATHEMATICS	**Elective**	**4**	**4**	**-**	**-**	**3**

Course Objectives:

1. For many years, this course has been studied for its essential in solving many enumeration problems.
2. It makes the students familiar with fundamental combinatorial structures that naturally appear in various other fields of Mathematics and Computer Science.
3. It develops skills to apply the techniques of combinations and permutations for counting the number of certain configurations.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	remember formulas for counting basic combinatorial outcomes to construct solutions to complete combinatorial enumeration problems	**K1, K6**
CO2	apply counting strategies to solve an optional assignment problem.	**K2, K5**
CO3	use specialized techniques to solve combinatorial enumeration problems: generating functions; recurrence relations.	**K1**
CO4	understand the concepts of permutations with restrictions on relative positions and the rook polynomials	**K2, K4**
CO5	enumerate configuration using the Inclusion - Exclusion principle	**K3**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : Selections and binomial coefficients - permutations - ordered selections - unordered selections. (9 hrs)

Unit II : Pairing problems - pairings within a set - pairing between sets - an **(9 hrs)**

optional assignment problem.

Unit III : Recurrence - Fibonacci type relations - using generating functions. **(9 hrs)**

Unit IV: The Inclusion - Exclusion principle - the principle - Rook polynomials. **(9 hrs)**

Unit V : Block designs - square block designs **(9 hrs)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	2	3	1	1	2	1	2	2	3
CLO2	2	3	1	1	2	1	2	2	3
CLO3	3	3	1	-	2	2	2	2	3
CLO4	3	2	2	-	2	2	2	2	2
CLO5	3	2	2	-	2	2	2	2	2

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

Ian Anderson, A first course in combinatorial mathematics. Oxford University Press, 1989.

Reference Books:

1. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics – An applied introduction, Pearson Addison Wesley, 5th Edition, 2004.
2. R. A. Brualdi, Introductory Combinatorics, 5th ed., China Machine Press, 2009.
3. E.A.Bender and S. G. Williamson, Foundations of combinatorics with applications,Dover Publ., 2007.
4. Jongsma Calvin, Discrete Mathematics: Chapter 0, Table of Contents and Preface,. Faculty Work: Comprehensive List. Paper 426, 2016

Webliography:

1. https://nptel.ac.in/courses/106/108/106108051/
2. https://nptel.ac.in/courses/111/104/111104026/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		ASTRONOMY	**Elective**	**4**	**4**	**-**	**-**	**3**

Course Objectives:

1. To familiarize students with knowledge of the material universe beyond the earth's atmosphere and the nature and constitution of heavenly bodies.
2. To promote knowledge on the topics spherical trigonometry, the zones of earth, refraction, laws of refraction, geocentric parallax and Kepler's laws.
3. To appraise that students gather knowledge about celestial bodies and their movements in the galaxy.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Solve problems in spherical Trigonometry	**K3**
CO2	Evaluate terrestrial latitudes and longitudes	**K5**
CO3	Rewrite laws and effects of refraction	**K6**
CO4	Estimate effects of geocentric parallax	**K4**
CO5	Interpret Kepler's laws and deduce its applications	**K2**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Spherical Trigonometry - Celestial sphere- Diurnal motion. **(9 hours)**

Unit II: Earth - the zones of Earth - Terrestrial latitudes and longitudes - radius of earth - rotation of earth - Dip of horizon - Twilight. **(9 hours)**

Unit III: Refraction laws of refraction - effects of refraction - cassini's formula horizontal refraction. **(9 hours)**

Unit IV: Geocetric parallax - effects - horizontal parallax of moon - angular diameter - comparison of geocentric parallax and refraction. **(9 hours)**

Unit V: Kepler's laws - longitude of perigee - eccentricity of earth's orbit - verification of Kepler's laws in the case of Earth Newton's deductions form Kepler's laws mean anomaly - Geocentric and heliocentric latitudes and longitudes. **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	2	-	2	1	2	2	1
CLO2	3	3	2	-	2	1	2	2	1
CLO3	3	3	2	-	2	3	2	2	2
CLO4	3	2	2	-	2	3	2	2	2
CLO5	3	2	2	-	2	3	2	2	2

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Kumaravelu and Susheela Kumaravelu, Astronomy SKV. Publications, 2004

Reference Books:

1. Stephen P. Maran, Astronomy for dummies,1999
2. Andrew Fracknoi, Astronomy, 2016
3. Dinah L Mochi, Astronomy, 1978

Webliography: https://www.sciencefocus.com>Books

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		FORMAL LANGUAGES AND AUTOMATA THEORY	**Elective**	**4**	**4**	**-**	**-**	**3**

Course Objective

1. To provide fair knowledge on Deterministic and Nondeterministic Finite Automata Theory and their applications
2. To understand the concepts of Regular Expressions and Languages with applications
3. To provide knowledge on Context-Free Grammars and Languages

Course Outcomes (Cos)

CourseOutcomeNo.	CourseOutcome	Knowledge Level Upto
CO1	Understanding the notion of alphabets, strings and languages and study deterministic finite automata theory	**K2,K4**

CO2	Understanding nondeterministic finite automata theory and applications to text search	**K2,K4**
CO3	Become familiar with finite automata with regular expressions	**K2,K4**
CO4	Analyze and compare various properties of regular Languages	**K3,K5**
CO5	Understand and appraise context-free grammars and Languages	**K2,K5**
K1=Remember,K2=Understand, K3=Apply,K4=Analyze,K5=Evaluate,K6= Create		

Course Outline	
Unit I	The Central Concepts of Automata Theory – Finite Automata – Deterministic Finite Automata
Unit II	Nondeterministic Finite Automata – Application : Text Search – Finite Automata with Epsilon-Transitions
Unit III	Regular Expressions and Languages – Regular Expressions – Finite Automata with Regular Expressions
Unit IV	Properties of Regular Languages
Unit V	Context-Free Grammars and Languages

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	2	2	2	2	2	2	3
CLO2	3	1	2	2	2	2	2	2	3
CLO3	3	1	2	2	2	2	2	2	3
CLO4	3	1	2	2	2	2	2	2	3
CLO5	3	1	2	2	2	2	2	2	3

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Books :
1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, *Introduction to Automata Theory, Languages, and Computations*, Pearson Publications, 2001
Further Readings :
1. Kamala Krithivasan, R. Rama, *Introduction to Formal Languages, Automata Theory and Computations*, Pearson Publications, 2005 2. Alberto Pettorossi, *Automata Theory and Formal Languages*, Springer, 2022 3. V. Ravi Sankar, *Understanding Automata, Formal Languages and Grammar*, Alpha Science International, 2020 4. ShyamalenduKandar, *Introduction to Automata Theory, Formal Languages and Computation*, Pearson Education India, 2016

Skill Enhancement Courses (SEC)

Group III - Skill Enhancement Courses (SEC)

- **Mathematics for Competitive examinations I**
- **Office Automation**
- **Web Application Development**
- **LaTeX**
- **Programming with SageMath**
- **Computational Mathematics**
- **Mathematics for Competitive examinations II**
- **R Programming**
- **Advanced Excel**
- **E- Commerce & Tally**
- **Android App Development**

Title of the Course		MATHEMATICS FOR COMPETITIVE EXAMINATIONS I				
Paper Number		**SEC-I**				
Category	Skill Enhance-ment Course	**Year**	I	**Credits**	2	**Course Code**
Semester		I				
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
2	2	--		2		
Pre-requisite		12th Standard Mathematics				
Objectives of the Course		□ To learn the techniques for solving aptitude problems and to enable the students prepare themselves for various competitive examinations.				
Course Outline		**UNIT-I:** Simplification, averages.				
UNIT-II: Ratio and proportion.						
UNIT-III: Partnership-percentages.						
UNIT-IV: Profit and Loss						
UNIT-V: Problems on numbers.						
Extended Professional Component		Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)				
Skills acquired from this course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill				
Reference Books		R.S.Agarwal - Objective Arithmetic, Published by S.Chand & Co Ltd.Edition 2018				
Recommended Text		1. R.S.Agarwal - Arithmetic subjective and Objective, Published by S. Chand & Co Ltd. Revised Edition 2017 2. Rajesh Verma, Fast track Objective arithmetic, Arihant Publications India Limited Fourth Edition,1st January 2018.				
Website and e-Learning Source		https://nptel.ac.in				

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">OFFICE AUTOMATION</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">SEC -II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• The major objective in introducing the Computer Skills course is to impart training for students in Microsoft Office which has different components like MS Word, MS Excel and Power point.
• The course is highly practice oriented rather than regular class room teaching.
• To acquire knowledge on editor, spread sheet and presentation software.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT I: Introductory concepts: Memory unit – CPU-Input Devices: Key board, Mouse and Scanner. Output devices: Monitor, Printer. Introduction to Operating systems & its features: DOS – UNIX– Windows. Introduction to Programming Languages.</td></tr>
<tr><td colspan="8">UNIT II: Word Processing: Open, Save and close word document; Editing text – tools, formatting, bullets; Spell Checker - Document formatting – Paragraph alignment, indentation, headers and footers, numbering; printing – Preview, options, merge.</td></tr>
<tr><td colspan="8">UNIT III: Spreadsheets: Excel – opening, entering text and data, formatting, navigating; Formulas – entering, handling and copying; Charts – creating, formatting and printing, analysis tables, preparation of financial statements, introduction to data analytics.</td></tr>
<tr><td colspan="8">UNIT IV: Database Concepts: The concept of data base management system; Data field, records, and files, Sorting and indexing data; Searching records. Designing queries, and reports; Linking of data files; Understanding Programming environment in DBMS; Developing menu drive applications in query language (MS – Access).</td></tr>
<tr><td colspan="8">UNIT V: Power point: Introduction to Power point - Features – Understanding slide typecasting & viewing slides – creating slide shows. Applying special object – including objects & pictures – Slide transition – Animation effects, audio inclusion, timers.</td></tr>
</table>

Extended Professional Component	Questions related to the above topics, from variouscompetitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication andTransferrable Skill
Recommended Text	Peter Norton, "Introduction to Computers" –Tata McGraw-Hill.
Reference Books	Jennifer Ackerman Kettel, Guy Hat-Davis, Curt Simmons, "Microsoft 2003", Tata McGraw-Hill.
Website and e-Learning Source	https://nptel.ac.in

Course Outcomes: (for students: To know what they are going to learn)

CO1: Understand the basics of computer systems and its components.

CO2: Understand and apply the basic concepts of a word processing package.

CO3: Understand and apply the basic concepts of electronic spreadsheet software.

CO4: Understand and apply the basic concepts of database management system.

CO5: Understand and create a presentation using PowerPoint tool.

Title of the Course		**Web Application Development**					
Paper Number		**SEC -III**					
Category	SEC	**Year**	I	**Credits**	2	**Course Code**	
		Semester	II				
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**	**Total**
		2		-		--	2
Pre-requisite		12^{th} Standard Mathematics					
Objectives of the Course		• To develop an ability to design and implement static and dynamic websites.					

Course Outline	**Practical Program List:** 1. Write a JavaScript to design a simple calculator to perform the following operations: sum, product, difference and quotient. 2. Write a JavaScript that calculates the squares and cubes of the numbers from 0 to 10 and outputs HTML text that displays the resulting values in an HTML table format. 3. Write a JavaScript code that displays text "TEXT-GROWING" with increasing font size in the interval of 100ms in RED COLOR, when the font size reaches 50pt it displays "TEXT-SHRINKING" in BLUE colour. Then the font size decreases to 5pt. 4. Develop and demonstrate an HTML5 file that includes JavaScript script that uses functions for the following problems: a. Parameter: A string b. Output: The position in the string of the left-most vowel c. Parameter: A number d. Output: The number with its digits in the reverse order 5. Design an XML document to store information about a student in an engineering college affiliated with VTU. The information must include USN, Name, and Name of the College, Branch, Year of Joining, and email id. Makeup sample data for 3 students. Create a CSS style sheet and use it to display the document. 6. Change the Content of the webpage using AJAX. Perform Different Operations using JQUERY Selectors. 7. Create an XHTML form with Name, Address Line 1, Address Line 2, and E-mail text fields. On submitting, store the values in the MySQL table. Retrieve and display the data based on Name.
Extended Professional Component	Questions related to the above topics, from variouscompetitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication andTransferrable Skill
Recommended Text	1.Pankaj Sharma, "Web Technology", S k Kataria & Sons Bangalore 2011. 2.Achyut S Godbole & Atul Kahate, "Web Technologies", 2002, 2nd Edition.

Reference Books	1. Laura Lemay, Rafe Colburn , Jennifer Kyrnin, "Mastering HTML, CSS & Javascript Web Publishing",2016. 2. DT Editorial Services (Author), "HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)", Paperback 2016, 2ndEdition. 3. Purewal, Semmy. Learning Web App Development: Build Quickly with Proven JavaScript Techniques. " O'Reilly Media, Inc.", 2014.
Website and e-Learning Source	https://www.w3schools.com/whatis/default.asp https://www.edureka.co/blog/web-development-tutorial/ https://www.tutorialspoint.com/website_development/index.htm

Title of the Course		**LATEX**					
Paper Number		**SEC -IV**					
Category	SEC	**Year**	II	**Credits**	2	**Course Code**	
		Semester	III				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		-	--	2	
Pre-requisite		12th Standard Mathematics					
Objectives of the Course		• This course introduces the LaTeX typesetting language to all prospective interestedstudents. • It is used for writing all scientific papers and presentations in Mathematics, thisknowledge how to use it is essential for all to be professionals. • Understand the basic components of computer programming using the Python language. Demonstrate significant experience with the Python program development environment.					
Course Outline		**Unit I:** Document Layout and organization – Document class, Page style, Parts of the document, Text formatting, TeX and its offspring, what's different in latex 2 - Distinguishing LaTeX 2 and basics of LaTeX file.					
		Unit II: Commands and environments-command names and arguments, Environments, Declarations, Lengths, Special characters, Fragile Commands, Exercise.					
		Unit-III Table of contents, Fine - Tuning text, Word division, Labelling, Referencing, Displayed text – Changing font, Centering and identifying, Lists, Generalized Lists, Theorem like declarations, Tabular stops, Boxes.					

	Unit IV: Tables, Printing literal text, Footnotes and marginal notes. Drawing pictures using LaTeX, Mathematical formulas – mathematical environments,
	Unit-V Main elements of math mode, Mathematical symbols, Addition elements, Fine – tuning Mathematics.
Extended Professional Component	Questions related to the above topics, from variouscompetitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication andTransferrable Skill
Recommended Text	H. Kopka and P.W. Daly, A Guideline to LaTeX, Third edition, Addison – Wesley,London, 1999.
Reference Books	L. Lamport, LATEX: A Document Preparation System, User's Guide and Reference Manual, Addison-Wesley, New York, second edition, 1994. Martin J. Erickson and Donald Binder, A Student's Guide to the Study, Practice, andTools of Modern Mathematics, CRC Press, Boca Raton, FL, 2011.
Website and e-Learning Source	https://nptel.ac.in/courses/106/106/106106182/

Title of the Course		**PROGRAMMING WITH SAGEMATH**					
Paper Number		**SEC VI**					
Category	SEC	**Year**	II	**Credits**	2	**Course Code**	
		Semester	III				
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	-		--	2	
Pre-requisite		School level Differential Equations					
Objectives of the Course							
Course Outline		**Unit I:** Using sagemath as a calculator, basic functions (square root, logarithm, numeric value, exponential, trigonometric, conversion between degrees and radians, etc.); Vector calculus : Defining vectors, operations like sum, dot product, cross product, vector valued functions, divergence, curl, multiple integrals;					

	Unit II: Matrix Algebra : Adding, multiplying two matrices, row reduced echelon forms to solve linear system of equations, finding inverses of square matrices, determinants; Combinatorcs & Number theory: Permutations, combinations, finding gcd, lcm, prime factorization, prime counting function, n th prime funcion, divisors of a number, counting divisors, modular arithmetic;
	Unit III: Polynomials: Defining polynomials, operations on them like multiplication and division, expanding a product, factorizing a polynomial, finding gcd; Solving single variable equations, declaring multiple variables, solving multi variable equations, solving system of non linear equations, finding the numerical value of roots of equations.
	Unit IV: Finding derivatives of functions, higher order derivatives, integrating functions, definite and indefinite integrals, numerical integration, partial fractions and integration,
	Unit V: Plotting : simple plots of known functions, controlling range of plots, controlling axes, labels, gridlines, drawing multiple plots on a single picture, adding plots, polar plotting, plotting implicit functions, contour plots, level sets, parametric 2D plotting, vector fields plotting, gradients;
Extended Professional Component	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Mathematical Computation with Sage by Paul Zimmermann available from on http://www.sagemath.org 2. A First Course in Linear Algebra by Robert Beezer available online http://linear.ups.edu/ 3. Abstract Algebra: Theory and Applications by Tom Judson and Robert Beezer (http://abstract.ups.edu/) 4. An Introduction to SAGE Programming: With Applications to SAGE Interacts for Numerical Methods by Razvan A Mezei, Springer
Website and e-Learning Source	http://linear.ups.edu/ http://abstract.ups.edu/ http://www.sagemath.org

Title of the Course		**COMPUTATIONAL MATHEMATICS**						
Paper Number		**SEC V**						
Category	SEC	**Year**	II	**Credits**	2	**Course Code**		
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**	
		2	-		--		2	
Pre-requisite		School level Differential Equations						
Objectives of the Course								
Course Outline		**UNIT I:**Errors in Numerical Calculations: Errors and their computations - A general error formula - Error in a series. Approximation Solution of Algebraic and Transcendental equations: The Bisection method - The Method of False position - Iteration method - Newton - Raphson method.						
		UNIT II: Interpolation: Finite differences - Forward Differences - Backward Differences - Central Differences - Symbolic Relations and Separation of Symbols. Newton‘s Formulae for Interpolation - Gauss‘s central difference formulae - Stirling‘s formula - Interpolation with unevenly spaced points: Lagrange‘s interpolation formula - Inverse Interpolation.						
		UNIT III: Numerical Differentiation: Derivatives using Newton‘s Forward Difference Formula -Derivatives using Newton‘s Backward Difference Formula - Derivatives using Stirling‘s Formula - Maxima and Minima of Tabulated Function						
		UNIT IV: Numerical Integration: General Quadrature Formula - Trapezoidal Rule - Simpson‘s 1/3 Rule - Simpson‘s 3/8 Rule.						
		UNIT V: Numerical Solutions of System of Linear Equations: Gauss elimination method - Gauss - Jordan method - Jacobi‘s method - Gauss - Seidel method.						
Extended Professional Component		Questions related to the above topics, from various competitive examinations UPSC /TRB/NET/SET/GATE/ others to be solved (To be discussed during the Tutorial hour)						
Skills acquired from this course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill						
Recommended Text		S. S. Sastry, Introductory Methods of Numerical Analysis, Fourth Edition, Prentice Hall of India, Pvt. Ltd., New Delhi, 2005.						

Reference Books	M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Methods for Scientific and Engineering Computation, Second Edition, Wiley Eastern Ltd, New Delhi. D. Vaughan Griffiths, I. M. Smith, Numerical Methods for Engineers, Chapman &Hall, CRC, 2006. V. N. Vedamurthy, S. N. Iyengar Numerical Methods, Vikas Publishing house PVT. Ltd 1998.
Website and e-Learning Source	https://nptel.ac.in/courses/111/107/111107105/ https://nptel.ac.in/courses/127/106/127106019/ https://nptel.ac.in/courses/111/107/111107062/

Title of the Course		MATHEMATICS FOR COMPETETIVE EXAMINATIONS II					
Paper Number		SEC VII					
Category	SEC	Year	II	Credits	2	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		2	-		--	2	
Pre-requisite		School level Differential Equations					
Objectives of the Course		To learn the techniques for solving aptitude problems. Also to motivate the students for attending various competitive examinations. .					
Course Outline		**UNIT-I:** Simple interest and Compound interest.					
		UNIT-II: Time and work.					
		UNIT-III: Time and Distance.					
		UNIT-IV: Chain Rule.					
		UNIT-V: Pipes and Cistern					
Extended Professional Component		Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)					
Skills acquired from this course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					
Recommended Text		R.S.Agarwal- Objective Arithmetic,Published by S.Chand &Co Ltd.,Edition(2018).					
Reference Books		Rajesh Verma- Fasttrack Objective arithmetic, Arihant Publications (India) Limited. ,Fourth Edition 1st January 2018. R.S.Aggarwal, Arithmetic Subjective and objective, Published by S.Chand and. Co . Ltd. Revised Edition.1st April 2017.					
Website and e-Learning Source		https://nptel.ac.in					

Title of the Course		R PROGRAMMING					
Paper Number		SEC					
Category	SEC	Year		Credits	2	Course Code	
		Semester					
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		2	-		--	2	
Pre-requisite		School level Differential Equations					

Objectives of the Course	• Acquire programming skills in core R Programming • Acquire Object-oriented programming skills in R Programming. • Develop the skill of designing graphical-user interfaces (GUI) in R Programming • Acquire R Programming skills to move into specific branches
Course Outline	**List of Programs:** 1. Program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice. 2. Program, to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user. 3. Write a program to find list of even numbers from 1 to n using R-Loops. 4. Create a function to print squares of numbers in sequence. 5. Write a program to join columns and rows in a data frame using cbind() and rbind() in R. 6. Implement different String Manipulation functions in R. 7. Implement different data structures in R (Vectors, Lists, Data Frames) 8. Write a program to read a csv file and analyze the data in the file in R. 9. Create pie chart and bar chart using R. 10. Create a data set and do statistical analysis on the data using R. 11. Program to find factorial of the given number using recursive function 12. Write a R program to count the number of even and odd numbers from array of N numbers.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	
Reference Books	
Website and e-Learning Source	

Title of the Course	**Advanced Excel**
Paper Number	**SEC**

Category	SEC	Year		Credits	2	Course Code	
		Semester					

Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total
	2	-	--	2

Pre-requisite	School level Differential Equations
Objectives of the Course	The objective of this course is to help the students get hands on exposure on the advanced concepts in Excel .
Course Outline	**List of Programs** 1. Using Formulas – VLOOKUP,COUNTIFS,COUNT,IF,COUNTIF,COUNTIFS 2. Using Filters - Quick Filtering ,Filtering by Multiple Criteria, Saving the filtered data, Performing Calculations on Filtered Data 3. PivotTable - Adding row labels, adding column data, changing formulas in columns, changing headers & number formats 4. PivotTable Report – Adding multiple row labels, collapsing and expanding, drill down to data, sorting, & refreshing. 5. Pivot Table Report - Grouping by dates, grouping by ranges, show items with no detail, show values in empty cells, grouping across columns 6. User defined groups, adding/removing ,subtotals 7. Using formulas on pivoted data 8. Displaying multiple row labels in columns, or tabular form 9. Report Filters and Report Slicers 10. Expanding Filter Results to Individual Tabs 11. Using Date, Time and Text Functions 12. Formatting reports using Charts and Graphs
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Excel 2019 All-in-One For Dummies – 2018- Greg Harvey 2. Microsoft Excel 2019 Pivot Table Data Crunching-2019,Bill Jelen and Michael Alexander
Reference Books	
Website and e-Learning Source	

Title of the Course	E- COMMERCE & TALLY						
Paper Number	**SEC**						
Category	**SEC**	**Year**		**Credits**	**2**	**Course Code**	

	Semester			
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	2	**-**	**--**	**2**
Pre-requisite	School level Differential Equations			
Objectives of the Course	• To provide knowledge on Ecommerce technology, Business Models and M-Commerce. • To explore the major issues associated with e-commerce-security, privacy, authentication, encryption and e-Payment			
Course Outline	**UNIT I:** History of E-commerce and Indian Business Context: E-Commerce –Emergence of the Internet – Emergence of the WWW – Advantages of E-Commerce – Transition to E-Commerce in India – The Internet and India – E-transition Challenges for Indian Corporate. Business Models for E- commerce: Business Model – E-business Models Based on the Relationship of Transaction Parties - E-business Models Based on the Relationship of Transaction Types.			
	UNIT II: Enabling Technologies of the World Wide Web: World Wide Web – Internet Client-Server Applications –Networks and Internets – Software Agents – Internet Standards and Specifications – ISP. e-Marketing :Traditional Marketing – Identifying Web Presence Goals – Online Marketing – E-advertising – E-branding.			
	UNIT III: E-Security: Information system Security – Security on the Internet – E-business Risk Management Issues – Information Security Environment in India. Legal and Ethical Issues : Cybers talking – Privacy is at Risk in the Internet Age – Phishing – Application Fraud – Skimming – Copyright – Internet Gambling – Threats to Children.			
	UNIT IV: e-Payment Systems: Main Concerns in Internet Banking – Digital Payment Requirements – Digital Token-based e-payment Systems – Classification of New Payment Systems – Properties of Electronic Cash – Cheque Payment Systems on the Internet – Risk and e-Payment Systems – Designing e-payment Systems – Digital Signature – Online Financial Services in India - Online Stock Trading.			
	UNIT V: Information systems for Mobile Commerce: What is Mobile Commerce? – Wireless Applications –Cellular Network – Wireless Spectrum – Technologies for Mobile Commerce – Wireless Technologies –Different Generations in Wireless Communication – Security Issues Pertaining to Cellular Technology. Portals for E-Business: Portals – Human Resource Management – Various HRIS Modules.			

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	P.T.Joseph, S.J., "E-Commerce - An Indian Perspective", PHI 2012, 4th Edition
Reference Books	David Whiteley , "E-Commerce Strategy, Technologies and Applications", Tata McGraw Hill, 2001. Ravi Kalakota, Andrew B Whinston, "Frontiers of Electronic Commerce", Pearson 2006, 12th Impression.
Website and e-Learning Source	

Title of the Course		**ANDROID APP DEVELOPMENT**						
Paper Number		**SEC**						
Category	**SEC**	**Year**		**Credits**	**2**	**Course Code**		
		Semester						
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**	
		2	**-**		**--**		**2**	
Pre-requisite		School level Differential Equations						
Objectives of the Course		The objective is to help the student understands the working of Android OS practically and to develop Android user interfaces, deploy and maintain the Android Applications.						
Course Outline		**List of Programs:** 1. Using Login Screen 2. Browse by Intent 3. Using content provider 4. Simple program using Layouts 5. Displaying progress Dialog 6. Alert Dialog Box 7. Create and send Notifications 8. Sending SMS and Email 9. Playing audio and video 10. SQLite Database						

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd edition. (2011) 2. Android Mobile Application Development, ISBN-978-81-940577-2-7 June 2019 by Dr. BabasahebAmbedkar Open University. 3. Android User Interface Design: Turning Ideas and Sketches into Beautifully Designed Apps byIan G. Clifton
Reference Books	1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd 2. Android Application Development All in one for Dummies by Barry Burd, Edition: I
Website and e-Learning Source	https://www.javatpoint.com/android-tutorial https://www.w3schools.blog/android-tutorial https://www.tutorialspoint.com/android/index.htm