APPENDIX - AP

MADURAIKAMARAJUNIVERSITY

(University with Potential for Excellence)

B.Sc. Mathematics

CHOICE BASED CREDIT SYSTEM

SYLLABUS

(For the candidates admitted from the academic 2023-2024 onwards)

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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.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	**B.Sc., MATHEMATICS**
Programme Code:	
Duration:	**3 years [UG]**
ELIGIBILITY FOR ADMISSION	Candidate should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Education, Government of Tamil Nadu or any other Examination accepted by syndicate, as equivalent thereto, with **Mathematics** as one of the subjects in Higher Secondary Education. The candidate should possess the eligibility criteria prescribed by the Directorate of Collegiate Education, Government of Tamil Nadu.
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** 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. **PO3: 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. **PO4: 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. **PO5: 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. **PO6: Research-related skills**: 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 **PO7: Cooperation/Team work:** 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 **PO8: 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. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** 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. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** 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. **PO 13: Moral and ethical awareness/reasoning**: Ability toembrace 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 demonstratingthe 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. **PO 14: Leadership readiness/qualities:** 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. **PO 15: Lifelong learning:** 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.

Under Graduate Programme

Programme Outcomes:

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

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

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

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

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

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

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:

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

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

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

1. Template for Curriculum Design for UG Programme in Mathematics

Credit Distribution for UG Programme in Mathematics

B.Sc Mathematics

First Year

Semester-I

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language –Tamil	3	6
Part-II	English	3	6
Part-III	Core Courses 2 (CC1, CC2)	10	10
	Elective Course 1 (Generic / Discipline Specific)EC1	3	4
Part-IV	Skill Enhancement Course SEC-1 (Non Major Elective)	2	2
	Foundation Course FC	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language –Tamil	3	6
Part-II	English	3	6
Part-III	Core Courses 2 (CC3, CC4)	10	10
	Elective Course 1 (Generic / Discipline Specific) EC2	3	4
Part-IV	Skill Enhancement Course -SEC-2 (Non Major Elective)	2	2
	Skill Enhancement Course -SEC-3 (Discipline Specific / Generic)	2	2
		23	**30**

Second Year

Semester-III

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language –Tamil	3	6
Part-II	English	3	6
Part-III	Core Courses 2 (CC5, CC6)	10	10
	Elective Course 1 (Generic / Discipline Specific) EC3	3	4
Part-IV	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline Specific/ Generic)	2	2
	Environmental Studies (EVS)		1
		22	**30**

Semester-IV

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language –Tamil	3	6
Part-II	English	3	6
Part-III	Core Courses 2 (CC7, CC8)	10	9
	CC7: Core Industry Module -1 - **Industrial Statistics**		
	CC8: Any Core paper		
	Elective Course 1 (Generic / Discipline Specific) EC4	3	4
Part-IV	Skill Enhancement Course -SEC7	2	2
	Skill Enhancement Course -SEC-8 (Discipline Specific / Generic)	2	2
	Environmental Studies EVS	2	1
		25	**30**

Third Year

Semester-V

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	Core Courses 3(CC9, CC10, CC11)	12	15
	Elective Courses 2 (Generic / Discipline Specific) EC5, EC6	6	9
	Core /Project with Viva voce CC12	4	4
Part-IV	Value Education	2	2
	Internship / Industrial Training (Carried out in II Year Summer vacation) (30 hours)	2	
		26	**30**

Semester-VI

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	Core Courses 3 (CC13, CC14, CC15)	12	18
	Elective Courses 2 (Generic / Discipline Specific) EC7, EC8	6	10
Part IV	Professional Competency Skill Enhancement Course SE8	2	2
Part-V	Extension Activity (Outside college hours)	1	-
		21	**30**

Total Credits: 140

4. Credit Distribution for UG Programme in Mathematics

Sem I	Credit	Sem II	Credit	Sem III	Credit	Sem IV	Credit	Sem V	Credit	Sem VI	Credit
1.1. Language – Tamil	3	2.1. Language – Tamil	3	3.1. Language – Tamil	3	4.1. Language - Tamil	3	5.1 Core Course –\CC IX	4	6.1 Core Course – CC XIII	4
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5.2 Core Course – CC X	4	6.2 Core Course – CC XIV	4
1.3 Core Course – CC I	5	2.3 Core Course – CC III	5	3.3 Core Course – CC V	5	4.3 Core Course – CC VII Core Industry Module	5	5. 3.Core Course CC -XI	4	6.3 Core Course – CC XV	4
1.4 Core Course – CC II	5	2.4 Core Course – CC IV	5	3.4 Core Course – CC VI	5	4.4 Core Course – CC VIII	5	5. 3.Core Course –/ Project with viva- voce CC -XII	4	6.4 Elective -VII Generic/ Discipline Specific	3
1.5 Elective I Generic/ Discipline Specific	3	2.5 Elective II Generic/ Discipline Specific	3	3.5 Elective III Generic/ Discipline Specific	3	4.5 Elective IV Generic/ Discipline Specific	3	5.4 Elective V Generic/ Discipline Specific	3	6.5 Elective VIII Generic/ Discipline Specific	3
1.6 Skill Enhancement Course SEC-1 (NME)	2	2.6 Skill Enhancement Course SEC-2 (NME)	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	4.6 Skill Enhancement Course SEC-6	2	5.5 Elective VI Generic/ Discipline Specific	3	6.6 Extension Activity	1
		2.7 Skill Enhancement Course –SEC-3	2	3.7 Skill Enhancement Course SEC-5	2	4.7 Skill Enhancement Course SEC-7	2	5.6 Value Education	2	6.7 Professional Competency Skill	2
								5.5 Summer Internship /Industrial Training	2		
1.8 Skill Enhancement - (Foundation Course)	2			3.8 E.V.S		4.8 E.V.S	2				
	23		**23**		**22**		**25**		**26**		**21**
	Total Credit Points										**140**

5. Consolidated Semester wise and Component wise Credit distribution

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

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

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	100	

The following distribution of marks for Computer related subjects which have both theory and practical (Syllabus combined both theory and practical in each paper together) in B.Sc Mathematics to be followed

Paper	Internal	External	Total
Theory	25	75	100
Practical	40	60	100

Finally, theory marks (100) to be reduced to 60% and practical marks (100) to be reduced to 40%

8. B.Sc Mathematics Curriculum Design

First Year

Semester-I

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language - Tamil	3	6
Part-II	English	3	6
Part-III	**Core M1** - Algebra &Trigonometry	5	5
	Core M2 - Differential Calculus	5	5
	Elective – Discipline Specific Elective- EC I [Any One] a)Allied Physics - I/ Allied Chemistry - I b)Numerical Methods with Applications	3	4
Part-IV	**Skill Enhancement Course (Non Major Elective) – SEC1** Mathematics for Competitive Examination	2	2
	Foundation Course FC	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language - Tamil	3	6
Part-II	English	3	6
Part-III	**Core M3** - Analytical Geometry (Two & Three Dimensions)	5	5
	Core M4 - Integral Calculus	5	5
	Elective – Discipline Specific Elective- EC2 [Any One] a) Allied Physics – II / Allied Chemistry – II b) Calculus of Finite Differences	3	4
Part-IV	**Skill Enhancement Course (Non Major Elective) – SEC 2** Basic Data Analysis using Excel	2	2
	Skill Enhancement Course (Discipline / Subject Specific) – SEC3[Any One] a) Computational Mathematics b) LaTeX	2	2
		23	**30**

Second Year

Semester-III

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language - Tamil	3	6
Part-II	English	3	6
Part-III	**Core M5** -Vector Calculus and Applications	5	5
	Core M6 - Differential Equations and Applications	5	5
	Elective – Discipline Specific Elective- EC3 [Any One] a) Mathematical Statistics - **Theory & Practical** b) Programming in Java - **Theory & Practical**	3	4
Part-IV	**Skill Enhancement Course (Entrepreneurial Based) – SEC 4 [Any One]** a) E Commerce and Tally b) Web Designing	1	1
	Skill Enhancement Course – SEC 5 [Any One] a) Statistics with R Programming b) Data Analysis using SPSS	2	2
	Environmental Studies		1
		22	**30**

Semester-IV

Part	List of Courses	Credit	Hours / week (L/T/P)
Part-I	Language - Tamil	3	6
Part-II	English	3	6
Part-III	**Core M7** - Industry Module – Industrial Statistics	5	4
	Core M8-Elements of Mathematical Analysis	5	5
	Elective – Discipline Specific Elective- EC4 [Any One] a) Transformation Techniques b) Statistical Methods	3	4
Part-IV	**Skill Enhancement Course – SEC 6 [Any One]** a) Introduction to Data Science b) Mathematical Finance	2	2
	Skill Enhancement Course – SEC 7 [Any One] a) Computing Mathematics b) Introduction to Artificial Intelligence	2	2
	Environmental Studies	2	1
		25	**30**

Third Year

Semester-V

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	**Core M9** - Abstract Algebra	4	5
	Core M10 - Real Analysis	4	5
	Core M11- Mathematical Modelling	4	5
	Core M 12 - Project with Viva voce	4	4
	Elective – Discipline Specific Elective- EC5 [Any One] a) Introduction to Machine Learning – **Theory & Practical** b) Programming in C - **Theory & practical**	3	5
	Elective – Discipline Specific Elective- EC6 [Any One] a) Optimization Techniques b) Discrete Mathematics	3	4
	Value Education	2	2
Part-IV	Internship / Industrial Training (Summer vacation at the end of IV semester activity)	2	
		26	**30**

Semester-VI

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	**Core M13** - Linear Algebra	4	6
	Core M14 - Complex Analysis	4	6
	Core M15 - Mechanics	4	6
	Elective – Discipline Specific Elective- EC7 [Any One] a) Programming in C++ - **Theory & Practical** b) Programming in Python – **Theory & Practical**	3	5
	Elective – Discipline Specific Elective- EC8 [Any One] a) Graph Theory and Applications b) Fuzzy Sets and Applications	3	5
Part-IV	**Professional Competency Skill – SEC 8** Essential Reasoning and Quantitative Aptitude	2	2
Part -V	Extension Activity (Outside college hours)	1	
		21	**30**

Total Credits: 140

Madurai Kamaraj University

B.Sc Mathematics

Core Component

Syllabus

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">Foundation course - Bridge Mathematics</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">FC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">FC</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td>--</td><td colspan="2">2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">• To bridge the gap and facilitate transition from higher secondary to tertiary education;
• To instill confidence among stakeholders and inculcate interest for Mathematics;</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT-I:Algebra: Binomial theorem, General term, middle term, problems based on these concepts[Hours: 6]</td></tr>
<tr><td colspan="7">Unit II:Sequences and series (Progressions). Fundamental principle of counting. Factorial n. [Hours: 6]</td></tr>
<tr><td colspan="7">Unit III: Permutations and combinations, Derivation of formulae and their connections, simple applications, combinations with repetitions, arrangements within groups, formation of groups. [Hours: 6]</td></tr>
<tr><td colspan="7">Unit IV:Trigonometry: Introduction to trigonometric ratios, proof of sin(A+B), cos(A+B), tan(A+B) formulae, multiple and sub multiple angles, sin(2A), cos(2A), tan(2A) etc., transformations sum into product and product into sum formulae, inverse trigonometric functions, sine rule and cosine rule[Hours: 6]</td></tr>
<tr><td colspan="7">UnitV:Calculus: Limits, standard formulae and problems, differentiation, rest principle, uv rule, u/v rule, methods of differentiation, application of derivatives, integration - product rule and substitution method.[Hours: 6]</td></tr>
</table>

Recommended Text	1. NCERT class XI and XII text books. 2. Any State Board Mathematics text books of class XI and XII
Website and e-Learning Source	https://www.aicte-india.org/sites/default/files/final%20maths.pdf https://egyankosh.ac.in/bitstream/123456789/13834/1/Unit-1.pdf

Course Learning Outcome

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

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

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

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

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

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">ALGEBRA & TRIGONOMETRY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE M1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Basic ideas on the Theory of Equations, Matrices and Number Theory.
• Knowledge to find expansions of trigonometry functions, solve theoretical and applied problems.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">Unit I: Reciprocal Equations-Standard form–Increasing or decreasing the roots of a given equation- Removal of terms, Approximate solutions of roots of polynomials by Horner’s method – related problems.
Chapter-6 Section 16, 16.1, 16.2, 17, 19, 30 [Hours: 15]</td></tr>
<tr><td colspan="6">Unit II: Summation of Series: Binomial– Exponential – Logarithmic series (Theorems without proof) – Approximations - related problems.
Chapter-3 Section 10
Chapter -4 Sections 3.1, 3.5, 3.6, 3.7 [Hours: 15]</td></tr>
<tr><td colspan="6">Unit III: Characteristic equation –Eigen values and Eigen Vectors-Similar matrices - Cayley –Hamilton Theorem (Statement only) - Finding powers of square matrix, Inverse of a square matrix up to order 3, Diagonalization of square matrices - related problems.
Chapter-2 Sections 16, 16.1 to 16.4 [Hours: 15]</td></tr>
</table>

	Unit IV: Expansions of sinnθ, cosnθ in powers of sinθ, cosθ - Expansion of tannθ in terms of tan θ, Expansions of $\cos^n\theta$, $\sin^n\theta$, $\cos^m\theta\sin^n\theta$ –Expansions of $\tan(\theta_1+\theta_2+,\ldots,+\theta_n)$- Expansions of sinθ, cosθ and tanθ in terms of θ - related problems. **Chapter 2 Sections 2.1, 2.1.1, 2.1.2** **Chapter 3 Sections 3.1, 3.1.1 to 3.4.3** [**Hours: 15**]
	Unit V: Hyperbolic functions – Relation between circular and hyperbolic functions Inverse hyperbolic functions, Logarithm of complex quantities, Summation of trigonometric series - related problems. **Chapter 4 Sections 4.1 to 4.7 Chapter 5 Sec 5.3** **Chapter 6 Sections 6.1.to 6.6** [**Hours: 15**]
	Total Hours: 75
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, problem solving, analytical ability, professional competency, professional communication and transferable skill.
Text books	1.Algebra, Volume I by T.K.ManicavachagomPillay, T.Natarajan, K.S.Ganapathy, Viswanathan Publication 2007, **Unit – 1 and Unit – 2**
	2. Algebra, Volume II by T.K.ManicavachagomPillay, T.Natarajan, K.S.Ganapathy, Viswanathan Publication 2008 **Unit -3**
	3. Trigonometry by P.Duraipandian and KayalalPachaiyappa, Muhil publishers, **Unit – 4, Unit – 5**

Reference Books	1.W.S. Burnstine and A.W. Panton, Theory of equations 2.David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007 3.G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005 4.C.V.Durell and A. Robson, Advanced Trigonometry, Courier Corporation, 2003 5.J.Stewart, L. Redlin, and S. Watson, Algebra and Trigonometry, Cengage Learning, 2012. 6.Calculus and Analytical Geometry, G.B. Thomas and R. L. Finny, Pearson Publication, 9th Edition, 2010.
Website and e-Learning Source	https://www.mathwarehouse.com/ https://www.mathhelp.com/ https://www.mathsisfun.com/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Classify and Solve reciprocal equations

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

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

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">DIFFERENTIAL CALCULUS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE M2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours

per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• The basic skills of differentiation, successive differentiation, and their applications.
• Basic knowledge on the notions of curvature, evolutes, involutes and polar co-ordinates and in solving related problems.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT-I:Successive Differentiation: Introduction (Review of basic concepts) – The n^{th} derivative – Standard results – Fractional expressions – Trigonometrical transformation – Formation of equations involving derivatives – Leibnitz formula for the n^{th} derivative of a product – Feynman’s method of differentiation.
Chapter 3 Sections 1.1 – 1.6 and Section 2.1 and 2.2 [Hours: 15]</td></tr>
<tr><td colspan="6">UNIT-II:Partial Differentiation: Partial derivatives – Successive partial derivatives – Function of a function rule – Total differential coefficient – A special case – Implicit Functions.

Chapter 8 Sections 1.1 – 1.5 [Hours: 15]</td></tr>
<tr><td colspan="6">UNIT-III:Partial Differentiation (Continued): Homogeneous functions – Partial derivatives of a function of two variables – Maxima and Minima of functions of two variables - Lagrange’s method of undetermined multipliers.
Chapter 8 Sections 1.6, 1.7, Sections 4 and 5 [Hours: 15]</td></tr>
</table>

	UNIT-IV:Envelope: Method of finding the envelope – Another definition of envelope – Envelope of family of curves which are quadratic in the parameter **Chapter 9 Sections 1.1 – 1.4[Hours: 15]**
	UNIT-V:Curvature: Definition of Curvature – Circle, Radius and Centre of Curvature – Evolutes and Involutes – Radius of Curvature in Polar Co-ordinates. **Chapter 9 Sections 2.1, 2.2** and **2.5 – 2.7 [Hours: 15]**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Text book	**Calculus Volume I - S. Narayanan and T.K. ManickavachagomPillay, -S. Viswanathan Publishers Pvt. Ltd. 2006**
Reference Books 1. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2010. 2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007. 3. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer- Verlag, New York, Inc., 1989. 4. T. Apostol, Calculus, Volumes I and II.	
Website and e-Learning Source	https://nptel.ac.in https://www.mathwarehouse.com/ https://www.mathhelp.com/

Course Learning Outcome (for Mapping with PLOs and PSOs)

Students will be able to

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

CLO 2: Find the partial derivative and total derivative coefficient

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

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ANALYTICAL GEOMETRY (Two & Three Dimensions)</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE M3</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• Necessary skills to analyze characteristics and properties of two- and three-dimensional geometric shapes.
• To present mathematical arguments about geometric relationships.
• To solve real world problems on geometry and its applications.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="8">UNIT-I: Pole, Polar - conjugate points and conjugate lines – diameters – conjugate diameters of an ellipse - semi diameters-conjugate diameters of hyperbola.

Chapter 7: Sections 7.1 to 7.3 , Chapter – 8 Section 8.1 to 8.5. [Hours:15]</td></tr>
<tr><td colspan="8">UNIT-II: Polar coordinates: General polar equation of straight line – Polar equation of a circle given a diameter, Equation of a straight line, circle, conic – Equation of chord, tangent, normal. Equations of the asymptotes of a hyperbola.

Chapter 10 : Sec 10.1 to 10.8. [Hours:15]</td></tr>
<tr><td colspan="8">UNIT-III: System of Planes-Length of the perpendicular–Orthogonal projection. Chapter 2 Sec 2.1 to 2.10. [Hours:15]</td></tr>
<tr><td colspan="8">UNIT-IV: Representation of line–angle between a line and a plane – co – planar lines–shortest distance between two skew lines –length of the perpendicular–intersection of three planes.

Chapter 3 :Sec 3.1 to 3.8. [Hours:15]</td></tr>
</table>

	UNIT-V: Equation of a sphere-general equation-section of a sphere by a plane-equation of the circle- tangent plane- angle of intersection of two spheres- condition for the orthogonality- radical plane. **Chapter 6 : Sec 6.1 to 6.8 [Hours:15]**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Text Books	1. Analytical Geometry of 2D by P.Duraipandian- Muhil publishers for **Unit – 1 and 2** 2. Analytical Solid Geometry of 3D by Shanthi Narayan and Dr.P.K. Mittal-S.Chand& amp; Co. Pvt.Ltd.- for **Unit – 3 to 5**

Reference Books

1. S. L. Loney, Co-ordinate Geometry.
2. Robert J. T. Bell, Co-ordinate Geometry of Three Dimensions.
3. Calculus and Analytical Geometry, G.B. Thomas and R. L. Finny, Pearson Publication, 9th Edition, 2010.
4. William H. McCrea, Analytical Geometry of Three Dimensions, Dover Publications, Inc, New York, 2006.
5. John F. Randelph, Calculus and Analytic Geometry, Wadsworth Publishing Company, CA, USA, 1969.
6. Ralph Palmer Agnew, Analytic Geometry and Calculus with Vectors, McGraw-Hill Book Company, Inc. New York, 1962.

Website and e-Learning Source	https://nptel.ac.in https://www.mathwarehouse.com/ https://www.mathhelp.com/ https://www.mathsisfun.com/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

CLO 3: Explain in detail the system of Planes

CLO 4: Explain in detail the system of Straight lines

CLO 5: Explain in detail the system of Spheres

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">INTEGRAL CALCULUS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE M4</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Knowledge on integration and its geometrical applications, double, triple integrals and improper integrals.
• Knowledge about Beta and Gamma functions and their applications.
• Skills to Determine Fourier series expansions.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT-I: Reduction formulae -Types, integration of product of powers of algebraic and trigonometric functions, integration of product of powers of algebraic and logarithmic functions - Bernoulli’s formula, Feyman’s technique of integration.

Chapter 1 Section 13, 13.1 to 13.10, 14, 15.1 [Hours:15]</td></tr>
<tr><td colspan="6">UNIT-II: Multiple Integrals - definition of double integrals - evaluation of double integrals – double integrals in polar coordinates - Change of order of integration.

Chapter 5 Sections 1, 2.1, 2.2, 3.1. [Hours:15]</td></tr>
<tr><td colspan="6">UNIT-III: Triple integrals –applications of multiple integrals - volumes of solids of revolution - areas of curved surfaces–change of variables - Jacobian.

Chapter 5 Sections 4, 5.1 to 5.3, 6.1 to 6.3 & Section 7
Chapter 6 Sections 1.1,1.2, 2.1 to 2.4 [Hours:15]</td></tr>
</table>

	UNIT-IV: Beta and Gamma functions – infinite integral - definitions–recurrence formula of Gamma functions – properties of Beta and Gamma functions- relation between Beta and Gamma functions - Applications. **Chapter 7 Sections 1.1 to 1.4, 2.1, 2.3 , 3 to 6 [Hours:15]**
	UNIT-V: Geometric and Physical Applications of Integral calculus. **Chapter 2 Sections 1.4, 2.1, 2.2, 4, 4.1, 4.2 & 5** **Chapter 3 Sections 1.1 to 1.5, 2.1 to 2.7 [Hours:15]**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Text book	Calculus, Volume II, by S.Narayanan and T.K ManicavachagomPillay. – S. Viswanathan, Publishers - 2007
Reference Book	1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002. 2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007. 3. P. Dyke, An Introduction to Laplace Transforms and Fourier Series, Springer Undergraduate Mathematics Series, 2001 (second edition). 4. D. Chatterjee, Integral Calculus and Differential Equations, Tata-McGraw Hill Publishing Company Ltd.

Website and e-Learning Source	https://nptel.ac.in https://www.mathwarehouse.com/ https://www.mathhelp.com/ https://www.mathsisfun.com/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

CLO 5: Explain Geometric and Physical applications of integral calculus

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">VECTOR CALCULUS AND ITS APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE M5</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Knowledge about differentiation of vectors and on differential operators. Knowledge about derivatives of vector functions.
• Skills in evaluating line, surface and volume integrals.
• The ability to analyze the physical applications of derivatives of vectors.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I: Vector point function - Scalar point function - Derivative of a vector and derivative of a sum of vectors - Derivative of a product of a scalar and a vector point function - Derivative of a scalar product and vector product.
Chapter 2 sections 2.1 to 2.3 [Hours 15]</td></tr>
<tr><td colspan="6">UNIT-II: The vector operator ‘del’, The gradient of a scalar point function - Divergence of a vector - Curl of a vector - solenoidal and irrotational vectors – simple applications.
Chapter 2 sections 2.4 to 2.7 [Hours 15]</td></tr>
<tr><td colspan="6">UNIT-III:Laplacian operator, Vector identities - Line integral - simple problems.
Chapter 2 sections 2.9 to 2.13 Chapter 3 sections 3.1 to 3.4 [Hours 15]</td></tr>
<tr><td colspan="6">UNIT-IV: Surface integral - Volume integral – Applications.
Chapter 3 Sections 3.5 to 3.7 [Hours 15]</td></tr>
<tr><td colspan="6">UNIT-V: Gauss divergence Theorem, Stoke’s Theorem, Green’s Theorem in two dimensions – Applications to real life situations.
Chapter 4 sections 4.1 to 4.5 [Hours 15]</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Text book	Vector Analysis by P. Duraipandian and KayalalPachaiyappa-S.ChandPublication
Recommended Text	1. J.C. Susan ,Vector Calculus, , (4th Edn.) Pearson Education, Boston, 2012. 2. A. Gorguis, Vector Calculus for College Students, Xilbius Corporation, 2014. 3. J.E. Marsden and A. Tromba ,Vector Calculus, , (5^{th}edn.) W.H. Freeman, New York, 1988.
Website and e-Learning Source	https://nptel.ac.in https://www.mathwarehouse.com/ https://www.mathhelp.com/ https://www.mathsisfun.com/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

CLO 3: Solve simple line integrals

CLO 4: Solve surface integrals and volume integrals

CLO 5: Verify the theorems of Gauss, Stoke’s and Green’sTwo 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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">DIFFERENTIAL EQUATIONS AND APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE M6</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional Hours

per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">12th Standard Mathematics</td></tr>
<tr><td>Objectives of the Course</td><td colspan="7">• Knowledge about the methods of solving Ordinary and Partial Differential Equations.
• The understanding of how Differential Equations can be used as a powerful tool in solving problems in science.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I:Ordinary Differential Equations: Variable separable - Homogeneous Equation-Non-Homogeneous Equations of first degree in two variables -Linear Equation - Bernoulli’s Equation-Exact differential equations.Chapter 2 Sections 1 – 6 [Hours:15]</td></tr>
<tr><td colspan="7">UNIT-II: Equation of first order but not of higher degree: Equation solvable for dy/dx- Equation solvable for y-Equation solvable for x- Clairauts’ form - Linear Equations with constant coefficients-Particular integrals of algebraic, exponential, trigonometric functions and their products.

Chapter 4 Sections 1, 2.1, 2.2, 3.1,
Chapter 5 Section 4 [Hours:15]</td></tr>
<tr><td colspan="7">UNIT-III: Simultaneous linear differential equations- Linear Equations of the Second Order -Complete solution in terms of a known integrals-Reduction to the Normal form-Change of the Independent Variable-Method of Variation of Parameters.

Chapter 6 Section 6, Chapter 8 Sections 1 – 4 [Hours:15]</td></tr>
</table>

	UNIT-IV: Partial differential equation: Formation of PDE by Eliminating arbitrary constants and arbitrary functions – complete integral – singular integral-General integral-Lagrange's Linear Equations –Simple Applications. **Chapter 12 Sections 1.2, 3.1, 3.2** and **4 [Hours:15]**
	UNIT-V: Special methods – Standard forms-Charpit's Methods – Simple Applications **Chapter 12 Sections 5.1, 5.2, 5.3, 5.4** and **6 [Hours:15]**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Text Books	S. Narayanan and T.K. ManickavachagomPillay, Differential Equations and Its Applications, S. Viswanathan Publishers Pvt. Ltd. 2006
Reference Books	1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984. 2. G.F. Simmons, Differential equations with applications and historical notes, 2nd Ed, Tata Mcgraw Hill Publications, 1991. 3. H.T. H. Piaggio, Elementary Treaties on Differential Equations and their applications, C.B.S Publisher & Distributors, Delhi,1985. 4. Horst R. Beyer, Calculus and Analysis, Wiley, 2010. **5.** Braun, M. Differential Equations and their Applications. (3rd Edn.), Springer- Verlag, New York. 1983.

Website and e-Learning Source	https://nptel.ac.in https://www.mathwarehouse.com/ https://www.mathhelp.com/ https://www.mathsisfun.com/

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

Course Code CORE M7	INDUSTRIAL STATISTICS		Credits 5
Year &Semester: II YEAR & IV SEMESTER	Course Category	CORE	Total:(L+T+P) Per week: 3+1 = 4

Course Objective

- To bridge the gap between industry academia interface – to apply the theory learnt to industrial applications
- Explain the importance of statistical quality control in industrial settings.
- Identify sources of variation in industrial processes and products.
- Explain the importance of Analysis of time series, Analysis of Variance and Design of Experiments in Industrial applications.
- Create and interpret control charts for attributes

UNIT	Details	No. of Hours
I	Statistical Quality Control: Introduction – Basis of SQC – Benefits of SQC – Process Control and Product control – Control Charts – Tools for SQC - Control chart for variables – control chart for mean (X chart) ,Range Chart (R chart) Standard deviation chart (σ chart)	12
II	Control chart for attributes - Natural Tolerance limits and specification limits - Acceptance of sampling plans for attributes - single, double, Multiples and sequential sampling plans	12
III	Analysis of Time Series: Components – Analysis – Measurement of Trend – Measurement of Seasonal variation- Index of Industrial production	12
IV	Analysis of Variance: Introduction – One way classification – two way classifications with one observation per cell.	12
V	Design of Experiments: Introduction – Three Principles of Experimental Design – Completely Randomised Design – Randomised Block Design.	12
	Total	60

Course Outcomes	
CO	On completion of this course, students will
1	Understand the need for statistical quality control techniques in industrial settings.
2	Identify the causes of variation in industrial processes and products
3	Understand the importance of Time series in industrial applications
4	Understand the applications of Analysis of variance in industrial settings
5	Gain knowledge in Experimental designs
Text Book	
1.	**Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals Of Applied Statistics, 4th Edition(Reprint), Sultan Chand & Sons** **Unit I**: Chapter 1 - 1.1 to 1.8 **Unit II**: Chapter 1 – 1.9 to 1.12 **Unit III:** Chapter 2 – 2.1 to 2.5 and Chapter 3 – 3.7 **Unit IV**: Chapter 5 – 5.1 to 5.3 [5.3.1 to 5.3.4] **Unit V**: Chapter 6 – 6.1 to 6.5
2.	Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.
Reference Books	
1	S. Leavenworth (1988) Statistical Quality Control (Sixth Edition), McGrawhill Book co, New York.
2	Goon, A. M., M.K. Gupta and B. Dasgupta (1987) Fundamentals of Statistics, Vol. II. World Press, Kolkata.
3	Mahajan (1997) Statistical Quality Control, DhanpatRai& sons, New Delhi.
4	Papoulis A. Probability, Random Variables and Stochastic process, Tata McGraw Hill Education Pvt. Ltd., New Delhi
5	Baisnab A., Jas M., Elements of Probability and Statistics, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 1993

Web Resources	
1.	**OpenIntro Statistics** - https://www.openintro.org/book/stat/
2	http://spcchartsonline.com/ - **Statistical Quality Control Tutorial**
3.	**"Control Charts" (Online Tutorial):**https://www.spcforexcel.com/knowledge/control-chart-basics/control-charts
4	https://www.analyticsvidhya.com/blog/2018/01/anova-analysis-of-variance/ **- ANOVA Tutorial**

INDUSTRIAL STATISTICS PRACTICAL ASSIGNMENT

- ✓ Construction of control chart for mean using Excel / R /SPSS
- ✓ Control charts for mean using Range in Excel / R /SPSS
- ✓ Control Charts for Mean using Standard Deviation in Excel / R /SPSS
- ✓ Control Charts for Range using Excel / R /SPSS
- ✓ Control Charts for Standard Deviation using Excel / R /SPSS

Note:

1. There will be **no practical exam** for Industrial Statistics.
2. The above activity is mainly intended for providing practical knowledge in Industrial Statistics.
3. Instruct the students to submit the above as an **assignment.**

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ELEMENTS OF MATHEMATICAL ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE M8</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Identify and characterize sets and functions and Understand, test and analyze the convergence and divergence of sequences, series.
• Understand metric spaces with suitable examples</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNIT-I: Sets and Functions: Sets and elements- Operations on sets- functions- real valued functions- equivalence-countability- real numbers- least upper bounds.

Chapter 1 Sections 1.1 – 1.7 - Hours: 15</td></tr>
<tr><td colspan="6">UNIT-II: Sequences of Real Numbers: Definition of a sequence and subsequence-limit of a sequence – convergent sequences– divergent sequences- bounded sequences-monotone sequences

Chapter 2 Sections 2.1 – 2.6 - Hours: 15</td></tr>
<tr><td colspan="6">UNIT-III: Operations on convergent sequences – operations on divergent sequences – limit superior and limit inferior-Cauchy sequences.

Chapter 2 Sections 2.7 – 2.10 - Hours: 15</td></tr>
<tr><td colspan="6">UNIT-IV:Series of Real Numbers: Convergence and divergence – series with non –negative terms-alternating series-conditional convergence and absolute convergence- tests for absolute convergence.

Chapter 3 Sections 3.1 – 3.4 and 3.6 - Hours: 15</td></tr>
</table>

	UNIT-V: Limits and Metric Spaces: Limit of a function on a real line - Metric spaces - Limits in metric spaces – Continuous Functions on Metric Spaces: Function continuous at a point on there a line- Function continuous on a metric space. **Chapter 4 Sections 4.1 – 4.3, Chapter 5 Sections 5.1 – 5.3 Hours: 15**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Methods of Real Analysis, Richard R. Goldberg, Oxford and IBH Publishing, (1 January 2020).
Reference Books	1. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002. 2. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd., 2000. 3. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983. 4. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.
Website and e-Learning Source	https://nptel.ac.in https://www.mathwarehouse.com/ https://www.mathhelp.com/ https://www.mathsisfun.com/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ABSTRACT ALGEBRA</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE M9</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Concepts of Sets, Groups and Rings.
• Construction, characteristics and applications of the abstract algebraic structures</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I: Introduction to groups- Subgroups- cyclic groups and properties of cyclic groups- Lagrange’s Theorem-A counting principle – Examples

Chapter 2 Section 2.4 and 2.5 Hours: 15</td></tr>
<tr><td colspan="6">UNIT-II: Normal subgroups and Quotient group- Homomorphism-Automorphism -Examples.

Chapter 2 Section 2.6 to 2.8 Hours: 15</td></tr>
<tr><td colspan="6">UNIT-III: Cayley’s Theorem-Permutation groups - Examples

Chapter 2 Section 2.9 and 2.10 Hours: 15</td></tr>
<tr><td colspan="6">UNIT-IV: Definition and examples of ring- Some special classes of rings- homomorphism of rings- Ideals and quotient rings- More ideals and quotient rings.

Chapter 3 Section 3.1 to 3.5 Hours: 15</td></tr>
<tr><td colspan="6">UNIT-V: The field of quotients of an integral domain-Euclidean Rings - The particular Euclidean Ring – Examples

Chapter 3 Section 3.6 to 3.8 Hours: 15</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Topics in Algebra–I.N.Herstein, Wiley Eastern Ltd. Second Edition (1^{st} January 2006)
Reference Books	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.
Website and e-Learning Source	**https://www.open.edu/openlearn/mod/resource/view.php?id=72698**

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">REAL ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE M10</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Real Numbers and properties of Real–valued functions.
• Connectedness, Compactness, Completeness of Metric spaces.
• Convergence of sequences of functions, Examples and counter examples</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT-I: Continuous Functions on Metric Spaces: Open sets–closed sets–Discontinuous function on R^1. Connectedness, Completeness and Compactness: More about open sets-Connected sets.
Chapter 5 Sections 5.4 – 5.6, Chapter 6 Sections 6.1, 6.2 [Hours: 15]</td></tr>
<tr><td colspan="6">UNIT-II: Bounded sets and totally bounded sets: Complete metric spaces- compact metric spaces, continuous functions on a compact metric space, continuity of inverse functions, uniform continuity.
Chapter 6 Sections 6.3 – 6.8 [Hours: 15]</td></tr>
<tr><td colspan="6">UNIT-III: Calculus: Sets of measure zero, definition of the Riemann integral, existence of the Riemann integral-properties of Riemann integral.
Chapter 7 Sections 7.1 – 7.4 [Hours: 15]</td></tr>
</table>

	UNIT-IV: Derivatives-Rolle's theorem, Law of mean, Fundamental theorems of calculus. **Chapter 7 Sections 7.5 – 7.8 [Hours: 15]**
	UNIT-V: Taylor's theorem-Point wise convergence of sequences of functions, uniform convergence of sequences of functions **Chapter 8 Section 8.5,** **Chapter 9 Sections 9.1** and **9.2 [Hours: 15]**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Methods of Real Analysis-Richard R.Goldberg (John Wiley & sons, 2nd edition) (Indian edition –Oxford and IBH Publishing Co, New Delhi, 1st January 2020)
Reference Books	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, 2nd edition (1974), Addison-Wesley publishing company, New Delhi.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICAL MODELLING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE M11</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">• Construction and Analysis of Mathematical models found in real life problems.
• Modelling through differential and difference equations</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Mathematical Modelling: Simple situations requiring mathematical modelling, characteristics of mathematical models.Chapter 1 – section 1.1. to 1.4 [Hours: 15]</td></tr>
<tr><td colspan="7">UNIT-II: Mathematical Modelling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.
Chapter 2 – section 2.1 to 2.4[Hours: 15]</td></tr>
<tr><td colspan="7">UNIT-III: Mathematical Modelling, through system of Ordinary differential equations of first order: Prey-predator models, Competition models, Model with removal and model with immigrations. Epidemics: simple epidemic model, Susceptible-infected- susceptible (SIS) model, SIS model with constant number of carriers. Medicine: Model for Diabetes Mellitus.
Chapter 3 – Section 3.1,3.2, and 3.5.1[Hours: 15]</td></tr>
<tr><td colspan="7">UNIT – IV: Introduction to difference equations.
Chapter 5 - Sections 5.2.1 - 5.2.9 [Hours: 15]</td></tr>
<tr><td colspan="7">UNIT-V: Mathematical Modelling through difference equations: Harrod Model, cob web model application to Actuarial ScienceChapter 5 - Section 5.3.1 – 5.3.4 [Hours: 15]</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Mathematical Modeling, J N KapurNew Age International publishers(2009).
Reference Books	1. Mathematical Modeling by Bimalk. Mishra and DipakK.Satpathi. Ane Books Pvt. Ltd(1 Januuary 2009) 2. Mathematical Modeling Models, Analysis and Applications, by Sandip Banerjee, CRC Press, Taylor & Francis group, 2014 3. Mathematical Modeling applications with Geogebra by Jonas Hall & Thomas Ligefjard, John Wiley & Sons, 2017 4. Mark M. Meerschaert: Mathematical Modeling, Elsevier Publ., 2007. 5. Edward A. Bender: An introduction to mathematical Modeling, CRC Press,2002 6. Walter J. Meyer, Concepts of Mathematical Modeling, Dover Publ., 2000
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Explain simple situations requiring Mathematical Modelling and to Determine the characteristics of such models

CLO 2: Model using differential equations in-terms of linear growth and Decay models

CLO 3: Model using systems of ordinary differential equations of first order, to discuss about various models under the categories ‘Epidemics’ and ‘Medicine’

CLO 4: Explain in detail about difference equations

CLO 5: Model using difference equations

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">PROJECT WITH VIVA VOCE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE M12</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">3</td><td colspan="2">1</td><td>--</td><td>4</td></tr>
<tr><td colspan="2">Objectives of the Project</td><td colspan="6">Theaimoftheminiprojectis that the studenthastounderstandtherealtime work place environment. The student should gain a thorough knowledge in the problem and fields which he/she hasselected fortheirproject work.</td></tr>
<tr><td colspan="2">ProjectPlanning</td><td colspan="6">Mini Project isan involved exercise,which has to be planned well in advance. The topic should be chosen in the beginning of finalyear itself. Related reading training and discussions of project should be completed in the firsttermof finalyear.</td></tr>
<tr><td colspan="2">Selectionof Team</td><td colspan="6">To meet the stated objectives, it is imperative that mini project is done through a team effort.Though it would be ideal to select the team members at random and this should be stronglyrecommended, due to practical consideration students may also be given the choice of formingthemselves into teams with Two members.

A team leader shall be selected. Team shall maintainthe minutes of meeting of the team members and ensure that tasks have been assigned to everyteam member in writing. Team meeting minutes shall form a part of the project report. Even ifstudents are doing project as groups, each one must independently take different modules of theworkand must submit the report.</td></tr>
<tr><td colspan="2">Selectionof Fields</td><td colspan="6">No restrictions shall be placed on the students in the choice of fields / tools/ techniques to beutilized for their project work, though open source is strongly recommended, wherever possible.Novalue shall beplacedonthe useof tools in theevaluation of theproject.</td></tr>
<tr><td colspan="2">ProjectEvaluation:</td><td colspan="6">• Continuous Internal Assessment:
• Evaluation (External)
• Viva-voce (jointly)
Three copies of the project report must be submitted by each student. The students may use power point presentation during their viva voce examination.</td></tr>
</table>

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">LINEAR ALGEBRA</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE M13</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Vector Spaces, linear dependence and independence of vectors .Dual spaces, Inner product and norm – orthogonalization process.
• Linear transformations. Various operators on vector spaces</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNIT-I: Vector spaces – Subspaces – Linear Combinations and linear span - Systems of Linear equations – Homogenous Equations – Non-homogenous Equations – Elementary Matrices – Row reduced -Echelon form
Chapter: 1 Sections:1.1–1.6. [Hours: 18]</td></tr>
<tr><td colspan="6">UNIT-II: Linear Dependence and Linear independence – Bases – Dimensions
Chapter 2: Section: 2.7
Chapter 3: Section 3.4 [Hours: 18]</td></tr>
<tr><td colspan="6">UNIT-III: Linear transformations, null spaces and ranges – Matrix representation of a linear transformation –invertibility and isomorphisms – dual spaces.
Chapter 2: Sections:2.1 –2.4 and 2.6. [Hours: 18]</td></tr>
<tr><td colspan="6">UNIT – IV: Eigen values, eigen vectors, diagonalizability – invariant subspaces – Cayley– Hamilton theorem
Chapter 5: Sections:5.1,5.2 and 5.4. [Hours: 18]</td></tr>
</table>

	UNIT-V: Inner products and norms – Gram Schmidt Orthogonalization Process - Orthogonal complements**Chapter 6: Sections:6.1,6.2. [Hours: 18]**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Linear Algebra - Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5 th edition (2018) Pearson
Reference Books	1. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd. Second Edition, 2006. 2. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005 3. N.S.Gopalakrishnan, University Algebra, New Age International Publications, Wiley Eastern Ltd. 4. John B.Fraleigh, First course in Algebra, Addison Wesley. 5. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004. 6. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007. 7. . Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Acquire a detailed knowledge about vector spaces and subspaces

CLO 2: Explain the concepts of Linear Dependence, Linear Independence, Bases and Dimension of basis

CLO 3: Explain the concept of Linear Transformations, their Matrix representation and the notion of dual spaces

CLO 4: Find the Eigen values and Eigen vectors, to apply the concepts for diagonalisation

CLO5: Explain about Inner product and norms and to apply Gram Schmidt Orthogonalization Process to problems on inner product spaces

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">COMPLEX ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE M14</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Apply concept and consequences of analyticity and C-R equations.
• Understand the concept of mappings and transformations.
• Compute complex contour integrals and applying Cauchy‘s integral in various versions.
• Understand zeros and singularities of an analytic function, apply their properties in the evaluation of definite integral.</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="6">UNIT-I:Analytic functions: Functions of a Complex variable –Limits –Theorem on limits –Continuity – Derivatives – Differentiation formulas – Cauchy Riemann equation – conditions for differentiability – Polar coordinates– Analytic functions– Harmonic functions.

Chapter 2- Sections- 11- 25 (Omit Sections 12, 13 and 16) [Hours: 18]</td></tr>
<tr><td colspan="6">UNIT-II:Conformal mapping: Mappings – Mapping by exponential function – Linear transformation – The transformation w= $\frac{1}{z}$ – Mappings by $\frac{1}{z}$ – Linear fractional transformations (bilinear)
Chapter 2- Sections: 12, 13

Chapter 8- Sections: 83-87 [Hours: 18]</td></tr>
</table>

	UNIT-III:Complex Integration: Contour integrals**–** Some examples **–** Simply and Multiply connected domains**–** Cauchy integral formula **–** Formula for derivatives**–** Liouville's theorem –Fundamental theorem of Algebra**–** Maximum modulus principle. **Chapter 4- Sections- 39, 40, 46-50. [Hours: 18]**
	UNIT – IV:Sequences and Series: Convergence of sequences **–** Convergence of series**–** Taylor's series **–** Laurent series**–** Absolute and uniform convergence of power Series **–** Continuity of sums of power series**–**Integration & differentiation of power series **Chapter 5- Sections: 51-57. [Hours: 18]**
	UNIT-V:Residues and Poles: Isolated singular points **–** Residues**–** Cauchy Residue theorem **–** Residue at infinity **–** The three types of isolated singular points **–** Residues at poles **–** Zeros of analytical functions **–** Zeros and poles **–** Evaluation of real improper integrals (excluding poles on the real axis). **Chapter 6- Sections: 62-69 (omit Section 64)** **Chapter 7 – Section 71. [Hours: 18]**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text	Complex variables and application, Seventh Edition by James Ward Brown and Ruel V. Churchill, Mc-Graw Hill Book Co., International Edition, 2009.
Reference Books	1. Linear Algebra – Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5th Edition 920180, Pearson. 2. S. Ponnusamy and H. Silverman, Complex variables with applications, Birkhauser, 2006 3. Theodore W. Gamelan, Complex Analysis, Springer Verlag, 2008 4. .Joseph Bak and Donald J. Newman, Complex analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997. 5. Complex Analysis ,P.Duraipandian&KayalalPachiyappa,S.Chand& Company PVT.LTD ,New Delhi, 2016
Website Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MECHANICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE M15</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours

per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">• Equilibrium of a particle under the action of given forces
• Simple Harmonic Motion
• Projectiles</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="7">UNIT-I:Force: Newton’s laws of motion – Resultant of two forces on a particle - Equilibrium of a Particle: Equilibrium of a particle – Limiting equilibrium of a particle on an inclined plane.

Chapter 2 : Section 2.1 to 2.2
Chapter 3 : Section 3.1 to 3.2 [Hours: 18]</td></tr>
<tr><td colspan="7">UNIT-II:Forces on a Rigid Body: Moment of a Force – General motion of a body – Equivalent systems of forces- Parallel Forces – Forces acting along a Triangle - A specific reduction of Forces: Reduction of coplanar forces into a force and couple – Problems involving frictional forces.

Chapter 4 : Sections 4.1 to 4.4, 4.6
(Omit Sections 4.5, 4.7 to 4.9)
Chapter 5 : Sections 5.1 to 5.2 [Hours: 18]</td></tr>
<tr><td colspan="7">UNIT-III:Work, Energy and Power: Work – Conservative field of force – Power -Rectilinear Motion under Varying Force: Simple Harmonic Motion - along a horizontal line – along a vertical line.

Chapter 11 : Sections – 11.1 and 11.2
Chapter 12 : Sections – 12.1 to 12.3 (Omit Section 12.4)
[Hours: 18]</td></tr>
</table>

	UNIT – IV: Projectiles: Forces on a projectile – Projectile projected on an inclined plane **Chapter 13: Sections – 13.1 , 13.2 (Omit Section 13.3) [Hours: 18]**
	UNIT-V: Central Orbits**:** General orbits – Central orbit – Conic as a centered orbit **Chapter 16 : Section 16.1 – 16.3 [Hours: 18]**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Mechanics - P.Duraipandian, LakmiDuraipandian and MuthamizhJayapragasam,, S.Chand and co. Private limited - Reprint 2016.
Reference Books	1. J.L. Meriam and L. G. Kraige, Engineering Mechanics: Statics, Seventh Edition,Wiley and sons Pvt ltd., New York, 2012. 2. J.L. Meriam, L. G. Kraige, and J.N. Bolton, Engineering Mechanics: Dynamics, 8thedn, Wiley and sons Pvt ltd., New York, 2015. 3. A. K. Dhiman, P.Dhinam and D. Kulshreshtha, Engineering Mechanics (Statics and Dynamics) ,McGraw Hill Education(India) Private Limited, New Delhi, 2015.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will able to

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

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

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

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

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

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

Internship / Industrial Training

OBJECTIVES:

- Tomakestudents acquire practical knowledgebygoingto a companyandlearn in a live environment
- Tomake studentslearnteamworkandwork ethics
- Tomake studentstoknowthe recent trends in the area relevant to their study
- Tomakestudentsanalyse theirskillsandinterests
- To help students examine academicand career goals

OUTCOME:

At the endofthisinternship programme thestudentswill be able to

- ✓ Applytheory to real life
- ✓ work as apart of team
- ✓ learnfrom thecompanyexperts
- ✓ learnlatesttrendingtechnologies
- ✓ comeoutwith ahighmorale
- ✓ enrichCV

About the internship programme: The internship programme provides students with practical,real-world experience and a valuable complement to their academic training.It enhances thestudents' skills in problem solving by making him/her work in a live environment in whichsystematic problem solving methods are practiced.

Duration: Internshiprequiresstudentstospendaminimumof15days(duringvacation) employed, full-time, as trainees **during vacation at the end of fourthsemester**. During this period, they are engaged in work of direct relevance to their programme ofstudy.

Areas: Some of thefieldsthatareopentostudentsinclude:

- Industries
- Companies
- Market Research
- Web designing
- Anyotherfieldrelatedto / Mathematics / Statistics / IT /Applications.

Certificate: A certificate is to be obtained from the organization in which the student undergoesinternship programme. This certificate is to be submitted to the college within fifteen days afterthecollegereopens for the next semester.

Credits: TheInternship programmedoesnotcarryanycredit.

Madurai Kamaraj University

B.Sc Mathematics

ELECTIVE COURSES [GENERIC / DISCIPLINE CENTRIC]

Syllabus

Course Code EC 1	NUMERICAL METHODS WITH APPLICATIONS		Credits 3
Year &Semester: I YEAR & I SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3+1 = 4

Course Objectives

1. To solve Transcendental and Algebraic equations.
2. To understand the difference operators and their relations.
3. To interpolate the given data using different methods.
4. To use difference formula to compute derivatives and integrals.

UNIT	Details	No. of Hours
I	**The Solutions of Numerical Algebraic and Transcendental Equations:** Introduction – Bisection method – Iteration method – RegulaFalsi method – Newton – Raphson method – Horner's method **(Chapter III: Sections – 1 to 5, 8)**	12
II	**Simultaneous Linear Algebraic equations**: Introduction – Gauss Elimination method – Computation of the inverse of a matrix using Gauss Elimination method – Method of Triangularisation – Iterative methods **(Chapter IV: Sections – 1 to 4, 6)**	12
III	**Finite Differences**: Backward differences – central difference notations – Properties of the Operator △ - Difference of polynomials – Factorial polynomials – The Operator E – Relation between E and △ - Relation between D and △ – Relation between the operators - Summation of Series **(Chapter V: Sections – 6,8, 10 – 12, 14 – 16, 18, 19)**	12
IV	**Central Difference Interpolation Formulae**: Gauss forward and backward interpolation formula – Stirling's formula – Bessel's formula **(Chapter VII: Sections- 3 to 6)**	12
V	**Interpolation with unequal intervals**; Divided differences and Newton's divided differences formula for interpolation and Lagrange's formula for interpolation **[Chapter VIII: Sections – 1to 4.]**	12
	Total	60

Course Outcomes	
CO	On completion of this course, students will able to
1	Solve algebraic and transcendental equations using bisection method, iteration method, regulafalsi method, and Newton Raphson method.
2	Solve simultaneous linear equations using Gauss elimination method, Gauss Jordon method, and Gauss Seidel method.
3	Use finite differences to calculate differences of a polynomial, factorial polynomials, differences of zero, and summation series.
4	Perform interpolation using central differences formulae, and Gauss forward and backward formulae.
5	Perform Numerical differentiation and integeration.
Text Book	
1	Dr.M.K.Venkatraman, Numerical Methods in Science and Engineering, The National Publishing Company, Madras – 600 001.(Third Edition)
Reference Books	
• 1.P.Kandasamy, K.Thilagavathy, K.Gunavathy, Numerical Method, S.Chand and company Ltd., New Delhi (Reprint 2002) • 2.M.K.Jain, S.R.K.Iyankar, R.K.Jain, Numerical Methods for Scientific and Engineering Computations Sixth Edition),New Age International (P) Ltd.,Publishers New Delhi. • 3. A.Singaravelu, Numerical Methods, Meenakshi Agencies, Chennai – 601302.	
Web Resources	
1.	Applications of Numerical Methods : https://nm.mathforcollege.com/textbook-numerical -methods-with-applications/
2.	https://ocw.mit.edu/courses/mathematics/18-336-numerical-methods-for-partial-differential-equations-spring-2009/

Course Code EC 2	CALCULUS OF FINITE DIFFERENCES		Credits 3
Year &Semester: I YEAR & II SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3+1 = 4

Course Objectives

- To introduce students to numerical differentiation and integration.
- To teach students how to solve difference equations
- To familiarize students with the concept of Numerical solution of ordinary differential equations..

UNIT	Details	No. of Hours
I	**UNIT-I: Numerical differentiation**; Derivatives using Newton's forward and backward difference formulae – derivatives using sterling's formula – derivatives using divided difference formula – Simple Problems. **Chapter: 7 Sections 7.1 – 7.4 Omit 7.5, 7.6**	12
II	**UNIT-II: Numerical Integration**; General quadrature formula – Trapezoidal rule - Simpson's one third rule – Simpson's three-eight rule – Weddle's rule – Simple Problems **Chapter 7 : Sections 7.7 – 7.11, 7.13 – 7.15 Omit 7.12**	12
III	**UNIT-III: Difference equation:** Linear homogeneous and non-homogeneous difference equation with constant coefficients, particular integrals for ax, am, sin kx, coskx – Simple Problems **Chapter: 8 Sections 8.1 – 8.6**	12
IV	**UNIT – IV: Numerical solution of ordinary differential equations (I order only**) Taylor's series method – Picard's method – Eulers' method – Simple Problems **Chapter: 9: Sections 9.5 – 9.7**	12
V	**UNIT-V: Numerical solution of ordinary differential equations (I order only)** Modified Euler's method – Runge – kutta method forth order only - Simple Problems **Chapter 9: Sections 9.9 – 9.11**	12
	Total	**60**

Course Outcomes	
CO	On completion of this course, students will able to
1	Find numerical differentiation using types of interpolation formulae .
2	Find numerical integration using Trapezoidal rule - Simpson's 1/3 rule – Simpson's 3/8 rule – Weddle's rule
3	Solve linear homogeneous & non-homogeneous difference equation with constant coefficients and calculate particular integrals
4	Find numerical solution to ODE using Taylor's series, Picard's &Eulers' method
5	Find numerical solution to ODE using Modified Euler's method and 4th order RK method
Text Book	
1	P.Kandasamy&K.Thilagavathy - Calculus of finite differences and Numerical Analysis, S.Chand& Co Pvt Ltd, 2012.
Reference Books	
• Calculus of finite differences and Numerical analysis by Gupta-Malik, Krishna PrakastanMandir, Meerut, 2003 • Numerical Methods in Science and Engineering by M.K.Venkataraman, National Publishing house,Chennai.2001 • Numerical Analysis by B.D.Gupta, Konark Publishing,1990 • Calculus of finite differences and Numerical Analysis by Saxena, S.Chand& Co, 2010	
Web Resources	
1.	https://ocw.mit.edu/courses/mathematics/18-336-numerical-methods-for-partial-differential-equations-spring-2009/
2.	https://www.mathworks.com

Course Code EC 3	MATHEMATICAL STATISTICS		Credits 3
Year &Semester: II YEAR & III SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 2+1+0 = 3

Course Objective

- To provide an understanding of the fundamental concepts of probability theory and statistical inference.
- To develop skills in applying probability theory and statistical inference to solve real-world problems.
- To introduce students to various probability distributions and their applications in statistical inference.
- To provide a solid foundation for advanced courses in probability theory and statistical inference.

UNIT	Details	No. of Hours
I	**Probability**: Definition of Sample Space – Events – Definition of Probability –Addition and Multiplication laws of probability – independence of events- Conditional Probability –Baye's theorem – Simple Problems **Chapter 4 - sections 4.1 – 4.3 and sections 4.5 - 4.8**	9
II	**Random Variables** (Discrete and Continuous) – Distribution Function –Mathematical Expectation –Conditional Expectation and Conditional variance - Moment generating Function- Probability Generating Function – Cumulants – Characterisitc Function – Simple Problems. **Chapter 5 - sections 5.1 – 5.4.3** **Chapter 6 – Sections 6.1 – 6.12**	9
III	**Discrete distribution**: Binomial, Poisson Continuous distribution: and Normal **Chapter 7 - sections 7-7.3.** **Chapter 8 - sections 8.1 – 8.2.7**	9
IV	**Sampling distribution& Test of Significance**: Sampling - Tests of significance - Null Hypothesis - Tests of significancefor large samples. **Chapter 12**	9

V	**Tests of significance for small samples:** Using the chi-square distribution - Student's t- distribution - F-distribution **Chapter 13sections 13-13.5** **Chapter 14 sections 14-14.2.10 & Sections 14.5 – 14.5.5**	9
	Total	**45**

Course Outcomes	
CO	On completion of this course, students will able to
1	Define sample space, events, and probability and apply the addition and multiplication laws of probability to calculate probabilities of events.
2	Define random variables, probability density function, cumulative distribution function, and their properties.
3	Understand and apply the Binomial, Poisson, and Normal distributions to solve real-world problems
4	Understand the concept of sampling distribution and apply the Central Limit Theorem to calculate the mean and standard deviation of the sampling distribution.
5	Use the chi-square distribution, Student's t-distribution, and F-distribution to test hypotheses for small samples.

Text Book

1	S.C .Gupta&V.K .Kapoor :Fundamentals of Mathematical Statistics ,Sultan & sons

Reference Books

1. H.C.Saxena Elementary Statistics, AbhirorPrakashan ,New Delhi ,2008.
2. T.Veerarajan ,Fundamental of Applied Statistics, Yesdee Publishing Private Limited , 2017.
3. Kapoor, Mathematical statistics, second edition, Delhi PusthkSadan, 1961
4. P.R. Vittal, Mathematical Statistics, Margham Publications, Chennai, 2004

Web Resources

1.	https://www.zweigmedia.com/RealWorld/Summary7.html - interactive Statistics & Probability learning
2.	https://wise.cgu.edu/wp-content/uploads/2015/04/StatWISE1110p.xls You can download this Excel workbook to have easy access to basic statistics distributions on your computer. The workbook includes *Z*, *t*, *F*, chi-square, and binomial distributions as well as selected computations such as estimating the median for grouped data.

Course Code EC 3	MATHEMATICAL STATISTICS PRACTICAL		Credits
Year &Semester: II YEAR & III SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 0+0+1 = 1

USING R [OR] SPSS [OR] SCILAB

1. Find the Skewness and Kurtosis of a given dataset distribution.
2. Applying Bayes' theorem to solve simple problems.
3. Find the mass function of a binomial distribution with n=20, p = 0.4. also draw the graphs of mass function and cumulative distribution function.
4. Given the data n = 50, mean = 25, use appropriate function to find the mass function of a Poisson distribution. Also draw the graphs of the mass function and cumulative distribution function.
5. Using the normal distribution to calculate confidence intervals for the mean when the standard deviation is known.
6. Perform the Z test for difference in mean.
7. Conducting a hypothesis test for a sample mean with a known population variance.
8. Conducting a hypothesis test for the variance of a population using the chi-square distribution.
9. Conducting a hypothesis test for the difference between two variances using the F-distribution.
10. Perform t – test for equality of mean.

Note:

1. Each experiment should have the **Experiment No.** and the **title**. The first section of each experiment is **Aim**, and then writes the **Algorithm,** then **code** and finally **output** of the program.

2. Use of Scientific Calculator and Statistical Tables are allowed in the Practical Exam

Course Code EC 3	PROGRAMMING IN JAVA		Credits 3
Year &Semester: II YEAR & III SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 2+1+0 = 3

earning Objectives
• To get in-depth Knowledge about the evolution of java and its Features
• Bring out the difference and similarities between C, C++ and java.
• Develop programmers in Java with its special Features.
• To apply the exception handling in Programming
• Implementing the code in internet using Applet with AWT controls.

Unit	Contents	No. of Hours
I	**OVERVIEW OF JAVA LANGUAGE**: Introduction, Simple Java program structure, Java tokens, Java Statements, Implementing a Java Program, Java Virtual Machine, Command line arguments. **CONSTANTS, VARIABLES & DATA TYPES**: Introduction, Constants, Variables, Data Types, Declaration of Variables, Giving Value to Variables, Scope of variables, Symbolic Constants, Type casting, Getting Value of Variables, Standard Default values; Operators & Expressions	**9**
II	**DECISION MAKING & BRANCHING**: Introduction, Decision making with if statement, Simple if statement, if. Else statement, Nesting of if. else statements, the else if ladder, the switch statement, the conditional operator. **DECISION MAKING & LOOPING**: Introduction, The While statement, the do-while statement, the for statement, Jumps in loops **CLASSES, OBJECTS & METHODS**: Introduction, Defining a class, Adding variables, Adding methods, Creating objects, Accessing class members, Constructors, Method overloading, Static members, Nesting of methods;	**9**
III	I**NHERITANCE**: Extending a class, Overloading methods, Final variables and methods, Final classes, Finalizer methods, Abstract methods and classes; **ARRAYS, STRINGS AND VECTORS**: Arrays, One-dimensional arrays, Creating an array, Two – dimensional arrays, Strings, Vectors, Wrapper classes **MULTIPLE INHERITANCE**: Introduction, Defining interfaces, Extending interfaces, Implementing interfaces, Assessing interface variables;	**9**
IV	**MULTITHREADED PROGRAMMING**: Introduction, Creating Threads, Extending the Threads, Stopping and Blocking a Thread, Lifecycle of a Thread, Using Thread Methods, Thread Exceptions, Thread Priority, Synchronization, Implementing the 'Runnable' Interface. **MANAGING ERRORS AND EXCEPTIONS**: Types of errors : Compile-time errors, Runtime errors, Exceptions, Exception handling, Multiple Catch Statements, Using finally statement	**9**

V	**PACKAGES**: Introduction, Java API Packages, Using System Packages, Naming conventions, Creating Packages, Accessing a Package, using a Package. **MANAGING INPUT/OUTPUT FILES IN JAVA**: Introduction, Concept of Streams, Stream classes, Byte Stream Classes, Input Stream Classes, Output Stream Classes, Character Stream classes: Reader stream classes, Writer Stream classes, Using Streams, Reading and writing files	**9**
	TOTAL	**45**

	Course Outcomes
CO1	Importance of Java comparing the other language.
CO2	Develop program using constructors and its types.
CO3	Implementing the concept Exception handling various application.
CO4	Analyzing different types of inheritance .
CO5	Life Build Applet code using AWT controls and Layout managers
	Textbooks
1	E. Balagurusamy, “Programming with Java”, Fourth Edition, 2010, Tata McGraw-Hill **Unit I:**Chapters 1 - 5 **Unit II** : Chapters 6 ,7 and 8.1-8.10 **Unit III** : Chapter 8.11-8.18, Chapters 9 and 10 **Unit IV** : Chapter 12 and 13 **Unit V** : Chapter 14,11.1-11.7 and 16
2	P Radha Krishna, “Object Oriented Programming through Java”, Second Edition, 2007, Universities Press.
	Reference Books
1	K. Arnold and J. Gosling, “The Java Programming Language”, Second Edition, 1996, Addison Wesley
2	P. Naughton and H. Schildt, “Java2 (The Complete Reference)”, Eight Edition,2005, Tata McGraw Hill
3	Kathy Sierra and Bert Bates, “Head First Java”, Second Edition, 2003, Oreilly
	Web Resources
1	https://www.learnjavaonline.org/ - Free Interactive Java Tutorial
2	https://www.educative.io/courses/learn-java-from-scratch - Free online tutorial

Course Code EC 3	PROGRAMMING IN JAVA PRACTICAL		Credits
Year &Semester: II YEAR & III SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 0+0+1 = 1

1. Programs using constructor and destructor.
2. Creation of classes and use of different types of functions.
3. Count the number of objects created for a class using static member function.
4. Write programs on interfaces.
5. Write programs on packages.
6. Write programs using function overloading.
7. Programs using inheritance.
8. Programs using IO streams.
9. Programs using files.
10. Write a program using exception handling mechanism.
11. Programs using AWT
12. Programs on swing.

Course Code EC 4	TRANSFORMATION TECHNIQUES		Credits 3
Year &Semester: II YEAR & IV SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3 + 1 = 4

Course Objective

- To solve certain types of differential equations using Laplace Transforms
- To discuss the basic concepts relating Fourier series.

UNIT	Details	No. of Hours
I	The Laplace transforms: Definitions, Piecewise continuity – Sufficient condition for the existence of the Laplace Transform– results derived from the definitions – Laplace Transform of Periodic functions – Some General theorems -Using Laplace Transforms evaluate certain integrals.	12
II	The Inverse transforms – Modifying the results to get the inverse Laplace transforms.	12
III	Laplace transformation can be used to solve ordinary differential equations with constant coefficients – Solving system of differential equations– solving differential equations with variable coefficients-Solving equations involving integrals by Laplace transforms	12
IV	Fourier Transforms: Fourier integral theorem – Fourier sine and cosine integrals -Complex form of Fourier integral – Inversion formula for complex Fourier Transform – Fourier sine and cosine transform	12
V	Properties of Fourier Transform – Convolution Theorem – Parsavel's identity.	12
	Total	60

Course Outcomes

CO	On completion of this course, students will able to
1	Find the Laplace transform for the given function.
2	Find the inverse Laplace transformation for the given function.
3	Solve the differential equations using Laplace transforms...
4	Find the Fourier sine and cosine integrals for the given function.
5	Convolute the given transformations

Text Book	
1	S. Narayanan and T. K. ManickavasagamPillai, Differential Equations and its applications, (Reprint Oct 2014 – 2015), S.Viswanathan (Printers and Publishers) Private Ltd , Chennai- 600003. **Unit I: Chapter IX- Sections – 1.1, 1.2 and Sections 2 – 5** **Unit II: Chapter IX- Sections – 6, 7** **Unit III: Chapter IX- Sections – 8 to 11**
2.	P.R.Vittal, Differential Equations, Fourier and Laplace Transforms, Probablity – (3rd Edition, Reprint 2012), Margham Publications, Chennai – 600017. **Unit IV: Chapter VIII – Pages 8.1 – 8.8** **Unit V: Chapter VIII – Pages 8.8 – 8.19**
Reference Books	
1	George F.Simmons, Differential Equations with applications and Historical Notes,(12thReprint) TATA MAGRAW-Hill Publishing Company Ltd., New Delhi. .
Web Resources	
1.	https://mathworld.wolfram.com/LaplaceTransform.html
2.	https://mathworld.wolfram.com/FourierSeries.html

Course Code EC 4	STATISTICAL METHODS		Credits 3
Year & Semester: II YEAR & IV SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3+1=4

Course Objectives

- To understand the fundamental concepts and principles of statistics, including data collection, classification, and tabulation.
- To analyze raw and grouped data, and use measures of central tendency and dispersion to draw meaningful conclusions.
- To comprehend correlation and regression analysis, and the various methods of curve fitting.
- To construct and interpret index numbers, including weighted and unweighted indices and chain indices..

Units	Contents	No. of hours
I	Introduction: Statistics, Frequency Distribution - Measures of central Tendency: Mean, Median, Mode, Geometric mean, Harmonic mean.	12
II	Measures of dispersion and Coefficient of variation – Problems based on raw data and grouped data	12
III	Measure of Skewness - Karl Pearson and Bowley's, Kurtosis and Moment of frequency distribution.	12
IV	Curve fitting - Principle of least squares - linear, nonlinear, exponential and growth curves	12
V	Correlation - Rank Correlation - Regression analysis - Problems based on raw data and grouped data	12
	Total	**60**

Course Outcomes

CO	On completion of this course, students will
1	Develop an understanding of the fundamental concepts and principles of statistics, including data collection, classification, and tabulation.
2	Apply measures of central tendency and dispersion to analyze raw and grouped data and draw meaningful conclusions.
3	Utilize correlation and regression analysis to explore relationships between variables and fit various types of curves to the data.
4	Construct and interpret index numbers, including weighted and unweighted indices and chain indices.

5	Understand the association of attributes and how to measure consistency, independence, and Yule's coefficient of association
Text Book	
1	Golden Statistics – N.P.Bali, Lakshmi Publications Pvt Ltd, 2016 **Unit I** : Chapter 2; **Unit II**: Chapter 3 ; **Unit III**: Chapter 3 ;**Unit IV**: Chapter 4 **Unit V** : Chapter 6
2.	Goon A.M. Gupta. A.K. & Das Gupta, B (1987). Fundamentals of Statistics, Vol.2, World Press Pvt. Ltd., Calcutta
Reference Books	
1.	Bansilal and Arora (1989). New Mathematical Statistics, SatyaPrakashan, New Delhi.
2.	Kapoor, J.N. &Saxena, H.C. (1976) . Mathematical Statistics , Sultan Chand and Sons Pvt. Ltd, New Delhi
Web Resources	
1.	**Statistics e-labs - http://home.ubalt.edu/ntsbarsh/STAT-DATA/javastat.htm**
2.	**Statistical Analysis Lab - https://onlinestatbook.com/stat_analysis/index.html**
3.	https://www.w3schools.com/statistics/index.php **- Interactive Statistics Tutorial**
	https://www.open.edu/openlearn/pluginfile.php/1061809/mod_resource/content/4/Medical%20statistics%20PDF.pdf – **Medical Statistics**

Statistical Methods Practical Assignment

Use **Excel/R/SPSS/SCILAB** to plot the results in a graph and interpret the findings

Assignment 1: Create a dataset of 50 observations and Calculate the measures of central tendency, including mean, median, mode, geometric mean, and harmonic mean.

Assignment 2: Create a dataset of 50 observations and calculate the measures of dispersion, including range, variance, standard deviation, and coefficient of variation.

Assignment 3: Create a dataset of 50 observations and calculate the skewness and kurtosis using both the Karl Pearson and Bowley's methods.

Assignment 4: Create a dataset of 50 observations and perform curve fitting using the principle of least squares.

Assignment 5: Create a dataset of 50 observations and perform rank correlation and regression analysis for both raw and grouped data.

Course Code EC5	INTRODUCTION TO MACHINE LEARNING		Credits 3
Year &Semester: III YEAR & V SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3+1+0=4

Course Objective

- To introduce students to the concept of Machine Learning and its applications.
- To familiarize students with the different types of Machine Learning, such as Supervised, Unsupervised, Reinforcement Learning, and Deep Learning.
- To teach students about Classification and Model Selection

UNIT	Details	No. of Hours
I	**Introduction to Python & Machine Learning** Overview of Machine Learning and its applications - Components of Machine learning: Data, Feature Extraction, Model Selection, Training, Evaluation – Understanding Python: why Python, First Python program, Python Basics, data Structure and loops - Feature Engineering with Python: Pandas – Data visualization: Line chart, Bar chart, pie chart, Box plot, - Seaborn: Distplot, Jointplot.	10
II	**Classification and Model Selection** Types of Machine Learning: Supervised, Unsupervised, Reinforcement Learning, deep learning -Classification of machine Learning Concepts - Distance based Machine learning methods – K Nearest Neighbor-classifications –Decision Tree learning-Naïve Bayes –Linear regression - Logistic Regression – Linear regression Models – Support Vector Machine	12
III	**Unsupervised Machine Learning** Introduction to Clustering Techniques - requirements of clustering Algorithm – Types of Clustering Method – Clustering strategies – Partitioning clustering -: K-Means Clustering - kernel K means	13
IV	Hierarchical Clustering - Evaluation Metrics -Principal Component Analysis (PCA) – Kernel principle Component analysis	13
V	**Machine learning Algorithms** Designing Machine Learning Algorithms – classification Metrics – Regression Metrics – Statistical learning theory – Ensemble methods	12
	Total	**60**

Course Outcomes	
CO	On completion of this course, students will
1	Students will gain an understanding of the basics of Machine Learning, including its applications and types.
2	Students will gain knowledge of Classification and Model Selection techniques, including various distance-based Machine Learning methods.
3	Students will be able to implement and evaluate Unsupervised Machine Learning techniques such as Clustering and PCA.
4	Students will be able to design Machine Learning Algorithms for classification and regression tasks and evaluate their performance using relevant metrics.
5	Students will be able to apply Statistical Learning Theory and Ensemble methods to improve Machine Learning algorithms' performance
Text Book	
1	Machine Learning using Python by ManaranjanPradhan and U Dinesh Kumar , Wiley, 2019 **Unit I:** Chapter 1- 1.1,1.2 up to page no. 6; Chapter 2 – 2.1,2.3,2.4,2.5; Chapter 3 – 3.6: Chapter 4 – 4.1 to 4.7,4.8 – 4.8.1& 4.8.2
2	Machine Learning - V.K. Jain – Khanna Publishing Pvt. Ltd, 2018 **Unit II :**Chapter 1 – 1.2 to 1.15; **Unit III:** chapter 2 – 2.1 to 2.9 **Unit IV**: Chapter 2 – 2.13 to 2.16: **Unit V :** Chapter 3 – 3.1 to 3.6
Reference Books	
1.	Data Science and Machine Learning using Python – 2022 by DrReemaThareja, bpb Publication, 2020
3.	Data Science and Machine Learning by N. Meenakshi and K. E. Rajakumari, 2021
Web Resources	
1	https://www.nbshare.io/ - NBSHARE notebook for interactive tutorials on Machine Learning
2.	https://www.simplilearn.com/introduction-to-machine-learning-guide-pdf
3	http://www.r2d3.us/visual-intro-to-machine-learning-part-1/
4	https://www.w3schools.com/python/python_ml_getting_started.asp **-** ML Tutorials
5	https://www.simplilearn.com/tutorials/machine-learning-tutorial - ML Tutorials

Course Code EC5	INTRODUCTION TO MACHINE LEARNING PRACTICAL		Credits
Year &Semester: III YEAR & V SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 0+0+1=1

[Either by R Programming or Python Programming]

Using Python

1. Implementing a supervised learning algorithm (such as linear regression or support vector machines) to predict the price of a house based on its features,
2. Implement Naïve Bayes Theorem to classify the English Text.
3. Build a classification model using scikit-learn and TensorFlow to predict whether a patient has a particular disease based on various medical measurements such as blood pressure and cholesterol levels. Use Heart disease dataset
4. Use clustering algorithms such as K-means to group customers based on their purchasing behavior by using Matplotlib and Plotlylibraries.Data : Online retail dataset
5. Implementing a decision tree algorithm from scratch to classify a dataset on your own and comparing its performance .
6. Write a Python Program to implement Principal Component Analysis on a dataset of your own choice

Using R

1. Implementing a supervised learning algorithm (such as linear regression or support vector machines) to predict the price of a house based on its features
2. Implement Naïve Bayes Theorem to classify the English Text in R
3. Use clustering algorithms such as K-means to group customers based on their purchasing behavior by using R.
4. Build a decision tree in R using the rpart() function from the rpart package to predict whether a customer will buy a product based on their age, gender, and income.
5. Implementing a decision tree algorithm from scratch to classify a dataset on your own and comparing its performance.
6. Write a R Program to implement Principal Component Analysis on a dataset of your own choice

Course Code EC5	PROGRAMMING IN C		Credits 3
Year &Semester: III YEAR & V SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3+1+0 = 4

Course Objective

- To gain knowledge in C language.
- To inculcate fundamental programming skills.

UNIT	Details	No. of Hours
I	Introduction - Importance of C - Programming style-character set - C Tokens-keywords and identifiers – Constants – Variables - Data types - Declaration of variables - Declaration of storage class-assigning values to variables-defining symbolic constants.	12
II	Operators and expressions-arithmetic, relational, logical, assignment, increment and decrement, bitwise, conditional, special operators-arithmetic expressions-evaluation of expressions-precedence of arithmetic expressions	12
III	Managing input and output operations-reading a character-writing a character-formatted input-formatted output-decision making with if - simple if, if else, nesting of if else, else if, switch, goto, while do while, for statements-jumps in loops	12
IV	Arrays-one dimensional arrays-declaration of one dimensional arrays-initialization of one dimensional arrays-two dimensional arrays initializing two dimensional arrays-multi dimensional arrays-dynamic arrays.	12
V	Structure definition-declaring structure variables-accessing structure members- structure initialization-pointer expressions-pointer increment and scale factor- pointer and arrays-array of pointers-pointers as function arguments-functions returning pointer- pointers to functions	12
	Total	**60**

Course Outcomes	
CO	On completion of this course, students will
1	Remember the program structure of C with its syntax and semantics
2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)
3	Apply the programming principles learnt in real-time problems
4	Analyze the various methods of solving a problem and choose the best method
5	Code, debug and test the programs with appropriate test cases
Text Book	
1	E. Balagurusamy, Programming in ANSI C, Fifth Edition, Tata McGraw-Hill, 2010. **Unit I** Chapter 2,3; **Unit II:** Chapter 4: **Unit III** – Chapter 5,6,7: **Unit IV** – Chapter 8; **Unit V** – Chapter 11, 12.
Reference Books	
1.	Byron Gottfried, Schaum's Outline Programming with C, Fourth Edition, Tata McGraw-Hill, 2018.
2.	Darrel L. Graham, C Programming Language, Createspace Independent Publishing Company, 2016
3.	YashavantKanetkar, Let Us C, Eighteenth Edition, BPB Publications,2021
Web Resources	
1.	The C Book - a free online book on C programming: https://publications.gbdirect.co.uk//c_book/ C Programming Wikibook - a free online wikibook on C programming: https://en.wikibooks.org/wiki/C_Programming
2.	https://www.w3schools.com/c/index.php - Free C Tutorial
3	https://www.geeksforgeeks.org/c-programming-language/
4.	http://visualcplus.blogspot.com/2006/02/lesson-3-data-types-in-registry.html - Free tutorial on C

Course Code EC5	PROGRAMMING IN C PRACTICAL		Credits
Year &Semester: III YEAR & V SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 0+0+1 = 1

1. Create a one dimensional array of characters and store a string inside it by reading from standard input.
2. Write a program to input 20 arbitrary numbers in one dimensional array. Calculate the frequency of each number. Print the number and its frequency in a tabular form.
3. Write a C function to remove duplicates from an ordered array.
4. Write a program which will arrange the positive and negative numbers in one dimensional array in such a way that all negative numbers should come first and then all the positive numbers will come without changing the original sequence of numbers.
5. Write a program to perform following operations on a 2D array a. Addition b. Multiplication c. Transpose
6. Write a program to find the GCD and LCM of two numbers
7. Implement a swap () function which exchanges the values of two integers. Call the function from the main to test the function with different values.
8. Write a program to remove duplicates from an ordered array
9. Write a function to generate the Fibonacci series using recursion.
10. Write a recursive function that adds first ‘n’ natural numbers.
11. Write a recursive function that finds factorial of a number
12. Write a program to demonstrate the use of recursion in Tower of Hanoi problem

Course Code EC 6	OPTIMIZATION TECHNIQUES		Credits 3
Year &Semester: III YEAR & V SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3 +1 = 4

Course Objective

- To provide students with the necessary mathematical tools to formulate and solve linear programming problems using graphical and simplex methods
- To introduce students to transportation problems, assignment problems, sequencing, replacement, and theory of games and their applications
- To equip students with the necessary skills to solve inventory problems using deterministic models and waiting line problems..
- To teach students how to use project network diagrams and CPM/PERT techniques for project management and scheduling

UNIT	Details	No. of Hours
I	**Linear programming**: Problem formulation, graphical solution, simplex method, artificial variables techniques, Big-M method	12
II	**Transportation problem**: Formulation, optimal solution, unbalanced transportation problem, Degeneracy; Assignment problem, formulation, optimal solution, variants of assignment problem.	12
III	**Sequencing**: Introduction, flow, shop sequencing, n jobs through two machines, n jobs through three machines **Replacement**: Introduction: Replacement of items that deteriorate with time, when money value is not considered, replacement of items when money value is considered	12
IV	**Theory Of Games:** Introduction – Terminology, Solution of games with saddle points and without saddle points, 2×2 games, dominance principle, m X 2 & 2 X n games, Graphical method.	12
V	**Waiting Lines**: Introduction, Terminology, Single Channel, Poisson arrivals and exponential service times with infinite population and finite population models, Multichannel, Poisson arrivals and exponential service times with infinite population **Network:** : Project Network diagram – CPM and PERT computations.	12
	Total	**60**

Course Outcomes	
CO	On completion of this course, students will
1	Formulate and solve linear programming problems using graphical and simplex methods confidently.
2	Use artificial variables techniques and the Big-M method to solve linear programming problems
3	Solve transportation problems, assignment problems, sequencing, replacement, and theory of games problems and apply them to solve real-world problems.
4	Analyze waiting line problems using single-channel and multi-channel models and apply them to solve real-world problems.
5	Use project network diagrams and CPM/PERT techniques for project management and scheduling
Text Book	
1	V. Sundaresan, K.S. GanapathySubramaian and K.Ganesan, Resource Management Techniques. A.R Publications, 2002 Unit 1: Chapter – 2, Chapter 3 – 3.1 to 3.2.1 Unit 2 : Chapter – 7, Chapter 8 - 8.1 to 8.8 Unit 3 : Chapter 14 – 14.1 to 14.5, Chapter 11 – 11.1 to 11.3 Unit 4 : Chapter 16 – 16.1 to 16.7 Unit 5 :Chapter 13 – 13.1 to 13.7, Chapter 15 – 15.1 to 15.7
2	Operations Research, by R.K.Gupta, Krishna Prakashan India (p),Meerut Publications, 2020
Reference Books	
1.	Gupta P.K. and Hira D.S., Problems in Operations Research - S.Chand& amp; Co., 2014
2.	KantiSwaroop, Gupta P.K and Manmohan, Problems in Operations Research, Sultan Chand & Sons, 2014
Web Resources	
1	https://www.linearprogramming.info/ Solve a Linear Programming model with **OpenSolver**- Excel Add-in that solves optimization models.
2	https://realpython.com/linear-programming-python/ Linear Programming With Python
3.	https://www.princeton.edu/~rvdb/LPbook/

Course Code EC6	DISCRETE MATHEMATICS		Credits 3
Year &Semester: III YEAR & V SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3+1 = 4

Course Objective

- To understand the fundamental concepts of discrete mathematics.
- To develop the ability to solve problems in combinatorics, propositional and predicate logic, relations and recurrence relations.
- To develop logical thinking skills and problem-solving skills.

UNIT	Details	No. of Hours
I	**Propositional Logic** Propositional Logic: Definition, Connectives, Statements & Notation, Truth Values, Tautology and contradiction, Statement Formulas & Truth Tables, Well-formed Formulas, Equivalence of Formulas, Duality Law, Tautological Implications, normal forms Examples	12
II	**Predicate Logic** Theory of inference, Truth table technique, Rules of inference, Indirect method of proof, Predicate Logic: Definition of Predicates; Statement functions, Variables, Quantifiers, Predicate Formulas, Free & Bound Variables; Valid Formulas & Equivalences, The Universe of Discourse - Examples.	12
III	**Lattices & Boolean Algebra** Lattices – Properties of lattices – Lattice as Algebraic System- Sub lattices- lattice Homomorphism- Special Lattices – Boolean Algebra- sub algebra- Boolean Expression and Boolean functions- expression of a Boolean function in canonical form- logic Gates- Karnaugh Map Method	12
IV	**Combinatorics** Permutations and Combinations , Pascal's identity, Permutation with repetition, The Pigeonhole Principle, Generalisation of Pigeonhole principle, Principles of Inclusion-Exclusion Principle - Examples	12

V	**Formal languages** Introduction- Phrase –Structure Grammar- Types – BNF- Finite state Machine – Input output strings- Finite state Automata	12
	Total	**60**

Course Outcomes	
CO	On completion of this course, students will
1	able to apply the concepts of propositional Logic
2	able to analyze and interpret predicate logic
3	able to apply the concepts of Lattices & Boolean Algebra.
4	ability to solve problems in Combinatorics
5	ability to apply the concepts of formal languages

Text Book

Discrete mathematics – T.Veerarajan – McGraw Hill Education 2017

Unit I: Chapter 1 – up to page no. 26
Unit II : Chapter 1–Page no.27 to 50
Unit III: Chapter 2 – Page no. 96 to 114
Unit IV: Chapter 6 – Page no 314 to 337
Unit V: Chapter 8 – Page no. 448 to 467

Reference Books

1.	Tremblay and Manohar – Discrete Mathematical Structures with application to Computer Science, (Tata McGraw Hill, New Delhi) 1997.
2.	Venkataraman .M.K. and others – Discrete mathematics 2000 The National Publishing Company

Web Resources

1.	https://www.javatpoint.com/discrete-mathematics-tutorial - Discrete mathematics Tutorial
2.	https://www.khanacademy.org/computing/computer-science/algorithms/intro-to-algorithms/v/discrete-mathematics

Course Code EC 7	PROGRAMMING IN C++		Credits 3
Year &Semester: III YEAR &VI SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3+1 +0 = 4

Learning Objectives
• To understand about object-oriented languages and their applications
• To introduce basic concepts of C++language
• To provide knowledge about various conversions
• To enlighten the various inheritance system
• To impart knowledge on files and exception handling

Unit	Contents	No. of Hours
I	Introduction to C++; Tokens, Keywords, Identifiers, Variables, Operators, Manipulators, Data types -Expressions and Control Structures in C++; Simple C++ Programs.	**12**
II	Functions in C++ - Main Function - Function Prototyping -Parameters Passing in Functions - Values Return by Functions – Inline Functions - Friend and Virtual Functions –Math Library functions	**12**
III	Classes and Objects; Constructors and Destructors; Operator Overloading and Type Conversions - Type of Constructors – Function Definition - Function overloading – Function Overriding.	**12**
IV	Inheritance: Single Inheritance - Multilevel Inheritance - Multiple Inheritance - Hierarchical Inheritance - Hybrid Inheritance - Pointers, Virtual Functions and Polymorphism; Managing Console I/O operations.	**12**
V	Working with Files: Classes for File Stream Operations -Opening and Closing a File – Endof -File Deduction - File Pointers - Updating a File - Error Handling during File Operations - Command-line Arguments.	**12**
	TOTAL	**60**

	Course Outcomes
CO1	Recalling various concepts relating to languages and applications
CO2	Understanding various functions of C++ language
CO3	Applying various classes and objects
CO4	Analyzing different types of inheritance system
CO5	Understanding working bout files and exception handling

Textbooks	
1	E. Balagurusamy, 2008, Object Oriented Programming with C++, Tata McGraw-Hill Publishing Company Ltd **Unit I** : Chapters 1,3 **Unit II:** Chapter 4 **Unit III**: Chapters 5-7 **Unit IV**: Chapters 8-10 **Unit V** : Chapter 11.
Reference Books	
1	Robert Lafore, Object Oriented Programming in Microsoft C++, Galgotia publication
2	Byron S.Gottfried, Schaum's Outline of programming with C++ 2nd Edition
3	"Let us C++" – YeswantKanetkar – BPB Publications, 1999
Web Resources	
1	http://cppannotations.sourceforge.net/
2	https://www.cplusplus.com/doc/tutorial/
3	https://www.programiz.com/cpp-programming
4	https://www.w3schools.com/cpp/default.asp - **C++ free tutorial**

Course Code EC 7	PROGRAMMING IN C++ PRACTICAL		Credits
Year &Semester: III YEAR & VI SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 0+0+1 =1

1. Write a Program to illustrate New and Delete Keywords for dynamic memory allocation
2. Write a program Illustrating Class Declarations, Definition, and Accessing Class Members.
3. Program to illustrate default constructor, parameterized constructor and copy constructors
4. Write a Program to Demonstrate the i)Operator Overloading. ii) Function Overloading.
5. Write a Program to Demonstrate Friend Function and Friend Class.
6. Write a Program to Access Members of a STUDENT Class Using Pointer to Object Members.
7. Write a Program to Generate Fibonacci Series use Constructor to Initialize the Data Members.
8. Write a C++ program to implement the matrix ADT using a class. The operations supported by this ADT are: a) Reading a matrix. b) Addition of matrices. c) Printing a matrix. d) Subtraction of matrices. e) Multiplication of matrices
9. Write C++ programs that illustrate how the following forms of inheritance are supported: a)Single inheritance b)Multiple inheritance c)Multi level inheritance d)Hierarchical inheritance
10. Write a C++ program that illustrates the order of execution of constructors and destructors when new class is derived from more than one base class.

Course Code EC 7	PROGRAMMING IN PYTHON		Credits 3
Year & Semester: III YEAR &VI SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3+1+0 =4

Course Objectives		
• To Understand fundamental programming concepts of Python programming		
• To study basic programming concepts and packages for data analysis,.		
• To study about structure and LOOP		
• To gain inputs in Data structure, plotting &visualisation		
UNIT	**Contents**	**No. of Hours**
I	**Introduction to Python** - Features of Python - Identifiers - Reserved Keywords - Variables Comments in Python – Input , Output and Import Functions – Operators **Data Types and Operations** – int, float, complex, Strings, List, Tuple, Set, Dictionary - Mutable and Immutable Objects – Data Type Conversion t	**12**
II	**Flow Control -** conditional (if), alternative (if-else), if-else if.-else, nested if - Loops for, while, break, continue, pass; **Functions:** Functions, Modules and Exception Handling Functions Definition, Function Calling, Function Arguments (Required, Keyword, Default), Recursion	**12**
III	**Built-in Modules** - Creating Modules - Import statement - Locating modules - Namespaces and Scope - Packages in Python **File Handling** : Opening, Closing, Writing, Reading and deleting **Exceptions Handling**: Built-in Exceptions Exception handling, Exception with arguments, Raising an Exception - User defined Exceptions - Assertions in Python	**12**
IV	**Object Oriented Programming**: Class Definition, Object Creation, Built-in Attribute Methods, Encapsulation, Data Hiding, Inheritance, Multi-Level Inheritance, Polymorphism (Method Overriding, Operator Overloading)	**12**
V	**GUI Programming** :Introduction – Tkinter Widgets – Label – Message Widget – Entry Widget – Text Widget – tk Message Box – Button Widget – Radio Button- Check Button – List box Frames _ Top-level Widgets – Menu Widget	**12**
	Total	**60**
	Course Outcomes	
CO1	Demonstrate the understanding of basic programming terminologies and packages of python language.	
CO2	Will gain knowledge on concepts and packages for data analysis, modelling, and visualization in python language.	

CO3	In depth understanding about structure and LOOP
CO4	In depth Understanding about OOP
CO5	gain inputs in GUI programming
Textbooks	
1.	Taming Python By Programming, Dr. Jeeva Jose, Khanna Publishing, 2019. **Unit I**: Chapter 1 & 2 ; **Unit II:** Chapter 3 – 3.1 to 3.4 and Chapter 4 **Unit III:** Chapter 5 – 5.1 -5.5. & 5.8; Chapter 6 – 6.1 to 6.7 and Chapter 8. **Unit IV:** Chapter 7 ; **Unit V**: Chapter 12- 12.1, 12.2 – 12.2.1 to 12.2.12
Reference Books	
1.	Introduction to Problem solving using Python -E.Balagurusamy – TMH – First Edition - 2015
2	ChSatyanarayana, M Radhika Mani, BN Jagadesh - Python Programming-Cengage, New Delhi.
Web Resources	
1.	http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf - free Python Book
2.	https://books.trinket.io/pfe/index.html - **Interactive HTML for Python**
3.	https://www.geeksforgeeks.org/formatted-string-literals-f-strings-python/
4.	https://docs.python.org/3/tutorial/index.html
5.	https://pandas.pydata.org/docs/getting_started/index.html#getting-started
6.	https://numpy.org/doc/stable/user/absolute_beginners.html
7.	https://matplotlib.org/stable/tutorials/introductory/pyplot.html#sphx-glr-tutorials-introductory-pyplot-py

Assignments In Python Module

Assignment to the students may be given from the list below:

- ✓ Introduction to f-strings for string formatting
- ✓ Arrays with Numpy
- ✓ Data Visualization in Python using matplotlib
- ✓ Working with pandas dataframes and series
- ✓ pathlib module for file handling,

Course Code EC 7	PROGRAMMING IN PYTHON - PRACTICAL		Credits
Year & Semester: III YEAR &VI SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 0+0+1 =1

1. Write a Python program to find the value of Triple Integral
2. Write a python program to find the solution of simultaneous linear equations.
3. Write a Python program to find the nth derivatives.
4. Python program to find nth derivative with and without Leibnitz rule.
5. Write a python program to solve partial differential equations.
6. Write a program to input and multiply two matrices
7. Write a program to compute Eigen value and Eigen vector of a given 3X3 matrix using Numpy
8. Write a python program to determine the intersection point of two lines.
9. Create a program that performs the Fourier transform of a given function. You can use the FFT algorithm to implement this.
10. Create a program that visualizes mathematical functions and data using the Matplotlib library. The program should be able to create line plots, scatter plots, bar charts, and other types of visualizations

Course Code EC8	GRAPH THEORY AND APPLICATIONS		Credits 3
Year &Semester: III YEAR & VI SEMESTER	Course Category:	ELECTIVE	Total:(L+T+P) Per week: 4+1=5

Course Objective

- Understand the fundamental concepts of graph theory.
- Learn about the connectivity and separability of graphs.
- Develop an understanding of vector spaces of a graph
- Gain knowledge about matrix representation of a graph

UNIT	Details	No. of Hours
I	Graphs - Subgraphs - Isomorphism and degrees - Walks and connected graphs - Cycles in graphs - Cut vertices and cut edges. **Chapter 1: Section 1.1 – 1.7**	15
II	Eluerain graphs - Fleury's algorithm - Hamiltonian graphs - Weighted graphs. **Chapter 2: Section 2.1 – 2.4**	15
III	Bipartite graphs - Marriage problem - Trees - Connector problem. Matrix representations – Vector spaces associated with graphs – Cycle space – Cut-set space. **Chapter 3: Section 3.1 – 3.4 Chapter 4: Section 4.1**	15
IV	Planar graphs - Euler formula - Platonic solids - Dual of a plane graph - Characterization of planar graphs. **Chapter 5: Section 5.1 – 5.5**	15
V	Vertex colouring - Edge colouring - An algorithm for vertex colouring – Directed graphs. **Chapter 6 – 6.1- 6.3** **Chapter 7 – 7.1**	15
	Total	**75**

Course Outcomes	
CO	On completion of this course, students will
1	Be able to define and classify graphs based on various parameters such as degree, isolated and pendent vertices, and isomorphisms..
2	Be able to identify and explain the properties of trees, including pendent vertices, distances and centres, rooted and binary trees, spanning trees, and fundamental circuits.
3	Be able to demonstrate an understanding of the connectivity and separability of graphs, including Euler graphs, Hamiltonian paths and circuits, and the various types of cut sets
4	Be able to explain the concepts of vector spaces of a graph, and their applications
5	Be able to use matrix representation of a graph and to solve problems related to graph theory
Text Book	
• S. A. Choudum, A First course in Graph Theory, Macmillan Publishers India Pvt Ltd, 2000.	
Reference Books	
1.	F. Harary, Graph Theory, Narosa Publishing Company, 2001.
2.	NarsinghDeo, Graph Theory with applications to Engineering & Computer Science, Prentice Hall of India ,New Delhi, 1997.
Web Resources	
1	https://d3gt.com/ - **Learn Graph Theory Interactively**
2	https://www.mathsisfun.com/graph/index.html
3	https://brilliant.org/courses/graph-theory-intro/
4	http://mathworld.wolfram.com/GraphTheory.html
5	https://www.javatpoint.com/graph-theory - **Graph Theory Tutorial**

Course Code EC 8	FUZZY SETS AND ITS APPLICATIONS		Credits 3
Year & Semester: III YEAR & VI SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 4+1 = 5

Course Objective

- Students will acquire the basic ideas on fuzzy sets and properties of fuzzy sets.
- Students will acquire the knowledge on fuzzy complements, fuzzy operations and fuzzy relations.

UNIT	Details	No. of Hours
I	Fuzzy set Theory: Fuzzy sets-Fuzzy set- Definition- Types of Fuzzy sets – Characteristics of Fuzzy sets.	15
II	Other Important Operations – General Properties: Fuzzy Vs Crisp - Operations on Fuzzy Sets – Some important theorems.	15
III	Extension Principle for Fuzzy sets - Fuzzy complements	15
IV	Fuzzy Relations and Fuzzy Graphs: Introduction – Projections and Cylindrical Fuzzy - Relations – Composition – Properties of Min-Max Compositions.	15
V	Decision Making in Fuzzy Environment: Introduction- Individual Decision Making - Multi person decision making.	15
	Total	**75**

Course Outcomes

CO	On completion of this course, students will
1	Able to identify Different Types of Fuzzy Sets
2	Able to find the union of two Fuzzy sets.
3	Able to define Fuzzy complements.
4	Able to Explain cylindrical Fuzzy relations
5	Able to Evaluate given decision making in Fuzzy environment.

Text Book

1.	Sudhir K. Pundir and RimplePundir, Fuzzy sets and their Applications, A PragatiPrakashan Publishers, Meerut, 2019 (9^{th} Edition) **Unit I: Chapter 1: Sections – 1.20, 1.21** **Unit II: Chapter 2: Sections – 2.1, 2.2**

	Unit III: Chapter 2; Sections – 2.3 to 2.5 **Unit IV: Chapter 4: Sections – 4.1 to 4.4** **Unit V: Chapter 10: Sections – 10.1 to 10.3**
Reference Books	
1	1.H. J. Zimmermann, Fuzzy Set Theory and its Applications, Springer Fourth Edition, 2001.Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw Hill Inc. New Delhi,2004.
2	M. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, PHI Learning Pvt Ltd, new Delhi, 2009.(4^{th} Edition.)
3	George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic Theory and Applications.Prentice Hall of India, New Delhi, 1995
Web Resources	
1	https://www.javatpoint.com/fuzzy-logic - **Fuzzy Logic Tutorials**
2	https://youtu.be/UQLBoCuf-GE
3.	https://youtu.be/oWqXwCEfY78

Madurai Kamaraj University

B.Sc Mathematics

SKILL ENHANCEMENT COURSES

[DISCIPLINE / SUBJECT SPECIFIC]

Syllabus

Course Code SEC 3	COMPUTATIONAL MATHEMATICS		Credits 2
Year & Semester: I YEAR & II SEMESTER	Course Category	SEC	Total:(L+T+P) Per week: 1+1 = 2

Course Objective

.1.To introduce students to computational mathematics and its applications in solving mathematical problems.

2. To familiarize students with the basics of Scilab programming language and its use in numerical computations.

3. To teach students how to implement numerical algorithms for solving mathematical problems using Scilab.

4. To enable students to use computational methods to solve mathematical problems and interpret the results obtained

UNIT	Details	No. of Hours
I	**Introductionto Scilab**– Scilab Environment: Manipulating the command line - Variables in Memory - Startup Commands - The Scilab Menu Bar –Toolboxes **Vectors** : Initialising vectors in Scilab - Mathematical operations on vectors - Relational operations on vectors - Logical operations on vectors **Functions:** Built-in logical functions -Elementary Mathematical Functions - Mathematical functions on scalars	5
II	**Matrices** : Introduction - Arithmetic operators for Matrices - Basic matrix processing **Programming in Scilab** : Introduction - Variables & Variable names - Assignment statements - Arithmetic, Relational & Logical operators - Input & Output - Flow control/branching /conditional statements - Break and continue - Handling Matrices With Loops	5

III	Scripts - The Concept of Functions - User Defined Functions - Special Function command **Graphic output** : Introduction - 2d Plotting - - Function versions for graphic commands - 3d plotting	4
IV	**Numerical Methods using SCILAB [Concepts, Problem &Scilab code]** **Solution of Algebraic and Transcendental Equation**: Bisection method -Newton-Raphson method –RegulaFalsi method -Secant method **Interpolation:** Finite Difference Operators – Newton's Gregory Forward Interpolation Method, - Newton's Gregory backward Interpolation Method - Lagrange interpolation method	8
V	**Numerical Differentiation**: Equal interval - Unequal Interval **Numerical Integration:** Newton Cotes formula - Trapezoidal rule - Simpson's 1/3 rule – Simpson's 3/8 rule - Monte Carlo method	8
	Total	**30**

Course Outcomes

CO	On completion of this course, students will
1	Develop an understanding of numerical methods for solving mathematical problems.
2	Acquire knowledge of programming concepts and the basics of Scilab language.
3	Apply numerical algorithms to solve mathematical problems using Scilab.
4	Implement and test numerical algorithms using Scilab.
5	Analyze and interpret the results of numerical differentiation and integerations

Text Book

1. SCILAB (A Free Software to MATLAB) -Author :Achuthsankar S Nair &HemaRamchandran -: S. Chand Publishing - : 2012

Unit I: Chapter 2 – 2.1, 2.2, 2.5, 2.8, 2.9 : Chapter 3 – 3.2 to 3.8

Unit II: Chapter 4 – 4.1,4.2,4.3 ; Chapter 5 – 5.1 to 5.8

Unit III: Chapter 5 – 5.9 to 5.12 : Chapter 8 – 8.1 – 8.4

2. NUMERICAL METHODS KIT : FOR MATLAB, SCILAB AND OCTAVE USERS by RohanVerma

Unit IV: Chapter 1 & 2

Unit V: Chapter 4 & 5

REFERENCE BOOK	
1	Introduction to Scilab: For Engineers and Scientists.-Sandeep Nagar
2.	Computing in Scilab -Chetana Jain – Cambridge University
3.	COMPUTER-BASED NUMERICAL & STATISTICAL TECHNIQUES - M. GOYAL - INFINITY SCIENCE PRESS LLC
Web Resources	
1.	https://www.scilab.org/tutorials - **Scilab Tutorials**
2	https://egyankosh.ac.in/bitstream/123456789/88092/1/Unit-15.pdf
3	https://www.edx.org/course/scilab-programming-for-beginners
4	https://www.scilab.org/sites/default/files/Scilab_beginners.pdf
5	https://spoken-tutorial.org/tutorial-search/?search_foss=Scilab&search_language=English **Scilab Spoken Tutorials**

Course Code SEC 3	LaTeX		Credits 2
Year &Semester: I YEAR & II SEMESTER	**Course Category**	**SEC**	**Total:(L+T+P) Per week: 1+1 = 2**

Course Objective

- To enable the students to acquire basic concepts of LaTeX
- To get knowledge to prepare sample reports, sample articles, sample presentation and sample poster

UNIT	Details	No. of Hours
I	Preamble : Motivation - Running LaTeX - Resources - Basic LaTeX - Sample Document and Key Concepts - Type Style - Environments - Lists - Centering - Tables - Verbatim - Vertical and Horizontal Spacing	6
II	Typesetting Mathematics - Examples - Equation Environments - Fonts, Hats, and Underlining - Braces -Arrays and Matrices - Customized Commands -Theorem-like Environments - Math Miscellany - Math Styles - Bold Math - Symbols for Number Sets - Binomial Coefficient	6
III	Further Essential LaTeX : Document Classes and the Overall Structure - Titles for Documents - Sectioning Commands - Miscellaneous Extras - Spacing - Accented Characters - Dashes and Hyphens - Quotation Marks - Troubleshooting - Pinpointing the Error - Common Errors - Warning Messages .	6
IV	Packages - Inputting Files - Inputting Pictures - Making a Bibliography - Making an Index –Latex through the years	6
V	Sample Article –Sample Report – Sample presentation - Sample Poster – Internet Resources	6
	Total	**30**

Course Outcomes

CO	On completion of this course, students will able to
1	Learn LaTeX.
2	Typesetting Mathematics
3	know the essential of LaTeX, Document Classes and the Overall Structure

4	Know the packages, Inputting Files, Inputting Pictures, Making a Bibliography
5	prepare theSample Article, Sample Report, Sample presentation and SamplePoster

Text Book	
1	Learning LaTeX : David F. Griffiths, Desmond J. Higham. - SIAM -Society for Industrial and Applied Mathematics, Philadelphia **Chapter 1 ,2,3,4 and 5**

Reference Books

1.A Guide to LaTeX, Helmut Kopka Patrick W. Daly, Electronic Publishing (Fourth edition) © Addison Wesley Longman Limited 2004.

2. LaTeXTutorials,A PRIMER, Indian TEX Users Group, Trivandrum, India 2003 September

3.LaTeX Beginner's Guide, Stefan Kottwitz, Published by Packt Publishing Ltd. 32 Lincoln road Olton,Birmingham, B27 6PA, UK

Web Resources	
1.	Overleaf: https://www.overleaf.com/
2.	ShareLaTeX: https://www.sharelatex.com/
3	LaTeXWikibook: https://en.wikibooks.org/wiki/LaTeX

Course Code SEC 4	E Commerce and Tally		Credits 1
Year &Semester: II YEAR & III SEMESTER	Course Category	SEC	Total:(L+T+P) Per week: 1

Course Objectives

- To acquire the basic concept of accounting fundamentals
- To understand the GST in Tally Essentials
- To identify the accounting treatments in tally prime essentials
- To explore the reports in tally

Unit	Contents	No. of Hours
I	**Introduction to E-Commerce** - Defining E – Commerce – features of E –Commerce - Benefits of E - Commerce - Components of E-Commerce - Functions of Electronic Commerce - Process of ECommerce - Types of E- Commerce;	3
II	**Fundamentals of Tally ERP 9** Features of Tally – opening Tally ERP 9 – Components of Tally ERP 9 – creating company – company info menu.	3
III	**Advanced Inventory Information in Tally ERP 9** Stock Groups, Stock categories, items ,type - Introducing Groups, Ledgers, Purchase order, sales order and invoices - capital account, current assets, current liabilities, Loans	3
IV	Revenue, - Primary groups, Net debit/credit balance for reporting – creating multiple groups – process of creation ledger – orders – invoicing- vouchers – inventory vouchers.	3
V	**Display / Reports in Tally ERP 9** Generating Basic Reports in Tally – Trial balance Report - Accounting Books and registers - Inventory Books and Registers – working with stock summary report – understanding ratio analysis – Principle ratio	3
	TOTAL	**15**

	Course Outcomes
CO1	Illustrate the basic concept of accounting
CO2	Illustrate the Tally essentials
CO3	Enumerate the accounting treatments in tally
CO4	Describe the inventory information in tally
CO5	Describe the extraction of report in tally

Textbooks

1	E-Commerce – Dr.V.Vidya, Dr.U.Umesh& others – Redshine Publications Pvt Ltd. **[Unit -1]**

2	Tally ERP 9 (Power of Simplicity) , SHRADDHA SINGH · 2015, V.S.Publishers. **Unit II**: Chapter 3 **Unit III:** Chapter 3 **Unit IV**: Chapter 3 **Unit V**: Chapter 4
Reference Books	
1	Official Guide To Financial Accounting Using Tally ERP 9 With GST by Tally Education Pvt.Ltd
2	Asok.Nadhani-TALLY ERP9 TRAINING GUIDE- 4TH EDITION, BPS Publications
Web Resources	
1	https://www.tutorialkart.com/tally/tally-tutorial/ - **Tally Tutorial**
2	https://sscstudy.com/tally-erp-9-book-pdf-free-download/
3	https://egyankosh.ac.in/bitstream/123456789/15151/1/Unit-7.pdf/
4	https://www.sarkarirush.com/tally-erp-9-book-pdf-download/
5	https://egyankosh.ac.in/bitstream/123456789/10325/1/Section-3.pdff
6	https://tallysolutions.com/learning-hub/#gref – **Tally Learning Hub**
7	https://www.tutorialkart.com/accounting/ - **Basic Accounting Tutorial**
8	https://www.javatpoint.com/e-commerce-definition - **E Commere Tutorial**

Course Code SEC 4	WEB DESIGNING		Credits 1
Year &Semester: II YEAR & III SEMESTER	Course Category	SEC	Total:(L+T+P) Per week: 1

Learning Objectives

- Understand the fundamentals of web design and electronic publishing
- Learn how to create lists and nested lists using HTML
- Learn how to create web page layouts and designs using CSS
- Learn how to work with block elements, objects, lists, and tables using CSS
- Understand the usage of themes, div, span, tables, and frames in web design

Unit	Contents	No. of Hours
I	**Introduction to Web Design & HTML Basics** - WWW, Website, Working of Websites, Web pages, Front End, Back End, Client and Server Scripting Languages, Responsive Web Designing, Types of Websites (Static and Dynamic Websites) – Free Editors – Notepad ++	**3**
II	**HTML Basics** : Introduction, Basic Structure of HTML Formatting Tags - HTML Tables – HTML Lists – HTML Forms – HTML - HTML 5 Introduction - HTML embed multimedia - HTML Layout	**3**
III	**Introduction to CSS**: Types of CSS, CSS Properties, Border Properties	**3**
IV	Block properties, Positioning Properties, CSS Lists , CSS Tables, CSS Menu Design CSS Image Gallery	**3**
V	**JavaScript**: Introduction to Client Side Scripting Language, Variables in Java Script, Operators in JS, Conditions Statements, JS Popup Boxes, JS Events, Basic Form Validations in JavaScript.	**3**
	TOTAL	**15**

	Course Outcomes
CO1	Students will be able to design and publish their own web pages using HTML
CO2	Students will be able to define styles using pseudo-elements and link a style sheet to an HTML document
CO3	Students will be able to create web page layouts and designs using CSS, and style various elements such as background, text, and font
CO4	Students will be able to design and implement forms and form elements in their web pages
CO5	Students will be able to create a well-structured web site with appropriate titles and themes

Textbooks	
1	Web Designing & Publishing – Satishjain, M.GeethaIyer, BPB Publications – 2022 **Unit I**: Chapter 1 – 1.4 to 1.7: **Unit II**: Chapter 2 – 2.1 to 2.12 **Unit III**: Chapter 3 – 3.1 to 3.5 **Unit IV**: Chapter 3 – 3.6 to 3.11 **Unit V**: Chapter 5 – 5.1 to 5.9
Reference Books	
1	HirdeshBharadwaj, Web designing, Paper Back, 2016
2	Brain D Miller, Principles of web design, Allworth Publications, 2022
Web Resources	
1	https://digital.com/wp-content/uploads/html-cheat-sheet.pdf
2	https://tutorial.techaltum.com/webdesigning.html - **Web Designing Tutorial**
3	https://www.w3schools.com/html/ - **HTML tutorial**
4	https://www.w3schools.com/css/default.asp - **CSS Tutorial**
5	https://www.w3schools.com/css/default.asp - **Javascript Tutorial**

Course Code SEC 5	STATISTICS WITH R PROGRAMMING		Credits 2
Year & Semester: II YEAR & III SEMESTER	Course Category	SEC	Total:(L+T+P) Per week: 1+1 = 2

Course Objectives

- To analyze data using the statistical tool R.
- To create vectors, lists, matrices, arrays and data frames using R.
- To draw charts and graphs using R.
- To automate data analysis, working collaboratively and openly on code.
- To know how to generate dynamic documents.

UNIT	Contents	No. of Hours
I	Features of R- -Reserved words –Identifiers – Constants – Variables - Operators -Operator Precedence –Strings- Basic Data Types	**5**
II	Creating and combining vectors -Accessing Vector Elements -Modifying Vectors-Vector arithmetic and Recycling -Vector Element Sorting -Reading Vectors -Creating Lists -Accessing List elements -Updating List Elements - Merging Lists -List to Vector conversion	**5**
III	Creating matrices -Creating Arrays -Creating factors - Creating Data Frames -Aggregating Data -Sorting Data -Merging Data -Reshaping data - Sub-setting data -Data Type Conversion - Bar charts– Histogram – Line graphs – Pie charts– Graphical analysis and summaries of Data using Descriptive Statistics	**6**
IV	Decision making (using if statement - if…else statement - Nested If…Else statement - if else function - Switch statement) -Loops (for loop – while Loop – repeat Loop) -Function definition and Function Calling - Function without arguments - Built-in functions	**6**
V	Probability distribution – Z test – F –test – t test – Correlation – Regression – Forecasting – Time Series Analysis	**8**
	Total	**30**
	Course Outcomes	
CO1	the students will be able to: analyze data using the statistical tool R.	
CO2	Create vectors, lists, matrices, arrays and data frames using R.	
CO3	Design and implement the program using data frame, list to provide the solution for various problem.	
CO4	Ability to apply statistical techniques using R Programming for decision making.	
CO5	Study about factors and tables and to solve statistical problems.	
	Textbooks	
1.	Jeeva Jose (2018),"Beginner's Guide for Data Analysis using R Programming", Khanna Book Publishing Co. Ltd., New Delhi**.**	

	Unit I – Chapter 1, & Chapter 2- 2.1,2.2 **Unit II – Chapter 2- 2.3, 2.4** **Unit III – Chapter 2 – 2.5 to 2.9, Chapter 5 – 5.1 to 5.4** **Unit IV – Chapter 3 , Chapter 4 – 4.1 to 4.3** **Unit V – Chapter 7 – 7.1 to 7.5, Chapter 11**
2.	Statistics Using R – SudhaG.Purohit , SharadD.Gore, ShailajaR.Deshmukh – Narosa Publishing House, 2015
	Reference Books
1.	Modern Statistics with R - MånsThulin – FREE ONLINE BOOK
2.	P. Dalgaard. Introductory Statistics with R, 2nd Edition.Springer 2008.
3.	Gardener, M (2012) Beginning R: The Statistical Programming Language, Wiley Publications.
	Web Resources
1.	https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf
2.	http://wise.cgu.edu/wp-content/uploads/2016/07/Getting-Started-with-R-and-RStudio.pdf
3.	https://www.w3schools.com/r/ - **R Tutorial**
4.	https://www.programiz.com/r - **learn R programming**
5.	https://www.upgrad.com/blog/r-shiny-tutorial-make-interactive-web-applications-in-r/ **R Shiny Tutorial**: - How to Make Interactive Web Applications in R
6.	https://swirlstats.com/ - Easy to learn R Programming

Course Code SEC 5	DATA ANALYSIS USING SPSS		Credits 2
Year &Semester: II YEAR & III SEMESTER	Course Category	SEC	Total:(L+T+P) Per week: 1+1 = 2

Course Objectives

- Train the students to gain knowledge in the statistical software (SPSS) packages for problem solving.
- Introduce the basic functions of SPSS.
- Train the students for making graphs and diagrams.
- Provide the students with the skills to use SPSS for processing and analyzing statistical data sets.
- Train the students to process data and generate outputs.

UNIT	Contents	No. of Hours
I	**Introduction of SPSS** SPSS – Introduction, opening a Data File SPP Data Editor - Running statistical Analysis – Editing and manipulating data – Missing values – Editing SPSS output – Viewing Results - Printing SPSS output -, Importing and Exporting Data Files	6
II	**Charts And Graphs in SPSS:** Bar chart - Line chart -Scatter Plot –Dot Plots - Pie Charts - Histogram	6
III	**Descriptive Statistics & t- Test Using SPSS** Measure of Central Tendency – Measure of Dispersion – Skewness& Kurtosis - One Sample T–Test, Independent Samples T-Test and Paired T-Test.	6
IV	**Analysis of Variance & Correlation Using SPSS**: One-way ANOVA – Two Way ANOVA .– Correlation – Spearman's Rank Correlation	6
V	**Regression & Chi Square Test Using SPSS** : Linear Regression – Multiple Regression - Chi-square test.	6
	Total	**30**

	Course Outcomes
CO1	Relating the SPSS packages and Files
CO2	Use the basic functions of SPSS
CO3	Process data and generate statistics for some demographic variable analysis.
CO4	Generate graphs and diagrams for data analysis.
CO5	Process data and generate outputs using SPSS software.

Textbooks

1. SPSS FOR YOU – A.Rajathi, P.Chandran – MJP Publishers, 2016
   Unit I – Chapter 2
   Unit II : Chapter 4
   Unit III – Chapter 3 – Pages 41-49 & Chapter 5 – Pages 91-110

	Unit IV – Chapter 6 – Pages 125 -143 & Chapter 7 – Pages 155 – 170 **Unit V** – Chapter 8 – Pages 178 – 193 & Chapter 9
2.	Statistical Methods for Practice and Research: A Guide to Data Analysis Using SPSS By**:**Ajai S. Gaur & Sanjaya S. Gaur - SAGE Publications India Pvt Ltd.
Reference Books	
1.	"SPSS in Simple Steps", SmrutiBulsari, Sanjay SinhaKiranPandya, Dreamtech Press, 2011..
2.	"Statistical Data Analysis: A PracticalGuide", Milan Meloun, Woodhead Publishing India; 1 edition, 2011.
3.	A HANDBOOK OF STATISTICAL ANALYSES USING SPSS (DR. BRIJESH AWASTHI) – Redshine Publication
Web Resources	
1.	https://med.und.edu/daccota/_files/pdfs/berdc_resource_pdfs/data_analysis_using_spss.pdf
2.	https://students.shu.ac.uk/lits/it/documents/pdf/analysing_data_using_spss.pdf
3.	https://www.lboro.ac.uk/media/media/schoolanddepartments/mlsc/downloads/spss-and-statistics-guide.pdf
4.	http://wise.cgu.edu/wp-content/uploads/2014/11/SPSS-Step-by-Step-Regression-Introduction.pdf
5.	https://www.javatpoint.com/spss - **SPSS Tutorial**
6.	https://www.open.edu/openlearn/society-politics-law/sociology/getting-started-spss/content-section-0?active-tab=description-tab - **Free Course SPSS**

Course Code SEC 6	INTRODUCTION TO DATA SCIENCE		Credits 2
Year &Semester: II YEAR & IV SEMESTER	Course Category	SEC	Total:(L+T+P) Per week: 1+1=2

Course Objective

- Understand the importance of data science in today's world.
- Build models for prediction and classification.
- Implement supervised and unsupervised machine learning algorithms.
- Understand the Hadoop framework.

UNIT	Details	No. of Hours
I	**Data science in a big data world** Benefits and uses – Facets of data – Data science process – Big data ecosystem and data science	6
II	**The Data science process**: Overview – research goals - retrieving data - transformation – Exploratory Data Analysis – Model building	6
III	**Algorithms** : Applications of Machine learning in Data Science - Machine learning algorithms – Modeling process – Types – Supervised – Unsupervised	6
IV	**Introduction to Hadoop** : Hadoop framework – Spark – replacing MapReduce	6
V	**Introduction to NoSQL** NoSQL – ACID – CAP – BASE – types	6
	Total	**30**

Course Outcomes

CO	On completion of this course, students will
1	Identify the different facets of data and explain the data science process.
2	Retrieve and transform data, perform exploratory data analysis, and build models.
3	Evaluate and compare machine learning algorithms and apply them to real-

	world data science problems
4	Understand the Hadoop framework and use it for big data processing
5	Explain the concepts of NoSQL databases and apply them to solve data management problems.

Text Book

Davy Cielen, Arno D. B. Meysman, Mohamed Ali, “Introducing Data Science”, manning publications 2016

Unit I : Chapter 1 - 1.1 – 1.4

Unit II: Chapter 2 - 2.1 -2.6

Unit III : Chapter 3 – 3.1 – 3.3

Unit IV : Chapter 5 – 5.1

Unit V : Chapter 6 – 6.1

Reference Books

1.	Introduction to Data Science - B. Uma Maheswari , R. Sujatha - WILLEY- 2021
2.	MurtazaHaider, “Getting Started with Data Science – Making Sense of Data with Analytics”, IBM press, E-book.

Web Resources

1.	Python Data Science Handbook: Essential Tools for Working with Data by Jake VanderPlashttps://jakevdp.github.io/PythonDataScienceHandbook/
2.	An Introduction to Machine Learning by Alpaydinhttps://www.cmpe.boun.edu.tr/~ethem/i2ml2e/
3	https://www.open.edu/openlearn/science-maths-technology/learn-code-data-analysis/content-section-overview?active-tab=content-tab – **Learn to code for data analysis – Free Course**
4	https://www.w3schools.com/datascience/ - **Data Science Tutorial**
5	https://www.kaggle.com/code/helgejo/an-interactive-data-science-tutorial - **Free data Science Tutorial**
6	https://www.nbshare.io/ - **Data science learning**

Course Code SEC 6	Mathematical Finance		Credits 2
Year &Semester: II YEAR & IV SEMESTER	Course Category	SEC	Total:(L+T+P) Per week: 1+1 = 2

Course Objective

- Understand the concept of time value of money and its applications in finance.
- Analyze different types of annuities and calculate their present and future values.
- Understand the principles of bond valuation and pricing.
- Analyze different types of stocks and evaluate their performance.
- Understand the principles of option valuation and hedging.

UNIT	Details	No. of Hours
I	The concept of interest – Simple interest - Compound Interest - Rate of interest - Accumulation factors - present values – capital gains and losses	6
II	Basic compound Interest- Functions – Interest rate quantitative – Annuities – Varying Annuities	6
III	Future Derivatives: Swaps and options - option payoff and profit - European option Pricing – Black - Scholes models – Trading strategies	6
IV	Stochastic Interest Rate models – Introductory – Independent annual rates of return – the log – normal distribution	6
V	Simulation techniques – Random number generation – dependent annual rate of return – Application of Brownian motion	6
	Total	**30**

Course Outcomes

CO	On completion of this course, students will
1	Apply mathematical concepts and techniques to solve financial problems.
2	Analyze different types of financial instruments and evaluate their risks and returns
3	Construct investment portfolios and manage risks
4	Communicate financial information effectively to stakeholders
5	Understand the ethical and professional standards in the finance industry.

Text Books	
1.	An Introduction to the Mathematics of Finance: A Deterministic Approach by Stephen Garrett. **Unit I:** Chapter 1 & 2 **Unit II** : Chapter 3 **Unit III**: Chapter 11 **Unit IV** : Chapter 12 – 12.1 to 12.3 **Unit V**: Chapter 12 – 12.4 to 12.7
2.	An Elementary Introduction To Mathematical Finance by Sheldon M. Ross
Reference Books	
1. Mathematics for Finance by M Capinski and T Zastawniak, Springer (International Edition), 2003. 2. The Calculus of Finance by Amber Habib, Universities Press, 2011. 3. Options, Futures and Other Derivatives 7th edition by John C Hull and SankarshanBasu, Pearson 2009. **4.** Investment Science by David Luenberger, Oxford University Press (Indian Edition), 1997.	
Web Resources	
1.	Financial Theory: https://ocw.mit.edu/courses/economics/14-03-financial-theory-fall-2008/
2.	Investopedia - Financial Education: https://www.investopedia.com/financial-education-4689775 EC - Financial Mathematics
3.	https://www.edx.org/course/financial-analysis-decision-making-0

Course Code SEC 7	COMPUTING MATHEMATICS		Credits 2
Year &Semester: II YEAR & IV SEMESTER	**Course Category**	**SEC**	**Total:(L+T+P) Per week: 1+1 = 2**

Course Objective

- To provide students with the necessary mathematical tools to perform matrix operations and vector algebra
- To introduce students to the concept of ordinary differential equations and their applications in real-world problems
- To teach students how to use Euler's method, Modified Euler's method, and Runge-Kutta method to solve first and second-order differential equations
- To provide students with an understanding of special functions such as Bessel function, Legendre polynomial, Hermite polynomial, and improper integrals
- To equip students with the necessary skills to use Fast Fourier Transform for signal processing and data analysis

UNIT	Details	No. of Hours
I	Matrices and Vector Space: Creation of a matrix- matrix operations – Vector Algebra – Applications	6
II	Least Square Curve Fitting : Fitting of linear data – Non linear data – Polynomial fitting - Applications	6
III	Ordinary Differential Equations: Eulers Method- First order Differential Equation – Second order Differential Equation – Modified Euler's method – Second order Runge - Kutta Method - Applications	6
IV	Special functions: Bessel function of the first kid – Legendre polynomial- Hermite polynomial – Improper Integral - Applications	6
V	Fourier Analysis : Periodic function – Fourier Series – Harmonic function – Fourier series expansion – Fast Fourier Transformation	6
	Total	**30**

Course Outcomes

CO	On completion of this course, students will able to
1	Understand the fundamental concepts of matrices and vector space and apply

	them to solve problems in physics, engineering, and computer science..
2	Fit linear and nonlinear data using least square curve fitting techniques and apply them to solve real-world problems.
3	Analyze and solve first and second-order differential equations using Euler's method, Modified Euler's method, and Runge-Kutta method.
4	Apply special functions such as Bessel function, Legendre polynomial, Hermite polynomial, and improper integrals to solve mathematical problems..
5	Use Fourier series expansion and Fast Fourier Transform to analyze signals and data
Text Book	
1	Computing in Scilab – Chetana Jain – Cambridge University Press **Unit I: Chapter 1- 1.1 to 1.6** **Unit II :Chapter 3 – 3.1 to 3.6** **Unit III: Chapter 4 – 4.1 – 4.4, 4.8 – 4.8.1,4.8.2,4.8.3,4.8.4,4.8.5,** **Unit IV: Chapter6 – 6.1 to 6.7** **Unit V :Chapter 7 – 7.1 to 7.6**
Reference Books	
1. Numerical methods kit for Matlab, Scilab and octave user – RohanVerma – University of Delhi, 2020 2. Computer based numerical and Statistical Techniques – M.Goyal – Infinity Press , 2008	
Web Resources	
• MathWorks: https://www.mathworks.com/ • Wolfram MathWorld: http://mathworld.wolfram.com/ • Numerical Recipes: https://www.nr.com/ • MATLAB Academy: https://matlabacademy.mathworks.com/	

Course Code SEC 7	INTRODUCTION TO ARTIFICIAL INTELLIGENCE		Credits 2
Year & Semester: II YEAR & IV SEMESTER	Course Category	SEC	Total:(L+T+P) Per week: 1+1=2

Course Objective

- To learn various concepts of AI Techniques.
- To learn various Search Algorithm in AI.
- To learn representation and reasoning in AI.
- To learn various type of Reinforcement learning.

UNIT	Details	No. of Hours
I	**Introduction to AI**: Scope of AI: Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques- Characteristics of AI problems – Intelligent Agent	6
II	**AI Approaches:** Problem Solving (Blind): State space search: production systems-searching techniques -Uninformed search techniques	6
III	**Informed /Heuristic Based Search**: Generate-and-Test Algorithm - Hill Climbing - Best-First Search/Greedy Search - Branch and Bound Search - A* Algorithm - Problem Reductiion- AO* Algorithm - Constraint Satisfaction - Means-End Analysis (MEA)	6
IV	**Knowledge Representation** Predicate logic: unification, modus ponens, modus tolens, resolution in predicate logic, conflict resolution, forward chaining, backward chaining, conflict resolutions.	6
V	**Structural knowledge representation**: semantic nets: slots, exceptions and default frames, conceptual dependency, scripts	6
	Total	**30**

Course Outcomes	
CO	On completion of this course, students will
1	Understand the various concepts of AI Techniques.
2	Understand various AI approaches
3	Understand various Search Algorithm in AI
4	Understand reasoning in AI
5	Understand Knowledge Representation in AI.
Text Book	
1	Artificial Intelligence – A Practical Approach - Rajiv Chopra – Second edition – S.Chand& Co Pvt Ltd **Unit I**: Chapter 1 **Unit II**: Chapter 2 – 2.0 - 2.2 , 2.2.1 to 2.2.2 **Unit III**: Chapter 2 – 2..2.3 **Unit IV**: Chapter 4 - 4.0 – 4.4 **Unit V**: Chapter 4 - 4.5
Reference Books	
1.	Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi, 2019
2.	SarojKaushik, "Artificial Intelligence", Cengage Learning India, 2011
3.	Artificial Intelligence – Mishra R.B – PHI Learning Pvt ltd, 2010
Web Resources	
1.	https://online-learning.harvard.edu/course/cs50s-introduction-artificial-intelligence-python
2.	https://www.javatpoint.com/artificial-intelligence-ai - **AI Tutorial**
3.	https://www.w3schools.com/ai/ **- AI learning**
4	https://www.nbshare.io/ - **AI learning**

Course Code SEC 8	Essential Reasoning and Quantitative Aptitude		Credits 2
Year &Semester: III YEAR &VI SEMESTER	Course Category	SEC	Total:(L+T+P) Per week 1+1=2

Course Objectives

- Develop problem-solving skills for competitive examinations
- Understand the concepts of averages, simple interest, compound interest, time and work, profit and loss, and problems on numbers
- Apply reasoning concepts to solve problems related to competitive examinations

Units	Contents	Hours
I	**Quantitative Aptitude**: Simplifications - Averages – concepts - problems -Problems on numbers - short cuts – concepts – problems	6
II	Profit and Loss - short cuts – concepts – problems - Time and work - short cuts – concepts - problems	6
III	Simple Interest - Compound interest – concepts - problems	6
IV	**Verbal Reasoning :**Analogy - Coding and decoding - Directions and Distance- Blood relation	6
V	**Analytical Reasoning**: Data sufficiency. **Non – Verbal Reasoning**: Analogy, Classification and Series	6
	Total	**30**

Course Outcomes

CO	On completion of this course, students will
1	Apply simplification and average skills to solve problems in competitive examinations
2	Understand the concepts of time and work
3	Understand the concepts of simple interest and compound interest
4	Understand Analogies, Coding and Decoding in Reasoning
5	Understanding Analytical reasoning and Non - verbal reasoning

Text Book	
1	"Quantitative Aptitude" by R.S.Aggarwal, S.Chand& Company Ltd., Ram Nagar, New Delhi (2007) **Unit I:** Chapter 4,6 and 7 **Unit II**: Chapter 12& 17 **Unit III** :Chapter 22 & 23
2	Essential Objective Reasoning – Abhishek Banerjee, Disha Publications **Unit IV**: Chapter 1, 3, 9, 10 **Unit V**: Analytical Reasoning - Chapter 10, Non-Verbal Reasoning - Chapter 1,2 & 3.
Reference Books	
1.	U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications, 2016.
2.	Dr.M.Manoharan, Dr.C.Elango and Prof K.L.Eswaran, Business Mathematics, Palani paramount Publications, Reprint 2013
Web Resources	
1.	https://tamilnaducareerservices.tn.gov.in/

Madurai Kamaraj University

B.Sc Mathematics

NON MAJOR ELECTIVES

&

ALLIED MATHEMATICS

Syllabus

Course Code SEC 1	MATHEMATICS FOR COMPETITIVE EXAMINATIONS		Credits 2
Year &Semester: I YEAR & I SEMESTER	Course Category	SEC	Total:(L+T+P) Per week 1+1=2

Course Objectives

- Develop problem-solving skills for competitive examinations
- Understand the concepts of averages, simple interest, compound interest, time and work, profit and loss, and problems on numbers
- Apply mathematical concepts to solve problems related to competitive examinations

Units	Contents	Hours
I	Simplifications - Averages – concepts - problems	6
II	Problems on numbers - short cuts – concepts – problems	6
III	Profit and Loss - short cuts – concepts - problems	6
IV	Time and work - short cuts – concepts - problems	6
V	Simple Interest - Compound interest – concepts - problems	6
	Total	**30**

Course Outcomes

CO	On completion of this course, students will
1	Apply simplification and average skills to solve problems in competitive examinations
2	Understand the concepts of simple interest and compound interest
3	Understand the concepts of time and work
4	Use formulas to calculate profit/loss percentages and break-even points
5	Solve problems related to HCF and LCM

Text Book	
1	"Quantitative Aptitude" by R.S.Aggarwal, S.Chand& Company Ltd., Ram Nagar, New Delhi (2007) **Unit I:** Chapter 4 & 6 **Unit II**: Chapter 7 **Unit III:** Chapter 12 **Unit IV** :Chapter 17 **Unit V** :Chapter 22 & 23
Reference Books	
1.	U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications, 2016.
2.	Dr.M.Manoharan, Dr.C.Elango and Prof K.L.Eswaran, Business Mathematics, Palani paramount Publications, Reprint 2013
Web Resources	
1.	https://tamilnaducareerservices.tn.gov.in/

Course Code SEC 2	BASIC DATA ANALYSIS USING EXCEL		Credits 2
Year & Semester: I YEAR & II SEMESTER	Course Category	SEC	Total:(L+T+P) Per week: 1+1 =2

Course Objective

- Understand the basic features of Microsoft Excel
- Understand basic data analysis using Excel
- Learn basic Excel functions and formulas

UNIT	Details	No. of Hours
I	**Introduction to Excel For Data Analysis** : Introduction of Data Analysis – Data Analysis process - Understanding Worksheet Basics – Editing Data – Insert, delete – Formatting cells	6
II	**Data Handling Wizards**: Data tools – Data grouping & cleansing –. Sort, Filter, Remove Duplicates, conditional formatting, Consolidate,- Data Validation - Quick analysis	6
III	**Data Analysis Function**: Formula & functions - Sum, Average, if, Count, max, min, Proper, Upper, Lower, AutoSum, Concatenate, Vlookup, Hlookup, Match, Countif, Text, Trim, Len, Days, Networkdays, sumifs, Averageifs, Countsifs, Counta, iferror, Find/search, left/right, Rank.	6
IV	**Charts:** Chart types and uses - Different types of chart, - Waterfall chart , Histogram and Pareto chart	6
V	**Pivot Tables**: Creating Pivot Tables, Manipulating a Pivot Table, Using the Pivot Table Toolbar, Changing Data Field, Properties, Displaying a Pivot Chart, Setting Pivot Table Options, Adding Subtotals to Pivot Tables	6
	Total	**30**

Course Outcomes	
CO	On completion of this course, students will able to
1	Ability to analyze data using Excel
2	Ability to create basic Excel formulas and functions
3	Understand the basic concepts of using formulas in Excel
4	Ability to apply data handling functions
5	Ability to create a data chart in excel
Text Book	
1	Data Analysis with Excel - Manish Nigam – BPB publications, 2019 Unit I: Chapter 1 – 1.8 – 1.8.1, 1.8.2 ,1.8.3 & 1.8.5.8 **and** https://www.analyticsvidhya.com/blog/2021/11/a-comprehensive-guide-on-microsoft-excel-for-data-analysis/ Unit II: Chapter 1 – 1.8.4 [1.8.4.1, 1.8.4.2] **and** https://www.analyticsvidhya.com/blog/2021/11/a-comprehensive-guide-on-microsoft-excel-for-data-analysis/ Unit III: Chapter 3 – 3.1, 3.5, 3.9 – 3.13 Unit IV: Chapter 4 – 4.1, 4.2, 4.3, 4.4 Unit V: Chapter 7 – 7.1, 7.2, 7.3 – 7.7
Reference Books	
1. Excel 2022 Bible by John Walkenbach 2. Excel 2022 All-In-One For Dummies by Greg Harvey	
Web Resources	
1.	https://www.w3schools.com/EXCEL/excel_sort.php - **Excel Data Analysis**
2.	**Excel Easy**: https://www.excel-easy.com
3	http://home.ubalt.edu/ntsbarsh/excel/excel.htm - **Excel for Data Analysis**

..Course Code EC 1	ALLIED MATHEMATICS - I		Credits 3
Year &Semester: I YEAR & I SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3+1 =4

Course Objective

- To explore the fundamental concepts of Mathematics.
- To acquire knowledge about finding approximate roots of the polynomial equations.
- To improve students' ability in applications of matrices and calculus.
- Students are exposed to understanding the concept of derivatives and their applications.
- To expose double and triple integrals and their applications.

UNIT	Details	No. of Hours
I	**SOLUTIONS OF TRANSCENDENTAL AND ALGEBRAIC EQUATIONS** Iteration method, Bisection method, Newton's method - RegulaFalsi method, Horner's method(without proof) (Simple problems only)	12
II	**SOLUTIONS OF SIMULTANEOUS EQUATIONS** Gauss Elimination method - Gauss Jordan method - Gauss Seidel Iterative method - Gauss Jacobi method (Restricted to three variables only) (Simple problems only)	12
III	**MATRICES** Characteristic equation of a square matrix– Eigen values and eigen vectors – Cayley – Hamilton theorem [without proof] – Verification and computation of inverse matrix	12
IV	**DIFFERENTIAL CALCULUS** n-th derivatives – Leibnitz theorem [without proof] and applications – Jacobians– Curvature and radius of curvature in Cartesian co-ordinates and polar co-ordinates	12
V	**APPLICATION OF INTEGRATION** Evaluation of double, triple integrals – Simple applications to area, volume, and centroid	12
	Total	**60**

Course Outcomes	
CO	On completion of this course, students will able to
1	Find out the approximate roots of polynomial equations.
2	Develop the skills of finding roots of simultaneous equations
3	Demonstrate knowledge about matrices and their applications
4	Carry out calculations of problems related to curvature and radius of curvature.
5	Evaluate double and triple integrals, and enabled to understand the applications of integration in real-life situations
Text Book	
1	P.Kandasamy, K.Thilagavathy (2003) Calculus of Finite differences & Numerical Analysis, S. Chand & Company Ltd., New Delhi-55. **Unit I** : Chapter 1 **Unit II:** Chapter 2
2	P. Duraipandian and Dr. S. Udayabaskaran (1997), "Allied Mathematics" ,Vol I & II. Chennai: Muhil Publishers. **Unit III**: Chapter 1 - Sec – 1.1.1, 1.1.2, 1.2, 1.4.3 **Unit IV** : Chapter 2 - Sec – 2.7, 4.1, 4.1.1, 4.2 **Unit V**: Chapter 3 – Sec - 3.4, 3.4.1, 3.5.1, 3.5.2, 3.6
Reference Books	
1.	S.J.Venkatesan, "Allied Mathematics - I", Sri Krishna Publications, Chennai.
2.	P. R. Vittal (2003), "Allied Mathematics", Margham Publication, Chennai.
3	A.Singaravelu "Numerical Methods"Meenakshi Publications
Web Resources	
1.	https://www.mathwarehouse.com/
2.	https://www.mathhelp.com/
3	https://www.mathsisfun.com/

Course Code EC 2	ALLIED MATHEMATICS - II		Credits 3
Year & Semester: I YEAR & II SEMESTER	Course Category	ELECTIVE	Total:(L+T+P) Per week: 3+1 =4

Course Objective

- This course is designed for the students to expose the topics such as expansions of trigonometric functions, partial differential equations, and integration.
- To gain knowledge of expansions of trigonometric functions.
- To acquire the knowledge of solving partial differential equations.
- Basic knowledge of vector calculus.
- To understand and carry out the calculations of a given set of data.

UNIT	Details	No. of Hours
I	**TRIGONOMETRY** Expansions of sin n θ, cos n θ, sinnθ, cosnθ, tannθ – Expansions of sinθ, cosθ, tanθ in terms of θ – Hyperbolic and inverse hyperbolic functions – Logarithms of complex numbers.	12
II	**PARTIAL DIFFERENTIAL EQUATIONS** Formation-complete integrals and general integrals-Four standard types-Lagranges equations	12
III	**VECTOR DIFFRENTIATION** Vector functions- Derivative of a vector function- Scalar and vector point functions- Gradient of a scalar point function-Gradient- Directional derivatives –Unit vector normal to a surface – angle between the surfaces-divergence, curl.	12
IV	**VECTOR INTEGRATION** Green's theorem in the plane- Gauss divergence theorem-Stoke's theorem [without proofs].	12
V	**FINITE DIFFERENCES** Operator E, Relation between Δ ,∇ and E – Interpolation – Newton – Gregory forward & backward formulae for interpolation-Lagrange's interpolation formula for unequal intervals(without proof) .	12
	Total	**60**

Course Outcomes	
CO	On completion of this course, students will able to
1	Find out the expansions of trigonometric functions and carry out problems related to hyperbolic and inverse hyperbolic functions.
2	Provide a basic knowledge of partial differential equations and develops knowledge on handling practical problems. Develop the skills of finding roots of simultaneous equations
3	Demonstrate knowledge of solving problems involving vector and scalar functions.
4	Carry out calculations of problems related to vector integration
5	Evaluate finite differences using various interpolation methods
Text Book	
1	P. Duraipandian and S. Udayabaskaran(1997), “Allied Mathematics”, Vol I & II. Chennai: Muhil Publishers. **Unit-I:** Chapter 6 (6.1,6.1.1-6.1.3,6.2,6.2.1-6.2.3,6.3,6.4), Vol I, **Unit-II:** Chapter :6 (6.1,6.1.1,6.2,6.3,6.4), Vol II, **Unit-III** Chapter 8 - (8.1,8.1.1,8.2,8.3,8.3.1,8.3.2,8.4,8.4.1,8.4.2,8.4.3,8.4.4),Vol I, **Unit-IV**: Chapter 8 - (8.6.1 - 8.6.3), Vol I, **Unit-V:** Chapter 5 - (5.1, 5.2), Vol II.
Reference Books	
1. S.P.Rajagopalan and R.Sattanathan(2005), “Allied Mathematics”, Vol I & II. New Delhi: Vikas Publications. 2. S.J.Venkatesan, “Allied Mathematics - II”, Sri Krishna Publications, Chennai. 3. P. R. Vittal (2003), “Allied Mathematics”, Margham Publications, Chennai. 4. P.Kandhasamy, K. Thilagavathy (2003), “Allied Mathematics” Vol I & II, New Delhi: Tata McGraw Hill. 5. P.Kandasamy, K.Thilagavathy (2003) Calculus of Finite differences & Numerical Analysis, S. Chand & Company Ltd., New Delhi-55.	
Web Resources	
1.	https://www.mathwarehouse.com/
2.	https://www.mathsisfun.com/