



**THIRUVALLUVAR UNIVERSITY**

**SERKKADU, VELLORE-632115**

**B.Sc. MATHEMATICS**

**SYLLABUS**

**FROM THE ACADEMIC YEAR**

**2023 - 2024**

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## 1. Introduction

### **B.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 Bachelor's Degree B.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.

Bachelor'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.

<b>LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME</b>	
<b>Programme:</b>	<b>B.Sc., MATHEMATICS</b>
<b>Programme Code:</b>	
<b>Duration:</b>	<b>3 years [UG]</b>
<b>Programme Outcomes:</b>	<p><b>PO1: Disciplinary knowledge:</b> Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study</p> <p><b>PO2: Communication Skills:</b> Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.</p> <p><b>PO3: Critical thinking:</b> 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.</p> <p><b>PO4: Problem solving: Capacity</b> 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 learning to real life situations.</p> <p><b>PO5: Analytical reasoning:</b> 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.</p> <p><b>PO6: Research-related skills:</b> A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation</p> <p><b>PO7: Cooperation/Team work:</b> Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team</p> <p><b>PO8: Scientific reasoning:</b> 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.</p> <p><b>PO9: Reflective thinking:</b> Critical sensibility to lived experiences, with</p>

	<p>self awareness and reflexivity of both self and society.</p> <p><b>PO10 Information/digital literacy:</b> Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.</p> <p><b>PO 11 Self-directed learning:</b> Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.</p> <p><b>PO 12 Multicultural competence:</b> Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.</p> <p><b>PO 13: Moral and ethical awareness/reasoning:</b> Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.</p> <p><b>PO 14: Leadership readiness/qualities:</b> Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.</p> <p><b>PO 15: Lifelong learning:</b> Ability to acquire knowledge and skills, including „learning how to learn“, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.</p>
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## Under Graduate Programme

### ProgrammeOutcomes:

**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 learning 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.

## B.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:

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	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.



### Value Additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
<b>I</b>	<b>Foundation Course</b> 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.	<ul style="list-style-type: none"> <li>• Instil confidence among students</li> <li>• Create interest for the subject</li> </ul>
<b>I, II, III, IV</b>	<b>Skill Enhancement papers</b> (Discipline centric / Generic / Entrepreneurial)	<ul style="list-style-type: none"> <li>• Industry ready graduates</li> <li>• Skilled human resource</li> <li>• Students are equipped with essential skills to make them employable</li> <li>• Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects</li> <li>• Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.</li> <li>• Entrepreneurial skill training will provide an opportunity for independent livelihood</li> <li>• Generates self – employment</li> <li>• Create small scale entrepreneurs</li> <li>• Training to girls leads to women empowerment</li> <li>• Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT tools</li> </ul>
<b>III, IV, V &amp; VI</b>	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	<ul style="list-style-type: none"> <li>• Strengthening the domain knowledge</li> <li>• Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature</li> <li>• Students are exposed to Latest topics on Computer Science / IT, that require strong mathematical background</li> </ul>

		<ul style="list-style-type: none"> <li>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</li> </ul>
<b>IV</b>	Industrial Statistics	<ul style="list-style-type: none"> <li>Exposure to industry moulds students into solution providers</li> <li>Generates Industry ready graduates</li> <li>Employment opportunities enhanced</li> </ul>
<b>II year Vacation activity</b>	Internship / Industrial Training	<ul style="list-style-type: none"> <li>Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens.</li> </ul>
<b>V Semester</b>	Project with Viva – voce	<ul style="list-style-type: none"> <li>Self-learning is enhanced</li> <li>Application of the concept to real situation is conceived resulting in tangible outcome</li> </ul>
<b>VI Semester</b>	Introduction of Professional Competency component	<ul style="list-style-type: none"> <li>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;</li> <li>‘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.</li> </ul>
<b>Extra Credits: For Advanced Learners / Honours degree</b>		<ul style="list-style-type: none"> <li>To cater to the needs of peer learners / research aspirants</li> </ul>

<b>Skills acquired from the Courses</b>	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
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## 2. Credit Distribution for UG Programme in Mathematics

Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course –CC IX <b>Abstract Algebra</b>	4	5	6.1 Core Course – CC XIII <b>Linear Algebra</b>	4	6
Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X <b>Real Analysis</b>	4	5	6.2 Core Course – CC XIV <b>Complex Analysis</b>	4	6
3.3 Core Course – CC V <b>Vector Calculus</b>	5	5	4.3 Core Course – CC VII <b>Optimization Techniques</b>	5	5	5. 3.Core Course CC – XI <b>Mathematical Modeling</b>	4	5	6.3 Core Course – CC XV <b>Mechanics</b>	4	6
3.4 Core Course – CC VI <b>Differential Equations</b>	5	5	4.4 Core Course – CC VIII <b>Elements of Mathematical Analysis</b>	5	5	5. 4.Core Course –/ <b>Project with viva- voce CC -XII</b>	4	5	6.4 Elective - VII Generic/ Discipline Specific <b>A. Programming in C++ B. Financial Analytics</b>	3	5
3.5 Elective III Generic/ Discipline Specific <b>Mathematical Statistics-I</b>	3	5	4.5 Elective IV Generic/ Discipline Specific <b>Mathematical Statistics-II</b>	3	6	5.5 Elective V Generic/ Discipline Specific <b>A. Transform Techniques B. Special Functions</b>	3	4	6.5 Elective VIII Generic/ Discipline Specific <b>A. Discrete Mathematics B. Big Data Analysis</b>	3	5
3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill) <b>Geogebra</b>	1	1	4.6 Skill Enhancement Course SEC-6 <b>Python Programming</b>	2	2	5.6 Elective VI Generic/ Discipline Specific <b>A. Graph Theory and Applications B. Number Theory</b>	3	4	6.6 <b>Extension Activity</b>	1	-
3.7 Skill Enhancement Course SEC-5 <b>Maxima</b>	2	2	4.7 Skill Enhancement Course SEC-7 <b>R- Programming for Statistics</b>	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
3.8 E.V.S.	2	2				5.8 Summer <b>Internship /Industrial Training</b>	2				
	<b>24</b>	<b>32</b>		<b>23</b>	<b>32</b>		<b>26</b>	<b>30</b>		<b>21</b>	<b>30</b>

**Template for Curriculum Design for UG Programme in Mathematics**

**Credit Distribution for UG Programme in Mathematics**

**B.Sc Mathematics**

**First Year – Semester-I**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses [in Total]	13	16
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		<b>23</b>	<b>32</b>

**Semester-II**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
Part-1	Language – Tamil	3	6
Part-2	English	3	6
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
		<b>23</b>	<b>32</b>

**Second Year – Semester-III**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	15
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	2	2
		<b>24</b>	<b>32</b>

**Semester-IV**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
Part-1	Language - Tamil	3	6
Part-2	English	3	6

Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	16
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
		<b>23</b>	<b>32</b>

**Third Year  
Semester-V**

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

**Semester-VI**

Part	List of Courses	Credit	No. of Hours
<b>Part-3</b>	Core Courses including Project / Elective Based & LAB	18	28
<b>Part-4</b>	Extension Activity	1	-
	Professional Competency Skill	2	2
		<b>21</b>	<b>30</b>

**Consolidated Semester wise and Component wise Credit distribution**

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
<b>Part I</b>	3	3	3	3	-	-	12
<b>Part II</b>	3	3	3	3	-	-	12
<b>Part III</b>	13	13	13	13	22	18	92
<b>Part IV</b>	4	4	3	6	4	1	22
<b>Part V</b>	-	-	-	-	-	2	2
<b>Total</b>	23	23	22	25	26	21	<b>140</b>

**\*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.**

## **Topics of the Core Courses**

1. Algebra and Trigonometry
2. Differential Calculus
3. Analytical Geometry
4. Integral Calculus
5. Vector Calculus
6. Differential Equations
7. Optimization Techniques
8. Elements of Mathematical Analysis
9. Abstract Algebra
10. Real Analysis
11. Mathematical Modelling
12. Project with viva-voce
13. Linear Algebra
14. Complex Analysis
15. Mechanics

## **Topics of the Generic Elective Course (Allied)**

1. Allied Mathematics – I
2. Allied Mathematics – II
3. Numerical Methods – I
4. Numerical Methods – II
5. Mathematical Statistics – I
6. Mathematical Statistics –II

## **Topics of the Discipline Specific Elective Courses**

1. Transform Techniques
2. Special Functions
3. Graph Theory and its Applications
4. Number Theory
5. Programming in C++
6. Financial Analytics
7. Discrete Mathematics
8. Big Data Analysis

## **Topics of the Discipline Skill Enhancement Courses**

1. Mathematics for Competitive Examinations – I
2. Mathematics for Competitive Examinations - I
3. Geogebra
4. Maxima
5. Python Programming
6. R-Programming for Statistics

# **B.Sc Mathematics**

## **Core Courses**



<b>Title of the Course</b>		<b>VECTOR CALCULUS</b>					
<b>Paper Number</b>		<b>CORE 5</b>					
<b>Category</b>	<b>Core</b>	<b>Year</b>	II	<b>Credits</b>	5	<b>Course Code</b>	
		<b>Semester</b>	III				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		5		--	5		
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• Knowledge about differentiation of vectors and on differential operators. Knowledge about derivatives of vector functions.</li> <li>• Skills in evaluating line, surface and volume integrals.</li> <li>• The ability to analyze the physical applications of derivatives of vectors.</li> </ul>					
<b>Course Outline</b>		<b>UNIT-I:</b> 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.					
		<b>UNIT-II:</b> 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.					
		<b>UNIT-III:</b> Laplacian operator, Vector identities - Line integral - simple problems.					
		<b>UNIT-IV:</b> Surface integral - Volume integral – Applications.					
		<b>UNIT-V:</b> Gauss divergence Theorem, Stoke’s Theorem, Green’s Theorem in two dimensions.					
<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>		Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)					
<b>Skills acquired from this course</b>		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					
<b>Recommended Text</b>		P. Duraipandiyan and KayalalPachaiyappan, Vector Analysis, S.Chand& Co. Ltd.					

<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>
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**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 solenoidal 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

<b>Title of the Course</b>		<b>DIFFERENTIAL EQUATIONS</b>					
<b>Paper Number</b>		<b>CORE 6</b>					
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	5	<b>Course Code</b>	
		<b>Semester</b>	III				
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		5				--	5
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• Knowledge about the methods of solving Ordinary and Partial Differential Equations.</li> <li>• The understanding of how Differential Equations can be used as a powerful tool in solving problems in science.</li> </ul>					
<b>Course Outline</b>		<b>UNIT-I:</b> Ordinary Differential Equations: Variable separable - Homogeneous Equation-Non-Homogeneous Equations of first degree in two variables -Linear Equation - Bernoulli's Equation-Exact differential equations.					
		<b>UNIT-II:</b> 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.					
		<b>UNIT-III:</b> Simultaneous linear differential equations- Linear Equations of the Second Order -Complete solution in terms of a known integrals-Method of Variation of Parameters.					
		<b>UNIT-IV:</b> 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.					
		<b>UNIT-V:</b> Special methods – Standard forms-Charpit's Methods – Simple Applications					

<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
<b>Skills acquired from this course</b>	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Text</b>	T.K. Manicavachagom Pillay, T. Natarajan, K.S. Ganapathy, Calculus Volume-II, S. Viswanathan Printers and Publishers Pvt. Ltd, 2012.
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. D.A. Murray, Introductory course in Differential Equations, Orient and Longman</li> <li>2. H.T. H. Piaggio, Elementary Treaties on Differential Equations and their applications, C.B.S Publisher &amp; Distributors, Delhi, 1985.</li> <li>3. Horst R. Beyer, Calculus and Analysis, Wiley, 2010.</li> <li>4. Braun, M. Differential Equations and their Applications. (3rd Edn.), Springer-Verlag, New York. 1983.</li> <li>5. Tyn Myint-U and Logan Debnath. Linear Partial Differential Equations for Scientists and Engineers. (4th Edn.) Birhauser, Berlin. 2007.</li> <li>6. Boyce, W.E. and R.C. DiPrima. Elementary Differential Equations and Boundary Value Problems. (7th Edn.) John Wiley and Sons, Inc., New York. 2001.</li> <li>7. Sundrapandian, V. Ordinary and Partial Differential Equations, Tata McGraw Hill Education Pvt. Ltd. New Delhi, 2013</li> </ol>
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### 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

<b>Title of the Course</b>		<b>Optimization Techniques</b>					
<b>Paper Number</b>		<b>CORE 7</b>					
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	5	<b>Course Code</b>	
		<b>Semester</b>	IV				
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>	
	5				--	5	
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		To develop the skill of formulation of LPP and different techniques to solve it. To know the applications of Transportation and Assignment problems. To study the optimizing problems in Sequencing, Networking and Inventory control.					
<b>Course Outline</b>		<p><b>Unit – I Linear Programming Problem</b> Introduction – Formulation of the Problem – Illustration on Mathematical Formulation of LPPs. Graphical Solution Method – Simplex method — Duality theory. ( Chapters 2, 3, 4, 6(6.1 – 6.3))</p> <p><b>Unit – II Transportation Problem</b> Transportation –Balanced and Unbalanced problems – Assignment Problem – Balanced and Unbalanced problems. (Chapter 8, Sections -8.1, 8.2, 8.3, 8.4 8.5; ,Chapter 9, Sections: 9.1, 9.2, 9.3, 9.4, 9.5;)</p> <p><b>Unit – III Sequencing Problem</b> Problems with n jobs through 2 machines - Problems with n jobs through 3 machines- Problems with n jobs through k machines. (Chapter 12: Sections 12.1 -12.5)</p> <p><b>Unit –IV Inventory Control</b> Inventory models: Introduction – Deterministic models- single item static models with and without shortages- Inventory Models with Probabilistic Demand. (Chapter 14, Sections: 14.1 - 14.8)</p> <p><b>Unit –V Network Scheduling by PERT/CPM</b> Introduction –Basic terms – Rules of Network Construction – Numbering the events - Time Analysis - Critical Path Method (CPM) – Programme Evaluation and Review Technique (PERT). (Chapter 13, Sections: 13.1-13.8)</p>					
<b>Skills acquired from this course</b>		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication, Transferrable Skill and designing mathematical models towards solving mathematical applications					

<b>Recommended Text</b>	S. Kalavathy, Operations Research – Vikas Publishing House Pvt. Ltd., 4 <sup>th</sup> Edition, Second Reprint 2018.
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Hamdy A. Taha, Operations Research – An Introduction, Pearson, Seventh edition, 2014.</li> <li>2. P. K Gupta, Problems in Operations Research, 2-e, S. Chand &amp; Sons, New Delhi, 1983.</li> <li>3. R. Pannerselvam, Operations Research, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.</li> <li>4. S. D. Sharma, Operations Research, KedarNath Ram Nath and Co, Meerut, 1998.</li> <li>5. J. K. Sharma, Operations Research Theory &amp; Applications – Trinity Press, India, Sixth edition, 2016.</li> <li>6. Kanti Swarup, P. K. Gupta, Man Mohan, Operations Research – Sultan Chand &amp; Sons, Reprint 2013.</li> </ol>
<b>Website and e-Learning Source</b>	<a href="http://cs.bme.hu/fcs/operations_research.pdf">http://cs.bme.hu/fcs/operations_research.pdf</a>

### Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	describe the concepts involved in solving linear programming problems which are widely used in business operations.	K1
CO2	apply mathematical techniques used in optimizing transportation and assignment problems.	K2
CO3	solve job sequencing problems.	K3
CO4	breakdown different inventory models	K4
CO5	evaluate PERT, CPM problems and develop applications	K5, K6

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	3	2	3	3	3	3	3	3	3	2	2	2.67
2	3	3	2	2	2	3	2	2	2	2	2	3	2.33
3	3	2	2	2	3	3	2	3	3	2	2	3	2.5
4	3	3	2	3	3	3	2	3	3	3	2	2	2.67
5	3	2	2	3	3	2	2	3	3	2	2	3	2.5

<b>Title of the Course</b>		<b>ELEMENTS OF MATHEMATICAL ANALYSIS</b>					
<b>Paper Number</b>		<b>CORE 8</b>					
<b>Category</b>	<b>Core</b>	<b>Year</b>	II	<b>Credits</b>	5	<b>Course Code</b>	
		<b>Semester</b>	IV				
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		5				--	5
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>Identify and characterize sets and functions and Understand, test and analyze the convergence and divergence of sequences, series.</li> <li>Understand metric spaces with suitable examples</li> </ul>					
<b>Course Outline</b>		<b>UNIT-I:</b> Sets and Functions: Sets and elements- Operations on sets- functions- real valued functions- equivalence-countability- real numbers- least upper bounds.					
		<b>UNIT-II:</b> Sequences of Real Numbers: Definition of a sequence and subsequence-limit of a sequence – convergent sequences–divergent sequences- bounded sequences-monotone sequences					
		<b>UNIT-III:</b> Operations on convergent sequences – operations on divergent sequences – limit superior and limit inferior-Cauchy sequences.					
		<b>UNIT-IV:</b> Series of Real Numbers: Convergence and divergence – series with non –negative terms-alternating series-conditional convergence and absolute convergence- tests for absolute convergence.					
		<b>UNIT-V:</b> 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.					
<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>		Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)					
<b>Skills acquired from this course</b>		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					



<b>Recommended Text</b>	<ol style="list-style-type: none"> <li>1. Richard R. Goldberg, Methods of Real Analysis: Oxford and IBH Publishing, (1 January 2020).</li> <li>2. Ethan D. Bloch, The Real Numbers and Real Analysis, Springer, 2011.</li> <li>3. G.M. The fundamentals of Mathematical Analysis, vol I. Pergamon Press, New York, 1965.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.</li> <li>2. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd., 2000.</li> <li>3. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.</li> <li>4. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.</li> </ol>
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

**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

<b>Title of the Course</b>		<b>ABSTRACT ALGEBRA</b>					
<b>Paper Number</b>		<b>CORE 9</b>					
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	V				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		5		--	5		
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• Concepts of Sets, Groups and Rings.</li> <li>• Construction, characteristics and applications of the abstract algebraic structures</li> </ul>					
<b>Course Outline</b>		<b>UNIT-I:</b> Introduction to groups- Subgroups- cyclic groups and properties of cyclic groups- Lagrange's Theorem-A counting principle – Examples					
		<b>UNIT-II:</b> Normal subgroups and Quotient group- Homomorphism- Automorphism -Examples.					
		<b>UNIT-III:</b> Cayley's Theorem-Permutation groups - Examples					
		<b>UNIT-IV:</b> Definition and examples of ring- Some special classes of rings- homomorphism of rings- Ideals and quotient rings- More ideals and quotient rings.					
		<b>UNIT-V:</b> The field of quotients of an integral domain-Euclidean Rings - The particular Euclidean Ring – Examples					
<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>		Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)					
<b>Skills acquired from this course</b>		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					
<b>Recommended Text</b>		Topics in Algebra–I.N.Herstein, Wiley Eastern Ltd. Second Edition (1 <sup>st</sup> January 2006)					

<b>Reference Books</b>	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.
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### 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

<b>Title of the Course</b>		<b>REAL ANALYSIS</b>					
<b>Paper Number</b>		<b>CORE 10</b>					
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	IV				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		5		--	5		
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• Real Numbers and properties of Real-valued functions.</li> <li>• Connectedness, Compactness, Completeness of Metric spaces.</li> <li>• Convergence of sequences of functions, Examples and counter examples</li> </ul>					
<b>Course Outline</b>		<b>UNIT-I:</b> Continuous Functions on Metric Spaces: Open sets– closed sets–Discontinuous function on $\mathbb{R}^1$ . Connectedness, Completeness and Compactness: More about open sets-Connected sets.					
		<b>UNIT-II:</b> 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.					
		<b>UNIT-III:</b> Calculus: Sets of measure zero, definition of the Riemann integral, existence of the Riemann integral-properties of Riemann integral.					
		<b>UNIT-IV:</b> Derivatives-Rolle's theorem, Law of mean, Fundamental theorems of calculus.					
		<b>UNIT-V:</b> Taylor's theorem-Point wise convergence of sequences of functions, uniform convergence of sequences of functions.					
<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>		Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)					
<b>Skills acquired from this course</b>		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					

<b>Recommended Text</b>	Methods of Real Analysis-Richard R.Goldberg (John Wiley & sons, 2 <sup>nd</sup> edition) (Indian edition –Oxford and IBH Publishing Co, New Delhi, 1 <sup>st</sup> January 2020)
<b>Reference Books</b>	1. Principles of Mathematical Analysis by Walter Rudin, Tata McGraw Hill Education, Third edition (1 July 2017). 2. Mathematical Analysis Tom M A postal, Narosa Publishing House, 2 <sup>nd</sup> edition (1974), Addison-Wesley publishing company, New Delhi.
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### 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

<b>Title of the Course</b>		<b>MATHEMATICAL MODELLING</b>					
<b>Paper Number</b>		<b>CORE 11</b>					
<b>Category</b>	<b>Core</b>	<b>Year</b>	II	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	IV				
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		5				--	5
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• Construction and Analysis of Mathematical models found in real life problems.</li> <li>• Modelling through differential and difference equations</li> </ul>					
<b>Course Outline</b>		<b>UNIT-I:</b> Mathematical Modelling: Simple situations requiring mathematical modelling, characteristics of mathematical models.					
		<b>UNIT-II:</b> Mathematical Modelling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.					
		<b>UNIT-III:</b> 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.					
		<b>UNIT – IV:</b> Introduction to difference equations.					
		<b>UNIT-V:</b> Mathematical Modelling through difference equations: Harrod Model, cob web model application to Actuarial Science					
<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>		Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)					
<b>Skills acquired from this course</b>		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					

<b>Recommended Text</b>	J N Kapur, Mathematical Modeling, New Age International publishers(2009).
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Mathematical Modeling by Bimalk. Mishra and DipakK.Satpathi. Ane Books Pvt. Ltd(1 January 2009)</li> <li>2. Mathematical Modeling Models, Analysis and Applications, by Sandip Banerjee, CRC Press, Taylor &amp; Francis group, 2014</li> <li>3. Mathematical Modeling applications with Geogebra by Jonas Hall &amp; Thomas Ligeftjard, John Wiley &amp; Sons, 2017</li> <li>4. Mark M. Meerschaert: Mathematical Modeling, Elsevier Publ., 2007.</li> <li>5. Edward A. Bender: An introduction to mathematical Modeling, CRC Press,2002</li> <li>6. Walter J. Meyer, Concepts of Mathematical Modeling, Dover Publ., 2000</li> </ol>
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### 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

<b>Title of the Course</b>		<b>PROJECT WITH VIVA VOCE</b>						
<b>Paper Number</b>		<b>CORE 12</b>						
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>	4	<b>Course Code</b>		
		<b>Semester</b>	V					
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>		<b>Total</b>
		5		-		--		5

<b>Title of the Course</b>		<b>LINEAR ALGEBRA</b>					
<b>Paper Number</b>		<b>CORE 13</b>					
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	VI				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		6		--	6		
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• Vector Spaces, linear dependence and independence of vectors .Dual spaces, Inner product and norm – orthogonalization process.</li> <li>• Linear transformations. Various operators on vector spaces</li> </ul>					
<b>Course Outline</b>		<p><b>UNIT-I:</b> Vector spaces – Subspaces – Linear Combinations and linear span - Systems of Linear equations – Homogenous Equations – Non-homogenous Equations – Elementary Matrices – Row reduced - Echelon form.</p> <p><b>UNIT-II:</b> Linear Dependence and Linear independence – Bases – Dimensions</p> <p><b>UNIT-III:</b> Linear transformations, null spaces and ranges – Matrix representation of a linear transformation –invertibility and isomorphisms – dual spaces</p> <p><b>UNIT – IV:</b> Eigen values, eigen vectors, diagonalizability – invariant subspaces – Cayley– Hamilton theorem</p> <p><b>UNIT-V:</b> Inner products and norms – Gram Schmidt Orthogonalization Process - Orthogonal complements</p>					
<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>		<p>Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</p>					
<b>Skills acquired from this course</b>		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					
<b>Recommended Text</b>		Linear Algebra - Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5 <sup>th</sup> edition (2018) Pearson					

<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd. Second Edition, 2006.</li> <li>2. N.S.Gopalakrishnan, University Algebra, New Age International Publications, Wiley Eastern Ltd.</li> <li>3. John B.Fraleigh, First course in Algebra, Addison Wesley.</li> <li>4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004.</li> <li>5. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.</li> <li>6. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.</li> <li>7. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.</li> </ol>
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### 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

<b>Title of the Course</b>		<b>COMPLEXANALYSIS</b>					
<b>Paper Number</b>		<b>CORE 14</b>					
<b>Category</b>	<b>Core</b>	<b>Year</b>	II	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	VI				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		6		--	6		
<b>Pre-requisite</b>		<b>12<sup>th</sup> Standard Mathematics</b>					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• Apply concept and consequences of analyticity and C-R equations.</li> <li>• Understand the concept of mappings and transformations.</li> <li>• Compute complex contour integrals and applying Cauchy's integral in various versions.</li> <li>• Understand zeros and singularities of an analytic function, apply their properties in the evaluation of definite integral.</li> </ul>					
<b>Course Outline</b>		<b>UNIT-I:Analytic functions:</b> 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.					
		<b>UNIT-II:Conformal mapping:</b> Mappings – Mapping by exponential function – Linear transformation – The transformation $w = \frac{1}{z}$ – Mappings by $\frac{1}{z}$ – Linear fractional transformations (bilinear)					
		<b>UNIT-III:Complex Integration:</b> 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.					
		<b>UNIT – IV:Sequences and Series:</b> 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					
		<b>UNIT-V:Residues and Poles:</b> 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).					

<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
<b>Skills acquired from this course</b>	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Text</b>	S. Arumugam, A. Thangapandi Issac, A. Somasundaram, Complex Analysis, Scitech Publications, Pvt. Ltd, Chennai.
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Theodore W. Gamelan, Complex Analysis, Springer Verlag, 2008</li> <li>2. Joseph Bak and Donald J. Newman, Complex analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.</li> <li>3. Richard A. Silverman, Introductory Complex Analysis. Dover Publications, 1972.</li> <li>4. S. Ponnusamy and H. Silverman, Complex variables with applications, Birkhauser, 2006.</li> <li>5. Complex variables and application, Seventh Edition by James Ward Brown and Ruel V. Churchill, Mc-Graw Hill Book Co., International Edition, 2009.</li> </ol>
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### 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, Liouville'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

<b>Title of the Course</b>		<b>MECHANICS</b>					
<b>Paper Number</b>		<b>CORE 15</b>					
<b>Category</b>	<b>Core</b>	<b>Year</b>	II	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	VI				
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		6				--	6
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• Equilibrium of a particle under the action of given forces</li> <li>• Simple Harmonic Motion</li> <li>• Projectiles</li> </ul>					
<b>Course Outline</b>		<b>UNIT-I:</b> 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.					
		<b>UNIT-II:</b> 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.					
		<b>UNIT-III:</b> 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.					
		<b>UNIT – IV:</b> Projectiles: Forces on a projectile – Projectile projected on an inclined plane					
		<b>UNIT-V:</b> Central Orbits: General orbits – Central orbit – Conic as a centered orbit					
<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>		<p>Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</p>					
<b>Skills acquired from this course</b>		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					



<b>Recommended Text</b>	P. Duraipandiyan, LaxmiDuraipandian, MutthamizhJayapragasam, Mechanics, S.Chand Publications, Pvt. Ltd, New Delhi, 2005.
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. J.L. Meriam and L. G. Kraige, Engineering Mechanics: Statics, Seventh Edition, Wiley and sons Pvt Ltd., New York, 2012.</li> <li>2. J.L. Meriam, L. G. Kraige, and J.N. Bolton, Engineering Mechanics: Dynamics, 8<sup>th</sup>edn, Wiley and sons Pvt Ltd., New York, 2015.</li> <li>3. A. K. Dhiman, P. Dhinam and D. Kulshreshtha, Engineering Mechanics (Statics and Dynamics), McGraw Hill Education (India) Private Limited, New Delhi, 2015.</li> </ol>
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### Course Learning Outcome (for Mapping with POs and PSOs)

Students will be 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

### Generic Elective Courses (Allied Courses)

<b>Title of the Course</b>		<b>MATHEMATICAL STATISTICS - I</b>					
<b>Paper Number</b>		<b>Elective - III</b>					
<b>Category</b>	<b>Core</b>	<b>Year</b>	II	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	III				
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>		<b>Total</b>
	4		--		--		4
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• To makethestudentstogainwideknowledgeinthefundamentalconceptsof Statistics</li> <li>• Tounderstandtheideaofrandomvariablesandits types</li> <li>• Toderivecertainvaluesincorporatedwithrandomvariables</li> <li>• Torelatethestatisticaldistributionswiththereallifesituations</li> <li>• Toapplystatisticaltechniquestogetthesolutionstoreallifeproblems</li> </ul>					
<b>Course Outline</b>		<b>Unit I:</b> Random variables: Distribution function-Discrete random variable- Continuous random variable.					
		<b>Unit II:</b> Mathematical expectation- Expected value of function of a random variable- Properties of expectation - Properties of variance – Covariance.					
		<b>Unit III:</b> Moment generating function– Properties of cumulants- Chebychev's inequality- Binomial distribution.					
		<b>Unit IV:</b> Poisson distribution: Properties, Moments of Poisson distribution– Geometric distribution: Moment generating function of Geometric distribution.					
		<b>Unit V:</b> Normal distribution: Moment generating function of Normal distribution, Mean deviation about mean – Gamma distribution - Exponential distribution.					

<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
<b>Skills acquired from this course</b>	Knowledge, problem solving, analytical ability, professional competency, professional communication and transferable skill.
<b>Text Book</b>	S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co, New Delhi, Reprint 2019.
<b>Recommended Text</b>	1. Vittal, P.R. (2004). <i>Mathematical statistics</i> . Margham Publications. 2. Kapur, J. N & Saxena, H. C. (2010). <i>Mathematical statistics</i> (20 <sup>th</sup> ed.). S. Chand & Company Ltd.
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

<b>Course Outcomes</b>		
<b>CO No.</b>	<b>CO-Statements</b>	<b>Cognitive Levels (K- Level)</b>
	On successful completion of this course, students will be able to	
<b>CO1</b>	acquire the knowledge of basic concepts in statistics	<b>K1</b>
<b>CO2</b>	be able to understand various types of random variables and the distributions	<b>K2</b>
<b>CO3</b>	calculate moments, cumulants, moment generating function and various constants of probability distributions	<b>K3</b>
<b>CO4</b>	illustrate the theory of random variables, distribution functions and probability distributions with suitable	<b>K4</b>
<b>CO5</b>	be able to evaluate solution of real-life problems under the concept of probability and probability distributions.	<b>K5</b>

<b>Relationship Matrix</b>											
<b>Course Outcomes</b>	<b>ProgrammeOutcomes (POs)</b>					<b>ProgrammeSpecificOutcomes(PSOs)</b>					<b>Mean Scoreof COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	3	3	2	2	1	3	3	2	1	2	2.2
<b>CO2</b>	3	3	2	2	1	3	3	2	1	2	2.2
<b>CO3</b>	3	2	2	2	1	3	3	2	1	2	2.1
<b>CO4</b>	3	3	2	2	1	3	3	2	1	2	2.2
<b>CO5</b>	3	3	3	2	1	3	3	2	1	2	2.3

<b>Title of the Course</b>		<b>MATHEMATICAL STATISTICS - II</b>					
<b>Paper Number</b>		<b>Elective - IV</b>					
<b>Category</b>	<b>Core</b>	<b>Year</b>	II	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	III				
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>		<b>Total</b>
	3		--		--		3
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• To test the significance of sampling</li> <li>• Finding the Goodness of Fit</li> <li>• To derive the various measures of t and F distributions</li> <li>• To Analyze the correlation coefficient and Regression lines</li> </ul>					
<b>Course Outline</b>		<p><b>Unit I:</b> Introduction - Types of Sampling - Parameter and Statistic - Tests of significance - Procedure for testing of hypothesis - Test of significance for large samples - Sampling of attributes - Sampling of variables.</p> <p><b>Unit II:</b> Introduction - Student's t - distribution - Applications of t-distribution</p> <p><b>Unit III:</b> -F-distribution - Applications of F-distribution.</p> <p><b>Unit IV:</b> Meaning of Correlation – Scatter Diagram – Karl Pearson's Coefficient of Correlation – Rank Correlation</p> <p><b>Unit V:</b> Introduction - Linear regression</p>					
<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>		<p>Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</p>					

<b>Skills acquired from this course</b>	Knowledge, problem solving, analytical ability, professional competency, professional communication and transferable skill.
<b>Text Book</b>	S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co, New Delhi, Reprint 2019.  <b>UnitI:</b> Ch 14 (Full) <b>UnitII:</b> Ch 16 (Sec16.1-16.3.3) <b>UnitIII :</b> Ch 16 (Sec16.5-16.6.5) <b>UnitIV:</b> Ch10(Sec10.1-10.4, 10.7.1) <b>UnitV:</b> Ch.11 (Sec11.1-11.2.5)
<b>Recommended Text</b>	1. Vittal,P.R.(2004). <i>Mathematicalstatistics</i> .MarghamPublications. 2. Kapur, J. N &Saxena, H. C. (2010). <i>Mathematical statistics</i> (20 <sup>th</sup> ed.). S. Chand & Company Ltd.
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

CONo.	CO-Statements	Cognitive Levels (K-levels)
	On successful completion of this course, students will be able to	
CO-1	Recognize the parameters and statistics to test the significance of sampling	K1
CO-2	Finding the Goodness of Fit	K2
CO-3	Derive the various measures of Chi-square, t and F distributions	K3
CO-4	Correlation coefficients between Observed and Estimated values	K4
CO-5	Analyse the Regression lines	K4

Semester	Course Code	Title of the Course									Hours	Credits
II	21UMA23AC02	ALLIED-2:STATISTICS-II									6	4
Course Outcomes↓	Programme Outcomes(PO)					Programme Specific Outcomes(PSO)					Mean Scores of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	1	2	2	2	2	3	3	2	2	2	2.1	
CO-2	2	3	1	2	2	2	2	3	3	2	2.2	
CO-3	2	3	2	1	3	2	2	3	2	2	2.2	
CO-4	3	2	3	3	1	2	2	2	3	2	2.3	
CO-5	3	1	2	2	2	2	3	2	2	3	2.2	

## Discipline Specific Electives

<b>Title of the Course</b>		<b>TRANSFORM TECHNIQUES</b>					
<b>Paper Number</b>		<b>ELECTIVE COURSE-V</b>					
<b>Category</b>	Elective	<b>Year</b>	II	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	V				
<b>Instructional Hours Per Week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		4		-		-	4
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>➤ The basic knowledge about Laplace Transforms and its inverse</li> <li>➤ Apply Laplace Transforms in solving ODE</li> <li>➤ To solve problems in Fourier Series and Fourier Transforms</li> </ul>					
<b>Course Outline</b>		<b>Unit I: Laplace Transforms:</b> Definition – Sufficient Condition for the Existence of Laplace Transforms (Without Proof) – Laplace Transform of Periodic Functions – Some General Theorems – Evaluation of Integrals Using Laplace Transform – Problems. <b>Chapter: 5 Sections 1–5</b>					
		<b>Unit II: The Inverse Laplace Transforms:</b> The Inverse Laplace Transforms – Problems. <b>Chapter: 5 (Sections 6 &amp; 7)</b>					
		<b>Unit III: Fourier Series:</b> Fourier Series – Expansion of Periodic Functions of Period 2 – Expansion of Odd and Even Functions – Problems. <b>Chapter: 6 (Sections 1–3)</b>					
		<b>Unit IV: Fourier Transforms:</b> Fourier Transform – Infinite Fourier Transform (Complex Form) – Properties of Fourier Transforms. <b>Chapter: 6 (Sections 8–10)</b>					
		<b>Unit V: Fourier Transforms (Continued):</b> Fourier Cosine and Sine Transform – Properties – Problems. <b>Chapter : 6 (Sections 11 &amp; 12)</b>					

<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>	Questions related to the above topics, from various competitive examinations UPSC/TNPSC /other to be solved (To be discussed during the Tutorial Hour)
<b>Skills acquired from this course</b>	Knowledge, Problem Solving, Analytical Ability, Professional Competency, Professional Communication and Transferable Skill
<b>Recommended Text</b>	Calculus Volume III by S. Narayanan and T. K. Manickavachagom Pillay, S. Viswanathan Publishers Pvt. Ltd. 2006
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Engineering Mathematics Volume III, P. Kandasamy and Others, (S. Chand and Co)</li> <li>2. Advanced Engineering Mathematics – Stanley Grossman and William R. Devit</li> <li>3. Engineering Mathematics III, A. Singaravelu, Meenakshi Agency, Chennai 2008.</li> </ol>
<b>Website and e-Learning source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a> <a href="https://www.mathhelp.com/">https://www.mathhelp.com/</a>

### **Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

**CLO1:** Find the Laplace Transform and evaluation of integrals using Laplace Transform

**CLO2:** Find the Inverse Laplace Transforms

**CLO3:** Expansion of Periodic Functions of Period 2, Expansion of Odd and Even Functions

s

**CLO4:** Find the Fourier Transforms, Infinite Fourier Transforms and their properties

**CLO 5:** Evaluate Fourier sine and cosine transform.



	POs						PSOs		
	1	2	3	4	5	6	1	2	3
<b>CLO1</b>	3	3	1	3	1	-	3	1	1
<b>CLO2</b>	3	3	1	3	1	-	3	1	1
<b>CLO3</b>	3	3	1	3	1	-	3	1	1
<b>CLO4</b>	3	3	1	3	1	-	3	1	1
<b>CLO5</b>	3	3	1	3	1	-	3	1	1

<b>Title of the Course</b>		<b>SPECIAL FUNCTIONS</b>					
<b>Paper Number</b>		<b>ELECTIVE COURSE-V</b>					
<b>Category</b>	Elective	<b>Year</b>	II	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	V				
<b>Instructional Hours Per Week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		4		-		-	4
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ol style="list-style-type: none"> <li>1. To develop computational skills in certain special functions which are frequently occurring in higher mathematics and mathematical physics.</li> <li>2. Learn the concepts of simultaneous linear differential equations and some solvable types of nonlinear equations.</li> <li>3. Basic knowledge about numerical solutions using the Taylor series.</li> <li>4. To understand the concepts of Bessel functions, Legendre functions, and their properties.</li> <li>5. To give an insight about Fourier integral, term by term differentiation of Fourier series and Legendre series.</li> </ol>					
<b>Course Outline</b>		<b>UNIT-I:</b> Properties of Linear Operators- Simultaneous Linear Differential Equations- Special Solvable Types of Nonlinear Equations.					
		<b>UNIT-II:</b> Numerical Solutions Using Taylor Series- Adams and Modified Adams Method- Extrapolation with Differences					
		<b>UNIT-III:</b> Properties of Power Series- Examples- Singular Points of Linear Second Order Differential Equations - Method of Frobenius.					
		<b>UNIT-IV:</b> Bessel Functions- Properties- Legendre Functions.					

	<b>UNIT-V:</b> Term by Term Differentiation of Fourier Series, Legendre Series- Fourier Integral.
<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>	Questions related to the above topics, from various competitive examinations UPSC/TNPSC /other to be solved (To be discussed during the Tutorial Hour)
<b>Skills acquired from this course</b>	Knowledge, Problem Solving, Analytical Ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Text</b>	F.B.Hildebrand.(1977)Advanced Calculus for Applications. Prentice Hall. New Jersey.
<b>Reference Books</b>	1. J.N.Sharma and R.K.Gupta(1998)Special Functions, Krishna Prakashan Mandir, Meerut. 2. Satya Prakash.(2004)Mathematical Physics. Sultan & Sons. New Delhi. 3. B.D.Gupta(1978)Mathematical Physics, Vikas Publishing House.
<b>Website and e-Learning source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a> <a href="https://www.mathhelp.com/">https://www.mathhelp.com/</a>

### Course Outcomes

1. After studying unit-1, the student will be able to acquire the concept of linear operators, and solve simultaneous linear differential equations.
2. After studying unit-2, the student will be able to interpret Adams and Modified Adams method and extrapolation techniques.
3. After studying unit-3, the student will be able to understand the concept of power series solution.
4. After studying unit-4, the student will be able to explain the concepts of Bessel functions, Legendre functions, and their properties.

5. After studied unit -5, the student will be able to analyze term-by-term differentiation of the Fourier series and Legendre series.

### MappingwithProgramme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	3	3	3	3	2	3	2
CO2	3	2	3	3	2	3	3	3	2	3
CO3	2	2	3	3	3	3	2	3	3	2
CO4	3	3	2	3	3	2	3	2	3	3
CO5	2	3	3	2	3	3	3	3	2	2

<b>Title of the Course</b>		<b>GRAPH THEORY AND APPLICATIONS</b>					
<b>Paper Number</b>		<b>ELECTIVE COURSE-VI</b>					
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	V				
<b>Instructional Hours Per Week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		4		-		-	4
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		To study and develop the concepts of Graphs, sub graphs, Trees, Connectivity, Eulerian, Hamiltonian graphs, Matchings and Planar graphs.					
<b>Course Outline</b>		<b>UNIT-I:</b> Graphs, Degrees, Subgraphs, Isomorphism of graphs, Ramsey Numbers, Independent sets and Coverings. ( Sec 2.1, 2.2, 2.3, 2.4, 2.5, 2.6 )					
		<b>UNIT-II :</b> Intersection graphs and line graphs, Matrices, Operations on graphs, Degree Sequence, Graphic Sequence. ( Sec 2.7, 2.8, 2.9, 3.1, 3.2 )					
		<b>UNIT-III:</b> Walks, Trails, Paths, Connectedness and Components, Cutpoint, Bridge, Block, Connectivity. ( 4.1, 4.2, 4.3, 4.4 )					
		<b>UNIT-IV:</b> Eulerian graphs, Hamiltonian graphs, Characterization of Trees, Centre of a Tree ( 5.1, 5.2, 6.1, 6.2 )					
		<b>UNIT-V:</b> Matchings, Matchings in Bipartite Graphs, Definition and properties of a planar graphs, characterization of planar graphs. ( 7.1, 7.2, 8.1, 8.2 )					
<b>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</b>		Questions related to the above topics, from various competitive examinations UPSC/TNPSC /other to be solved (To be discussed during the Tutorial Hour)					

<b>Skills acquired from this course</b>	Knowledge, Problem Solving, Analytical Ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Text</b>	S.Arumugam and S.Ramachandran, "Invitation to Graph Theory", SCITECH Publications India Pvt. Ltd., 7/3C, Madley Road, T.Nagar, Chennai - 17
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Douglas B. West 'Introduction to Graph Theory', Pearson Education, Inc. Pearson Prentice Hall, London.</li> <li>2. S.A. Choudham, A First Course in Graph Theory, Macmillan India Ltd.</li> <li>3. Robin J. Wilson, Introduction to Graph Theory, Longman Group Ltd.</li> <li>4. J.A. Bondy and U.S.R. Murthy, Graph Theory with Applications, Macmillan, London.</li> </ol>
<b>Website and e-Learning source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a> <a href="https://www.mathhelp.com/">https://www.mathhelp.com/</a>

<b>Title of the Course</b>		<b>NUMBER THEORY</b>					
<b>Paper Number</b>		<b>ELECTIVE COURSE-VI</b>					
<b>Category</b>	<b>Core</b>	<b>Year</b>	III	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	V				
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>		<b>Total</b>
	4		-		--		4
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>		<ul style="list-style-type: none"> <li>• Apply the various techniques of solving puzzles in applications.</li> <li>• Know the connections of number theory with other branches.</li> <li>• Gain competence in solving problems.</li> </ul>					
<b>Course Outline</b>		<p><b>UNIT-I Introduction</b>– Basic binary Operations on the set of Integers– Ordering of Integers - Well Ordering Principle– Mathematical Induction. (Simple problems only)</p> <p><b>UNIT-II: Divisibility Theory:</b> Greatest common Divisor- Relatively Prime integers– Algorithm to find G.C.D: Investigation of the set of integers <math>\{bx+cy\}</math>- Least Common Multiple. (Simple problems only)</p> <p><b>UNIT-III: Linear Diophantine Equations:</b> Linear Diophantine Equations – The Equation <math>ax+by=c</math> – Diophantine Equations in Three or More Unknowns (Statements and simple problems only)</p> <p><b>UNIT-IV: Quadratic Residues:</b> Introduction, quadratic residues, Elementary Properties. (Simple problems only)</p> <p><b>UNIT-V: Perfect Numbers:</b> Introduction, Perfect Numbers, Necessary and Sufficient Conditions for a positive Integer to be an even Perfect number, Mersenne Numbers, Fermat Numbers. (Simple problems only)</p>					
<b>Skills acquired from this course</b>		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					
<b>Recommended Text</b>		Theory of Numbers, Dr. Sudhir, K. Pundir, Pragati Prakashan Publications, third revised edition 2012.					

<b>Reference Books</b>	1. An introduction to the Theory of Numbers (7th edition) by Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery John Wiley & Sons, Inc. 2001. 2. Elementary theory of numbers, by Hsiung, Allied publishers, 1995. 3. Elementary Number Theory, Allyn and Bacon Inc., Boston, 1980.
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

**CLO 1:** Understand the fundamental concepts of Mathematical Induction.

**CLO 2:** Evaluate the Greatest common Divisor and Least common multiple using the algorithms.

**CLO 3:** Determine and understand the Diophantine equations for three or more unknowns.

**CLO 4:** Demonstrate the quadratic residues, elementary Properties

**CLO 5:** Evaluate and analyze the perfect numbers using the Mersenne and Fermat Numbers.

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



Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
Elective Course - VII	<b>OBJECT ORIENTED PROGRAMMING CONCEPTS USING C++</b>	Core	5	-	-	-	3	5	25	75	100
<b>Learning Objective</b>											
LO1	Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects										
LO2	Understand dynamic memory management techniques using pointers, constructors, destructors, etc										
LO3	Describe the concept of function overloading, operator overloading, virtual functions and polymorphism										
LO4	Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming										
LO5	Demonstrate the use of various OOPs concepts with the help of programs										
<b>UNIT</b>	<b>Contents</b>									<b>No. of Hours</b>	
I	Introduction to C++ - key concepts of Object-Oriented Programming – Advantages – ObjectOriented Languages – I/O in C++ - C++ Declarations. Control Structures : - Decision Makingand Statements : If ..else, jump, goto, break, continue, Switch case statements - Loops in C++ :for, while, do - functions in C++ - inline functions – Function Overloading.									15	
II	Classes and Objects: Declaring Objects – Defining Member Functions – Static Member variablesand functions – array of objects –friend functions – Overloading member functions – Bit fieldsand classes – Constructor and destructor with static members.									15	
III	Operator Overloading: Overloading unary, binary operators – Overloading Friend functions –type conversion – Inheritance: Types of Inheritance – Single, Multilevel, Multiple, Hierarchal,Hybrid, Multi path inheritance – Virtual base Classes – Abstract Classes.									15	
IV	Pointers – Declaration – Pointer to Class , Object – this pointer – Pointers to derived classes andBase classes – Arrays – Characteristics – array of classes – Memory models – new and deleteoperators – dynamic object – Binding, Polymorphism and Virtual Functions.									15	
V	Files – File stream classes – file modes – Sequential Read / Write									15	

	operations – Binary and ASCIIFiles – Random Access Operation – Templates – Exception Handling - String – Declaring andInitializingstring objects – String Attributes – Miscellaneous functions.	
	<b>Total</b>	<b>75</b>
<b>Course Outcomes</b>		<b>Programme Outcome</b>
CO	Upon completion of the course the students would be able to:	
1	Remember the program structure of C with its syntax and semantics	PO1,PO6
2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)	PO2
3	Apply the programming principles learnt in real-time problems	PO4 ,PO5
4	Analyze the various methods of solving a problem and choose the best method	PO6
5	Code, debug and test the programs with appropriate test cases	PO3,PO6
<b>Text Book</b>		
1	E. Balagurusamy, “Object-Oriented Programming with C++”, TMH 2013, 7th Edition.	
<b>Reference Books</b>		
1.	Ashok N Kamthane, “Object-Oriented Programming with ANSI and Turbo C++”, Pearson Education 2003.	
2.	Maria Litvin&GrayLitvin, “C++ for you”, Vikas publication 2002.	
<b>Web Resources</b>		
1.	<a href="https://alison.com/course/introduction-to-c-plus-plus-programming">https://alison.com/course/introduction-to-c-plus-plus-programming</a>	

#### Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	2	3	3
CO 3	3	2	2	2	3	2
CO 4	3	3	3	3	2	3
CO 5	3	2	3	2	3	3
<b>Weight age of course contributed to each PSO</b>	15	13	14	12	14	14

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>Elective Course - VII</b>	<b>OBJECT ORIENTED PROGRAMMING CONCEPTS USING C++LAB</b>	Core	-	-	2	-		2	25	75	100
<b>Course Objective</b>											
C1	Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects										
C2	Understand dynamic memory management techniques using pointers, constructors, destructors, etc										
C3	Describe the concept of function overloading, operator overloading, virtual functions and polymorphism										
C4	Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming										
C5	Demonstrate the use of various OOPs concepts with the help of programs										
<b>S.No</b>	<b>List of Exercises</b>										<b>No. of Hours</b>
1	Write a C++ program to demonstrate function overloading, Default Arguments and Inlinefunction.										60
2	Write a C++ program to demonstrate Class and Objects										
3	Write a C++ program to demonstrate the concept of Passing Objects to Functions										
4	Write a C++ program to demonstrate the Friend Functions.										
5	Write a C++ program to demonstrate the concept of Passing Objects to Functions										
6	Write a C++ program to demonstrate Constructor and Destructor										
7	Write a C++ program to demonstrate Unary Operator Overloading										
8	Write a C++ program to demonstrate Binary Operator Overloading										
9	Write a C++ program to demonstrate: <ul style="list-style-type: none"> <li>• Single Inheritance</li> <li>• Multilevel Inheritance</li> <li>• Multiple Inheritance</li> <li>• Hierarchical Inheritance</li> <li>• Hybrid Inheritance</li> </ul>										
10	Write a C++ program to demonstrate Virtual Functions.										
11	Write a C++ program to manipulate a Text File.										
12	Write a C++ program to perform Sequential I/O Operations on a file.										
13	Write a C++ program to find the Biggest Number using Command Line Arguments										

14	Write a C++ program to demonstrate Class Template	
15	Write a C++ program to demonstrate Function Template.	
16	Write a C++ program to demonstrate Exception Handling.	
Course Outcomes		Programme Outcome
CO	Upon completion of the course the students would be able to:	
1	Remember the program structure of C with its syntax and semantics	PO4,PO5
2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)	PO6
3	Apply the programming principles learnt in real-time problems	PO4 ,PO5
4	Analyze the various methods of solving a problem and choose the best method	PO6
5	Code, debug and test the programs with appropriate test cases	PO4,PO5
Text Book		
1	E. Balagurusamy, “Object-Oriented Programming with C++”, TMH 2013, 7th Edition.	
Reference Books		
1.	Ashok N Kamthane, “Object-Oriented Programming with ANSI and Turbo C++”, Pearson Education 2003.	
2.	Maria Litvin&GrayLitvin, “C++ for you”, Vikas publication 2002.	
Web Resources		
1.	<a href="https://alison.com/course/introduction-to-c-plus-plus-programming">https://alison.com/course/introduction-to-c-plus-plus-programming</a>	

**Mapping with Programme Outcomes:**

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	2	3	3	2	3
CO 3	3	3	3	3	3	3
CO 4	3	2	2	3	3	3
CO 5	3	2	3	3	3	2

<b>Title of the Course</b>		<b>FINANCIAL ANALYTICS</b>				
<b>Paper Number</b>		<b>ELECTIVE COURSE-VII</b>				
<b>Category</b>	<b>Year</b>	III	<b>Credits</b>	3	<b>Course Code</b>	
	<b>Semester</b>	VI				
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		5	-	--		5
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics				
<b>Objectives of the Course</b>		The course aims to provide students with a comprehensive understanding of the various aspects of financial analytics, emphasizing the stock market, portfolio management, risk assessment and management, fraud analytics, and financial modeling.				
<b>Course Outline</b>		<b>Unit I: Understanding Financial Analytics</b> Provide an in-depth understanding of financial analytics - its relevance, and scope in today's financial landscape - Highlight recent trends and introduce the tools and techniques employed in finance.				
		<b>Unit II: Stock Market Fundamentals:</b> Introduce the history – importance and role of the stock market in the economy. Familiarize students with stocks - bonds, derivatives, and the roles of different market participants - Long-term vs. short-term investing - Diversification and its importance in a portfolio Regulatory bodies and their role in overseeing stock market activities - Compliance and legal aspects in stock market operations.				
		<b>Unit III: Portfolio Management Skills:</b> The principles of portfolio construction - including Modern Portfolio Theory, asset allocation, and the use of fundamental and technical analysis. Explore behavioural finance - the Capital Asset Pricing Model - risk measures in portfolio management.				
		<b>Unit IV: Risk Assessment and Management:</b> Explain different types of financial risks - their characteristics, and interrelationships. Cover methodologies such as Value at Risk - stress testing, and risk control methods like hedging and diversification. Discuss regulatory aspects related to risk management.				
		<b>Unit V: Fraud Analytics and Prevention:</b> Define various types of financial fraud, emphasize ethical considerations - regulatory compliance - the strategies and technologies employed in fraud risk management. Introduce real-world case studies for practical understanding.				
<b>Skills acquired from this course</b>		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill				
<b>Recommended Text</b>		Pitabas Mohanty (2023), "Financial Analytics", Wiley India, ISBN 978-93-5464-417-7				

<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Argimiro Arratia (2014), “Computational Finance An Introductory Course with R”, Atlantis Press, ISBN 978-94-6239-069-0</li> <li>2. Bernhard Pfaff (2013), “Financial risk modelling and portfolio optimization with R”, Wiley, ISBN 978-0-470-97870-2</li> <li>3. Cairns, A.J. G (2004), “Interest Rate Models: An Introduction”, Princeton University Press, ISBN: 9780691118949</li> <li>4. Christian Gouriéroux &amp; Joann Jasiak (2002), “Financial Econometrics: Problems, Models, and Methods”, Princeton University Press, ISBN: 9780691088723</li> <li>5. David Ruppert (2011), “Statistics and Data Analysis for Financial Engineering”, Springer, ISBN 978-1-4419-7786-1</li> <li>6. Duffie, D. and Singleton, K.J (2003), “Credit Risk: Pricing, Measurement, and Management”, Princeton University Press, ISBN: 9780691090467</li> <li>7. John Y. Campbell, Andrew W. Lo, &amp; A. Craig MacKinlay (1997), “The Econometrics of Financial Markets”, Princeton University Press, ISBN: 9780691043012</li> </ol>
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

**Course Outcome:**

Upon completion of the course, students will:

**CO 1: Grasp Financial Analytics Fundamentals:** Understand the significance and relevance of financial analytics, recent trends, and the application of analytical tools and techniques in finance.

**CO 2: Comprehend Stock Market Dynamics:** Gain a comprehensive understanding of the stock market, its history, functions, and the roles played by different market participants and regulatory bodies.

**CO 3: Apply Portfolio Management Principles:** Acquire the skills necessary to construct portfolios based on Modern Portfolio Theory, analyze asset allocation, employ fundamental and technical analysis, and monitor and adjust portfolios.

**CO 4: Assess and Manage Financial Risks:** Identify different types of financial risks, understand risk and return relationships, and apply various risk assessment and management techniques.

**CO 5: Understand Fraud Analytics and Prevention:** Recognize different types of financial fraud, apply ethical considerations in fraud detection, and develop strategies to prevent and manage fraud.

The course is designed to provide a holistic understanding of financial analytics, preparing students to navigate the complex landscape of the stock market, risk management, fraud detection, and decision-making through modeling and forecasting in finance.

**CO-PSO-PO Mapping**

	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	2
<b>CO2</b>	2	3	1
<b>CO3</b>	3	3	2
<b>CO4</b>	3	2	2
<b>CO5</b>	2	3	3

(Low-1; Moderate-2; High-3; No Correlation -0)

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	3	2	1	2	1	2
<b>CO2</b>	2	3	3	1	2	3
<b>CO3</b>	3	2	2	2	3	1
<b>CO4</b>	2	3	2	2	1	3
<b>CO5</b>	3	2	1	2	2	3

<b>Title of the Course</b>	<b>DISCRETE MATHEMATICS</b>					
<b>Paper Number</b>	<b>ELECTIVE COURSE-VIII</b>					
<b>Category</b>	<b>Year</b>	III	<b>Credits</b>	3	<b>Course Code</b>	
	<b>Semester</b>	VI				
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		5	-	--		5
<b>Pre-requisite</b>	12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>	This course aims to develop mathematical maturity and ability to deal with abstraction and to develop construction and verification of formal logical manipulation.					
<b>Course Outline</b>	<b>UNIT I: RECURRENCE RELATIONS AND GENERATING FUNCTIONS</b> Recurrence - Polynomials and their Evaluations - Recurrence Relations - Solution of Finite Order Homogeneous [linear] Relations - Solutions of Non-homogeneous Relations. (Chap V . Sections:1 to 5 )					
	<b>UNIT II: MATHEMATICAL LOGIC</b> TF Statements - Connectives - Atomic and Compound Statements - Well-formed [Statement Formulae]- Truth Table of a Formula-Tautology -Tautological Implications and Equivalence of Formulae. (Chap IX . Sections:1 to 8 )					
	<b>UNIT III: MATHEMATICAL LOGIC [CONTD..]</b> Replacement process - Functionally complete sets of connectives and Duality law – Normal Forms-Principal Normal Forms.(Chap IX . Sections: 9 to 12 )					
	<b>UNIT IV: LATTICES</b> Lattices [omit example 15 PpNo.10.6]- Some properties of Lattices - New Lattices (omit remark Pp 10.14)-Modular and Distributive Lattices (omit theorem 10 and 17,Example 4-Pp10.23, Example 11-Pp10.24) (Chap X . Sections:1 to 4 )					
	<b>UNIT-V BOOLEAN ALGEBRA</b> Boolean Algebra (omit theorem 25) - Boolean Polynomials- Karnaugh Maps (omit K- map for 5 and 6 variables) (Chap X . Sections:5 to 7)					
<b>Skills acquired from this course</b>	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					
<b>Recommended Text</b>	M.K.Venkataraman, N.Sridharan and N.Chandrasekaran, [2003] Discrete Mathematics, The National Publishing company, Chennai.					



<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Oscar Levin, Discrete Mathematics, 3rd Edition, 2016.</li> <li>2. B. A. Davey &amp; H. A. Priestley (2002). <i>Introduction to Lattices and Order</i> (2<sup>nd</sup> edition). Cambridge University Press.</li> <li>3. Edgar G. Goodaire &amp; Michael M. Parmenter (2018). <i>Discrete Mathematics with Graph Theory</i> (3rd edition). Pearson Education.</li> <li>4. Rudolf Lidl &amp; Günter Pilz (1998). <i>Applied Abstract Algebra</i> (2nd edition). Springer.</li> <li>5. Kenneth H. Rosen (2012). <i>Discrete Mathematics and its Applications: With Combinatorics and Graph Theory</i> (7th edition). McGraw-Hill.</li> <li>6. C. L. Liu (1985). <i>Elements of Discrete Mathematics</i> (2nd edition). McGraw-Hill.</li> </ol>
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	Analyse and perceive various graph theoretic concepts and familiarize with their applications.	K4, K5
CO2	Describe about partially ordered sets, Boolean algebra, lattices and their types.	K1
CO3	Apply Karnaugh map for simplifying the Boolean expression	K3
CO4	Demonstrate the skill to construct simple mathematical proofs and to validate.	K2, K6
CO5	Achieve greater accuracy, clarity of thought and language.	K6

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	3	2	3	3	3	3	3	3	3	2	2	2.67
2	3	2	2	2	3	3	3	2	2	2	2	3	2.42
3	2	2	2	2	3	3	3	3	3	3	2	3	2.58
4	3	2	2	3	3	3	2	3	3	3	3	2	2.67
5	3	2	2	3	3	2	2	3	3	2	2	3	2.5
	Mean Overall Score												2.57
	Result												High

<b>Title of the Course</b>	<b>BIG DATA ANALYTICS</b>					
<b>Paper Number</b>	<b>ELECTIVECOURSE–VIII</b>					
<b>Category</b>	<b>Year</b>	III	<b>Credits</b>	3	<b>Course Code</b>	
	<b>Semester</b>	VI				
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		5	-	--		5
<b>Pre-requisite</b>	12 <sup>th</sup> Standard Mathematics					
<b>Objectives of the Course</b>	This course gives an overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the “technologies”, i.e., the tools/algorithms that are available for storage, processing of Big Data. It also helps a student to perform a variety of “analytics” on different data sets and to arrive at positive conclusions.					
<b>Course Outline</b>	<b>UNIT - I: BUSINESS POTENTIAL OF BIG DATA (6 Hrs)</b>					
	Definition – Big data, computing perfect storm, Data perfect storm, Convergence perfect storm, dependent, Independent, Interdependent, wider variety of data, Big Data and the New School of Marketing, Cross-Channel Lifecycle Marketing, Social and Affiliate Marketing, Fraud and Big Data, High volume, High velocity, High variety, Risk and Big Data, Credit Risk Management, Algorithmic Trading, Complex Interrelated Data, Intraday Risk Analytics, Disruptive Analytics, Optimization, Marketing Mixed Modelling.					
	<b>Unit – II BIG DATA TECHNOLOGY (8 Hrs)</b>					
Big Data Technology Terms , Hadoop Distributed File System (HDFS), Map Reduce, Old vs. New Approaches, Open-Source Technology, The Cloud and Big Data, Mobile Business Intelligence, Ease of Mobile Application Deployment, Crowdsourcing Analytics, Inter- and Trans-Firewall Analytics, R&D Approach, Adding Big Data Technology						
<b>Unit - III: INFORMATION MANAGEMENT (8 Hrs)</b>						
Big Data Foundation, Computing Platforms, More on Big Data Storage, Computational Limitations, Emerging Technologies, Consumption of Analytics, communication, Implement, Measure, Align incentives, Develop cognitive repairs, Creation to Consumption, Visualizing data, Describing, reporting, observing, discovering, Tools to Analytic Applications.						

	<p><b>Unit - IV: BIG DATA BUSINESS MODEL USING AI (8 Hrs)</b>  AI based Business Monitoring, AI Business Insights, AI Business Optimization, Data Monetization, Business Metamorphosis, Leveraging Technology, Power Competitive Differentiation, Economic-Driven Business Transformation, Evolution of the Business, Focus Initial Big Data Efforts Internally, Preparing for Organizational Transformation, Data as an Asset, Establishing Common Business, Corporate Mission, Business Strategy, Strategic Business Initiatives, Business Entities, Business Stakeholders, Business Decisions.</p> <p><b>Unit – V: DATA SCIENCE FOR BUSINESS STAKEHOLDER(10 Hrs)</b>  Forecasting Identify Key Business Initiative, Develop Business Stakeholder Personas Identify Strategic Nouns, Capture Business Decisions, Brainstorm Business Questions, Leverage BY Analysis, Create Actionable Scores, Analytics into Action. Articulate the Business Metamorphosis Vision, Data and Analytic Requirements, Identify Business and Operational Decisions, and Identify Analytic Requirements, Business Metamorphosis in Health Care, Prioritization Matrix, Privacy, Trust, and Decision Governance.</p>
<b>Skills acquired from this course</b>	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Text</b>	<p>A) Minelli, Michael, Michele Chambers, and AmbigaDhiraj (2013). Big data, big analytics: emerging business intelligence and analytic trends for today's businesses. John Wiley &amp; Sons.</p> <p>B) Keighley, L. and Hill, P., (2017). Big Data MBA-Driving Business Strategies with Data Science Bill Schmarzo.</p>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. SeemaAcharya, SubhashiniChellappan, (2015)“Big Data Analytics”, 1st Edition, Wiley</li> <li>2. Liebowitz, J. ed., 2013. Big data and business analytics. CRC press.</li> <li>3. Maheshwari, A., 2014. Data analytics made accessible. Seattle: Amazon Digital Services.</li> </ol>
<b>Website and e-Learning Source</b>	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

## **Course Outcome**

At the end of the course students will be able to:

**CO 1:** To Understand Big Data and its Business analytics in the real world.

**CO 2:** knowledge about to big data analyze the Big Data framework like Hadoop and process Big Data to generate analytics.

**CO 3:** Application of Business Information and computational methods.

**CO 4:** To discuss Business Strategy, Strategic Business Initiatives, Business Entities, Business Stakeholders.

**CO 5:** Have a high level understanding of Develop Business Stakeholder Personas  
Identify Strategic Nouns, Capture Business Decisions, and Brainstorm Business.

### **CO-PSO-PO Mapping**

	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	2
<b>CO2</b>	2	3	1
<b>CO3</b>	3	3	2
<b>CO4</b>	3	2	2
<b>CO5</b>	2	3	3

(Low-1; Moderate-2; High-3; No Correlation -0)

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	3	2	1	2	1	2
<b>CO2</b>	2	3	3	1	2	3
<b>CO3</b>	3	2	2	2	3	1
<b>CO4</b>	2	3	2	2	1	3
<b>CO5</b>	3	2	1	2	2	3

## Skill Enhancement Courses

<b>Title of the Course</b>		<b>GEOGEBRA</b>					
<b>Paper Number</b>		<b>ELECTIVE (SEC)</b>					
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	2	<b>Course Code</b>	
		<b>Semester</b>	III				
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>	
		2		--	--	2	
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					

### Description:

This course introduces students to Geogebra, a dynamic math software. Over 30 hours, they'll learn to use Geogebra to visualize, solve, and analyze math problems across various fields. The goal is to build skills and enable the use of geometry for advanced mathematical applications.

### Objectives:

- To introduce the students to Geogebra.
- To enhance understanding of mathematical concepts.
- To make the students to progressively build skills and knowledge.
- To leverage geometry for advanced applications.
- To ensure prerequisite knowledge and skills.

### Prerequisites:

Solid foundation in basic math, including algebra and geometry. Completion of one year of high school or college-level math is recommended. Familiarity with equations, functions, and basic geometry, plus computer proficiency, is essential.

#### Unit - I: Introduction to Geogebra and Matrices (6 hours)

Introduction to Geogebra and its Applications- Exploring the Geogebra interface- Creating and manipulating matrices - Matrix operations (addition, multiplication) - Rank and Transpose of a matrix- Inverse of a matrix.

#### Unit - II: Trigonometry and Geogebra (6 hours)

Trigonometric functions and identities- Graphing trigonometric functions - Using Geogebra to solve trigonometric equations- Trigonometric applications and Geogebra tools.

#### Unit - III: Roots of Polynomials (6 hours)

Solving polynomial equations- Graphical representation of polynomial functions- Finding roots and factors of polynomials - Maxima and Minima of polynomial equations.

#### Unit - IV: Limits and Continuity (6 hours)

Introduction to limits and their graphical representation- Calculating limits- Exploring the concept of continuity - Continuity and limits in real-world scenarios.

#### Unit - V: Advanced Topics and Practical Applications (6 hours)

Further exploration of mathematical concepts- Real-world applications and case studies of the topics covered- Interactive problem-solving.

**Assessment and Evaluation:**

<b>Assessment Component</b>	<b>Description</b>	<b>Weight</b>
Weekly Assignments	Ongoing assessments consisting of weekly quizzes and assignments to evaluate topic understanding and participation.	40%
Mid-term Examination	A mid-term examination is held at the midpoint of the course, covering material from the first half of the syllabus.	20%
Final Examination	A comprehensive final examination that covers all course content. This examination evaluates student's overall understanding and retention of the course material.	40%

**Textbook and Resources:**

- 1. Online Geogebra Documentation:**Geogebra provides extensive online documentation and tutorials to support learning and exploration.
- 2. Additional Reading:** Students are encouraged to explore additional resources related to specific topics covered in the course, such as calculus textbooks for more in-depth coverage of differentiation and integration.
- 3. Course Materials:** Lecture notes, slides, and assignments provided by the instructor throughout the course will be essential references.
- 4. Geogebra Software:** Ensure you have access to the latest version of GeoGebra, which can be downloaded for free from the Geogebra website

**E –Learning source**

- [1. Search Tutorials | spoken-tutorial.org](http://spoken-tutorial.org)
- [2. Applications of GeoGebra - Course \(swayam2.ac.in\)](http://swayam2.ac.in)
- [3. GeoGebra 5.04 - Course \(swayam2.ac.in\)](http://swayam2.ac.in)

**Course Learning Outcomes:**

<b>Course Outcome (CO)</b>	<b>Description</b>
<b>CO1: Proficiency</b>	- Navigate the Geogebra interface effectively. - Construct and manipulate geometric objects, points, lines, and angles. - Perform symbolic computations using the algebra view. - Graph functions and equations using Geogebra. - Utilize Geogebra tools for geometry and algebraic tasks. - Employ Geogebra scripting for

	advanced mathematical tasks.
<b>CO2:</b> Matrix and Trigonometry Mastery	- Using matrices, including operations like addition, multiplication, and inversion. - Solve trigonometric equations and graph trigonometric functions using Geogebra. - Understand matrix transformations and trigonometric properties.
<b>CO3:</b> Understanding Limits and Continuity	- Analyze limits graphically and mathematically. - Comprehend the concept of mathematical continuity. - Represent limits and continuity visually using Geogebra.
<b>CO4:</b> Geogebra Scripting and Advanced Tasks	- Use Geogebra scripting for advanced mathematical tasks and explorations.
<b>CO5:</b> Critical Thinking and Mathematical Problem-Solving	- Develop critical thinking skills in approaching mathematical problems. - Apply mathematical concepts systematically to real-world scenarios. - Enhance overall problem-solving abilities.
<b>CO6:</b> Effective Communication of Mathematical Ideas	- Communicate mathematical ideas clearly, both verbally and in writing. - Present mathematical concepts and solutions in an organized manner - Demonstrate mathematical reasoning effectively.
<b>CO7:</b> Independent Learning and Exploration	- Gain confidence and skills for independent learning and exploration of mathematical concepts using Geogebra. - Apply mathematics in various academic and practical contexts.

<b>Title of the Course</b>		<b>MAXIMA</b>					
<b>Paper Number</b>		<b>ELECTIVE(SEC)</b>					
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	2	<b>Course Code</b>	
		<b>Semester</b>	IV				
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>	
		2		--	--	2	
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					

**Description:**

This course empowers students with advanced Maxima skills for symbolic math. Tailored to deepen understanding of complex math, it covers symbolic calculations, algebra, differentiation, integration, and intricate problem-solving. Students will finish proficient in using Maxima for math exploration and research.

**Objectives:**

- To gain advanced skills in Maxima.
- To understand complex math concepts better.
- To use Maxima to its fullest.
- To simplify math like professionals.
- Make the students to handle difficult math problems.
- To utilize Maxima for exploring, researching, and problem-solving.

**Prerequisites:**

1. Strong foundation in mathematics, including calculus and algebra.
2. Prior experience with Maxima is helpful but not required.
3. Good understanding of fundamental math concepts, computer proficiency, and a passion for math encouraged.

**Unit - I: Introduction to Maxima (6 hours)**

Overview of Maxima software - Installation and setup - Basic commands and syntax - Using variables and functions - Introduction to symbolic expressions.

**Unit - II: Algebraic Manipulations with Maxima (6 hours)**

Simplifying expressions - Expanding and factoring polynomials - Solving equations and inequalities - Manipulating matrices and vectors.

**Unit - III: Differentiation with Maxima (6 hours)**

Symbolic differentiation - Chain rule and product rule - Differentiating trigonometric and exponential functions - Higher-order derivatives - Applications of differentiation.



**Unit - IV: Integration with Maxima (6 hours)**

Symbolic integration - Integration techniques (substitution, integration by parts) - Definite and indefinite integrals - Applications of integration - Numerical integration.

**Unit - V: Ordinary Differential Equations with Maxima (6 hours)**

Introduction to ordinary differential equations (ODEs) - First-order ODEs: Separable, linear, and integrating factor methods - Second-order ODEs: Homogeneous and non-homogeneous - Applications of ODEs.

**Assessment and Evaluation:**

Assessment Component	Description	Weight
Weekly Assignments	Ongoing assessments consisting of weekly quizzes and assignments to evaluate topic understanding and participation.	40%
Mid-term Examination	A mid-term examination is held at the midpoint of the course, covering material from the first half of the syllabus.	20%
Final Examination	A comprehensive final examination that covers all course content, including differentiation, integration, and other topics. This examination evaluates students' overall understanding and retention of the course material.	40%

**Textbooks and Resources:**

1. **Online Maxima Documentation:** Maxima provides extensive online documentation and tutorials on its official website. Students can access a wealth of information and examples to support their learning and exploration of Maxima.
2. **Additional Reading:** Students are encouraged to explore additional resources related to specific topics covered in the course. Consider referring to textbooks on symbolic mathematics and computer algebra systems, which can provide more in-depth coverage of Maxima's capabilities and applications.
3. **Course Materials:** Lecture notes, slides, and assignments provided by the instructor throughout the course will serve as essential references. These materials will reinforce course concepts and provide practical exercises for students to apply what they've learned.
4. **Maxima Software:** Ensure you have access to the latest version of Maxima, which can be downloaded for free from the official Maxima website. Installing and familiarizing yourself with the software is crucial for hands-on practice and applying symbolic math techniques.

### E –Learning source

1. [Maxima, a Computer Algebra System \(sourceforge.io\)](https://sourceforge.io)
2. [The Maxima Book \(sourceforge.io\)](https://sourceforge.io)
3. [Maxima-tutorial \(cheat-sheets.org\)](https://cheat-sheets.org)

### Course Learning Outcomes:

Course Outcomes (CO)	Description
<b>CO1:</b> Use Maxima for symbolic math effectively.	Utilize Maxima software proficiently for symbolic mathematical calculations, including algebraic manipulations, differentiation, and integration.
<b>CO2:</b> Simplify complex mathematical expressions.	Demonstrate the ability to simplify complex mathematical expressions and solve equations using Maxima with precision and efficiency.
<b>CO3:</b> Visualize mathematical functions and data.	Apply Maxima's capabilities to visualize and graphically represent mathematical functions and data, enhancing the understanding of mathematical concepts.
<b>CO4:</b> Solve advanced mathematical problems.	Solve advanced mathematical problems from various branches of mathematics, including algebra, calculus, and differential equations, using Maxima as a powerful computational tool.
<b>CO5:</b> Develop problem-solving skills.	Develop problem-solving skills by tackling challenging mathematical tasks and utilizing Maxima's functionality to find solutions.
<b>CO6:</b> Communicate mathematical solutions effectively.	Communicate mathematical solutions effectively, both in written and graphical formats, demonstrating a clear understanding of the underlying mathematical principles.
<b>CO7:</b> Build a foundation in computer algebra systems.	Cultivate a strong foundation in computer algebra systems, enabling students to adapt and utilize similar software tools for future mathematical endeavors.

<b>Title of the Course</b>		<b>PYTHON PROGRAMMING</b>					
<b>Paper Number</b>		<b>ELECTIVE (SEC)</b>					
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	2	<b>Course Code</b>	
		<b>Semester</b>	IV				
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		2		--		--	2
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					

**Objective:** To train student in programming techniques and provide hands on experience in using programs to solve basic mathematical problems.

#### UNIT -I

**Introduction:** Features of Python-How to run Python-variables-comments-Indentation-Multi-Line Statements-Quotes-Input, Output and Import Functions-Operators-Datatypes: Numbers-Strings-List-Tuple-Set-Dictionary-Datatype conversion, Booleans.

#### UNIT-II

**Control Flow Statements:** The if Decision Control Flow Statement, The if...else Decision Control Flow Statement, The if...elif...else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements. **Functions:** Definition- calling- Function Arguments- Anonymous functions-Recursive with more than one return value, Python Arrays, Introduction to Tensors.

#### UNIT-III

**Modules and Packages:** Built-in modules- creating modules- import statement- package in Python-Date and Time modules- Case study: Numpy, Pandas, matplotlib- math, Python File handling. **Data Visualization:** Generating Data-Installing Matplotlib, Plotting a Simple Line Graph, Random Walks, Rolling Dice with Plotly.

#### UNIT-IV

Addition and subtraction of matrices-Multiplication of matrices-Trace and Transpose of Matrix-Rank of matrix-Inverse of a Matrix-Finding the eigen values and eigen vectors.

#### UNIT -V

Finding the Derivative of  $e^{ax}$ , trigonometric and hyperbolic functions-Finding the Derivative of algebraic and logarithmic functions-evaluate the line integrals with constant and variable limits.

#### Books for Reference:

1. Jeeva Jose, "Taming Python by Programming", Revised Edition, Khanna Publishing, 2019. ISBN : 978-93-86173-34-8.
2. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor

- r&Francis,2018.ISBN-13: 978-0815394372
3. ChSatyanarayana,“PythonProgramming”,OrientBlackSwanPvt. Ltd,2022.ISBN:978-93-86235-63-3.
  4. S.NarayananandT.K.ManicavachagomPillay,Calculus,VolumeI,S.Viswanathan(PrintersandPublishers),PVTLtd,Chennai, 2011.
  5. A.K.Sharma,DifferentialCalculus,DiscoveryPublishingHouse,NewDelhi,2004.
  6. G.B.Thomas andR.L. Finney,Calculus,PearsonEducation,2007.
  7. P.R.VitalandV.Malini,Algebraand Trigonometry–I,MarghamPublications –Reprint2015.
  8. S.ArumugamandA.ThangapandiIssac,AlgebraandTrigonometry,NewGammaPublishingHouse,July2011.

<b>Title of the Course</b>		<b>R Language for Statistics</b>					
<b>Paper Number</b>		<b>ELECTIVE(SEC)</b>					
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>	2	<b>Course Code</b>	
		<b>Semester</b>	VI				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		2	--	--	2		
<b>Pre-requisite</b>		12 <sup>th</sup> Standard Mathematics					

**Objective:** To introduce to the students the novel applications of R language and to give them hands on experience of working with data.

### Unit–I: Basic Concepts in R

Assignment of values, Character, Vector arithmetic, Understanding Data types, importing/exporting data - Computation of tables and graphical representation in R: plot, pie chart, box plot, generating graphs from imported data

### Unit– II: Probability Distributions

Fitting and plotting of binomial, Poisson and Normal distributions

### Unit–III: Correlation and Regression

Correlation and linear regression: Representation of bivariate data through scatter diagram, Karl Pearson's, Spearman's and Kendall's coefficients of correlation, Coefficient of determination, linear regression model, Multiple Linear Regression.

### Unit–IV: Tests of Hypothesis

Student's t-test, One sample Z-test, Paired data t-test

### Unit–V: Chi-square test and Design of Experiments

Chi-square test: Independence of attributes and goodness of fit – Design of Experiments: Completely randomized design (CRD), Randomized block design (RBD) and Latin square design (LSD).

### Books for Reference

1. Mark Gardener, *Beginning R the Statistical Programming Language*, John Wiley & Sons, Inc. 2012.
2. Joseph Adler, *R in a Nutshell A Desktop Quick Reference*, O'reilly, 2010.
3. Cornillon Pierre Andre Et Al, *R For Statistics*, T and F India, 2015.
4. R for Everyone: Advanced Analytics and Graphics, Jared P. Lander, *Addison-Wesley Data & Analytics Series*, 2018.
5. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, Hadley Wickham, Garrett Grolemund, Shroff publishers, 2017.
6. Learn R For Applied Statistics: With Data Visualizations Regressions And Statistics by Hui, Apress, 2019

### Course Learning Outcomes

This course will enable the students to:

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	explain practical implications of expectation and variance and how they predict the shapes of distribution and density (mass) functions of a random variable	K5
CO2	demonstrate capability to write programming codes for plotting different distributions.	K4
CO3	evaluate the independence of attributes and design of experiments.	K6
CO4	describe and apply probability distribution function and different types of distributive function through R Language.	K1
CO5	know and understand about Tests of Hypothesis through R.	K2

E- Learning source: <https://www.r-project.org/>  
<https://www.r-statistics.com/>

