



**MARUDHAR KESARI JAIN COLLEGE FOR WOMEN  
(AUTONOMOUS)**

**Vaniyambadi – 635 751**

**PG & Research Department of Mathematics**

**for**

**Undergraduate Programme**

**Bachelor of Science in Mathematics**

**Regulations 2024-2025**

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# LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE AND POSTGRADUATE EDUCATION

## 1. Preamble

The Department endeavors to be a center of excellence nurturing joyful curiosity in Learning, enthusiastic creativity in research, and passion for building a respectful, free, transparent and dynamic pedagogic community.

To provide an education that transforms students from curriculum to the needs of society. Offer broad and balanced academic programs that are mutually reinforcing and emphasize high quality and creative instruction to the students. We aim to develop well-rounded and thoughtful students prepared to cope with a changing post-modern and globalized world. To provide high quality education, respectful and inclusive environment that builds a foundation for life-long learning.

The Department of Mathematics established in the year 1994 with UG course and it offers PG since 2000. The Department offers research program M.Phil from 2012 and Ph.D from 2022. The objective of the Department is to enhance student knowledge towards global perspective and skill oriented. The Department is well known for its teaching and learning process of quality education. The department organizes International Conferences, Seminars, and Hands on training, Workshops, Competitions, Guest lecturers to inculcate the skill of students to face contemporary growth in Mathematics. Memorandum of Understanding with reputed Institutions. Apart from curriculum the department offers Aptitude test, Bridge Course Value Added Courses and NET/SET/CSIR Coaching for the students.

## PROGRAMME OUTCOMES (PO)

<b>Programme</b>	<b>B.Sc., Mathematics</b>
<b>Programme Code</b>	<b>US09</b>
<b>Duration</b>	<b>3 years[UG]</b>
<b>Programme Outcomes</b>	<p><b>PO1:Disciplinary knowledge:</b> Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study</p> <p><b>PO2:Critical thinking:</b> Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.</p> <p><b>PO3: Problem solving:</b> Capacity to extrapolate from what one has learned and applies their competencies to solve different kinds of non- familiar problems, rather than replicate curriculum content knowledge; and apply one’s learning to real life situations.</p> <p><b>PO4:Analytical reasoning:</b> Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.</p> <p><b>PO5: Scientific reasoning:</b> Ability to analyze interprets and draws conclusions from quantitative/qualitative data; and critically evaluates ideas, evidence and experiences from an open-minded and reasoned perspective.</p> <p><b>PO6: Self-directed Lifelong learning:</b> Ability to work independently, identify and manage a project. Ability to acquire knowledge and skill, including “ learning how to learn”, through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.</p> <p><b>PO7: Lifelong learning:</b> Ability to acquire knowledge and skills, including learning how to learn“, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill Development / re skilling.</p> <p><b>PO8: Moral and ethical awareness / reasoning:</b> Ability to embrace moral/ethical values in conducting one’s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one’s work, avoid unethical behavior such</p>

	<p>as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.</p>
<p><b>Programme Specific Outcomes:</b></p>	<p><b>PSO1:</b> Acquire good knowledge and understanding, to solve specific theoretical &amp; applied Problems in different area of mathematics &amp; statistics.</p> <p><b>PSO1:</b> Understand, formulate, develop mathematical arguments, logically and use quantitative Models to address issues arising in social sciences, business and other context /fields.</p> <p><b>PSO3:</b> To prepare the students who will demonstrate respectful engagement with other’s ideas, behaviors, and 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.</p>

**Eligibility for Admission:**

Candidate for admission to the first year of (B.Sc Maths) Department of Mathematics shall be required to have passed the Higher Secondary Examination with Mathematics

## Methods of Evaluation and Assessment

<b>Methods of Evaluation</b>		
Internal Evaluation		25 Marks
External Evaluation	End Semester Examination	75 Marks
	<b>Total</b>	<b>100 Marks</b>
<b>Methods of Assessment</b>		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand / Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate Between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or off beat situations, Discussion, Debating or Presentations	

Semester-I						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA11	Tamil-1	4	1	0	0	3
24UFUR11	Urdu-1	4	1	0	0	3
24UFEN11	English-1	4	1	0	0	3
24UMAC11	CC-1Algebra and Trigonometry	2	1	2	0	4
24UMAC12	CC-2Differential Calculus	2	1	2	0	4
24UMAA11/ 24UMAA12	EC-1Numerical Methods I /Physics I	2	1	1	0	3
24UMAS11/ 24UMAS12	SEC – 1 NM-Basic Mathematics/ Mathematics for Competitive Exam	1	0	1	0	2
24UMAS13	SEC - 2 Mathematics for Competitive Examinations I	1	0	1	0	2
24UMAF11	FC - Bridge Mathematics	1	1	0	0	2
<b>Total</b>					<b>30</b>	<b>23</b>

Semester- III						
24UFTA31	Tamil-3	4	1	0	0	3
24UFUR31	Urdu-3	4	1	0	0	3
24UFEN31	English-3	4	1	0	0	3
24UMAC31	CC-5 Differential Equations	3	1	1	0	4
24UMAC32	CC-6 Optimization Techniques	3	1	1	0	4
24UMAA31/ 24UCHA11	EC-4 Mathematical Statistics I/AlliedChemistry1	3	1	0	0	3
24UMAA31P/ 24UCHS12P	EC - 5 AL Mathematical Statistics I practical Using Excel /Chemistry Practical for Physical and Biological Sciences-I	1	0	1	0	2
24UMAS31	SEC-4 R-Programming	1	0	1	0	2
24UAEC31	AEC -2 Human Value and Ethics	1	1	0	0	2
<b>Total</b>					<b>30</b>	<b>23</b>

Semester-V						
24UMAC51	CC-9 Abstract Algebra	3	1	1	0	4
24UMAC52	CC-10 Elements of Mathematical Analysis	3	1	1	0	4
24UMAC53	CC-11Complex Analysis	3	1	1	0	4
24UMAC54	CC-12 Object Oriented Programming Concepts Using C++	2	0	1	0	3
24UMAC54P	CC-13 Object Oriented Programming Concepts Using C++ Practical	0	0	2	0	1
24UMAA51/ 24UMAA52	EC-8 GraphTheory/ Special Functions	2	1	0	0	3
24UMAA53/ 24UMAA54	EC-9 Mathematical Modeling/ Financial Analytics	2	1	0	0	3
24UAEC51	AEC- 4 Gender Equality and Social Inclusion	2	0	0	0	2
24UMAIN51	Internship				0	2
24UMAICKS51	Indian Mathematics: Tradition to Transformation	1	1	0	0	0
<b>Total</b>					<b>30</b>	<b>26</b>

Semester-II						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA21	Tamil-2	4	1	0	0	3
24UFUR21	Urdu-2	4	1	0	0	3
24UFEN21	English-2	4	1	0	0	3
24UMAC21	CC-3Integral Calculus	3	1	1	0	4
24UMAC22	CC-4Analytical Geometry	3	1	1	0	4
24UMAA21/ 24UMAA22	EC-2Numerical Methods II /Physics II	3	1	0	0	3
24UMAA21P/ 24UMAA22P	EC - 3 AL Numerical Methods I & II Practicals Using Python / Physics I & II Practicals	0	0	2	0	2
24UMAS21	SEC - 3 Mathematics for Competitive Examinations II	1	0	1	0	2
24UAEC21	AEC – 1 Life Skills Through Yoga	1	1	0	0	2
<b>Total</b>					<b>30</b>	<b>23</b>

Semester-IV						
24UFTA41	Tamil-4	4	1	0	0	3
24UFUR41	Urdu-4	4	1	0	0	3
24UFEN41	English-4	4	1	0	0	3
24UMAC41	CC-7 Vector Calculus	3	1	1	0	4
24UMAC42	CC-8 Mechanics	3	1	1	0	4
24UMAA41/ 24UCHA41	EC-6 Mathematical Statistics II /Allied Chemistry II	3	1	0	0	3
24UMAA41P/ 24UCHA41P	EC - 7 AL Mathematical Statistics II practical Using R Programming /Chemistry Practical for Physical and Biological Sciences-II	0	0	2	0	2
24UMAS41	SEC-5Python Programming	1	0	1	0	2
24UAEC41	AEC -3Environmental Studies and Disaster Management	1	1	0	0	2
<b>Total</b>					<b>30</b>	<b>23</b>

Semester-VI						
24UMAC61	CC-13Linear Algebra	3	1	1	0	4
24UMAC62	CC-14Real Analysis	3	1	1	0	4
24UMAC63	CC-15-Project	0	0	0	5	4
24UMAA61/ 24UMAA62	EC-10 Transform Techniques / Discrete Mathematics	3	1	1	0	4
24UMAA63/ 24UMAA64	EC-11 Fuzzy Mathematics / Number Theory	3	1	1	0	3
24UMAP61	PEC–1Data Visualization Using TABLEAU	1	1	1	0	2
24UMAL61	SLC– Mathematical Aptitude				2	2
<b>Total</b>					<b>30</b>	<b>23</b>
						<b>141+2*</b>

Students must complete atleast one online course (MOOC) from plat forms like SWAYAM, NPTEL, or Nanmudalvan within the fifth semester. Additionally, engaging in a specified Self-learning Course is mandatory to qualify for the degree, and successful participation will be acknowledged with an extra credit of 2\*.

**1<sup>st</sup> YEAR: FIRST SEMESTER**

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC11	Algebra and Trigonometry	Core Course 1	2	1	2	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	Basic ideas on the Theory of Equations										
LO2	To gain Knowledge on Summation of Series										
LO3	To understand Eigen values and Eigen Vectors										
LO4	Knowledge To Find Expansions Of Trigonometry Functions										
LO5	Relations Between Hyperbolic And Trigonometric Functions										
Unit	Content										Hours
1	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.										15
2	Summation of Series: Binomial– Exponential –Logarithmic series (Theorems without proof) – Approximations - related problems.										15
3	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										15
4	Expansions of $\sin n\theta$ , $\cos n\theta$ in powers of $\sin\theta$ , $\cos\theta$ - Expansion of $\tan n\theta$ in terms of $\tan \theta$ , Expansions of $\cos^n \theta$ , $\sin^n \theta$ , $\cos^m \theta \sin^n \theta$ – Expansion of $\tan(\theta_1 + \theta_2 + \dots + \theta_n)$ -Expansions of $\sin\theta$ , $\cos\theta$ and $\tan\theta$ in terms of $\theta$ - related problems.										15
5	Hyperbolic functions – Relation between circular and hyperbolic functions Inverse hyperbolic functions, Logarithm of complex quantities, Summation of trigonometric series - related problems.										15

CO	Course Outcomes
CO1	To Classify and solve Reciprocal equations
CO2	To Find the sum of Binomial, Exponential, Logarithmic series
CO3	To Find Eigen values, Eigen vectors, verify Cayley – Hamilton theorem

CO4	To Expand the powers and multiples of trigonometric functions in terms of sine and cosine
CO5	To Determine relationship between circular and hyperbolic functions and the summation of trigonometric series
<b>Textbooks:</b>	
1	Algebra, Volume 1, T. K. Manicavachagom Pillay, T. Natarajan, K. S. Ganapathy, S.Viswanathan ( Printers & Publishers) Pvt. Ltd., 2013
2	Algebra, Volume 2, T. K. Manicavachagom Pillay, T. Natarajan, K.S.Ganapathy, S.Viswanathan ( Printers & Publishers) Pvt.Ltd., 2008
3	Trignometry, S. Narayanan, T.K. Manicavachagom Pillay, S.Viswanathan (Printers &Publishers) Pvt. Ltd., 2013
4	W.S. Burnstine And A.W. Panton, Theory Of Equations
5	Algebra And Trigonometry, Hari Kishan, R.K. Shrivastav, S.K.Singh, Ram Prasad Publications
<b>Reference Books:</b>	
1	David C. Lay, Linear Algebra And Its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007
2	G.B. Thomas And R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005
3	C.V.Durell And A. Robson, Advanced Trigonometry, Courier Corporation, 2003
4	J.Stewart, L. Redlin, And S. Watson, Algebra And Trigonometry, Cengage Learning, 2012.
5	Calculus And Analytical Geometry, G.B. Thomas And R. L. Finny, Pearson Publication, 9th Edition, 2010.
<b>Web resources:</b>	
1	<a href="https://nptel.ac.in/">https://nptel.ac.in/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	3	3	2	3	3	2	2	3	2
<b>CO2</b>	3	3	2	3	2	3	2	2	2	3	2
<b>CO3</b>	3	2	2	3	2	3	3	3	2	2	2
<b>CO4</b>	3	3	3	2	3	3	2	2	3	3	3
<b>CO5</b>	3	2	3	2	3	2	3	3	3	2	3
<b>Total</b>	15	13	13	13	12	14	13	12	12	13	12
<b>Average</b>	3	2.6	2.6	2.6	2.4	2.8	2.6	2.4	2.4	2.6	2.4

**3 – Strong, 2- Medium, 1- Low**

**1<sup>st</sup> YEAR: FIRST SEMESTER**

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC12	Differential Calculus	Core Course 2	2	1	2	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	The basic skills of successive differentiation and their applications.										
LO2	To know about Partial Differentiation										
LO3	To gain Knowledge on Maxima and Minima of functions of two variables										
LO4	To originate Method of finding the Envelope										
LO5	Basic concepts on curvature and evolutes										
Unit	Content										Hours
1	<b>Successive Differentiation:</b> Introduction (Review of basic concepts) – The $n^{th}$ derivative – Standard results– Fractional expressions - Trigonometrical Transformation – Formation of equations involving derivatives – Leibnitz formula for the derivative of a product – Feynman’s method of differentiation										15
2	<b>Partial Differentiation:</b> Partial derivatives – Successive partial derivatives – Function of a functionrule – Total differential coefficient – A special case – Implicit Functions.										15
3	<b>Partial Differentiation (Continued):</b> Homogeneous functions – Partial derivatives of a function of two variables – Maxima and Minima of functions of two variables - Lagrange’s method of undetermined multipliers.										15
4	<b>Envelope:</b> Method of finding the envelope –Another definition of envelope– Envelope of family of curves which are quadratic in the parameter.										15
5	<b>Curvature:</b> Definition of Curvature – Circle, Radius and Centre of Curvature –Evolutes and Involute – Radius of Curvature in Polar Co-ordinates.										15

CO	Course Outcomes
CO1	To find the $n^{th}$ derivative, form equations involving derivatives and apply Leibnitz formula
CO2	To find the partial derivative and total derivative coefficient
CO3	To Determine maxima and minima of functions of two variables and to use the Lagrange’s method of undetermined multipliers

CO4	To Find the envelope of a given family of curves
CO5	To Find the evolutes and involutes and radius of curvature using polar coordinates
<b>Textbooks:</b>	
1	Calculus Volume –I, S. Narayan M.A , Retaired Professor Department of Mathematics (U.G.C), Vivekananda College , Madras, T.K. Manicavachagom Pillay , M.A., L.T., Retired Professor, Department of Mathematics, A.G. College of Techonology Guindy, Madras, S. Viswanathan (Printers & Publishers) Chennai.
2	H. Anton, i. Birens and s. Davis, calculus, john wiley and sons, inc., 2002.
3	Differential Calculus , Published by Discovery Publishing House, New Delhi
4	M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P.Ltd. (Pearson Education), Delhi, 2007.
5	Shanti Narayan, Formerly , Dean of College – Delhi University , Delhi and Principal , Hans Raj College, Delhi, Revised by ,D.R. P.K. Mittal M.Sc.,Ph.D ,Head of the Mathematics Department. Govt. Post Graduate College Rishikesh (Uttaranchal) , S Chand and Company Limited
<b>Reference Books:</b>	
1	R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.
2	T. Apostol, Calculus, Volumes I and II.
3	S. Goldberg, Calculus and mathematical analysis.
4	G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2010.
5	Differential Calculus by N P Bali, Lakshmi Publishers
<b>Web resources:</b>	
1	<a href="https://nptel.ac.in/">https://nptel.ac.in/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	3	3	3	3	3	2	2	2	3
<b>CO2</b>	3	3	2	3	3	3	2	2	2	2	3
<b>CO3</b>	3	2	2	3	2	3	3	3	2	2	2
<b>CO4</b>	3	3	3	2	2	3	2	2	2	3	3
<b>CO5</b>	3	2	3	2	3	2	3	3	3	3	2
<b>Total</b>	15	13	13	13	13	14	13	12	11	12	13
<b>Average</b>	3	2.6	2.6	2.6	2.6	2.8	2.6	2.4	2.2	2.4	2.6

3 – Strong, 2- Medium, 1- Low

**1<sup>st</sup> YEAR: FIRST SEMESTER**

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAA11	Numerical Methods-I	Elective Core	2	1	1	0	3	4	25	75	100
<b>Learning Objectives</b>											
LO1	To know the methods of solving Algebraic and Transcendental Equations										
LO2	To acquire knowledge on solving simultaneous linear equations.										
LO3	Knowledge about central difference operators										
LO4	To acquire knowledge about Interpolation										
LO5	To study Newton's divided difference formula and problems based on Lagrange's interpolation formula.										
Unit	Content										Hours
1	Solutions of Algebraic and Transcendental Equations: Bisection Method- Iteration Method- Regula-Falsi Method-Newton-Raphson Method. Chapter 1 : Section 1.1 to 1.4										12
2	Solutions of Simultaneous Linear Equations: Gauss-Elimination Method, Gauss-Jordan Method, Gauss Jacobi Method, Gauss Seidel Method. Chapter 2 :Section 2.1 to 2.3										12
3	Finite Differences: E Operators and Relation between them - Differences of Polynomial-Factorial Polynomials. Chapter 3 :Section 3.1 to 3.4										12
4	Interpolation with Equal Intervals: Newton's Forward and Backward Interpolation formulae. Central Differences Formulae: Gauss-Forward and Backward Formulae - Stirling's Formula and Bessel's Formula. Chapter 4 :Section 4.1 to 4.3 (omit 4.1a) Chapter 5 :Section 5.1 to 5.6										12
5	Interpolation with Unequal Intervals: Divided Differences - Newton's Divided Differences Formula for Interpolation -Lagrange's Formula for Interpolation-Inverse Interpolation-Lagrange's method. Chapter 6 :Section 6.1, 6.2, 6.5 & 6.7										12

CO	Course Outcomes
CO1	After studied unit -1, the student will be able to solve Iteration method- Regula-falsi method-Newton-Raphson method.
CO2	After studied unit -2, the student will be able to calculate interpolation values by applying Gauss-Elimination method, Gauss-Jordan method.
CO3	After studied unit -3, the student will be able to calculate Differences of a polynomial, Factorial polynomials.
CO4	After studied unit -4, the student will be able to estimate Central Differences Formulae.

CO5	After studied unit -5, the student will be able to estimate the interpolation value for unequal intervals based on Divided Difference formula and Lagrange's formula of interpolation.
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**Textbooks:**

1	P.Kandasamy, K.Thilagavathy (2003) Calculus of Finite differences & Numerical Analysis,S. Chand & Company Ltd., New Delhi-55.
2	Kandasamy. P, Thilagavathi. K and Gunavathi. K “Numerical methods” – S. Chand and Company Ltd, New Delhi – Revised Edition 2007.
3	Numerical Methods, G.Balaji, HOD, Department of Maths , Thangevelu Engineering College Chennai ,June 2009, G.Balaji Publisher,Chennai-33
4	Finite Difference and Numerical Analysis, H.C. Saxena, Former Senior Lectures, Department of Maths, Ramjas College, Delhi University, Delhi,2000, S.chand &Company Ltd., New delhi -110055
5	Numerical Methods in Science and Engineering , Dr. M.K. Venkataraman, M.A., M.Tech.,Ph.D, Retires Proffessor of Mathematics, Alagappa Chettigar College of Engineering and Techonology, Karaikudi, 2007 ,The National Publishing Company , Chennai

**Reference Books:**

1	H.C. Saxena. (1991) Finite differences and Numerical analysis S.Chand& Co., Delhi
2	M.K. Venkataraman. (1992) Numerical methods for Science and Engineering National Publishing Company, Chennai.
3	Sankara Rao K., “Numerical Methods for Scientists and Engineers” 2nd Edition Prentice Hall India 2004.
4	Numerical Analysis, Dr. B.SW. Goel, Senior Deputy director, Institute of productivity and Management Ghaziabad, Dr.S.K. Mittal , Department of Maths, M. M. College , Modinagar (Meerut University)1993, Chand offset Printer, Chennai
5	Venkataraman M. K.,”Numerical Methods in Science and Engineering” National Publishing company V Edition 1999

**Web resources:**

1	<a href="https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/">https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/</a>
2	<a href="https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/">https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/</a>

**Mapping with Programme Outcomes and Programme Specific Outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	3	3	3	3	3	2	2	3	2
<b>CO2</b>	3	3	2	3	3	3	2	2	2	3	2
<b>CO3</b>	3	2	2	3	2	3	3	3	2	2	2
<b>CO4</b>	3	3	3	2	2	3	2	2	3	3	2
<b>CO5</b>	3	2	3	2	3	2	3	3	3	2	3
<b>Total</b>	15	13	13	13	13	14	13	12	12	13	11
<b>Average</b>	3	2.6	2.6	2.6	2.6	2.8	2.6	2.4	2.4	2.6	2.2

**3 – Strong, 2- Medium, 1- Low**

### 1<sup>st</sup> YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAS13	Mathematics for Competitive Examinations	Skill Enhancement Course 2	1	0	1	0	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	To study on number system.										
LO2	To answer real life simple problems by using HCF and LCM.										
LO3	To know about the correct sequence on mathematical expressions.										
LO4	To acquire knowledge in solving the problems involving square roots, cube roots and average										
LO5	To carry out the problems related to age and Indices										
Unit	Content										Hours
1	Number System.										6
2	H.C.F and L.C.M of numbers.										6
3	Decimal Fractions, Simplification.										6
4	Averages, Percentage.										6
5	Problems on numbers, Problems on Age.										6

CO	Course Outcomes
CO1	To Solve Mathematical Problems using Mathematical formulae.
CO2	To Understand the knowledge of application of Mathematics
CO3	To Understand the concepts of simplification.
CO4	To Calculate the square root and cube root.
CO5	To Solve the problems on age
<b>Textbooks:</b>	
1	R.S. Aggarwal [2017], Quantitative Aptitude for Competitive Examinations, S. Chand and Company, New Delhi. Chapters11-13, 18, 19, 22, 23.
2	Quantitative Aptitude Quantum CAT Common Admission Tests for Admission into IIMs by Sarvesh K. Verma - Arihant
3	The Pearson Guide to Quantitative Aptitude for Competitive Examinations by Dinesh Khattar - Pearson
4	How to Prepare for Quantitative Aptitude for CAT by Arun Sharma - Tata McGraw Hill
5	Quantitative Aptitude for the CAT by Nishit K Sinha - Pearson
<b>Reference Books:</b>	
1	Praveen R.V, Quantitative Aptitude and reasoning, PHIL earning Pvt, New Delhi

2	Abhijit Guha-Quantitative Aptitude for Competitive Examinations-6 <sup>th</sup> Edition-Mc Graw Hill Education Pvt Ltd, Chennai
3	U. Mohan Rao-Quantitative Aptitude for Competitive Examinations-Scitech Publications Pvt Ltd, Chennai.
4	Arun Sharma-Teach Yourself Quantitative Aptitude- Mc Graw Hill Education Pvt Ltd, Chennai-second Edition
5	Rapid Quantitative Aptitude-Er.Deepak Agarwal, Mr. D. P. Gupta –Disha Nursing Ambitions
<b>Web resources:</b>	
1	<a href="https://guides.lib.uni.edu/oer">https://guides.lib.uni.edu/oer</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	2	3	3	2	3	3	2	2	2
<b>CO2</b>	2	3	3	2	2	3	2	2	2	3	3
<b>CO3</b>	3	3	2	3	3	2	3	3	2	3	2
<b>CO4</b>	3	2	3	3	3	3	3	3	3	2	3
<b>CO5</b>	3	3	3	2	3	3	2	1	2	3	3
<b>Total</b>	14	13	13	13	14	13	13	12	11	13	13
<b>Average</b>	2.8	2.6	2.6	2.6	2.8	2.6	2.6	2.4	2.2	2.6	2.6

**3 – Strong, 2- Medium, 1- Low**

**1<sup>st</sup> YEAR: FIRST SEMESTER**

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAF11	Bridge Mathematics	Foundation Course	1	1	0	0	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	Basic concepts on Algebra										
LO2	To know about Sequence and Series										
LO3	To study on Permutations and combinations										
LO4	To acquire knowledge on trigonometric ratios										
LO5	To gain knowledge on Calculus										
Unit	Content										Hours
1	Algebra: Binomial theorem, General term, middle term, problems based on these concepts.										6
2	Sequences and series principle of counting, Factorial n.										6
3	Permutations and combinations, Derivation of formulae and their connections, simple applications, combinations with repetitions, arrangements within groups, formation of groups										6
4	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										6
5	Calculus: Limits, standard formulae and problems, differentiation, first Principle, uv rule, u/v rule, methods of differentiation, application of derivatives, integration- product rule and substitution method.										6

CO	Course Outcomes
CO1	To Prove the binomial theorem and apply it to find the expansions of any $(X + Y)^n$ and also, solve the related problems
CO2	To Find the various sequences and series and solve the problems related to them. Explain the principle of counting.
CO3	To Find the number of permutations and combinations in different cases. Apply the principle of counting to solve the problems on permutations and combinations
CO4	To Explain various trigonometric ratios and find them for different angles, including sum of the angles, multiple and sub multiple angles, etc. Also, they can solve the problems using the transformations.

CO5	To 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.
<b>Textbooks:</b>	
1	NCERT class XI textbooks.
2	NCERT class XII textbooks.
3	Any State Board Mathematics textbooks of class XI
4	Any State Board Mathematics textbooks of class XII
5	Bridge course in Mathematics, Part-1, Edited by R. S. Sharma (IIT Delhi)
<b>Reference Books:</b>	
1	Algebra, Volume I, T. K. Manicavachagom Pillay, T. Natarajan, K S Ganapathy, S. Viswanathan printers and Publishers, PVT, LTD, 2008
2	Trigonometry, S. Narayanan, T. K. Manicavachagom Pillay, S. Viswanathan printers and Publishers, PVT, LTD, 2008
3	S. Goldberg, Calculus and mathematical analysis.
4	Algebra, Volume II, T. K. Manicavachagom Pillay, T. Natarajan, K S Ganapathy, S. Viswanathan printers and Publishers, PVT, LTD, 2008
5	T. Apostol, Calculus, Volumes I and II.
<b>Web resources:</b>	
1	<a href="https://nptel.ac.in/">https://nptel.ac.in/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	2	2	3	2	3	3	2	2	2
<b>CO2</b>	2	3	3	2	2	3	2	2	2	3	2
<b>CO3</b>	3	3	2	2	3	2	3	3	2	3	2
<b>CO4</b>	3	2	3	2	3	3	3	3	3	2	2
<b>CO5</b>	3	3	3	3	3	3	2	1	2	3	3
<b>Total</b>	14	13	13	11	14	13	13	12	11	13	11
<b>Average</b>	2.8	2.6	2.6	2.2	2.8	2.6	2.6	2.4	2.2	2.6	2.2

3 – Strong, 2- Medium, 1- Low

**1<sup>st</sup> YEAR: SECOND SEMESTER**

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC21	Integral Calculus	Core Course 3	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To develop knowledge on integration and trigonometric functions										
LO2	To evaluate double integrals in Cartesian and polar coordinates										
LO3	To Understand the concept of triple integrals										
LO4	To learn about Beta and Gamma functions										
LO5	To acquire knowledge on the Applications of Integral Calculus										
Unit	Content										Hours
1	<b>Reduction formulae</b> Bernoulli's formula – Reduction Formulae – Solved Problems <b>Chapter 11: Page No : 11.1-11.32</b>										15
2	<b>Multiple Integrals</b> Definition of double integrals - Evaluation of double integrals – double integrals in polar coordinates – Change of order of Integration. <b>Chapter 17: Page No.: 17.1 – 17.17,17.22 – 17.32</b>										15
3	<b>Multiple Integrals (Continuation)</b> Definition of Triple integral - Evaluation of Triple integral - Applications of double and Triple integral. <b>Chapter 17: Page No: 17.18 – 17.22 to 17.33 – 17.43</b>										15
4	<b>Beta and Gamma functions</b> Definitions - Properties of Beta and Gamma functions - Relation between Beta and Gamma functions – Finite and Infinite integral of Beta and Gamma functions <b>Chapter 13: Page No: 13.1 – 13.30</b>										15
5	<b>Geometrical Applications of Integral calculus</b> Area under plane curves - Volume of solid of revolution - Length of an arc of a curve - Area of surface of revolution – Applications – Simple Problem <b>Chapter 21 - 24</b>										15

CO	Course Outcomes
CO1	Determine the integrals of algebraic, trigonometric and logarithmic functions and to find the reduction formulae
CO2	Learn double integrals and problems using change of order of integration
CO3	Solve multiple integrals and to find the areas of curved surfaces and volumes of solids of revolution
CO4	Know beta and gamma functions and to use them in solving problems of integration.
CO5	Understand Geometric and Physical applications of integral calculus
<b>Textbooks:</b>	
1	Dr.P .R. Vittal, V.Malini, Calculus, Margam Publications 2012, Chennai ( Unit 1 - 4)
2	Dr.P .R. Vittal, Mathematical Foundations, Margam Publications 2011, Chennai ( Unit 5)
<b>Reference Books:</b>	
1	H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002
2	G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007
3	D. Chatterjee, Integral Calculus and Differential Equations, Tata- McGraw Hill Publishing Company Ltd.
4	Dr.P.R. Vittal, Mathematical Foundations, Margam Publications, Chennai
5	A.K.Sharma, Text Book of Integral Calculus, Discovery Publishing House, 2005
<b>Web resources:</b>	
1	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	2	3	3	3	2	3	2	3	2
<b>CO2</b>	2	3	3	3	3	2	2	3	2	3	3
<b>CO3</b>	3	3	2	3	3	3	2	3	2	3	2
<b>CO4</b>	2	3	2	3	3	2	2	3	2	3	2
<b>CO5</b>	3	2	3	3	3	3	2	3	2	2	3
<b>Total</b>	13	14	12	15	15	13	10	15	10	14	12
<b>Average</b>	2.6	2.8	2.4	3	3	2.6	2	3	2	2.8	2.4

3 – Strong, 2- Medium, 1- Low

**1<sup>st</sup> YEAR: SECOND SEMESTER**

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks			
									CIA	External	Total	
24UMAC22	Analytical Geometry	Core Corse 4	3	1	3 <sub>1</sub>	0	4	5	1	25	75	100 <sup>1</sup>
<b>Learning Objectives</b>												
LO1	To understand and apply the concept of homogeneous equations of second degree to represent straight lines in different forms											
LO2	To derive polar equations for straight lines, circles, and conic sections and analyze their geometric properties											
LO3	To formulate general equations of planes, calculate angles between two planes, and determine plane equation through intersection of two planes											
LO4	To calculate the angle between a line and a plane and analyze coplanar and skew lines											
LO5	To originate equation of sphere, determine length of tangent and analyze plane section of sphere											
Unit	Content											Hours
1	<b>Pair of Straight lines:</b> Introduction – Homogeneous equation of second degree - Condition for a second - degree equation to represent a pair of straight lines – Angle between the lines. <b>Chapter III Pages: 68-88</b>											15
2	<b>Polar Equations:</b> Introduction – Definition of polar coordinates – Transformation of polar coordinates and Cartesian coordinates – Equation of a straight line – Circle and its applications – Polar equation of a conic <b>Chapter IX Pages: 325-340</b>											15
3	<b>Plane:</b> Introduction – General equation of plane – Angle between two planes – Plane passing through: Three given points, Intersection of two given planes - Length of perpendicular <b>Chapter II Pages :24-40</b>											15
4	<b>Straight Line:</b> Introduction – Equations of straight Lines – The plane and the straight line - Angle between a line and plane – Applications on Coplanar lines and Skew lines <b>Chapter III Pages :46-75</b>											15
5	<b>Sphere:</b> Equation of sphere – Length of the tangent – Section of a sphere – Equation of circle – Intersection of two spheres - Tangent plane. <b>Chapter IV Pages :92-114</b>											15

CO	Course Outcomes
CO1	Understand and apply the concept of homogeneous equations of second degree to represent straight lines in different forms.
CO2	Derive polar equations for straight lines, circles, and conic sections, and analyze their geometric properties
CO3	Formulate general equations of planes, calculate angles between two planes, and determine the plane equation through intersection of planes.
CO4	Calculate the angle between a line and a plane and analyze coplanar and skew lines.
CO5	Formulate equations of sphere, determine length of tangent, and analyze plane section of sphere.
<b>Textbooks:</b>	
1	T.K. Manicavachagom Pillay & T. Natarajan, Analytical Geometry of Two dimensions, S. Viswanathan (Printers & Publishers) Pvt Ltd, Chennai(2007) (Unit 1 & 2)
2	T.K. Manicavachagom Pillay & T. Natarajan, Analytical Geometry of Three dimensions, S. Viswanathan(Printers & Publishers) Pvt Ltd, Chennai (2007) (Unit 3,4 & 5)
<b>Reference Books:</b>	
1	P.R.Vittal(2023), Analytical Geometry 2D and 3D, Pearson Publications, Chennai.
2	Shanti Narayan, Analytical Solid Geometry, S. Chand Publications, New Delhi.
3	P.Duraipandian and Laxmi Duraipandian, Analytical Geometry Two dimensions, Emerald Publication.
4	P. Duraipandian and Kayalal Pachaiyappa(2009), Analytical Geometry 3D, Muhil Publishers, Revised Edition.
5	P.R.Vittal (2003) Coordinate Geometry. Margham Publishers, Chennai.
<b>Web resources:</b>	
1	<a href="https://mathworld.wolfram.com/">https://mathworld.wolfram.com/</a>
2	<a href="http://www.univie.ac.at/future.media/moe/galerie.html/">http://www.univie.ac.at/future.media/moe/galerie.html/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO2	3	3	3	3	2	3	3	3	3	2	3
CO3	3	3	3	3	2	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	3	3	3	3	2	3	2	3
<b>Total</b>	15	15	15	15	12	15	15	14	15	10	15
<b>Average</b>	3	3	3	3	2.4	3	3	2.8	3	2	3
CO2	3	3	3	3	2	3	3	3	3	2	3

3 – Strong, 2- Medium, 1- Lo

**1<sup>st</sup> YEAR: SECOND SEMESTER**

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAA21	Numerical Methods II	Elective Course 2	3	1	0	0	3	4	25	75	100
<b>Learning Objectives</b>											
LO1	To evaluate derivatives using Newton's Forward and Backward Difference Formulae										
LO2	To acquire the knowledge about evaluation of numerical integration										
LO3	To evaluate the solution of linear homogeneous and non- homogeneous difference equations with constant coefficients										
LO4	To obtain numerical solutions to the ordinary differential equations by Taylor's series method- Picard's method										
LO5	To acquire the knowledge on Euler's and Modified Euler's Method -Runge-Kutta Method										
Unit	Content										Hours
1	<b>Numerical Differentiation:</b> Derivatives using Newton's Forward and Backward Difference Formulae- Derivatives using Stirling's Formula- Derivatives using Divided Difference Formula- Maxima and Minima using the above Formulae <b>Chapter 7: Section 7.1 to 7.4 , 7.6</b>										12
2	<b>Numerical Integration:</b> Introduction - General Quadrature formula -Trapezoidal Rule-Simpson's One-Third Rule - Simpson's Three-EighthRule-Application <b>Chapter 7: Section 7.7- 7.9 , 7.13- 7.14</b>										12
3	<b>Difference Equations:</b> Linear Homogenous and Non-Homogenous Difference Equation with constant coefficients- Simple problem <b>Chapter 8: Section 8.1 - 8.4 , 8.6</b>										12
4	<b>Numerical solution of Ordinary Differential Equations (I order only):</b> Taylor's series method and its application- Picard's method <b>Chapter 9: Section 9.5 - 9.6</b>										12
5	<b>Numerical Solution of Ordinary Differential Equations (I order only):</b> Euler's Method - Modified Euler's Method - Runge - Kutta Method (Fourth Order only). <b>Chapter 9: Section 9.7,9.9 - 9.11</b>										12

CO	Course Outcomes
CO1	Compute derivatives using numerical differentiation methods
CO2	Understand numerical integration using various methods
CO3	Evaluate linear homogeneous and non- homogeneous difference equations with constant coefficients
CO4	Derive numerical solutions to the ordinary differential equations by Taylor's series method- Picard's method
CO5	Estimate approximate numerical solutions of ordinary differential equations by Euler, Modified Euler's and Runge - Kutta methods
<b>Textbooks:</b>	
1	P.Kandasamy and K.Thilagavathy, Calculus of Finite differences & Numerical Analysis, S.Chand & Company Ltd., New Delhi, 2003.
<b>Reference Books:</b>	
1	Venkataraman M. K, Numerical Methods in Science and Engineering, National Publishing Company V Edition 199
2	S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice, Hall of India, New Delhi
3	H.C.Saxena, Finite Difference and Numerical Analysis, Delhi, 2000, S.Chand & amp, Company ltd, New delhi-110055
4	Sankara Rao K, Numerical Methods for Scientists and Engineers, 2nd Edition Prentice Hall India 2004.
5	B.D.Gupta ,Numerical Analysis, Konark Pub.Ltd, Delhi, 2001.
<b>Web resources:</b>	
1	<a href="https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/">https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/</a>
2	<a href="https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/">https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	3	3	2	2	3	3	3	3	2
<b>CO2</b>	3	3	2	2	3	3	3	3	2	2	3
<b>CO3</b>	3	2	2	3	2	2	3	3	2	3	2
<b>CO4</b>	2	3	2	3	2	2	3	3	2	3	2
<b>CO5</b>	3	2	2	2	3	2	3	2	2	2	3
<b>Total</b>	14	13	11	13	12	11	15	14	11	13	12
<b>Average</b>	2.8	2.6	2.2	2.6	2.4	2.2	3	2.8	2.2	2.6	2.4

**3 – Strong, 2- Medium, 1- Low**

### 1<sup>st</sup> YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAA21	Applied Numerical Methods I & II Practical Using Python	Elective Course 3	1	0	1	0	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	To understand the concepts of derivatives using Newton's methods										
LO2	To acquire the knowledge on Gauss -Elimination, Jacobi and Seidel method.										
LO3	To obtain the solution of finite differences using Newton's forward and backward differences formulae										
LO4	To understand the method of Lagrange interpolation, Trapezoidal and one-Third rules.										
LO5	To acquire the knowledge on Picard's Method, Euler's and Runge- Kutta Method.										
	<b>List of Problems</b>										<b>Hours</b>
	1. Bisection methods. 2. Gauss Elimination method. 3. Gauss-Jacobi method. 4. Gauss-Seidal method. 5. Newton's forward and backward interpolation 6. Lagrange interpolation. 7. Trapezoidal rule. 8. Simpson one-third rules. 9. Euler's method. 10. Runge-Kutta's method.										12

CO	Course Outcomes
CO1	Interpret Newton's method using python
CO2	Understanding the concepts of Gauss -Elimination, Jacobi and Seidal method using python
CO3	Learn to find the solution of finite differences using Newton's forward and backward interpolation formulae
CO4	Understanding the methods of Lagrange interpolation, Trapezoidal and One-Third rules
CO5	Estimate approximate numerical solutions of ordinary differential equations by Picard's, Euler and Runge-Kutta methods.
<b>Textbooks:</b>	
1	Python programming & Numerical Methods: A Guide for Engineers & Scientists – Qingkai Kong, Timmy Siau, Alexandre Bayen
<b>Reference Books:</b>	
1	Robert Johanson, Numerical Python: A Practical Techniques Approach for Industry, Apress online

<b>Web resources:</b>	
1	<a href="https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/">https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/</a>
2	<a href="https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/">https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	3	3	3	3	2	3	2	3	3	2	3
<b>CO2</b>	3	3	2	2	3	3	2	3	2	3	3
<b>CO3</b>	3	2	2	3	2	2	2	3	2	2	2
<b>CO4</b>	2	3	3	3	2	3	2	3	3	2	3
<b>CO5</b>	3	2	2	2	3	2	2	3	2	3	2
<b>Total</b>	14	13	14	13	12	13	10	15	14	12	13
<b>Average</b>	2.8	2.6	2.8	2.6	2.4	2.6	2	3	2.8	2.4	2.6

**3 – Strong, 2- Medium, 1- Low**

**1<sup>st</sup> YEAR: SECOND SEMESTER**

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAS21	Mathematics For Competitive Examinations-II	Skill Enhancement Course 3	1	0	1	0	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	To solve problems on time, work and distance using appropriate formulae										
LO2	To calculate simple and compound interest and to draw graphs										
LO3	To identify and calculate logical sequences										
LO4	To evaluate data sufficiency and understanding the concepts of decisions making										
LO5	To analyze and solve problems related to non-verbal reasoning										
Unit	Content										Hours
1	Time and work – Time and distance – Problems on Trains. <b>Chapters :15,17,18</b>										6
2	Simple Interest, Compound Interest– Bar Graph – Pie Charts– Line Graphs. <b>Chapters :21,22,37,38,39</b>										6
3	<b>Verbal Reasoning:</b> Logical Sequence of Words–Arithmetical Reasoning – Inserting the Missing Character. <b>Chapters: 14,15,16</b>										6
4	<b>Verbal Reasoning (Contd.):</b> Data Sufficiency – Assertion & Reason – Verification of Truth of the Statement. <b>Chapters :17,19,21</b>										6
5	<b>Non-Verbal Reasoning:</b> Mirror Images – Water Images– Grouping of identical Figures. <b>Chapters :5,6,13</b>										6

CO	Course Outcomes
CO1	Solve problems involving time, work, and distance using appropriate formulas
CO2	Calculate both simple and compound interest
CO3	Identify and calculate logical sequences, recognizing patterns
CO4	Evaluate data sufficiency and decisions making skills
CO5	Analyze and solve problems related to non-verbal reasoning
<b>Textbooks:</b>	
1	Dr. R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand and Company Ltd. 2010 (Unit 1 & 2)
	Dr. R.S. Aggarwal, A Modern Approach to Verbal and Nonverbal Reasoning, S. Chand, 2022 (Unit 3, 4 & 5)
<b>Reference Books:</b>	
1	R.V. Praveen, Quantitative Aptitude and Reasoning, Third Edition, PHIL earning Pvt, New Delhi
2	U. Mohan Rao, Quantitative Aptitude for competitive examinations, SciTech Publications Pvt Ltd, Chennai
<b>Web resources:</b>	
1	<a href="https://guides.lib.uni.edu/over">https://guides.lib.uni.edu/over</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO2	2	3	3	2	2	3	2	2	2	3	3
CO3	3	3	2	3	3	2	3	3	2	3	2
CO4	3	2	3	3	3	3	3	3	3	2	3
CO5	3	3	3	2	2	3	2	1	2	3	3
<b>Total</b>	14	13	13	13	14	13	13	12	11	13	13
<b>Average</b>	2.8	2.6	2.6	2.6	2.8	2.6	2.6	2.4	2.2	2.6	2.6
CO2	2	3	3	2	2	3	2	2	2	3	3

**3 – Strong, 2- Medium, 1- Low**

## II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC31	Differential Equations	Core Course-5	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To understand the methods for solving first-order differential equations, including exact equations.										
LO2	To apply appropriate techniques to determine particular integrals for algebraic, exponential, and trigonometric functions.										
LO3	To recall the fundamental concepts of simultaneous linear differential equations and second-order linear equations.										
LO4	To understand the process of forming PDEs by eliminating arbitrary constants and arbitrary functions										
LO5	To create solutions for complex PDEs by implementing Charpit's methods.										
Unit	Content										Hours
1	Ordinary Differential Equations: Introduction, Equations of the first order and of the first degree: Variable Separable- Homogeneous Equations- Non-Homogeneous Equations of first degree in two variables- Linear Equation- Bernoulli's Equation- Exact differential equations – Problems. <b>Chapter I : Sections 1 - 3, Chapter II: Sections 1 - 6.3</b>										15
2	Equation of first order but of higher degree: Equations solvable for $dy/dx$ - Equations solvable for $y$ - Equations solvable for $x$ - Clairaut's form-Problems. Linear Equations with constant coefficients: Definitions-Particular integrals of algebraic, exponential, trigonometric functions and their products. <b>Chapter IV: Sections:1-3.1</b> <b>Chapter V: Sections: 1- 4</b>										15
3	Simultaneous linear differential equations- Linear Equations of the Second Order: Complete solution in terms of a known integral-Reduction to the normal form- Change of the independent variable- Variation of Parameters and its applications. <b>Chapter VI : Section: 6</b> <b>Chapter VIII: Sections: 1- 4</b>										15
4	Partial differential equations of the first order: Introduction- Classification of Integrals-Derivation of PDE by eliminating arbitrary constants and arbitrary functions – Lagrange's method of solving linear Equation –Simple Applications. <b>Chapter XII: Sections: 1- 4</b>										15
5	Partial differential equations of the first order(continuation): Special methods – Standard forms - Charpit's Method –Applications. <b>Chapter XII: Sections: 5 and 6</b>										15
<b>Total</b>										75	
<b>Theory-20% Problem-80%</b>											

CO	Course Outcomes
	<b>The student will be able to</b>
CO1	Determine solutions of homogeneous equations, non-homogeneous equations of degree one in two variables.
CO2	Solve the solutions of equations of first order but not of higher degree and to Determine particular integrals of algebraic, exponential, trigonometric functions.
CO3	Find solutions of simultaneous linear differential equations.
CO4	Form a PDE by eliminating arbitrary constants and arbitrary functions.
CO5	Illustrate standard forms and Differential equations using Charpit's method
<b>Textbooks:</b>	
1	S.Narayanan and T.K. Manickavachagom Pillay, Differential Equations and its Applications, S. Viswanathan Printers and Publishers Pvt. Ltd, 2007.
<b>Reference Books:</b>	
1	T.K.Manicavachagom Pillay, T.Natarajan, K.S. Ganapathy, Calculus Volume-III, S. Viswanathan Printers and Publishers Pvt. Ltd, 2012.
2	Dr.P.R.Vittal, Differential Equations, Fourier and Laplace Transforms, Margham Publications, Chennai, 1998.
3	V. Sundrapandian, Ordinary and Partial Differential Equations, Tata McGraw Hill Education Pvt.Ltd. New Delhi, 2013
4	H.T. H.Piaggio, Elementary Treaties on Differential Equations and their applications, C.B.S Publisher & Distributors, Delhi,1985.
5	Boyce, W.E. and R.C.DiPrima. Elementary Differential Equations and Boundary Value Problems. (7th Edn.) John Wiley and Sons, Inc., New York. 2001
<b>Web resources:</b>	
1	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	3	2	1	2	2	1	3	2	2
<b>CO2</b>	3	2	3	2	1	2	3	1	3	2	2
<b>CO3</b>	3	1	3	2	1	1	2	2	3	3	2
<b>CO4</b>	3	3	3	2	2	2	2	2	3	3	2
<b>CO5</b>	3	3	3	2	2	2	1	2	3	3	2
<b>Total</b>	15	12	15	10	7	9	10	8	15	13	10
<b>Average</b>	3	2.4	3	2	1.4	1.8	2	1.6	3	2.6	2

**3 – Strong, 2- Medium, 1- Low**

## II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC32	Optimization Techniques	Core Course-6	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To develop the skill on formulation of LPP.										
LO2	To solve Transportation and Assignment problems.										
LO3	To study optimization sequencing problems.										
LO4	To describe inventory control methods										
LO5	To acquire knowledge on construction of Network										
Unit	Content										Hours
1	<b>Linear Programming Problem</b> Introduction-Concept of Linear Programming Model-Development of LP Models-Graphical Method- Linear Programming Methods (Simplex Method only)-Duality <b>Chapter 2: Sections 2.1 - 2.5(2.5.1only), 2.7(2.7.1,2.7.2)</b>										15
2	<b>Transportation Problem</b> Introduction- Mathematical Model for Transportation Problem- Types of Transportation Problem-Methods to Solve Transportation Problem. Assignment Problem: Introduction-Types of Assignment Problem- Hungarian Method. <b>Chapter 3: Sections: 3.1-3.4; Chapter 4: Sections: 4.1-4.4</b>										15
3	<b>Sequencing Problem</b> Introduction-Problems with n jobs through 2 machines - Problems with n jobs through 3 machines- Problems with n jobs through k machines. <b>Chapter: 12 (12.1-12.6)</b>										15
4	<b>Inventory Control</b> Inventory Control: Introduction- Cost associated with inventories-Factors affecting Inventory Control- Deterministic Inventory Problems with and without shortages- Probabilistic Inventory Problems. <b>Chapter 19: Sections: 19.1 to 19.7, 19.12.</b>										15
5	<b>Network Scheduling by PERT/CPM</b> Introduction- Network and Basic Components-Logical Sequencing- Rules of Network Construction- Critical Path Method (CPM)- Programme Evaluation and Review Technique (PERT) <b>Chapter: 21</b>										15
	<b>Total</b>										75
<b>Theory-20% Problem-80%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	<b>The student will be able to</b>
CO1	Understand and apply the concepts involved in solving linear programming problems
CO2	Work on mathematical techniques to optimize transportation and assignment problems.
CO3	Solve sequencing problems.
CO4	Work on inventory management and control models.
CO5	Utilize mathematical techniques for project scheduling, networking, and time-based probability analysis.
<b>Textbooks:</b>	
1	R. Panner selvam, Operations Research, Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008. (Unit I and Unit II)
2	Kanti Swarup, P. K. Gupta, Man Mohan, Operations Research –Sultan Chand & Sons, New Delhi- Reprint 2006. (Unit III, Unit IV and Unit V)
<b>Reference Books:</b>	
1	J. K. Sharma, Operations Research Theory & Applications – Trinity Press, India, Sixth edition, 2016
2	Hamdy A. Taha, Operations Research – An Introduction, Pearson, Seventh edition, 2014.
3	P. K Gupta, Problems in Operations Research, 2-e, S. Chand & Sons, New Delhi, 1983
4	S. Kalavathy, Operations Research – Vikas Publishing House Pvt. Ltd., 4th Edition, Second Reprint 2018
5	P.R.Vittal, V.Malini, Operations Research, Margham Publications, Chennai, 2002

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	2	3	2	3	3	3	3	3	3	3	2
<b>CO2</b>	3	3	2	2	2	3	2	2	2	2	2
<b>CO3</b>	3	2	2	2	3	3	2	3	3	2	2
<b>CO4</b>	3	3	2	3	3	3	2	3	3	3	2
<b>CO5</b>	3	2	2	3	3	2	2	3	3	2	2
<b>Total</b>	14	13	10	13	14	14	11	14	14	12	10
<b>Average</b>	2.8	2.6	2	2.6	2.8	2.8	2.2	2.8	2.8	2.4	2

**3 – Strong, 2- Medium, 1- Low**

## II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAA31	Mathematical Statistics I	Elective Course - 4	3	1	0	0	3	4	25	75	100
<b>Learning Objectives</b>											
LO1	To understand the basic concepts of random variables and its types.										
LO2	To apply expectation properties in statistical problems.										
LO3	To study on cumulants in probability theory.										
LO4	To acquire knowledge on discrete probability distributions.										
LO5	To describe the characteristics and applications of distribution function .										
Unit	Content										Hours
1	Random variables: Introduction -Distribution Function - Discrete random variable - Continuous random variable <b>Chapter: V Sections: 5.1-5.4.2</b>										12
2	Mathematical Expectation: Introduction - Expected value of function of a random variable – Properties of expectation -Properties of variance – Covariance <b>Chapter: VI Sections: 6.1-6.6</b>										12
3	Generating Functions: Moment generating function – Cumulants - Chebychev's inequality. <b>Chapter: VII Sections: 7.1,7.2 and 7.5</b>										12
4	Discrete probability distribution: Introduction (Bernoulli distribution)- Binomial distribution-Poisson distribution – Geometric distribution <b>Chapter VIII Sections: 8.1, 8.4(8.4.1-8.4.9), 8.4.12, 8.5(8.5.1- 8.5.7, 8.5.10) and 8.7</b>										12
5	Normal distribution: Introduction - Normal distribution - Gamma distribution - Exponential distribution. <b>Chapter IX: Sections: 9.1, 9.2 (9.2.1-9.2.10, 9.2.14), 9.5, 9.8</b>										12
	<b>Total</b>										60
<b>Theory-60% Problem-40%</b>											

CO	Course Outcomes
	<b>The student will be able to</b>
CO1	Identify, differentiate, and analyze discrete and continuous random variables.
CO2	Apply Mathematical expectation properties to solve statistical problems
CO3	Illustrate the cumulants in probability theory
CO4	Work on discrete distributions in statistical applications
CO5	Evaluate continuous distribution functions.
<b>Textbooks:</b>	
1	S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co, New Delhi, Reprint 2019.
<b>Reference Books:</b>	
1	P.R. Vittal, Mathematical statistics, Margham Publications, 2004.
2	J.N. Kapur & H.C. Saxena, Mathematical statistics, S.Chand & Company Ltd, 2010.
3	R.V. Hogg, J.W. McKean & A.T. Craig, Introduction to mathematical statistics, Pearson Education, India.
4	Murray R. Spiegel, Statistics, 2-e, McGraw Hill Book Company, New Delhi, 1992.
5	Richard A. Janson, Miller, Friends, Probability and statistics for engineers, 6-e Pearson Education Pvt. Ltd. Delhi, 2001
<b>Web resources:</b>	
1	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	2	2	2	1	2	3	3	2	2
<b>CO2</b>	3	3	2	2	2	1	2	3	3	2	2
<b>CO3</b>	3	2	2	2	2	2	2	3	3	2	2
<b>CO4</b>	3	3	2	2	3	2	3	3	3	2	3
<b>CO5</b>	3	3	3	2	2	2	2	3	3	2	2
<b>Total</b>	15	14	11	10	11	7	11	15	15	10	11
<b>Average</b>	3	2.8	2.2	2	2.2	1.4	2.2	3	3	2	2.2

**3–Strong, 2-Medium, 1-Low**

## II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAA31P	Mathematical Statistics -I Practical Using Excel	Elective-5	1	0	1	0	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	To describe MS Excel in measures of central tendency for different types of data sets.										
LO2	To utilize Excel functions to calculate geometric mean and harmonic mean.										
LO3	To analyze measures of dispersion by computing range and standard deviation using Excel										
LO4	To apply Excel tools to construct histograms and subdivided bar diagrams.										
LO5	To develop skills in constructing pie charts and frequency polygons using Excel for data representation										
	<b>Content</b>										<b>Hours</b>
	<ol style="list-style-type: none"> <li>1. Measures of Central Tendency for individual data (Mean, Median, Mode)</li> <li>2. Measures of Central Tendency for discrete data (Mean, Median, Mode)</li> <li>3. Measures of Central Tendency for Continuous data (Mean, Median, Mode)</li> <li>4. Measures of Central Tendency for individual data (Geometric Mean, Harmonic Mean)</li> <li>5. Measures of Central Tendency for discrete data (Geometric Mean, Harmonic Mean)</li> <li>6. Measures of Central Tendency for continuous data (Geometric Mean, Harmonic Mean)</li> <li>7. Measures of dispersion for Individual data</li> <li>8. Measures of dispersion for discrete data</li> <li>9. Measures of dispersion for Continuous data</li> <li>10. Graphical Presentation of data (Histogram, Subdivided bar diagram)</li> <li>11. Graphical Presentation of data (Pie chart)</li> <li>12. Graphical Presentation of data (Frequency polygon)</li> </ol>										6

CO	<b>Course Outcomes</b>
	<b>The student will be able to</b>
CO1	Explain the use of MS Excel in computing measures of central tendency for various types of data sets
CO2	Employ Excel functions in determining geometric mean and harmonic mean.
CO3	Compute and analyze measures of dispersion, including range and standard deviation, using Excel.
CO4	Interpret histograms and subdivided bar diagrams using Excel.
CO5	Design pie charts and frequency polygons in Excel for presenting the data.

<b>Textbooks:</b>	
1	Remenyi, D., Onofrei, G., & English, J. (2022). <i>An introduction to statistics using Microsoft Excel</i> . UJ Press.
2	Rayat, C. S., & Rayat, C. S. (2018). Applications of Microsoft Excel in statistical methods. <i>Statistical Methods in Medical Research</i> , 139-146.
3	Abbott, M. L. (2014). <i>Understanding educational statistics using Microsoft Excel and SPSS</i> . John Wiley & Sons
<b>Website and e-learning source</b>	
	<a href="https://real-statistics.com">https://real-statistics.com</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	3	3	2	2	2	1	1	3	3	2	2
<b>CO2</b>	3	3	2	2	2	1	1	3	3	2	2
<b>CO3</b>	3	2	2	2	2	2	1	3	3	2	2
<b>CO4</b>	3	3	2	2	3	2	1	3	3	2	2
<b>CO5</b>	3	3	3	2	2	2	1	3	3	2	3
<b>Total</b>	15	14	11	10	11	7	5	15	15	10	11
<b>Average</b>	3	2.8	2.2	2	2.2	1.4	1	3	3	2	2.2

**3 – Strong, 2- Medium, 1- Low**

## II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHA11	Allied Chemistry - I	Elective Course - 4	3	1	0	0	3	4	25	75	100
<b>Learning Objectives</b>											
LO1	To understand chemical bonding and nuclear chemistry.										
LO2	To know about the important materials used in industries.										
LO3	To understand the various fundamental concepts in organic chemistry										
LO4	To understand the various fundamental concepts in organic chemistry										
LO5	To understand separation and purification techniques.										
Unit	Content										Hours
1	<b>Chemical Bonding and Nuclear Chemistry:</b> Chemical Bonding: Molecular Orbital Theory-bonding, anti-bonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties. Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers.										12
2	<b>Industrial Chemistry:</b> Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones: Synthesis, properties and uses. Fertilizers: Urea, NPK fertilizer, superphosphate, triple superphosphate.										12
3	<b>Fundamental Concepts in Organic Chemistry:</b> Hybridization: Orbital overlap, hybridization and geometry of CH <sub>4</sub> , C <sub>2</sub> H <sub>4</sub> and C <sub>6</sub> H <sub>6</sub> . Electronic effects: Inductive effect, electromeric effect, mesomeric effect, hyper conjugation and steric effects - examples. Reaction mechanisms: Types of reactions – aromaticity (Huckel's rule) – aromatic electrophilic substitution: nitration, halogenation, Friedel-Craft's alkylation and acylation										12
4	<b>Thermodynamics and Phase Equilibria:</b> Thermodynamics: Types of systems, reversible and irreversible processes, Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine. Entropy and its significance. Relationship between Gibbs free energy and entropy, Gibb's-Helmholtz equation - derivation. Phase equilibria: Gibb's phase rule, terms involved, phase diagram of water system										12
5	<b>Analytical Chemistry:</b> Principles of volumetric analysis. Separation and purification techniques – extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography										12
<b>Total</b>										60	
<b>Theory - 100</b>											

CO	Course Outcomes
	<b>The student will be able to</b>
CO1	Gain in-depth knowledge about the theories of chemical bonding, nuclear reactions and its applications
CO2	Evaluate the efficiencies and uses of various fuels and fertilizers.
CO3	Explain the type of hybridization, electronic effect and mechanism involved in the organic reactions
CO4	Apply various thermodynamic principles, systems and phase rule.
CO5	Explain various methods to identify an appropriate method for the separation of chemical components.
<b>Textbooks:</b>	
1	Arun Bahl S. and Bahl B. S, "Advanced Organic Chemistry", S. Chand and Company, New Delhi, 23rd ed., 2012.
2	Soni P. L. and Chawla H. M, "Textbook of Organic Chemistry", Sultan Chand & Sons, New Delhi, 29th ed., 2007.
3	Gopalan R, "Analytical Chemistry", Sultan Chand & Sons, 2017.
4	Puri B. R, Sharma L. R. and Madan S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 48th ed., 2024.
5	Veeraiyan V. and Vaithyanathan S, "Textbook of Ancillary Chemistry", Priya Publications, Karur, 2006.
<b>Reference Books:</b>	
1	Soni P. L. and Mohan Katyal, "Textbook of Inorganic Chemistry", Sultan Chand & Sons, New Delhi, 20th ed., 2006.
2	Sharma B. K, "Industrial Chemistry", GOEL publishing House, Meerut, 16th ed., 2014.
3	Puri B. R. and Sharma L. R, "Textbook of Physical Chemistry", 47th ed., 2020.
4	Puri, Sharma, Pathania and Kaur, "Textbook of Physical Chemistry", Vishal Publishing Co., New Delhi, 2018
5	Veeraiyan V, "Textbook of Ancillary Chemistry", Priya Publications, Karur, 1sted., 2009.
<b>Web resources:</b>	
1	<a href="https://www.khanacademy.org/science/hs-chemistry/x2613d8165d88df5e:nuclearchemistry- hs">https://www.khanacademy.org/science/hs-chemistry/x2613d8165d88df5e:nuclearchemistry- hs</a>
2	<a href="https://pubs.acs.org/journal/enfuem">https://pubs.acs.org/journal/enfuem</a>
3	<a href="https://m.youtube.com/watch?v=8c4urO_h1Ds">https://m.youtube.com/watch?v=8c4urO_h1Ds</a>
4	<a href="https://www.energy.gov/nnsa/national-nuclear-security-administration">https://www.energy.gov/nnsa/national-nuclear-security-administration</a>
5	<a href="https://en.wikipedia.org/wiki/Molecular_orbital">https://en.wikipedia.org/wiki/Molecular_orbital</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	3	3	3	3	3	2	3	3	3
<b>CO2</b>	2	3	3	3	2	3	3	2	3	3	3
<b>CO3</b>	3	3	3	2	3	3	3	2	3	3	3
<b>CO4</b>	3	3	3	3	3	3	3	2	3	3	3
<b>CO5</b>	3	2	3	3	3	3	3	2	3	3	3
<b>Total</b>	14	14	15	14	14	15	15	10	15	15	15
<b>Average</b>	2.8	2.8	3.0	2.8	2.8	3.0	3.8	2.0	3.0	3.0	3.0

3-Strong, 2-Medium, 1-Low

## II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAA31P	Chemistry Practical for Physical and Biological Sciences - I	Elective-5	0	0	2	0	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	Demonstrate accurate use of volumetric glassware, including burettes, pipettes, and volumetric										
LO2	Differentiate between types of titrations (acid-base, redox, complexometric, and precipitation)										
LO3	Prepare standard solutions and perform standardization procedures to determine the exact										
LO4	Calculate the concentration of analytes from titration data using appropriate formulas and stoichiometric relationships										
LO5	Select suitable indicators for various types of titrations based on their pH range and the expected equivalence point.										
	<b>Content</b>										<b>Hours</b>
	<ol style="list-style-type: none"> <li>1. Estimation of sodium hydroxide using standard sodium carbonate</li> <li>2. Estimation of sodium carbonate using standard sodium hydroxide 6</li> <li>3. Estimation of hydrochloric acid using standard oxalic acid</li> <li>4. Estimation of ferrous sulphate using standard Mohr's salt</li> <li>5. Estimation of oxalic acid using standard ferrous sulphate</li> <li>6. Estimation of potassium permanganate using standard sodium hydroxide</li> <li>7. Estimation of Ca (II) using EDTA solution</li> <li>8. Estimation of Mg (II) using EDTA solution</li> <li>9. Estimation of total hardness of water</li> <li>10. Estimation of ferrous ion using diphenyl amine as indicator</li> </ol>										6

CO	Course Outcomes
	<b>The student will be able to</b>
CO1	Gain an understanding of the use of standard flask and volumetric pipettes, burette.
CO2	Design, carry out, record and interpret the results of volumetric titration
CO3	Apply their skill in the analysis of water/hardness.
CO4	Analyze the chemical constituents in allied chemical products
CO5	Describe the measurable skills, abilities, knowledge in qualitative analysis

<b>Textbooks:</b>	
1	Venkateswaran V, Veerasamy R and Kulandaivelu A. R, "Basic Principles of Practical Chemistry", Sultan Chand & Sons, 2nd ed., 1997.
2	Vogel A. I, Tatchell A. R, Furnis B. S, Hannaford A. J and Smith P. W. G, "Vogel's Textbook of Practical Organic Chemistry", Prentice Hall, 5th ed., 1989.
3	Donald L. Pavia, Gary M. Lampman, George S. Engel & Roger G. Gries, "Experimental Organic Chemistry", Cengage Learning, 2005
4	Jerry Mohrig, Craig Hammond & Paul F. Snyder, "Techniques in Organic Chemistry", Macmillan Learning, 4th ed., 2014.
5	Mann F. G and Saunders B. C, "Practical Organic Chemistry", Pearson Education, 4th ed., 1975.
<b>Reference Books:</b>	
1	Ralph J. Fessenden and Joan S. Fessenden, "Organic Chemistry Laboratory Manual", Brooks/Cole, 3rd ed., 1982.
2	Middleton H, "Organic Qualitative Analysis", Longmans, Green and Co., 1st ed., 1951.
3	Bansal R. K, "Laboratory Manual of Organic Chemistry", New Age International Publishers, 5th ed., 2010.
4	John Leonard, Barry Lygo and Garry Procter, "Advanced Practical Organic Chemistry", CRC Press, 3rd ed., 2013.
5	Lisa Nichols, Organic Chemistry Laboratory Techniques", LibreTexts, 1st ed., 2016
<b>Web resources:</b>	
1	<a href="https://webbook.nist.gov/chemistry/">https://webbook.nist.gov/chemistry/</a>
2	<a href="https://www.organic-chemistry.org/">https://www.organic-chemistry.org/</a>
3	<a href="https://www.routledge.com/Advanced-Practical-Organic-Chemistry/Leonard-Lygo-Procter/p/book/978143986097">https://www.routledge.com/Advanced-Practical-Organic-Chemistry/Leonard-Lygo-Procter/p/book/978143986097</a>
4	<a href="https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_Lab_Techniques_(Nichols)">https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_Lab_Techniques_(Nichols)</a>
5	<a href="https://www.academia.edu/43215226/Advanced_Practical_Organic_Chemistry_Third_Edi">https://www.academia.edu/43215226/Advanced_Practical_Organic_Chemistry_Third_Edi</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO3</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO4</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	3	3	3	3	3	3
<b>Total</b>	15	15	15	15	15	15	15	15	15	15	15
<b>Average</b>	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2- Medium, 1- Low

## II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAS31	R – Programming		1	0	1	0	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	To learn the fundamental concepts of ‘R’ using RGui and R Studio										
LO2	To understand the special data structures of R language Character Vector, Array, Matrix and List										
LO3	To provide knowledge for various control structures										
LO4	To provide knowledge in Data types and packages										
LO5	To understand about graphical analysis pie and bar charts										
Unit	Content										Hours
1	Introduction: History of R- Benefits of Using R – Working with code Editor: RGui and R Studio - Starting your First R Session - Sourcing a script - Navigating the workspace- Vectors: Creating vectors- combing vectors repeating vector - Getting values in and out of vectors- working with logical vectors										6
2	Using character vector for text data - Manipulating text - Factoring in Factors - Naming matrix rows and columns - Calculating with matrices- Creating an array- Creating a list Creating a list - Extracting elements from lists - Changing elements in lists										6
3	Control Structures: Conditional control structures: if statement - if..else statement - switch statement - Loops: for, while and repeat loops - break and next statement. Functions: The Function Keyword - Arguments - Return Values-Computing basic statistics: mean, median, mode, correlation and covariance.										6
4	Getting data into and out of R: Working with other data types - Getting your data out of R - Working with Files and Folders. Packages: Finding packages, installing packages, loading packages, updating package and unloading packages.										6
5	Introduction to Graphical Analysis: Box-Whiskers plots - Scatter plots - Pairs plots - Line charts - Pie charts - Bar charts: single category bar chats and multiple category bar charts.										6
<b>COURSE OUTCOMES</b>											
<b>The student will be able to</b>											
CO1	Understand the basics of R programming										
CO2	Work with vectors and matrices										
CO3	Acquire the knowledge of various control structures										
CO4	Parse data files using built-in functions										

CO5	Apply the various statistical functions and produce high quality graphics
<b>Practice</b>	
1	To Understand how to install and set up R and R Studio
2	To learn how to write and run R scripts.
3	To Write R code to assign values to variables
4	To Generate basic plots using base R.
5	Learner visualizes relationships between variables using plot() and pairs()
<b>Textbooks:</b>	
1	Andrie Devries And Jorismey's , "R Programming For Dummies", Wiley Publications, Isbn:978-81-265-5201-6. (Unit 1 : chapter-2,3,4) (Unit 4: chapter 12,14) (Unit 2 chapter 5,6,7)
2	Tilman M .Davis “The Book of R”, No Starch Press, 2016 (Unit 3: chapter 10,11,3)
3	Paul Teetor, "R Cook Book",O'relly Publications, First Edition, 2011, Isbn: 978-0-596-80915-7 (Unit 5: Chapter 10)
4	Alex Nordeen, Learn R Programming In 24 Hours: Complete Guide For Beginners, Guru99, 2020.
5	Dr.Mark Gardener, "Beginning R- The Statistical Programming Language", Wiley Publications, Isbn: 978-81-265-4120-1.
<b>Reference Books:</b>	
1	Joseph Adler, "R In Nutshell A Desktop Quick Reference",Isbn:978-0-596- 80170-0
2	Roger D. Peng, "R Programming For Data Science", Leanopub, 2015
3	Matloff, Norman, And Matloff, Norman S, The Art Of R Programming: A Tour Of Statistical Software Design, No Starch Press, 2011
4	Lovelace, Robin, And Gillespie, Colin. Efficient R Programming: A Practical Guide to Smarter Programming, O'reilly Media, 2016.
5	Jeeva Jose, Beginner's Guide For Data Analysis Using R Programming., Khanna Publishing House,2019
<b>Web resources:</b>	
1	<a href="https://www.tutorialspoint.com/r/index.htm">https://www.tutorialspoint.com/r/index.htm</a>
2	<a href="https://www.youtube.com/watch?v= V8eKsto3Ug">https://www.youtube.com/watch?v= V8eKsto3Ug</a>
3	<a href="https://www.youtube.com/watch?v=SYyUBytX1ng">https://www.youtube.com/watch?v=SYyUBytX1ng</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	3	3	3	3
CO2	3	3	2	2	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	2	2	1
CO4	3	2	3	3	3	2	3	3	2	2	2
CO5	3	3	3	2	3	3	3	3	3	3	3
<b>Total</b>	15	14	14	13	14	14	13	15	13	13	12
<b>Average</b>	3	2.8	2.8	2.6	2.8	2.8	2.6	3	2.6	2.6	2.4

3 – Strong, 2- Medium, 1- Low

## II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC41	Vector Calculus	Core	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To gain knowledge on differentiation of vectors, gradient of scalar functions and equation of tangent plane.										
LO2	To apply the fundamental concepts of vector calculus, divergence, curl of vector and vector identities.										
LO3	To evaluate line integral and surface integral.										
LO4	To develop skills in evaluating volume integral and Gauss divergence theorem.										
LO5	To solve problems on Stoke's and Green's theorem.										
Unit	Content										Hours
1	<b>Vector Differentiation:</b> Introduction-Geometrical significance of vector differentiation - Partial derivatives of a vector function - Velocity and Acceleration- Scalar and Vector Point Function-Level Surface- Gradient of a Scalar Point Function- Equation of tangent Plane and Normal line to a level surface - Simple problems.										15
2	<b>Divergence and Curl:</b> Divergence and Curl of a vector valued function- Solenoidal and Irrotational Vectors - Vector identities - Laplacian operator - Applications.										15
3	<b>Line and Surface Integrals:</b> Introduction--Line Integral-Applications of Line integral- Surface integral-simple problems.										15
4	<b>Volume integral and Integral Theorem:</b> Volume Integral - Applications- Gauss Divergence theorem (Statement only) – Simple problems.										15
5	<b>Integral Theorem (Cont...)</b> : Stoke's Theorem and Green's Theorem (Statement Only)-Simple Problems.										15
<b>Total</b>										75	
<b>Theory 20% Problem 80%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	The students will be able to
CO1	Understand the Scalar and Vector point function, determine the equation of tangent Plane and Normal line to a level surface.
CO2	Evaluate the divergence, curl and verify whether it is solenoidal and irrotational of the vector point function.
CO3	Solve the line integrals and surface integrals.
CO4	Inter-relationship among the line integral, surface integral and Volume integral formulation.
CO5	Check Green's and Stoke's theorem.
<b>Recommended Text:</b>	
1	P.R. Vittal and V. Malini, Vector Analysis, Margham Publications, Chennai, 2004.
<b>Reference Books:</b>	
1	P.R. Vittal, Vector Analysis, Analytical Solid Geometry and Sequences and Series, Margham Publications, Chennai, 1997.
2	Santi Narayanan, P.K. Vittal, A Textbook of Vector Analysis, S.Chand & Company Ltd, New Delhi, 2003.
3	P. Duraipandiyan and Kayalal Pachaiyappan, Vector Analysis, S. Chand and Co. Ltd.
4	M.K. Venkataraman, Engineering Mathematics, The National Publishing Company, Chennai, 1999.
5	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers (40 <sup>th</sup> Edition), 2007.
<b>Website and e-Learning Source</b>	
1	<a href="https://tutorial.math.lamar.edu">https://tutorial.math.lamar.edu</a>
2	<a href="https://betterexplained.com">https://betterexplained.com</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	3	2	3	2	2	3	3	2	3
<b>CO2</b>	3	2	3	2	3	2	3	3	3	2	2
<b>CO3</b>	2	2	3	3	3	3	3	3	3	2	2
<b>CO4</b>	3	3	3	3	3	3	2	2	3	2	3
<b>CO5</b>	3	3	3	3	3	3	2	3	3	2	3
<b>Total</b>	14	12	15	13	15	13	12	14	15	10	13
<b>Average</b>	2.8	2.4	3	2.6	3	2.6	2.4	2.8	3	2	2.6

## II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC42	Mechanics	Core	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To understand and apply the concepts of Newton's Law of Motion and equilibrium of a Particle.										
LO2	To study Momentum of forces and couples.										
LO3	To acquire knowledge on Work, Energy, Power and Rectilinear Motion under Varying Force.										
LO4	To learn the fundamentals of projectiles.										
LO5	To define central forces and understand the characteristics of conservative laws of motion.										
Unit	Content									Hours	
1	<b>Force:</b> Newton's laws of motion – Resultant of two forces on a particle. <b>Equilibrium of a Particle:</b> Equilibrium of a particle under three forces. Chapter:2 Sections 2.1 - 2.2 Chapter: 3 Sections 3.1(3.1.1)									15	
2	<b>Forces on a Rigid Body:</b> Moment of a Force – General motion of a body – Equivalent systems of forces- Parallel Forces – Forces along the sides of a Triangle – Couples- Resultant of several coplanar forces. Chapter: 4 Sections 4.1- 4.7									15	
3	<b>Work, Energy and Power:</b> Work – Conservative field of force – Power. <b>Rectilinear Motion under Varying Force:</b> Simple Harmonic Motion - Simple Harmonic Motion along a horizontal line – Simple Harmonic Motion along a vertical line. Chapter: 11 Sections 11.1-11.3 Chapter: 12 Sections 12.1-12.3									15	
4	<b>Projectiles:</b> Forces on a projectile – Projectile projected on an inclined plane. Chapter: 13 Sections 13.1- 13.2									15	
5	<b>Central Orbits:</b> General orbits – Central orbit – Conic as a centered orbit. Chapter: 16 Sections 16.1-16.3									15	
<b>Total</b>									75		
<b>Theory 20% problem 80%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	The students will be able to
CO1	Understand the Resultant, Component of a Force, Coplanar forces, like and unlike parallel forces, Equilibrium of a Particle.
CO2	Work on Moment of a force and Couple with examples.
CO3	Evaluate Work, Energy, Power, Recti linear motions under varying forces.
CO4	Determine the Projectile, impulse, impact and laws of impact.
CO5	Calculate central orbits and analyze orbital motion.
<b>Recommended Text:</b>	
1	P. Duraipandiyan , Laxmi Duraipandian, Muthamizh Jayapragasam, Mechanics, S.Chand Publications Pvt. Ltd, New Delhi, 2005.
<b>Reference Books:</b>	
1	J.L. Meriam and L. G. Kraige, Engineering Mechanics: Statics, Seventh Edition, Wiley and sons Pvt Ltd., New York, 2012.
2	S.G Venkatachalapathy, Mechanics, Margam Publications, Chennai.
3	A. K. Dhiman, P. Dhinam and D. Kulshreshtha, Engineering Mechanics (Statics and Dynamics), McGraw Hill Education (India) Private Limited, New Delhi, 2015.
4	J.L. Meriam, L. G. Kraige, and J.N. Bolton, Engineering Mechanics: Dynamics, 8 <sup>th</sup> edition, Wiley and sons Pvt Ltd., New York, 2015.
<b>Website and e-Learning Source</b>	
1	<a href="https://nptel.ac.in/">https://nptel.ac.in/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	3	2	2	2	3	3	2	2	3
<b>CO2</b>	3	2	3	2	2	2	3	3	2	3	2
<b>CO3</b>	3	2	3	2	2	3	3	3	2	2	2
<b>CO4</b>	3	2	3	2	3	2	3	3	2	3	2
<b>CO5</b>	3	2	3	2	3	2	3	3	2	2	3
<b>Total</b>	15	10	15	10	12	11	15	15	10	12	12
<b>Average</b>	3	2	3	2	2.4	2.2	3	3	2	2.4	2.4

3 – Strong, 2- Medium, 1- Low

## II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAA41	Mathematical Statistics II	Elective	3	1	0	0	3	4	25	75	100
<b>Learning Objectives</b>											
LO1	To measure and interpret correlation between variables using different methods.										
LO2	To study linear regression and their properties.										
LO3	To understand sampling techniques and test of significance of large samples.										
LO4	To gain knowledge on Student's <i>t</i> -distribution.										
LO5	To classify data variability using F-distribution .and its applications.										
Unit	Content									Hours	
1.	Introduction-Meaning of Correlation –Scatter Diagram – Karl Pearsons's Coefficient of Correlation – Rank Correlation. Chapter:10 (Sec10.1-10.4, 10.7)									12	
2	Introduction - Linear regression: Regression Coefficients-Properties of Regression Coefficients-Angle between two lines of Regression-Standard error of estimate or Residual Variance-Correlation coefficient between observed and estimated values. Chapter:11 (Sec 11.1-11.2.5)									12	
3	Introduction-Types of Sampling -Parameter and Statistic -Tests of significance-Procedure for testing of hypothesis - Test of significance for large samples - Sampling of attributes-Sampling of variables. Chapter: 14 (Sec 14.1-14.7, 14.8.3-14.8.4)									12	
4	Introduction – Derivation-Student's <i>t</i> - distribution: Fisher's <i>t</i> -Limiting form, critical value- -Applications of <i>t</i> distribution: Single mean-differen0ce of means-Paired <i>t</i> test. Chapter:16 (Sec 16.1-16.3.3)									12	
5	F-distribution: Derivation-mode and point of inflexion-Applications of F-distribution: Equality of two population variance-Multiple correlation co-efficient-Sample correlation ratio-Linearity of regression-Several means. Chapter: 16 (Sec16.5-16.6.5)									12	
	<b>Total</b>									60	
	<b>Theory 60% problem 40%</b>										

<b>Course Outcomes</b>	
<b>CO</b>	The students will be able to
CO1	Evaluate the degree of correlation between variables using scatter diagrams and correlation coefficients.
CO2	Analyze linear regression models and interpret regression coefficients.
CO3	Perform hypothesis testing for large samples and distinguish between types of sampling.
CO4	Compute and interpret results using Student's <i>t</i> -distribution for small samples.
CO5	Apply the F-distribution to compare sample variances in statistical problems.
<b>Recommended Text:</b>	
1	S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Co, New Delhi, Reprint 2019.
<b>Reference Books:</b>	
1	P.R. Vittal, Mathematical Statistics, Margham Publications 2004.
2	R.S.N Pillai and Bhagavathi. Statistics, S. Chand Publishing, 2010 (7th Ed)
3	S.P. Gupta, Statistical Methods, Sultan Chand and Sons (2014).
4	J. N Kapur and H.C. Saxena, Mathematical Statistics, S. Chand and Company Ltd, 2010 (20th Ed)
5	R Viswanathan, Elements of Mathematical Statistics, S.Viswanathan Publishers, 2015.
<b>Website and e-Learning Source</b>	
1	<a href="https://nptel.ac.in/">https://nptel.ac.in/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	2	2	2	3	2	2	3	3	2
<b>CO2</b>	3	2	2	2	3	2	2	3	3	3	2
<b>CO3</b>	3	2	2	3	3	2	2	2	3	3	2
<b>CO4</b>	3	2	3	2	2	3	2	2	3	3	2
<b>CO5</b>	3	2	2	2	3	2	2	2	3	3	2
<b>Total</b>	15	11	11	11	13	12	10	11	15	15	10
<b>Average</b>	3	2.2	2.2	2.2	2.6	2.4	2	2.2	3	3	2

**3 – Strong, 2- Medium, 1- Low**

## II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHA41	Allied Chemistry – II	Elective	3	1	0	0		4	25	75	100
<b>Learning Objectives</b>											
LO1	To providing a knowledge on Co-ordination Chemistry and Water Technology										
LO2	To classify and discuss about Carbohydrates and Amino acids.										
LO3	To explain the basics and applications of electrochemistry										
LO4	To evaluate the basics and applications of kinetics and catalysis										
LO5	To understand the various photochemical phenomenon										
Unit	Content									Hours	
1	<p><b>Co-ordination Chemistry and Water Technology</b> Co-ordination Chemistry: Definition of terms-IUPAC Nomenclature - Werner's theory - EAN rule - Pauling's theory – Postulates - Applications to <math>[\text{Ni}(\text{CO})_4]</math>, <math>[\text{Ni}(\text{CN})_4]^{2-}</math>, <math>[\text{Co}(\text{CN})_6]^{3-}</math> Chelation - Biological role of Hemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis.</p> <p><b>Water Technology:</b> Hardness of water, determination of hardness of water using EDTA method, zeolite method</p>									12	
2	<p><b>Carbohydrates and Amino acids</b> <b>Carbohydrates:</b> Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose – fructose interconversion. Properties of starch and cellulose. Amino acids: Classification - preparation and properties of alanine. RNA and DNA (elementary idea only).</p>									12	
3	<p><b>Electrochemistry</b> Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials -electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications - electroplating - Nickel and chrome plating – Types of cells -fuel cells-corrosion and its prevention.</p>									12	
4	<p><b>Kinetics and Catalysis</b> Order and molecularity. Integrated rate expression for I and II (2A Products) order reactions. Pseudo first order reaction, methods of determining order of a reaction – Half-life period – Catalysis - homogeneous and heterogeneous, catalyst used in Contact and Haber's processes. Concept of energy of activation and Arrhenius equation.</p>									12	
5	<p><b>Photochemistry</b> Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-Chloride and Hydroge-Bromide reaction. Jablonski Diagram - Phosphorescence,</p>									12	

	fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).	
	<b>Total</b>	60
<b>Theory – 100%</b>		

CO	Course Outcomes	
	The Students will be able to	
CO1	Write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology	
CO2	Explain the preparation and property of carbohydrate, amino acids and nucleic acids.	
CO3	Apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.	
CO4	Identify the reaction rate, order for chemical reaction and explain the purpose of a catalyst.	
CO5	Outline the various type of photochemical process.	
<b>Textbooks:</b>		
1.	F. Albert Cotton, Geoffrey Wilkinson, Paul L. Gaus, “ <i>Basic Inorganic Chemistry</i> ”, 3 <sup>rd</sup> ed., Wiley, 1995.	
2.	V.Veeraiyan, Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition, 2009.	
3.	S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.	
4.	Arun Bahl, B.S.Bahl, Advanced Organic Chemistry; S.Chand and Company, New Delhi, twenty third edition, 2012.	
5.	P.L.Soni, H.M.Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.	
<b>Reference Books:</b>		
1.	James E. Huheey, Ellen A. Keiter, Richard L. Keiter, “ <i>Inorganic Chemistry: Principles of Structure and Reactivity</i> ”, 4 <sup>th</sup> ed., Pearson, 1997.	
2.	P.L.Soni, Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007. 2.	
3.	Paula Yurkanis Bruice, “ <i>Organic Chemistry</i> ”, 8 <sup>th</sup> ed., Pearson, 2016.	
4.	R.Puri, L.R.Sharma, M.S.Pathania, Text book Physical Chemistry; Vishal Publishing Co., New Delhi, forty seventh edition, 2018.	
5.	B.K,Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.	
<b>Web resources:</b>		
1.	<a href="http://www.khanacademy.org/science/chemistry">www.khanacademy.org/science/chemistry</a>	
2.	<a href="https://chem.libretexts.org">https://chem.libretexts.org</a>	
3.	<a href="https://chem.libretexts.org/Bookshelves/Organic_Chemistry">https://chem.libretexts.org/Bookshelves/Organic_Chemistry</a>	
4.	<a href="https://ocw.mit.edu/courses/chemistry/">https://ocw.mit.edu/courses/chemistry/</a>	
5.	<a href="https://chem.libretexts.org/Bookshelves/Analytical_Chemistry">https://chem.libretexts.org/Bookshelves/Analytical_Chemistry</a>	

### Mapping with Programme Outcomes and Programme Specific Outcomes

<b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>C01</b>	3	3	3	2	3	1	2	2	3	3	3
<b>C02</b>	3	3	3	2	3	1	2	3	2	3	3
<b>C03</b>	3	3	3	2	2	1	2	2	3	3	3
<b>C04</b>	3	3	3	2	2	1	2	2	3	2	3
<b>C05</b>	3	3	3	2	3	1	2	3	2	3	2
<b>Total</b>	15	13	13	10	13	05	10	12	13	14	14
<b>Average</b>	<b>3.0</b>	<b>3.0</b>	<b>3.0</b>	<b>2.0</b>	<b>2.6</b>	<b>1.0</b>	<b>2.8</b>	<b>2.4</b>	<b>2.6</b>	<b>2.8</b>	<b>2.8</b>

**3 – Strong, 2- Medium, 1- Low**

## II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAA41P	<b>Mathematical Statistics II Practical Using R Programming</b>	Elective	0	0	2	0	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	To enhance understanding of visual data analysis through scatter plots.										
LO2	To develop the ability to perform correlation and regression analysis using R tools.										
LO3	To apply statistical methods for rank correlation via R programming.										
LO4	To introduce statistical hypothesis testing for large sample proportion and means through R programming.										
LO5	To equip students with skills to small sample test for mean and difference of means utilizing R programming.										
Unit	Content										Hours
	1.Create a scatter plot. 2.Correlation between two variables. 3.Rank Correlation between two variables. 4.Rank Correlation for repeated Ranks. 5.Linear Regression between two variables. 6.Large Sample test for single proportion. 7.Large Sample test for difference of proportions. 8.Large Sample test for single mean. 9.Large Sample test for difference of means. 10.Small Sample test t-tests for single mean. 11.Small Sample test t-tests for difference of means. 12. Small Sample test for F-test.										30
	<b>Total</b>										30
	<b>Problem 100%</b>										

<b>Course Outcomes</b>	
<b>CO</b>	The students will be able to
CO1	Generate and interpret scatter plots to understand variable relationships.
CO2	Analyze correlation and rank correlation between variables in R.
CO3	Implement linear regression models and interpret outcomes using R.
CO4	Perform large sample tests for proportions and means using R.
CO5	Learn t-tests and F-tests for small sample scenarios using R programming.
<b>Recommended Text:</b>	
1	Tilman M. Davies, The Book of R : A First Course in Programming and Statistics - No starch Press, San Francisco.
<b>Reference Books:</b>	
1	W. John Braun, Duncan J. Murdoch, A First Course in Statistical Programming with R, Cambridge University Press, 2007.
2	M. Gardener, Beginning R: The Statistical Programming Language, John Wiley and Sons, 2012.
3	T. Martin, The Undergraduate Guide to R. A Beginner's Introduction to R Programming Language, 2009.
4	J. Chambers, Software for Data Analysis: Programming with R. Springer Science and Business Media, 2008.
<b>Website and e-Learning Source</b>	
1	<a href="https://spoken-tutorial.org">https://spoken-tutorial.org</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	2	2	2	3	2	2	3	3	2
<b>CO2</b>	3	2	2	2	3	2	2	3	3	3	2
<b>CO3</b>	3	2	2	3	3	2	2	2	3	3	2
<b>CO4</b>	3	2	3	2	3	3	2	2	3	3	2
<b>CO5</b>	3	2	2	2	3	2	2	2	3	3	2
<b>Total</b>	15	11	11	11	13	12	10	11	15	15	10
<b>Average</b>	3	2.2	2.2	2.2	2.6	2.4	2	2.2	3	3	2

**3 – Strong, 2- Medium, 1- Low**

## II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCHA41P	Chemistry Practical for Physical and Biological Sciences – II	Elective	0	0	2	0	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	Different types of organic compounds with respect to their properties.										
LO2	Determination of elements in organic compounds.										
LO3	Identification of organic functional groups.										
LO4	Identify the components and structure of an unknown organic molecule.										
LO5	Skills to solve problems related to the identification of organic molecules through a series of tests and observations.										
	<b>Content</b>									<b>Hours</b>	
	Systematic Analysis of Organic Compounds The analysis must be carried out as follows: Preliminary Tests 1. To distinguish between aliphatic and aromatic compounds. 2. To distinguish – Saturated and unsaturated compounds. 3. Detection of special elements (N, S, Halogens). 4. Identification of Functional group tests (Absence of special elements) 5. Phenol, Acids (mono & di), Aldehyde and Carbohydrate 6. Identification of Functional group tests (Presence of special elements) 7. Presence aromatic primary amine, Amides (mono & di).									6	

## SCHEME OF VALUATION

### Chemistry Practical for Physical and Biological Science - II

(For Physics & Mathematics – II year / IV Semester)

Internal assessment : 25 Marks

External assessment : 75 Marks

Total : 100 Marks

Max. Marks : 75 Marks

Record : 10 Marks

Viva voce : 5 Marks

Organic Analysis : 60 Marks

Organic Analysis : 60 Marks

Preliminary Test : 10 Marks

Aliphatic or Aromatic : 5 Marks

Saturated or Unsaturated : 5 Marks

Tests for Special Elements : 10 Marks

Confirmation Tests : 15 Marks

Functional groups Tests : 15 Marks

CO	Course Outcomes
	The students will be able to
CO1	Design, carry out, record and interpret the results of volumetric titration.
CO2	Gain an understanding of the safe use of standard flask and volumetric pipettes, burette.
CO3	Perform stoichiometric calculations to determine the concentration of unknown solutions using data obtained from titration experiments.
CO4	Explain the underlying chemical principles governing various types of titrations, including acid-base, redox, and complexometric titrations, and their applications.
CO5	Analyze titration data, identify potential sources of error, and evaluate the precision and accuracy of experimental results.
<b>Textbooks:</b>	
1.	Venkateswaran V, Veerasamy R and Kulandaivelu A. R, "Basic Principles of Practical Chemistry", Sultan Chand & Sons, 2 <sup>nd</sup> ed., 1997.
2.	J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas, "Vogel's Textbook of Quantitative Chemical Analysis", 6 <sup>th</sup> ed., Pearson, 2000.
3.	Donald L. Pavia, Gary M. Lampman, George S. Engel & Roger G. Gries, "Experimental Organic Chemistry", Cengage Learning, 2005.

4.	Jerry Mohrig, Craig Hammond & Paul F. Snyder, "Techniques in Organic Chemistry", Macmillan Learning, 4 th ed., 2014.
5.	Mann F. G and Saunders B. C, "Practical Organic Chemistry", Pearson Education, 4 th ed., 1975.
<b>Reference Books:</b>	
1.	Ralph J. Fessenden and Joan S. Fessenden, "Organic Chemistry Laboratory Manual", Brooks/Cole, 3 rd ed., 1982.
2.	Middleton H, "Organic Qualitative Analysis", Longmans, Green and Co., 1 st ed., 1951.
3.	Bansal R. K, "Laboratory Manual of Organic Chemistry", New Age International Publishers, 5 th ed., 2010.
4.	John Leonard, Barry Lygo and Garry Procter, "Advanced Practical Organic Chemistry", CRC Press, 3 rd ed., 2013.
5.	Lisa Nichols, "Organic Chemistry Laboratory Techniques", LibreTexts, 1 st ed., 2016.
<b>Web resources:</b>	
1	<a href="https://webbook.nist.gov/chemistry/">https://webbook.nist.gov/chemistry/</a>
2	<a href="https://www.organic-chemistry.org/">https://www.organic-chemistry.org/</a>
3	<a href="https://www.routledge.com/Advanced-Practical-Organic-Chemistry/Leonard-Lygo-Procter/p/book/9781439860977">https://www.routledge.com/Advanced-Practical-Organic-Chemistry/Leonard-Lygo-Procter/p/book/9781439860977</a>
4	<a href="https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_Lab_Techniques_(Nichols)">https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_Lab_Techniques_(Nichols)</a>
5	<a href="https://www.academia.edu/43215226/Advanced_Practical_Organic_Chemistry_Third_Edition">https://www.academia.edu/43215226/Advanced_Practical_Organic_Chemistry_Third_Edition</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	2	2	3	2
CO2	2	3	3	3	2	3	3	2	3	3	3
CO3	3	3	2	2	3	3	3	2	3	3	3
CO4	3	3	2	3	2	3	3	2	2	3	3
CO5	3	3	3	3	3	3	3	2	3	2	3
<b>Total</b>	14	15	13	14	13	15	15	10	13	14	14
<b>Average</b>	<b>2.8</b>	<b>3.0</b>	<b>2.6</b>	<b>2.8</b>	<b>2.6</b>	<b>3.0</b>	<b>3.0</b>	<b>2.0</b>	<b>2.6</b>	<b>2.8</b>	<b>2.8</b>

3 – Strong, 2- Medium, 1- Low

## II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAS41	Python Programming	SEC	1	0	1	0	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	To train students in programming techniques and provide hands on experience in using programs to solve basic mathematical problems.										
LO2	To learn decision control statement and arrays.										
LO3	To learn about python file handling, modules and packages.										
LO4	To explore various matrix operations.										
LO5	To Implement mathematical operations using python.										
Unit	Content										Hours
1	Introduction: Features of Python-How to run Python-variables-comments-Indentation-Multi Line Statements-Quotes-Input, Output and Import Functions-Operators-Data types: Numbers- Strings-List -Tuple-Set-Dictionary-Data type conversion, Booleans.										6
2	Control Flow Statements: The if Decision Control Flow Statement, The if...else Decision Control Flow Statement, The if...elseif...else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements. Functions: Definition-calling- Function Arguments- Anonymous functions -Recursive with more than one return value, Python Arrays, Introduction to Tensors										6
3	Modules and Packages: Built-in modules- creating modules- import statement- package in Python-Date and Time modules- Case study: Numpy, Pandas, matplotlib- math, Python File handling. Data Visualization: Generating Data-Installing Matplotlib, plotting a Simple Line Graph, Random Walks, Rolling Dice with Plotly.										6
4	Addition and subtraction of matrices-Multiplication of matrices-Trace and Transpose of Matrix - Rank of matrix-Inverse of a Matrix-Finding the eigen values and eigen vectors.										6
5	Finding the Derivative of $e^{ax}$ , trigonometric and hyperbolic functions-Finding the Derivative of algebraic and logarithmic functions-evaluate the line integrals with constant and variable limits.										6
<b>Total</b>										30	
<b>Theory 100%</b>											

CO	Course Outcomes
	The students will be able to
CO1	Write, debug, and execute basic Python programs, understanding core concepts like variables, data types, operators, and control flow (conditionals and loops).
CO2	Differentiate between different types of control flow statements and apply them to solve problems, make decisions within a program, and create iterative processes.
CO3	Define and import modules, create and utilize packages for larger projects, and understand the benefits of modularity for code organization and maintainability.
CO4	Equip students with the fundamental concepts and techniques of matrices and their applications, enabling them to solve various mathematical problems.
CO5	Find derivatives using various techniques, including the chain rule and logarithmic differentiation, and apply these skills to solve problems involving slopes, tangents, and other related rates.
<b>Recommended Text:</b>	
1	Jeeva Jose, “Taming Python by Programming”, Revised Edition, Khanna Publishing, 2019. ISBN :978-93-86173-34-8.
2	Gowri Shankar S, Veena A, “Introduction to Python Programming” , 1 <sup>st</sup> Edition, CRC Press /Taylor & Francis, 2018. ISBN-13: 978-0815394372.
<b>Reference Books:</b>	
1	Ch Satyanarayana, “Python Programming”, Orient Black Swan Pvt. Ltd, 2022. ISBN:978-93- 86235-63-3.
2	S. Narayanan and T.K. Manicavachagom Pillay, Calculus, Volume I, S.Viswanathan (Printers and Publishers), PVT Ltd, Chennai, 2011.
3	A.K. Sharma, Differential Calculus, Discovery Publishing House, NewDelhi,2004.
4	G.B. Thomas and R.L. Finney, Calculus, Pearson Education,2007.
5	P.R. Vital and V. Malini, Algebra and Trigonometry–I, Margham Publications Reprint2015.
<b>Website and e-Learning Source</b>	
1	<a href="https://www.geeksforgeeks.org/python/python-programming-language-tutorial/">https://www.geeksforgeeks.org/python/python-programming-language-tutorial/</a>
2	<a href="https://www.youtube.com/watch?v=K5KVEU3aaeQ">https://www.youtube.com/watch?v=K5KVEU3aaeQ</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	2	3	3	2
CO2	3	2	2	2	3	2	2	3	3	3	2
CO3	3	2	2	3	3	2	2	2	3	3	2
CO4	3	2	3	2	3	3	2	2	3	3	2
CO5	3	2	2	2	3	2	2	2	3	3	2
<b>Total</b>	15	11	11	11	13	12	10	11	15	15	10
<b>Average</b>	3	2.2	2.2	2.2	2.6	2.4	2	2.2	3	3	2

3 – Strong, 2- Medium, 1- Low

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC51	Abstract Algebra	Core	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To state the group axioms, subgroups and understand Lagrange's theorem.										
LO2	To define a Normal subgroup, Quotient group and to work examples on Homomorphisms and Automorphisms.										
LO3	To study Cayley's Theorem and to solve problems on Permutation groups.										
LO4	To know the fundamental concepts of ring theory, ideals and quotient rings.										
LO5	To identify more ideals, quotient rings and define integral domains and to study Euclidean rings and fields.										
Unit	Content										Hours
1	<b>Group Theory:</b> Definition of a Group - Examples – Preliminary lemmas-Subgroups - A counting principle - Simple Problems. <b>Chapter: 2.1 - 2.5</b>										15
2	<b>Group Theory (Contd...)</b> Normal subgroups and Quotient groups – Homomorphisms - Automorphisms - Examples. <b>Chapter: 2.6 - 2.8</b>										15
3	<b>Group Theory (Contd...)</b> Cayley's Theorem - Permutation groups – Problems. <b>Chapter: 2.9 and 2.10</b>										15
4	<b>Rings:</b> Definition and examples of rings - Some special classes of rings - homomorphism of rings - Ideals and Quotient rings. <b>Chapter: 3.1 - 3.4</b>										15
5	<b>Rings (Contd...)</b> More ideals and Quotient rings - The field of quotients of an integral domain - Euclidean Rings - A particular Euclidean Ring – Examples. <b>Chapter: 3.5 - 3.8</b>										15
	<b>Total</b>										<b>75</b>
<b>Theory 80% Problem 20%</b>											

CO	Course Outcomes The students will be able to
CO1	Understand groups and to identify and differentiate abelian and non – abelian groups.
CO2	Work on Normal subgroup, Quotient groups, and verify the functions under homomorphism and automorphism properties.
CO3	Execute the problems based on permutation and apply Cayley’s theorem to problems.
CO4	Describe Rings, Ideals and Quotient Rings and examine their structure.
CO5	Analyze the field of quotient of an integral domain and to explain in detail about Euclidean Rings.
<b>Recommended Text Book:</b>	
1	I.N. Herstein, Topics in Algebra, Wiley India Pvt. Ltd., Second Edition, 2009.
<b>Reference Books:</b>	
1	S. Arumugam, Isaac. A.T Modern Algebra, SciTech Publications (India) Pvt. Ltd, Chennai.
2	N.S Gopalakrishnan, University Algebra, Second Edition, New Space Age International Pvt. Ltd., publishers.
3	I S Luthar & I B S Passi, Algebra, Volume -I: Groups Narosa Publishing House New Delhi, 1997.
4	Lloyd R.Jaisingh and Frank Ayres,Jr, Abstract Algebra, [2nd edition], Tata McGraw Hill, New Delhi, 2005.
5	Surjeet Singh and Qazi Zameeruddin, Modern algebra, Vikas Publishing House Pvt. Ltd., New Delhi, 1982.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://math.mit.edu/research/highschool/primes/circle/documents/2022/Sophia%20&amp;%20Jaeji.pdf">https://math.mit.edu/research/highschool/primes/circle/documents/2022/Sophia%20&amp;%20Jaeji.pdf</a>
2	<a href="https://en.wikipedia.org/wiki/Ring_(mathematics)">https://en.wikipedia.org/wiki/Ring_(mathematics)</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	3	2	3	2	2	3	3	2	3
<b>CO2</b>	3	2	3	2	3	2	3	3	3	2	2
<b>CO3</b>	2	2	3	3	3	3	3	3	3	2	2
<b>CO4</b>	3	3	3	3	3	3	2	2	3	2	3
<b>CO5</b>	3	3	3	3	3	3	2	3	3	2	3
<b>Total</b>	14	12	15	13	15	13	12	14	15	10	13
<b>Average</b>	2.8	2.4	3	2.6	3	2.6	2.4	2.8	3	2	2.6

**3–Strong, 2-Medium, 1-Low**

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC52	Elements of Mathematical Analysis	Core	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To develop logical thinking and enhance quality tertiary education through understanding sets and functions.										
LO2	To enhance analytical and problem-solving skills relevant to employability by analyzing the convergence and divergence of sequences.										
LO3	To gain knowledge of operations on convergent and divergent sequences, limit superior, limit inferior and Cauchy sequences.										
LO4	To study convergence and divergence of real numbers and tests for absolute convergence of series.										
LO5	To explore metric spaces with relevant examples, fostering lifelong learning and sustainable development.										
Unit	Content									Hours	
1	<b>Sets and Functions:</b> Sets and elements - Operations on sets – Functions - Real-valued functions - Equivalence - Count ability- Real numbers - Least upper bounds. <b>Chapter: 1 Section: 1.1 - 1.7</b>									15	
2	<b>Sequences of Real Numbers:</b> Definition of sequence and subsequence - Limit of sequence – Convergent sequences - Divergent sequences - Bounded sequences - Monotone sequences. <b>Chapter: 2 Section: 2.1 - 2.6</b>									15	
3	<b>Sequences of Real Numbers (Contd...)</b> Operations on convergent sequences – Operations on divergent sequences – Limit superior and Limit inferior - Cauchy sequences. <b>Chapter: 2 Section: 2.7 - 2.10</b>									15	
4	<b>Series of Real Numbers:</b> Convergence and divergence – Series with non-negative terms - Alternating Series - Conditional convergence and absolute convergence - Tests for absolute convergence. <b>Chapter: 3 Section: 3.1 - 3.4 and 3.6</b>									15	
5	<b>Limits, Metric Spaces and Continuous Functions on Metric Spaces</b> Limit of a function on the real line - Metric spaces - Limits in metric spaces. Functions continuous at a point on the real line - Reformulation - Functions continuous on a metric space. <b>Chapter: 4 Section: 4.1 - 4.3</b> <b>Chapter: 5 Section: 5.1 - 5.3</b>									15	
	<b>Total</b>									<b>75</b>	
<b>Theory 80% Problem 20%</b>											

CO	Course Outcomes
	<b>The students will be able to</b>
CO1	Apply sets and functions to develop logical thinking and support tertiary education.
CO2	Evaluate the convergence and divergence of sequences for problem solving and employability.
CO3	Illustrate operations on convergent and divergent sequences, limit superior, limit inferior and Cauchy sequences.
CO4	Work on convergence and divergence of series and to test for absolute convergence.
CO5	Comprehend metric spaces through examples.
<b>Recommended Text Book:</b>	
1	Richard R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2020.
<b>Reference Books:</b>	
1	Tom. M. Apostol, Mathematical Analysis, 2nd Edition, Narosa Publishing House, New Delhi, 1974.
2	R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) Pvt. Ltd., 2000.
3	S.C. Malik, S.C. and SavitaArora, Mathematical Analysis, Wiley Eastern Limited, New Delhi, 1991.
4	K.A. Ross, Elementary Analysis- The Theory of Calculus Series - Undergraduate Texts in Mathematics, Springer Verlag, 2003.
5	Sanjay Arora and Bansilal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1991.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://nptel.ac.in">https://nptel.ac.in</a>
2	<a href="https://swayam.gov.in/">https://swayam.gov.in/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	2	3	2	3	3	3	3	2	2
<b>CO2</b>	3	3	2	3	2	3	3	3	3	2	2
<b>CO3</b>	3	3	3	3	2	3	3	3	3	2	2
<b>CO4</b>	3	3	3	3	2	2	3	3	3	2	2
<b>CO5</b>	3	3	2	3	2	3	3	3	3	2	2
<b>Total</b>	15	15	12	15	10	14	15	15	15	10	10
<b>Average</b>	3	3	2.4	3	2	2.8	3	3	3	2	2

**3–Strong, 2-Medium, 1-Low**

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC53	Complex Analysis	Core	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To study the techniques of complex variables and functions together with their derivatives and differentiation.										
LO2	To derive Cauchy Riemann equation and applications of analytic functions, harmonic functions.										
LO3	To evaluate a complex integral using parameterization and apply the results of Cauchy's fundamental theorem and Cauchy's integral formula.										
LO4	To gain knowledge of Taylor's and Laurent's series, classifications of singularities, and evaluation of integrals using Cauchy's residue theorem.										
LO5	To estimate contour integrals or integrals over the real line.										
Unit	Content									Hours	
1	<b>Analytic Functions:</b> Functions of a Complex variable - Mappings - Limits - Theorems on Limits - Continuity - Derivatives - Differentiation formulas. <b>Chapter: 2</b>									15	
2	<b>Analytic Functions (Contd...)</b> Cauchy-Riemann equations - Sufficient conditions - Cauchy-Riemann equations in polar form - Analytic functions - Harmonic functions - problems. <b>Chapter: 2</b>									15	
3	<b>Integrals:</b> Contours - Contour Integrals – Cauchy-Goursat's Theorem (without proof) - Cauchy Integral Formula - An Extension of the Cauchy Integral Formula - Liouville's theorem and the Fundamental Theorem of Algebra - Maximum Modulus of Principle. <b>Chapter: 4</b>									15	
4	<b>Series, Residues and Poles:</b> Taylor series - Laurent's Series – Examples - Isolated singular Points - Residues - Cauchy's Residue theorem - problems - The Three Types of isolated Singular Points - Residues at Poles - Zeros of Analytic Functions - Zeros and Poles. <b>Chapter: 5 , Chapter: 6</b>									15	
5	<b>Applications of Residues:</b> Evaluation of Improper Integrals - Improper integrals from Fourier Analysis - Jordan Lemma (Statement only) - Definite integrals Involving Sines and Cosines-Argument principle - Rouche's theorem. <b>Chapter:7</b>									15	
<b>Total</b>									<b>75</b>		
<b>Theory 80% problem 20%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	<b>The students will be able to</b>
CO1	Learn the complex functions and their nature, continuous functions, necessary and sufficient conditions of an analytic function.
CO2	Work on Cauchy Riemann equations, Analytic functions and Harmonic problems.
CO3	Evaluate contour integrals using Cauchy's integral formula.
CO4	Express a function as Taylor series or Laurent's series at the given domain, and also work on problems on Cauchy Residue theorem.
CO5	Execute the problems related to improper integrals.
<b>Recommended Text book:</b>	
1	J.W. Brown and R.V.Churchill Complex Variables and Applications. McGraw Hill International Book Co., Singapore. (Eighth Edition), 1984.
<b>Reference Books:</b>	
1	P. Duraipandian and Laxmi Duraipandian. Complex Analysis: Emerald Publishers, Chennai, 1976.
2	S. Ponnusamy Foundations of Complex Analysis, Narosa Publishing House, New Delhi, 2000.
3	Tyagi B.S. Functions of Complex Variable, 17th Edition, Pragati Prakasham Publishing Company Ltd., Meerut, 1992.
4	S. Arumugam, A. Thangapandi Issac, A. Somasundaram, Complex Analysis, Scitech Publications, Pvt. Ltd, Chennai, 2003.
5	Richard A. Silverman, Introductory Complex Analysis. Dover Publications, 1972.
<b>Website and e-Learning Sources:</b>	
1	<a href="http://www.opensource.org/">http://www.opensource.org/</a>
2	<a href="http://en.wikipedia.org">http://en.wikipedia.org</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	3	3	2	3	3	3	3	3	3	3
<b>CO3</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO4</b>	3	2	3	3	3	2	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	3	3	3	3	3	3
<b>Total</b>	15	14	15	14	15	14	15	15	15	15	15
<b>Average</b>	3	2.8	3	2.8	3	2.8	3	3	3	3	3

**3 – Strong, 2- Medium, 1- Low**

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC54	<b>Object Oriented Programming Concepts using C++</b>	Core	2	0	1	0	3	3	25	75	100
<b>Learning Objectives</b>											
LO1	To describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects.										
LO2	To understand dynamic memory management techniques using pointers, constructors, destructors, etc.										
LO3	To describe the concept of function overloading, operator overloading, virtual functions and polymorphism.										
LO4	To classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming.										
LO5	To demonstrate the use of various OOPs concepts with the help of programs.										
Unit	Content										Hours
1	Introduction to C++ - key concepts of Object-Oriented Programming – Advantages – Object Oriented Languages – I/O in C++ - C++ Declarations. Control Structures: Decision Making and Statements: If else, jump, goto, break, continue, Switch case statements - Loops in C++ : for, while, do.										9
2	Classes and Objects: Declaring Objects – Defining Member Functions – functions in C++ - inline functions – Function Overloading - Static Member variables and functions – array of objects – friend functions – Overloading member functions.										9
3	Operator Overloading: Overloading unary, binary operators – Overloading Friend functions – type conversion – Constructor and destructor with static members.										9
4	Inheritance: Types of Inheritance – Single, Multilevel, Multiple, Hierarchal, Hybrid, Multi path inheritance – Virtual base Classes – Abstract Classes.– Arrays – Characteristics – array of classes – Memory models – new and delete operators.										9
5	Files – File stream classes – file modes – Sequential Read / Write operations – Exception Handling - String – Declaring and Initializing string objects – String Attributes – Miscellaneous functions.										9

CO	Course Outcomes
	<b>The Students will be able to</b>
CO1	Remember the program structure of C with its syntax and semantics.
CO2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files).
CO3	Apply the programming principles learnt in real- time problems.
CO4	Analyze the various methods of solving a problem and choose the best method.
CO5	Code, debug and test the programs with appropriate test cases.
<b>Recommended Text book:</b>	
1	E. Balagurusamy, Object-Oriented Programming with C++, 8th Edition, McGraw Hill Education (India), 2020.
<b>Reference Books:</b>	
1	Ashok N Kamthane, Object-Oriented Programming with ANSI and Turbo C++, Pearson Education, 2003.
2	Maria Litvin & Gray Litvin, C++ for you, Vikas publication, 2002.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://onlinecourses.nptel.ac.in/noc25_cs34/preview">https://onlinecourses.nptel.ac.in/noc25_cs34/preview</a>
2	<a href="https://www.geeksforgeeks.org/cpp/object-oriented-programming-in-cpp/">https://www.geeksforgeeks.org/cpp/object-oriented-programming-in-cpp/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	2	3	3	3	3	3	2	3	3	3
<b>CO3</b>	3	3	2	3	3	3	3	3	2	3	3
<b>CO4</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	3	3	3	3	3	3
<b>Total</b>	15	14	14	15	15	15	15	14	14	15	15
<b>Average</b>	3	2.8	2.8	3	3	3	3	2.8	2.8	3	3

3 – Strong, 2- Medium, 1- Low

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
<b>24UMAC54P</b>	<b>Object Oriented Programming Concepts using C++ Practical</b>	<b>Core</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>25</b>	<b>75</b>	<b>100</b>
<b>Learning Objectives</b>											
LO1	Identify and use basic C++ syntax, functions and control statements.										
LO2	Explain and apply object-oriented concepts such as classes, objects, constructors and destructors.										
LO3	Demonstrate advanced C++ features like function overloading, default arguments, friend functions and virtual functions.										
LO4	Develop programs to solve mathematical and logical problems.										
LO5	Create simple programs for matrix operations, patterns and input handling.										
<b>Content</b>										<b>Hours</b>	
<ol style="list-style-type: none"> <li>1. Design a C++ program to demonstrate function overloading, default arguments and inline functions.</li> <li>2. Develop a C++ program that illustrates the use of classes and objects by computing simple interest.</li> <li>3. Create a C++ program to calculate the factorial of a number using a function.</li> <li>4. Construct a C++ program to generate the Fibonacci series using friend functions.</li> <li>5. Build a C++ program to determine whether a given number is an Armstrong number.</li> <li>6. Demonstrate a C++ program showcasing the use of constructors and destructors.</li> <li>7. Create a C++ program to perform matrix addition.</li> <li>8. Design a C++ program to display the given pattern and experiment with similar patterns:  2  3 3  4 4 4  5 5 5</li> <li>9. Develop a C++ program to illustrate the concept of virtual functions.</li> <li>10. Construct a C++ program to find the largest number using command-line arguments.</li> </ol>										30	

<b>Course Outcomes</b>	
<b>CO</b>	<b>The Students will be able to</b>
CO1	Understand and apply basic C++ programming concepts including functions and control structures.
CO2	Demonstrate object-oriented programming using classes, objects, constructors and destructors.
CO3	Apply advanced features like function overloading, default arguments, friend functions and virtual functions.
CO4	Solve computational problems such as factorial, Fibonacci series, Armstrong numbers and matrix operations.
CO5	Develop programs for pattern generation and command-line input handling.
<b>Recommended Text book:</b>	
1	E. Balagurusamy, Object-Oriented Programming with C++, 8th Edition, McGraw Hill Education (India), 2020.
<b>Reference Books:</b>	
1	Ashok N Kamthane, Object-Oriented Programming with ANSI and Turbo C++, Pearson Education, 2003.
2	Maria Litvin & Gray Litvin, C++ for you, Vikas publication 2002.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://onlinecourses.nptel.ac.in/noc25_cs34/preview">https://onlinecourses.nptel.ac.in/noc25_cs34/preview</a>
2	<a href="https://www.geeksforgeeks.org/cpp/object-oriented-programming-in-cpp/">https://www.geeksforgeeks.org/cpp/object-oriented-programming-in-cpp/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO3</b>	3	3	2	3	3	3	3	3	2	3	3
<b>CO4</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	3	3	3	3	3	2
<b>Total</b>	15	15	14	15	15	15	15	15	14	15	14
<b>Average</b>	3	3	2.8	3	3	3	3	3	2.8	3	2.8

**3–Strong, 2-Medium, 1-Low**

**III YEAR: FIFTH SEMESTER**

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAE51	Graph Theory	Elective	2	1	0	0	3	3	25	75	100
<b>Learning Objectives</b>											
LO1	To impart knowledge on basic concepts of graphs and subgraphs.										
LO2	To study operations on graphs and adjacency and incidence of matrices.										
LO3	To gain the Knowledge about connectedness and components.										
LO4	To acquire the Knowledge about Eulerian and Hamiltonian graphs.										
LO5	To Know about Characterization of Trees.										
Unit	Content									Hours	
1	<b>Graphs and Subgraphs :</b> Graphs, Degrees, Subgraphs, Isomorphism of graphs, Independent sets and Coverings. <b>Chapter: 2 Sections: 2.1 - 2.4, 2.6</b>									9	
2	<b>Graphs and Subgraphs ( Contd...)</b> Intersection graphs, Matrices, Operations on graphs. <b>Chapter: 2 Sections: 2.7 - 2.9</b>									9	
3	<b>Connectedness :</b> Walks, Trails, Paths, Connectedness and Components, Blocks and connectivity. <b>Chapter: 4 Sections: 4.1 - 4.4</b>									9	
4	<b>Eulerian and Hamiltonian graphs :</b> Eulerian graphs, Hamiltonian graphs. <b>Chapter: 5 Sections: 5.1 and 5.2</b>									9	
5	<b>Trees :</b> Characterization of Trees - Centre of a Tree <b>Chapter: 6 Sections: 6.1 and 6.2</b>									9	
	<b>Total</b>									<b>45</b>	
<b>Theory 80% problem 20%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	<b>The Students will be able to</b>
CO1	Analyze different graph structures and determine isomorphism between graphs.
CO2	Represent graphs using adjacency and incidence matrices and apply graph operations.
CO3	Learn connected graphs, components, cut vertices, bridges and connectivity.
CO4	Evaluate Eulerian and Hamiltonian graphs and apply their properties in problem solving.
CO5	Understand the concept of trees.
<b>Recommended Text book:</b>	
1	S.Arumugam and S.Ramachandran, Invitation to Graph Theory, SCITECH Publications India Pvt. Ltd., 7/3C, Madley Road, T.Nagar, Chennai – 17, 2011.
<b>Reference Books:</b>	
1	John Clark, Derek Allan Holton, A first look at graph Theory, Allied publishers, 1995.
2	J.A. Bondy and U.S.R .Murthy, Graph Theory, Macmillon, London, 2013.
3	S.A. Choudum, A first course in graph theory, Macmillon Publishers, 1987.
4	Narsingh Deo, Graph theory with applications to Engineering and Computer Science, Prentice Hall of India, 2005.
5	Alan Gibbons, Algorithmic Graph Theory, Cambridge University, 1985.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://nptel.ac.in">https://nptel.ac.in</a>
2	<a href="https://www.mathhelp.com/">https://www.mathhelp.com/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	2	3	3	3	3	3	2	2	3	2	3
<b>CO2</b>	2	2	3	2	3	3	2	2	3	2	3
<b>CO3</b>	2	2	3	2	3	2	2	2	3	3	3
<b>CO4</b>	3	3	3	3	2	3	3	3	3	3	3
<b>CO5</b>	3	3	2	3	2	2	3	3	3	2	3
<b>Total</b>	12	13	13	13	13	13	12	12	15	12	15
<b>Average</b>	3	2.8	3	2.8	3	2.8	3	3	3	3	3

**3 – Strong, 2- Medium, 1- Low**

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
<b>24UMAE52</b>	<b>Special Functions</b>	<b>Elective</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>25</b>	<b>75</b>	<b>100</b>
<b>Learning Objectives</b>											
LO1	To develop computational skills in certain special functions which are frequently occurring in higher mathematics and mathematical physics.										
LO2	To know the numerical solutions using the Taylor series.										
LO3	To learn the concepts of simultaneous linear differential equations and some solvable types of nonlinear equations. .										
LO4	To understand the concepts of Bessel functions, Legendre functions and their properties										
LO5	To give an insight the Fourier integral, term by term differentiation of Fourier series and Legendre series.										
Unit	Content										Hours
1	Properties of Linear Operators-Simultaneous Linear Differential Equations - Special Solvable Types of Non-linear Equations.										9
2	Numerical Solutions Using Taylor Series - Adams and Modified Adams Method - Extrapolation with Differences										9
3	Properties of Power Series-Examples - Singular Points of Linear Second Order Differential Equations - Method of Frobenius.										9
4	Bessel Functions – Properties - Legendre Functions.										9
5	Term by Term Differentiation of Fourier Series, Legendre Series - Fourier Integral.										9
	<b>Total</b>										<b>45</b>
<b>Theory 80% problem 20%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	<b>The Students will be able to</b>
CO1	Solve simultaneous linear differential equations and analyze certain nonlinear differential equations.
CO2	Apply numerical methods such as Taylor series and Adams methods to approximate solutions of differential equations.
CO3	Know the power series solutions and apply the method of Frobenius to differential equations.
CO4	Understand Bessel and Legendre functions and apply their properties in problem-solving.
CO5	Evaluate Fourier series and Fourier integrals, including term-by-term differentiation and related concepts.
<b>Recommended Text book:</b>	
1	F. B. Hilde brand, Advanced Calculus for Applications. Prentice Hall, New Jersey,1977.
<b>Reference Books:</b>	
1	J. N. Sharma and R.K. Gupta, Special Functions, Krishna Prakashan Mandir, Meerut, 1998.
2	Satya Prakash, Mathematical Physics. Sultan & Sons. New Delhi, 2004.
3	B.D. Gupta, Mathematical Physics, Vikas Publishing House, 1978.
4	N.M. Temme, Special Functions, Wiley, 1996.
5	G.E. Andrews, R. Askey, R. Roy, Special Functions, Cambridge University Press, 2001.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://nptel.ac.in">https://nptel.ac.in</a>
2	<a href="https://www.mathhelp.com/">https://www.mathhelp.com/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	2	3	3	3	3	3	3	2	3	2	3
<b>CO2</b>	3	2	3	3	2	3	3	3	2	3	2
<b>CO3</b>	2	2	3	3	3	3	2	3	3	2	3
<b>CO4</b>	3	3	2	3	3	2	3	2	3	3	3
<b>CO5</b>	2	3	3	2	3	3	3	3	2	2	3
<b>Total</b>	12	13	14	14	14	14	14	13	13	12	14
<b>Average</b>	2.4	2.6	2.8	2.8	2.8	2.8	2.8	2.6	2.6	2.4	2.8

**3 – Strong, 2- Medium, 1- Low**

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
<b>24UMAE53</b>	<b>Mathematical Modelling</b>	<b>Elective</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>25</b>	<b>75</b>	<b>100</b>
<b>Learning Objectives</b>											
LO1	To understand the fundamentals and significance of mathematical modelling in representing real-world situations.										
LO2	To classify different types of mathematical models and identify their key characteristics and applications.										
LO3	To develop and analyze models formulated through differential equations, including linear, non-linear and compartmental types.										
LO4	To construct and interpret system models such as prey–predator, competition and epidemic models using ordinary differential equations.										
LO5	To Learn IPR concepts to identify and protect intellectual property.										
Unit	Content									Hours	
1	<b>Mathematical Modelling:</b> Simple situations requiring mathematical modelling – The Technique of mathematical modelling - Classification of Mathematical Models – Some Characteristics of mathematical models. <b>Chapter: 1 Section: 1.1 - 1.4.</b>									9	
2	<b>Mathematical Modelling through Ordinary differential equations of first order:</b> Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models. <b>Chapter: 2 Section: 2.2 - 2.4.</b>									9	
3	<b>Mathematical Modelling, through system of Ordinary differential equations of the first order:</b> Mathematical modelling in population dynamics - Mathematical modelling of epidemics through systems of ordinary differential equation of first order. <b>Chapter: 3 Section: 3.1 and 3.2.</b>									9	
4	<b>Mathematical Modelling through difference equations:</b> The need for Mathematical modelling through difference equations: some simple models - Basic theory of linear difference equations with constant coefficients - Mathematical modelling through difference equations in economics and finance. <b>Chapter: 5 Section: 5.1 - 5.3.</b>									9	
5	<b>Mathematical Modelling in IPR:</b> Introduction to intellectual Property rights, Patenting – Factors for Patentability – Novelty, Non-Obviousness, Marketability. Procedures for registration of Patents. Copyright works, Ownership, Transfer and Duration of copyright. Renewal and Termination of copyright. Industrial Designs – Need for Protection of Industrial designs. Procedure for obtaining design protection. Infringement, right of goodwill, passing off.									9	
<b>Total</b>									<b>45</b>		
<b>Theory 80% Problem 20%</b>											

CO	Course Outcomes
	<b>The Students will be able to</b>
CO1	Explain simple situations requiring mathematical modelling and determine the characteristics and classifications of such models.
CO2	Develop models using differential equations to represent linear and non-linear growth and decay processes, including compartmental systems.
CO3	Construct and analyze models using systems of first-order ordinary differential equations, including prey–predator, competition and epidemic models.
CO4	Apply the concept of difference equations in developing discrete-time mathematical models for various real-world scenarios.
CO5	Understand basics of IPR, patents, copyright, and design protection.
<b>Recommended Text books:</b>	
1	J. N Kapur, Mathematical Modelling, New Age International, Publishers, 2009 (Unit I - IV).
2	Elad Harison, Intellectual property rights, Innovation and software technologies. Edward Elgar Publishing Limited, UK, 2008 (Unit -V).
<b>Reference Books:</b>	
1	D. N. Burghes, Modelling with Difference Equations, Ellis Harwood and John Wiley, 2021.
2	D. J. G. James and J. J. Macdonald, Case studies in Mathematical Modelling, Stanly Thames, Cheltonham, 2025.
3	M. Cross and A. O. Moscardini, The art of Mathematical Modelling, Ellis Harwood and John Wiley, 1985.
4	Subbian A , Bhaskaran S, Intellectual property rights: Heritage, Science and Society, 2007.
5	Sateesh MK, Bioethics & Biosafety, IK International publications, 2008.
<b>Website and e-Learning Sources:</b>	
1	<a href="http://www.mathfoundation.com">http://www.mathfoundation.com</a>
2	<a href="https://nptel.ac.in">https://nptel.ac.in</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	2	3	3	3	2	2	3	3	2	3	2
<b>CO2</b>	2	3	3	3	2	2	3	2	2	3	2
<b>CO3</b>	2	3	3	3	2	2	3	3	2	3	2
<b>CO4</b>	3	2	3	2	2	2	3	2	2	3	2
<b>CO5</b>	2	3	2	3	2	2	3	3	2	3	2
<b>Total</b>	11	14	14	14	10	10	15	13	10	15	10
<b>Average</b>	2.2	2.8	2.8	2.8	2	2	3	2.6	2	3	2

3 – Strong, 2- Medium, 1- Low

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAE54	Financial Analytics	Elective	2	1	0	0	3	3	25	75	100
<b>Learning Objectives</b>											
LO1	To classify the fundamentals of financial analytics and its role in modern finance.										
LO2	To construct the structure, functions, and regulatory framework of the stock market.										
LO3	To apply portfolio management principles, including asset allocation and investment analysis techniques.										
LO4	To analyse financial risks and apply appropriate risk assessment and management methods.										
LO5	To understand fraud analytics and develop strategies for fraud detection and prevention.										
Unit	Content									Hours	
1	<b>Understanding Financial Analytics:</b> Provide an in-depth understanding of financial analytics - its relevance, and scope in today's financial landscape - Highlight recent trends and introduce the tools and techniques employed in finance.									9	
2	<b>Stock Market Fundamentals:</b> Introduce the history – importance and role of the stock market in the economy. Familiarize students with stocks - bonds, derivatives, and the roles of different market participants - Long-term vs. short-term investing - Diversification and its importance in a portfolio Regulatory bodies and their role in overseeing stock market activities - Compliance and legal aspects in stock market operations.									9	
3	<b>Portfolio Management Skills:</b> The principles of portfolio construction - including Modern Portfolio Theory, asset allocation, and the use of fundamental and technical analysis. Explore behavioral finance - the Capital Asset Pricing Model - risk measures in portfolio management.									9	
4	<b>Risk Assessment and Management:</b> Explain different types of financial risks - their characteristics, and interrelationships. Cover methodologies such as Value at Risk - stress testing, and risk control methods like hedging and diversification. Discuss regulatory aspects related to risk management.									9	
5	<b>Fraud Analytics and Prevention:</b> Define various types of financial fraud, emphasize ethical considerations - regulatory compliance - the strategies and technologies employed in fraud risk management. Introduce real-world case studies for practical understanding.									9	
	<b>Total</b>									<b>45</b>	
<b>Theory 80% problem 20%</b>											

CO	Course Outcomes The Students will be able to
CO1	Understand the significance and relevance of financial analytics, recent trends and the application of analytical tools and techniques in finance.
CO2	Gain a comprehensive understanding of the stock market, its history, functions and the roles played by different market participants and regulatory bodies.
CO3	Acquire the skills necessary to construct portfolios based on Modern Portfolio Theory, analyze asset allocation, employ fundamental and technical analysis and monitor and adjust portfolios.
CO4	Identify different types of financial risks, understand risk and return relationships and apply various risk assessment and management techniques.
CO5	Recognize different types of financial fraud apply ethical considerations in fraud detection and develop strategies to prevent and manage fraud.
<b>Recommended Text book:</b>	
1	Pitabas Mohanty, Financial Analytics, Wiley India, ISBN 978-93-5464-417-7, 2023.
<b>Reference Books:</b>	
1	Argimiro Arratia, Computational Finance An Introductory Course with R, Atlantis Press, ISBN 978-94-6239- 069-0, 2014.
2	Bernhard Pfaff, Financial risk Modeling and portfolio optimization with R, Wiley, ISBN 978-0-470-97870-2, 2013.
3	Cairns, A.J. G, and Interest Rate Models: An Introduction, Princeton University Press, ISBN: 9780691118949, 2004.
4	Christian Gourieroux & Joann Jasiak, Financial Econometrics: Problems, Models, and Methods, Princeton University Press, ISBN: 9780691088723, 2002.
5	David Ruppert, Statistics and Data Analysis for Financial Engineering, Springer, ISBN 978-1-4419-7786-1, 2011.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://nptel.ac.in/">https://nptel.ac.in/</a>
2	<a href="https://www.sanctions.io/blog/financial-fraud-prevention">https://www.sanctions.io/blog/financial-fraud-prevention</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	2	2	2	2	3	2	2	3	3
<b>CO2</b>	2	3	3	2	2	3	2	3	2	3	3
<b>CO3</b>	3	2	2	2	3	2	3	3	2	2	3
<b>CO4</b>	2	3	2	2	2	3	3	2	2	2	2
<b>CO5</b>	3	2	2	2	2	3	2	3	3	3	2
<b>Total</b>	13	12	11	10	11	13	13	13	11	13	13
<b>Average</b>	2.6	2.4	2.2	2	2.2	2.6	2.6	2.6	2.2	2.6	2.6

3 – Strong, 2- Medium, 1- Low

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UAEC51	<b>Gender Equality and Social Inclusion</b>	AEC	2	-	-	-	2	2	25	75	100
Learning Objectives											
LO1	To understand the introduction to Gender and Social Inclusion										
LO2	To acquire knowledge on Gender inequality in society										
LO3	To equip Social Exclusion and Marginalized Group										
LO4	To understand Legal Frameworks and Policies										
LO5	To assimilate knowledge about Strategies for Promoting Equality and Inclusion										
Unit	Content										Hours
1	<b>Introduction to Gender and Social Inclusion:</b> Concepts Gender-Gender roles, stereotypes, and socialization - Meaning and importance of social inclusion- Intersectionality (gender, caste, class, disability, etc.) - Historical perspectives on gender inequality.										6
2	<b>Gender Inequality in Society:</b> Forms of gender discrimination (education, health, employment) - Gender-based violence and its types - Wage gap and economic inequality - Representation of gender in media and culture - Case studies on gender inequality (local and global).										6
3	<b>Social Exclusion and Marginalized Groups:</b> Understanding social exclusion - Marginalized communities (women, LGBTQ+ individuals, persons with disabilities, minorities) - Barriers to inclusion (social, economic, political) - Role of culture, tradition, and norms in exclusion - Impact of exclusion on development.										6
4	<b>Legal Frameworks and Policies:</b> National and international laws promoting gender equality - Human rights perspective on inclusion - Government policies and welfare programs - Role of institutions (NGOs, UN, civil society).										6
5	<b>Strategies for Promoting Equality and Inclusion:</b> Gender mainstreaming and inclusive development - Education and awareness programs - Role of media and technology - Empowerment approaches (economic, social, political) - Community participation and leadership - Measuring progress (indicators like SDGs)										6
<b>Total</b>										30	

Theory 100%

CO	Course Outcomes
CO1	Understand the introduction to Gender and Social Inclusion
CO2	Acquire knowledge on Gender inequality in society
CO3	Equip the knowledge on Social Exclusion and Marginalized Group
CO4	Understand Legal Frameworks and Policies towards gender Equality
CO5	Gain knowledge about Strategies for Promoting Equality and Inclusion
<b>Textbooks:</b>	
1	Development as Freedom, Amartya Sen, Publisher: Oxford University Press (1999).
<b>Reference Books:</b>	
1	Gender Trouble: Feminism and the Subversion of Identity, 2 <sup>nd</sup> Edition (1999 revised edition) Publisher: Routledge, London & New York.
2	David E. Newton, Gender Inequality: A Reference Handbook, Bloomsbury Academic, 2019.
3	Gender Inequality: A Reference Handbook, by David E. Newton ABC-CLIO, 2019.
<b>Web resources:</b>	
1	<a href="#">GESI-Traning-Module.pdf</a>
2	Gender Equality_and_Social_Inclusion WV.pdf
3	<a href="#">integrity-action-gesi-strategy-version-2.pdf</a>
4	<a href="#">Major Marginalized Groups: A Closer Look - Urban Studies</a>
5	<a href="#">UNOPS GESI Mainstreaming in Projects Strategy (Final)</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	2	2	3	2	3	2	3	3	2	2	2
<b>CO2</b>	2	2	2	2	2	2	2	2	2	2	2
<b>CO3</b>	2	3	3	2	3	2	3	3	2	2	2
<b>CO4</b>	2	2	2	2	2	2	2	2	3	2	2
<b>CO5</b>	3	3	3	2	3	2	3	3	3	2	2
<b>TOTAL</b>	11	12	13	10	13	10	13	13	12	10	10
<b>AVERAGE</b>	2.2	2.4	2.6	2	2.6	2	2.6	2.6	2.4	2	2

**3– Strong,2-Medium, 1-Low**

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAIN51	Internship		0	0	0	0	2	0	25	75	100
<b>Learning Objectives</b>											
LO1	To gain practical exposure by working in a professional environment and understanding real-world applications of theoretical knowledge.										
LO2	To identify, analyze, and execute a suitable project related to the field of study during the internship period.										
LO3	To develop technical, problem-solving, and teamwork skills through active participation in assigned tasks.										
LO4	To enhance documentation and reporting skills by preparing a structured internship report as per institutional guidelines.										
LO5	To improve communication, presentation, and interpersonal skills through interaction and viva voce evaluation.										
<b>REGULATIONS</b>											
1	All students are required to complete an internship in a relevant company, industry, or organization as part of their course to gain practical experience.										
2	After finishing the fourth semester, students must select and evaluate an appropriate project to be carried out during the second-year vacation for duration of 30 hours.										
3	Throughout the internship, students should actively engage in the tasks assigned to them and maintain proper records of the work completed during the training period.										
4	Students must prepare a comprehensive internship report and submit it in the format specified by the institution.										
5	The internship report must be submitted at the end of the semester, followed by a viva voce examination, which is compulsory. Failure to submit the report or attend the viva will result in the student being marked absent.										
6	The internship will be evaluated for a total of 100 marks, comprising Internal Assessment – 25 marks and External Examination – 75 marks, including evaluation of the report and viva voce. The assessment will be conducted jointly by internal and external examiners as per university norms.										
7	Students must obtain at least 50% of the total marks to pass. Those who do not achieve this minimum must enhance their performance and resubmit the report in the next attempt. The final report should contain all required sections and be submitted to the Controller of Examinations within the given deadline.										

<b>Course Outcomes</b>	
<b>CO</b>	<b>The students will be able to</b>
CO1	Apply theoretical knowledge in practical situations through internship experience in a relevant organization.
CO2	Demonstrate the ability to plan, analyze and complete a project within the given duration effectively.
CO3	Exhibit improved technical competence, problem-solving ability and teamwork during the training period.
CO4	Prepare and present a detailed internship report following the prescribed academic standards.
CO5	Achieve overall professional development, including communication skills and the ability to perform in viva voce examinations.

#### **Internal Marks Awarded for the Internship – 25 Marks**

<b>Component</b>	<b>Marks</b>
Internship Review I (During the Beginning of the Semester)	5 Marks
Internship Review II (During the end of the Semester)	15 Marks
Progress of the Internship by the Student Participated	5 Marks

#### **External Marks Awarded for the Internship – 75 Marks**

<b>Component</b>	<b>Marks</b>
Evaluation of the Internship Report	25 Marks
Presentation	25 Marks
Viva Voce Examination	25 Marks

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAİK51	<b>Indian Mathematics: Tradition to Transformation</b>	IKS	1	1	0	0	0	2	25	75	100
<b>Learning Objectives</b>											
LO1	To understand the origin and development of ancient Indian mathematics and its key contributions.										
LO2	To learn large numbers, the decimal system and the concepts of zero and infinity in Jain and Buddhist traditions.										
LO3	To explore the Bakhshali Manuscript and understand early Indian mathematical notations, operations and the development of Siddhanta astronomy.										
LO4	To know the contributions of Aryabhata and his followers in the advancement of Indian mathematics and astronomy.										
LO5	To study Western mathematics, European accounts of Indian science and contributions of Srinivasa Ramanujan.										
Unit	Content									Hours	
1	<b>Indian mathematics in world mathematics: An overview</b> Indian Mathematics: Unravelling its Roots-Indian Mathematics in World Mathematics: Global Interactions <b>Chapter: 2 Section: 2.1 and 2.2</b>									6	
2	<b>From Zero to Infinity: Mathematics in Jain and Buddhist Literature :</b> Introduction-Large Numbers: An Indian Obsession- The Evolution of the Indian Decimal Place value system-Sunyata and the Emergence of the Mathematical Zero-The Infinity: The Jain Preoccupation <b>Chapter: 4 Section: 4.1 - 4.5</b>									6	
3	<b>Down to Earth and Reach for the Stars: The Bakhshali and Siddhanta Episodes :</b> The Bakhshali Manuscript- Notations and Operations-Early Indian Astronomy and the Emergence of the Siddhantas <b>Chapter: 5 Section: 5.1 - 5.3</b>									6	
4	<b>Heralding the Golden Age: Aryabhata I and his Followers:</b> Introduction-The Mathematics in Aryabhataiya <b>Chapter: 6 Section: 6.1 and 6.2</b>									6	
5	<b>Battle for the Mind: The Rise of Western Mathematics:</b> Introduction - Early European Accounts of Indian Astronomy and mathematics-Srinivasa Ramanujan -The Indian Way of Knowing <b>Chapter: 13 Section: 13.1 to 13.4</b>									6	
	<b>Total</b>									<b>30</b>	
<b>Theory100%</b>											

CO	Course Outcomes The students will be able to
CO1	Know the historical development of ancient Indian mathematics and its major contributions.
CO2	Explain large numbers, the decimal system, zero and infinity in Jain and Buddhist literature.
CO3	Understand the Bakhshali Manuscript and the development of early Indian mathematical methods and Siddhanta astronomy.
CO4	Describe the contributions of Aryabhata and his followers in the development of Indian mathematics and astronomy.
CO5	Classify Western mathematics, European accounts of Indian science and contributions of Srinivasa Ramanujan.
<b>Recommended Text Book:</b>	
1	George Gheverghese Joseph, Indian Mathematics Engaging with the World from Ancient to Modern Times, World Scientific Publishing Co. Pvt. Ltd, First Indian Edition-2022, Reprinted, 2024.
<b>Reference Books:</b>	
1	Kaye, G.R The Bakhshali Manuscript: A Study in Mediaeval Mathematics, Archaeological Survey of India, New Imperial Series, Vol. 43. Parts 1-3. Government of India Central Publication Branch, 1933.
2	Keller, A. Expounding the Mathematical Seed. Vols. 1 and 2, Birkhauser, Basel, 2006.
3	Puttusaamy, T. Mathematical Achievements of Pre-modern Indian Mathematicians, Elsevier, London, 2012.
4	Shukla, K. S. Aryabhatiya of Aryabhata, with the Commentary of Bhaskara I and Somesvara, Indian National Science Academy, New Delhi, 1976.
5	Sihag, B. S. Koutilya: The True Founder of Economics, Vitasta Publications, New Delhi, 2014.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://mathshistory.st-andrews.ac.uk/HistTopics/Jaina_mathematics/">https://mathshistory.st-andrews.ac.uk/HistTopics/Jaina_mathematics/</a>
2	<a href="https://www.britannica.com/biography/Aryabhata-I">https://www.britannica.com/biography/Aryabhata-I</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	3	2	3	2	3	2	3	3	3
<b>CO2</b>	2	3	2	3	3	3	3	2	2	3	2
<b>CO3</b>	3	2	2	3	3	3	3	2	3	3	2
<b>CO4</b>	3	3	3	3	3	2	2	2	3	3	3
<b>CO5</b>	3	2	3	3	3	3	2	2	3	3	3
<b>Total</b>	14	12	13	14	15	13	13	10	14	15	13
<b>Average</b>	2.8	2.4	2.6	2.8	3	2.6	2.6	2	2.8	3	2.6

3-Strong, 2-Medium, 1-Low

### III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC61	Linear Algebra	Core	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To understand the fundamental concepts of vector spaces, linear dependence, basis and dimension.										
LO2	To learn dual spaces, annihilators and inner product spaces.										
LO3	To study linear transformation and to define characteristics roots and vectors.										
LO4	To apply matrix representation of linear transformations and study their canonical and triangular forms.										
LO5	To understand matrices, determinants and their properties, and solve systems of linear equations.										
Unit	Content									Hours	
1	<b>Vector Spaces:</b> Elementary Basic Concepts - Linear dependence and independence - Bases - Dimension - Basic concepts and examples <b>Chapter: 4.1 and 4.2</b>									15	
2	<b>Vector Spaces [Contd...]</b> Dual spaces - Annihilator of a Subspace - Inner product spaces. <b>Chapter: 4.3 and 4.4</b>									15	
3	<b>Linear Transformations:</b> The Algebra of linear transformations - Sub Algebra - Minimal Polynomial - Invertible - Characteristics roots - Characteristic Vectors. <b>Chapter: 6.1 and 6.2</b>									15	
4	<b>Linear Transformations [Contd...]</b> Matrices - Matrix of a Linear Transformation and its Properties - Canonical forms - Triangular forms - Invariant Transformation - Triangular Matrix of 'T'. <b>Chapter: 6.3 and 6.4</b>									15	
5	<b>Linear Transformations [Contd...]</b> Trace and Transpose: Definition and Properties - Jacobson Lemma - Symmetric, Skew Symmetric and Adjoint of a matrix -Determinants: Definition and Properties - Solving system of Linear Equations - Secular Equation. <b>Chapter: 6.8 and 6.9</b>									15	
<b>Total</b>									<b>75</b>		
<b>Theory 80% Problem 20%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	<b>The students will be able to</b>
CO1	Identify and analyze linearly dependent and independent vectors.
CO2	Gain the ability to understand and apply the concepts of dual spaces and inner product spaces.
CO3	Explain linear transformation and to define characteristics roots and vectors.
CO4	Work on matrix of a linear transformation and its properties.
CO5	Solve systems of linear equations using matrices and determinants.
<b>Recommended Text Book:</b>	
1	I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd. New Delhi, 2009.
<b>Reference Books:</b>	
1	S. Arumugam, Isaac .A.T, Modern Algebra, SciTech Publications (India) Pvt. Ltd, Chennai.
2	Stephen H Friedberg, Arnold J Insel, Lawrence E Spence, Linear Algebra Fifth Edition, Pearson India Pvt. Ltd., Chennai.
3	N.S Gopalakrishnan, University Algebra, Second Edition, New Space Age International Pvt. Ltd., publishers.
4	Lloyd R. Jaisingh and Frank Ayres. Jr, Abstract Algebra, [2nd edition], Tat McGraw Hill, New Delhi, 2005.
5	Surjeet Singh and Qazi Zameeruddin, Modern algebra, Vikas Publishing House Pvt. Ltd., New Delhi, 1982.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://ocw.mit.edu/courses/18-702-algebra-ii-spring-2011/">https://ocw.mit.edu/courses/18-702-algebra-ii-spring-2011/</a>
2	<a href="http://www.wolfram.com/wolfram-u/introduction-to-linear-algebra/">http://www.wolfram.com/wolfram-u/introduction-to-linear-algebra/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	3	2	3	2	2	3	3	2	3
<b>CO2</b>	3	2	3	2	3	2	3	3	3	2	2
<b>CO3</b>	2	2	3	3	3	3	3	3	3	2	2
<b>CO4</b>	3	3	3	3	3	3	2	2	3	2	3
<b>CO5</b>	3	3	3	3	3	3	2	3	3	2	3
<b>Total</b>	14	12	15	13	15	13	12	14	15	10	13
<b>Average</b>	2.8	2.4	3	2.6	3	2.6	2.4	2.8	3	2	2.6

**3–Strong, 2-Medium, 1-Low**

### III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC62	Real Analysis	Core	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To study the concepts of Continuous functions, open and close sets and Connected sets.										
LO2	To gain the knowledge about bounded and totally bounded sets, continuity of inverse functions and Uniform continuity.										
LO3	To know about Riemann integral and properties of Riemann integral.										
LO4	To learn the concept of differentiability and to derivation of Rolle's theorem, Law of mean and Fundamental theorem of calculus.										
LO5	To derive the Taylor's theorem and understand the point wise and uniform convergence of sequence of function.										
Unit	Content										Hours
1	<b>Continuous Functions on Metric Spaces:</b> Introduction to Continuous Functions on Metric Spaces -Open sets – closed sets. <b>Connectedness, Completeness and Compactness:</b> More about open sets - Connected sets. <b>Chapter: 5 Section: 5.4 and 5.5</b> <b>Chapter: 6 Section: 6.1 and 6.2</b>										15
2	<b>Connectedness, Completeness and Compactness (Contd..)</b> Bounded sets and totally bounded sets - Complete metric spaces - Compact metric spaces - Continuous functions on compact metric spaces - Continuity of the inverse function - Uniform continuity. <b>Chapter: 6 Section: 6.3 - 6.8</b>										15
3	<b>Calculus:</b> Sets of measure zero - Definition of the Riemann integral - Properties of Riemann integral. <b>Chapter: 7 Section: 7.1 and 7.2, 7.4</b>										15
4	<b>Calculus (Contd...)</b> Derivatives - Rolle's theorem - The Law of the mean, Fundamental theorems of calculus. <b>Chapter: 7 Section: 7.5 - 7.8</b>										15
5	<b>Sequences and Series of Functions:</b> Point wise convergence of sequences of functions - Uniform convergence of sequences of functions - Consequences of Uniform convergence. <b>Chapter: 9 Section: 9.1 - 9.3</b>										15
<b>Total</b>										<b>75</b>	
<b>Theory 80% problem 20%</b>											

<b>CO</b>	<b>Course Outcomes</b>
	<b>The Students will be able to</b>
CO1	Understand the Continuous functions, open and close sets, Connected set.
CO2	Learn the bounded and totally bounded sets, continuity of inverse functions and Uniform continuity.
CO3	Acquired knowledge Riemann integral and work on properties of Riemann integral.
CO4	Apply the concept of differentiability and to Explain Rolle's theorem, Law of mean and Fundamental theorem of calculus.
CO5	Work on Taylor's theorem, the point wise and uniform convergence of sequence of function.
<b>Recommended Text Book:</b>	
1	Richard R. Goldberg, Methods of Real Analysis - Indian edition – Oxford and IBH Publishing Co, New Delhi, 1970.
<b>Reference Books:</b>	
1	Tom M Apostol, Mathematical Analysis, Narosa Publishing House, 2 <sup>nd</sup> edition, Addison-Wesley publishing company, New Delhi, 1974.
2	Walter Rudin, Principles of Mathematical Analysis, Tata McGraw Hill Education, Third edition, 2017.
3	R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) Pvt. Ltd., 2000.
4	E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.
5	K.A. Ross, Elementary Analysis- The Theory of Calculus Series Undergraduate Texts in Mathematics, Springer Verlag, 2003.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://nptel.ac.in/">https://nptel.ac.in/</a>
2	<a href="https://www.math.clemson.edu/~petersj/Courses/M454/Lectures/L12-RIProperties.pdf">https://www.math.clemson.edu/~petersj/Courses/M454/Lectures/L12-RIProperties.pdf</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	3	3	2	3	2	3	3	3	3	2	3
<b>CO2</b>	3	3	2	3	2	3	3	3	3	2	3
<b>CO3</b>	3	3	3	3	2	3	3	3	3	2	3
<b>CO4</b>	3	3	3	3	2	2	3	3	3	2	2
<b>CO5</b>	3	3	2	3	2	3	3	3	3	2	3
<b>Total</b>	15	15	12	15	10	14	15	15	15	10	14
<b>Average</b>	3	3	2.4	3	2	2.8	3	3	3	2	2.8

**3 – Strong, 2- Medium, 1- Low**

### III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAC63	Project	Core	0	0	0	5	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To engage in a real-time project environment to apply theoretical knowledge for practical problem-solving.										
LO2	To analyze different stages of project development and implementation while demonstrating effective teamwork and collaboration.										
LO3	To demonstrate technical proficiency, analytical skills, and professional ethics in executing the assigned project work.										
LO4	To develop specialized knowledge and innovative approaches relevant to the chosen project domain.										
LO5	To strengthen communication, documentation and presentation skills required for professional project execution.										
<b>REGULATIONS</b>											
1	Every student must undertake a project work in a relevant domain, preferably aligned with their area of specialization, during the course of study to gain practical and analytical exposure.										
2	Each student shall undertake the project work either individually or in a group under the guidance of a faculty member, ensuring proper supervision throughout the project.										
3	During the project period, students shall actively engage in all phases of the work, including problem identification, analysis, design, implementation, and documentation.										
4	A comprehensive project report shall be prepared and submitted by the student in accordance with the prescribed institutional format. The Project Report shall be prepared using Times New Roman font, size 12, with double line spacing, and the total length of the report shall be between 60 and 100 pages, including annexure.										
5	The project report submission will take place at the end of the semester, followed by a presentation and viva voce evaluation during the semester examination.										
6	The project work shall be evaluated for a total of 100 marks, comprising Internal Assessment of 25 marks and External Examination of 75 marks. The Internal Assessment includes 15 marks for the project report and 10 marks for the Internal Viva-Voce. The External Examination includes 50 marks for the project report and 25 marks for the Viva-Voce.										
7	Students must secure at least 50% of the total marks to pass. Those who fail to meet this requirement must improve their performance and resubmit the project report in the next available attempt. The final report must include all prescribed sections and be submitted to the Controller of Examinations within the specified date.										

<b>CO</b>	<b>Course Outcomes</b>
	<b>The Students will be able to</b>
CO1	Identify and define a real-world problem, applying relevant concepts and methodologies to develop an effective project solution.
CO2	Cultivate independent thinking, critical analysis and collaborative skills throughout the project lifecycle.
CO3	Demonstrate professional ethics, responsibility and effective project management abilities.
CO4	Communicate technical findings clearly through well-structured documentation and presentations.
CO5	Enhance readiness for professional employment or further research by applying innovative and creative approaches to project development.

#### **Internal Marks Awarded for the Project - 25 Marks**

<b>Component</b>	<b>Marks</b>
Project Review I (Beginning of the Semester)	5 Marks
Project Review II (End of the Semester)	15 Marks
Active Participation and Progress of the Project	5 Marks

#### **External Marks Awarded for the Project – 75 Marks**

<b>Component</b>	<b>Marks</b>
Evaluation of the Project Report	25 Marks
Project Presentation	25 Marks
Viva Voce Examination	25 Marks

### III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAE61	Transform Techniques	Elective	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To comprehend and apply Laplace transforms to evaluate elementary and periodic functions using its properties.										
LO2	To compute inverse Laplace transforms and employs them in solving differential equations.										
LO3	To understand and apply Fourier coefficients and Fourier series for odd and even functions.										
LO4	To gain knowledge of Fourier integrals, transforms and their applications.										
LO5	To study inverse Z transform and various methods for its determination.										
Unit	Content										Hours
1	<b>Laplace Transform:</b> Introduction - Laplace transform of elementary functions -Properties - Problems - Periodic functions. <b>Chapter: 7 Section: 1 - 3.</b>										15
2	<b>Inverse Laplace Transform:</b> Inverse Laplace transform of some functions - Properties - Problems - Solving Differential Equations using Laplace transform. <b>Chapter: 7 Section: 4 and 5.</b>										15
3	<b>Fourier Series:</b> Introduction - Fourier Coefficients - Problems - Fourier series for odd and even functions and its applications. <b>Chapter: 6</b>										15
4	<b>Fourier Transform:</b> Introduction - Dirichlet's conditions-Fourier Integral Theorem(statement only) - Fourier sine and cosine Integrals, Complex form of Fourier Integral, Inversion formula for Complex Fourier transform, Fourier sine and cosine transforms and properties of Fourier transforms(no derivation) - Convolution Theorem (Statement only)- Parsavel's Identity Applications. <b>Chapter: 8</b>										15
5	<b>The Z - Transforms:</b> Definition of Z - transform - Properties of Z -transform(Linearity, First Shifting and Second Shifting) - Initial value theorem - Final value theorem - The Inverse Z - transform - Methods of solving the inverse Z - transform(Method of Partial fraction, Method of Residue theorem, Long division method). <b>Chapter: 5</b>										15
<b>Total</b>										<b>75</b>	
<b>Theory 80% Problem 20%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	<b>The students will be able to</b>
CO1	Apply Laplace transform to evaluate elementary functions and solve problems.
CO2	Find inverse Laplace transforms and solve differential equations using Laplace transform.
CO3	Calculate Fourier coefficients and represent odd and even functions using Fourier series.
CO4	Utilize Fourier integrals, transforms, and associated results in solving problems.
CO5	Compute inverse Z transform using different methods.
<b>Recommended Text Books:</b>	
1	P.R. Vittal, Differential Equations, Fourier and Laplace Transforms Probability, Margham Publications, Chennai, 2002. <b>(Unit-I to IV)</b>
2	A. Singaravelu, Transforms and Partial Differential Equations, Meenakshi Agency, Chennai, 2010. <b>(Unit- V)</b>
<b>Reference Books:</b>	
1	S. Narayanan and T. K. Manickavachagom Pillay, Calculus, Volume III, S. Viswanathan Printers and Publishers Pvt. Ltd, Chennai, 2006.
2	S. Arumugam and Issac, Differential Equations and Applications, New Gamma Publishing House, Palayamkottai, 2011.
3	J.K. Goyal and K.P.Gupta, Laplace and Fourier Transforms, Pragati Prakashan Publishers, Meerut, 1995.
4	M. K. Venkataraman and Manorama Sridhar - Differential Equations and Laplace Transform, The National Publishing Company, 2004.
5	T. Veerarajan – Transforms and Partial Differential Equations- Tata McGraw Hill Education Pvt. Limited, New Delhi, 2012.
<b>Website and e -Learning Sources:</b>	
1	<a href="https://nptel.ac.in">https://nptel.ac.in</a>
2	<a href="https://www.mathhelp.com/">https://www.mathhelp.com/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	3	2	3	2	2	3	3	2	3
<b>CO2</b>	3	2	3	2	3	2	3	3	3	2	2
<b>CO3</b>	2	2	3	3	3	3	3	3	3	2	2
<b>CO4</b>	3	3	3	3	3	3	2	2	3	2	3
<b>CO5</b>	3	3	3	3	3	3	2	3	3	2	3
<b>Total</b>	14	12	15	13	15	13	12	14	15	10	13
<b>Average</b>	2.8	2.4	3	2.6	3	2.6	2.4	2.8	3	2	2.6

**3–Strong, 2-Medium, 1-Low**

### III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAE62	Discrete Mathematics	Elective	3	1	1	0	4	5	25	75	100
<b>Learning Objectives</b>											
LO1	To Solve recurrence relations and use generating functions.										
LO2	To Understand basic concepts of mathematical logic and truth tables.										
LO3	To Analyse logical statements using replacement process and duality law.										
LO4	To constrain the structure and properties of lattices.										
LO5	To Apply Boolean algebra and Karnaugh maps for simplification.										
Unit	Content									Hours	
1	<b>Recurrence Relations and Generating Functions:</b> Recurrence - Polynomials and their Evaluations - Recurrence Relations - Solution of Finite Order Homogeneous [linear] Relations - Solutions of Non-homogeneous Relations. <b>Chapter: 5 Section: 1 - 5</b>									15	
2	<b>Mathematical Logic:</b> TF Statements - Connectives - Atomic and Compound Statements - Well-formed [Statement Formulae]- Truth Table of a Formula-Tautology -Tautological Implications and Equivalence of Formulae. <b>Chapter: 9 Section: 1 - 8</b>									15	
3	<b>Mathematical Logic [Contd..]</b> Replacement process - Functionally complete sets of connectives and Duality law – Normal Forms Principal Normal Forms. <b>Chapter: 9 Section: 9 - 12</b>									15	
4	<b>Lattices:</b> Lattices - Some properties of Lattices - New Lattices - Modular and Distributive Lattices <b>Chapter: 10 Section: 1 - 4</b>									15	
5	<b>Boolean Algebra:</b> Boolean Algebra - Boolean Polynomials- Karnaugh Maps <b>Chapter: 10 Section: 5 - 7</b>									15	
<b>Total</b>									<b>75</b>		
<b>Theory 80% problem 20%</b>											

CO	Course Outcomes
	<b>The Students will be able to</b>
CO1	Solve recurrence relations and apply generating functions to discrete problems.
CO2	Analyse and apply concepts of mathematical logic, including truth tables, equivalence.
CO3	Construct and validate mathematical proofs with logical reasoning and Principle normal forms clarity.
CO4	Understand and apply concepts of lattices and their properties.
CO5	Apply Boolean algebra and Karnaugh maps to simplify logical expressions.
<b>Recommended Text Book:</b>	
1	M.K. Venkataraman, N. Sridharan and N. Chandrasekaran, Discrete Mathematics, The National Publishing company, Chennai, 2003.
<b>Reference Books:</b>	
1	Oscar Levin, Discrete Mathematics, 3rd Edition, 2016.
2	B. A. Davey & H. A. Priestley, Introduction to Lattices and Order (2 <sup>nd</sup> edition), Cambridge University Press, 2002.
3	Edgar G. Goodaire & Michael M. Parmenter, Discrete Mathematics with Graph Theory (3rd edition), Pearson Education, 2018.
4	Rudolf Lidl & Günter Pilz, Applied Abstract Algebra (2nd edition), Springer, 1998.
5	C. L. Liu, Elements of Discrete Mathematics (2nd edition), McGraw-Hill, 1985.
<b>Website and e-Learning Sources</b>	
1	<a href="https://nptel.ac.in/">https://nptel.ac.in/</a>
2	<a href="https://stevengann.com/posts/Boolean-Reduction/">https://stevengann.com/posts/Boolean-Reduction/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	2	3	2	3	3	3	3	2	3	3	3
<b>CO2</b>	3	2	2	2	3	3	3	3	2	2	2
<b>CO3</b>	2	2	2	2	3	3	3	2	3	3	3
<b>CO4</b>	3	2	2	3	3	3	2	3	3	3	3
<b>CO5</b>	3	2	2	3	3	2	2	3	3	3	2
<b>Total</b>	13	11	10	14	15	14	13	13	14	14	13
<b>Average</b>	2.6	2.2	2	2.8	3	2.8	2.6	2.6	2.8	2.8	2.6

3 – Strong, 2- Medium, 1- Low

### III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAE63	Fuzzy Mathematics	Elective	3	1	1	0	3	5	25	75	100
<b>Learning Objectives</b>											
LO1	To acquire knowledge about the fundamentals of Fuzzy Algebra.										
LO2	To know the basic properties of logic-connectives and concepts of Fuzzy Mappings.										
LO3	To understand the applications of Fuzzy Relations.										
LO4	To study the Algebra of Fuzzy Groups and Subgroups.										
LO5	To learn the concepts of Fuzzy Rings and Fuzzy Subfields.										
Unit	Content									Hours	
1	<b>Fuzzy Subset and Fuzzy Mappings:</b> Introduction - Fuzzy Subsets- Partially Ordered Sets - Lattices and Boolean Algebras - L Fuzzy Sets - Visual representation of a Fuzzy subset - Operations on Fuzzy subset - Disjunctive Sum - $\alpha$ Level Set. <b>Section: 1.1 - 1.9</b>									15	
2	<b>Fuzzy Subset and Fuzzy Mappings (contd..)</b> Properties of Fuzzy Subsets of a Set - Algebraic Product and Sum of Two Fuzzy Subsets - Properties Satisfied by Addition and Product - Cartesian Product of Fuzzy Subsets. <b>Section: 1.10 - 1.13.</b>									15	
3	<b>Fuzzy Relations:</b> Introduction - Algebra of Fuzzy Relations - Logic - Connectives- Some More Connectives. <b>Section: 2.1 - 2.5</b>									15	
4	<b>Fuzzy Groups and Fuzzy Rings:</b> Introduction - Fuzzy Subgroup - Homomorphic Image and Pre-image of Sub Groupoid - Fuzzy Invariant Subgroups - Fuzzy Subrings. <b>Section: 3.1 - 3.5</b>									15	
5	<b>Fuzzy Subfields:</b> Fuzzy Subfields and Fuzzy Subspaces - Fuzzy Subspace <b>Section: 4.1 and 4.2 (Upto proposition 4.2.4)</b>									15	
<b>Total</b>									<b>75</b>		
<b>Theory 80% Problem 20%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	<b>The Students will be able to</b>
CO1	Understand and apply the basic concepts and operations of Fuzzy Sets.
CO2	Apply Algebraic Sum and Product of Fuzzy Subsets and Construct Cartesian Products in Fuzzy Set Theory.
CO3	Explain Fuzzy Relations, perform Algebraic Operations on Fuzzy Relations and apply Fuzzy Logic Connectives.
CO4	Define Fuzzy Subgroups, and determine Homomorphic Images and Pre-images of Sub groupoids, Identify Fuzzy Invariant Subgroups.
CO5	Analyze Fuzzy Subrings in Algebraic Structures, Fuzzy Subfields and Fuzzy Subspaces.
<b>Recommended Text Book:</b>	
1	S. Nanda and N. R. Das, Fuzzy Mathematical concepts, Narosa Publishing House, New Delhi, 2014.
<b>Reference Books:</b>	
1	Anjan Mukherjee and S. Bhattacharya Halder, Fuzzy Set and Fuzzy Topology, Narosa Publishing House, New Delhi, 2015.
2	N. Palaniappan, Fuzzy Topology, Second Edition, Narosa Publishing House, New Delhi, 2005.
3	Gorge J. Klir/Bo Yuan, Fuzzy Sets and Fuzzy Logic Theory and Applications, Published by Prentice Hall PTR, A Simon & Schuster Company, New Jersey, 2015.
4	Zimmermann, H.J, Fuzzy Set Theory and its Applications, Second Edition, Kluwer Academic Publishers, Netherland, 1991.
5	Klir & Yuan, Fuzzy Sets and Fuzzy Logic, 1995.
<b>Website and e-Learning Sources:</b>	
1	<a href="http://www.pzs.dstu.dp.ua/logic/bibl/yuan.pdf">http://www.pzs.dstu.dp.ua/logic/bibl/yuan.pdf</a>
2	<a href="https://staibabussalamsula.ac.id/wp-content/uploads/2024/01/Fuzzy-Set-Theory-staibabussalamsula.ac_id_.pdf">https://staibabussalamsula.ac.id/wp-content/uploads/2024/01/Fuzzy-Set-Theory-staibabussalamsula.ac_id_.pdf</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	3	2	3	2	3	3	3	2	3
<b>CO2</b>	3	3	2	3	3	3	3	2	2	3	2
<b>CO3</b>	2	2	2	3	2	3	3	3	3	2	2
<b>CO4</b>	3	3	3	2	3	2	2	2	3	3	3
<b>CO5</b>	3	3	3	3	3	3	2	3	3	2	3
<b>Total</b>	14	13	13	13	14	13	13	13	14	12	13
<b>Average</b>	2.8	2.6	2.6	2.6	2.8	2.6	2.6	2.6	2.8	2.4	2.6

**3–Strong, 2-Medium, 1-Low**

### III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAE64	Number Theory	Elective	3	1	1	0	3	5	25	75	100
<b>Learning Objectives</b>											
LO1	To apply the various techniques of solving puzzles in applications.										
LO2	To understand the connections between number theory and other branches of mathematics.										
LO3	To develop competence and confidence in solving mathematical problems systematically.										
LO4	To analyze and solve problems involving divisibility, Diophantine equations and quadratic residues using appropriate number-theoretic methods.										
LO5	To explore special classes of numbers such as perfect numbers and Fermat numbers and apply their properties in problem-solving contexts.										
Unit	Content									Hours	
1	<b>Introduction:</b> Basic binary Operations on the set of Integers - Ordering of Integers - Well Ordering Principle - Mathematical Induction.									15	
2	<b>Divisibility Theory:</b> Greatest common Divisor - Relatively Prime integers - Algorithm to find G.C.D: Investigation of the set of integers $\{bx + cy\}$ - Least Common Multiple.									15	
3	<b>Linear Diophantine Equations:</b> Linear Diophantine Equations - The Equation $ax + by = c$ - Diophantine Equations in Three or More Unknowns (Statements only)									15	
4	<b>Quadratic Residues:</b> Introduction - Quadratic residues - Elementary Properties. (Simple problems only)									15	
5	<b>Perfect Numbers:</b> Introduction- Perfect Numbers - Necessary and Sufficient Conditions for a positive Integer to be an even Perfect number - Mersenne Numbers, Fermat Numbers. (Simple problems only)									15	
<b>Total</b>									<b>75</b>		
<b>Theory 80% problem 20%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	<b>The Students will be able to</b>
CO1	Understand the fundamental concepts of Mathematical Induction.
CO2	Evaluate the Greatest common Divisor and Least common multiple using the algorithms.
CO3	Determine and understand the Diophantine equations for three or more unknowns.
CO4	Demonstrate the quadratic residues, elementary Properties.
CO5	Evaluate and analyze the perfect numbers using the Mersenne and Fermat Numbers.
<b>Recommended Text Book:</b>	
1	Dr. Sudhir, K. Pundir, Theory of Numbers, Pragati Prakashan Publications, third revised edition, 2012.
<b>Reference Books:</b>	
1	Ivan Niven, Herbert S.Zuckarman and Hugh L. Mont gomety John Wiley & Sons, Inc An introduction to the Theory of Numbers (5 <sup>th</sup> edition), 2001.
2	CY. Hsiung, Elementary theory of numbers, Allied publishers, 1995.
3	Allyn and Bacon Inc, Elementary Number Theory, Boston, 1980.
4	Gareth A. Jones and J. Mary Jones, Elementary Number Theory, 1998.
5	Gove Effinger and Gary L. Mullen, Elementary Number Theory, 2022.
<b>Website and e-Learning Sources</b>	
1	<a href="https://nptel.ac.in/">https://nptel.ac.in/</a>
2	<a href="https://en.wikipedia.org/wiki/Perfect_number">https://en.wikipedia.org/wiki/Perfect_number</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	2	2	2	2	2	2	2	2	3	2	2
<b>CO2</b>	2	3	2	3	2	2	3	3	3	2	1
<b>CO3</b>	2	3	3	2	2	2	3	2	3	2	2
<b>CO4</b>	3	2	2	2	3	2	2	2	3	2	2
<b>CO5</b>	2	2	2	2	2	2	2	2	2	2	2
<b>Total</b>	11	12	11	11	11	10	12	11	14	10	9
<b>Average</b>	2.2	2.4	2.2	2.2	2.2	2	2.4	2.2	2.8	2	1.8

3 – Strong, 2- Medium, 1- Low

### III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAP61	Data Visualization Using TABLEAU	PEC	1	1	1	0	2	3	25	75	100
<b>Learning Objectives</b>											
LO1	To understand the Tableau analytics platform, workspace and data preparation.										
LO2	To create basic data visualizations including bar, line and heat maps.										
LO3	To apply advanced visualization techniques using calculated fields, parameters and aggregation.										
LO4	To design symbol maps, filled maps, density maps and maps with pie charts.										
LO5	To build interactive dashboards, apply dashboard actions and visualize cloud data.										
Unit	Content										Hours
1	<b>Introduction to Tableau:</b> Data types - Data collection - Setting up a Data Connector - Selecting Data Tables – Joins – Unions - Data extracts and live connections - Editing the model's metadata.										9
2	<b>Creating Basic Data Visualizations:</b> Creating Charts - Chart types -Bar Charts, Legends, Filters and Hierarchies - Line Charts - Highlight Tables - Heat Maps - Bullet Charts - Cumulative Sums with Waterfall Charts.										9
3	<b>Creating Advanced Data Visualizations:</b> Aggregate Functions - Calculated Fields - Aggregations in Calculated Fields - Text Operator - Data fields - Logical functions – Parameters - Types of calculations - Quick Table calculations - Level of detailed expression.										9
4	<b>Creating Symbol Maps:</b> Filled Maps - Density Maps - Map Layers - Maps embedded with Pie Charts.										9
5	<b>Creating Interactive Dashboards:</b> Creating a Dashboard - Dashboard Title - Navigation Buttons - Dashboard Actions - Templates for visualizing Cloud data.										9

<b>Course Outcomes</b>	
<b>CO</b>	<b>The Student will be able to</b>
CO1	Explain the Tableau environment, data connections and data preparation techniques.
CO2	Create basic visualizations such as bar charts, line charts and heat maps.
CO3	Apply calculated fields, aggregate functions and parameters for advanced visualizations.
CO4	Design geographic visualizations using symbol maps, filled maps and density maps.
CO5	Develop interactive dashboards with filters, actions and navigation features.
<b>Recommended Text Book:</b>	
1	Claus O. Wilke, Fundamentals of Data Visualization, O'Reilly, 2019.
<b>Reference Books:</b>	
1	Alexander Loth, Visual Analytics with Tableau, Wiley, 2019.
2	Davy Cielen, Arno D. B. Meysman and Mohamed Ali, Introducing Data Science, Manning Publications, 2016.
3	D J Patil, Hilary Mason & Mike Loukides, Ethics and Data Science, O' Reilly, 2018.
<b>Website and e-Learning Sources:</b>	
1	<a href="https://www.geeksforgeeks.org/tableau/tableau-tutorial/">https://www.geeksforgeeks.org/tableau/tableau-tutorial/</a>
2	<a href="https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/data-visualization-with-r/?v=13b5bfe96f3e">https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/data-visualization-with-r/?v=13b5bfe96f3e</a>
3	<a href="https://www.javatpoint.com/tableau">https://www.javatpoint.com/tableau</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	3	3	3	3	3	2	3	3	3	3	3
<b>CO2</b>	3	3	3	2	3	3	3	3	3	2	3
<b>CO3</b>	3	3	3	3	3	3	3	3	3	3	3
<b>CO4</b>	2	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	3	3	3	3	3	3	3	3	3	3	3
<b>Total</b>	14	15	15	14	15	14	14	15	15	14	15
<b>Average</b>	2.8	3	3	2.8	3	2.8	2.8	3	3	2.8	3

**3 – Strong, 2- Medium, 1- Low**

### III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAL61	Mathematical Aptitude	SLC	0	0	0	2	2	2	25	75	100
<b>Learning Objectives</b>											
LO1	To build skills in simplifying surds and indices, applying profit and loss concepts, and solving problems using ratio and proportion.										
LO2	To apply partnership and chain rule to solve profit-sharing and time-work problems.										
LO3	Solve problems on boats and streams and mixtures using the allegation method.										
LO4	To develop the ability to solve verbal reasoning problems on coding–decoding and blood relations with logical accuracy and clear interpretation.										
LO5	To enhance non-verbal reasoning skills by solving analogy and classification problems with logical accuracy and pattern recognition.										
Unit	Content										Hours
1	<b>Arithmetical Ability:</b> Surds and Indices - Profit and Loss - Ratio and Proportion <b>Chapter: 9, 11 and 12</b>										6
2	<b>Arithmetical Ability (Contd..)</b> Partnership - Chain Rule. <b>Chapter: 13 and 14</b>										6
3	<b>Arithmetical Ability (Contd..)</b> Boats and Streams - Alligation or Mixture <b>Chapter: 19 and 20</b>										6
4	<b>Verbal Reasoning:</b> Coding - Decoding - Blood Relations <b>Chapter: 4 and 5</b>										6
5	<b>Non - Verbal Reasoning:</b> Analogy - Classification <b>Chapter: 2 and 3</b>										6
	<b>Total</b>										<b>30</b>
<b>Problems 100%</b>											

<b>Course Outcomes</b>	
<b>CO</b>	<b>The Students will be able to</b>
CO1	Simplify surds and indices, solve profit and loss problems and apply ratio–proportion reasoning in practical contexts.
CO2	Apply partnership and chain rule concepts to solve problems involving profit-sharing and proportional work.
CO3	Utilize concepts of boats and streams along with the allegation method to effectively solve real-world problems related to speed, distance and mixtures.
CO4	Accurately solve verbal reasoning problems on coding–decoding and blood relations by applying logical interpretation and analytical skills.
CO5	Solve non-verbal reasoning problems involving analogy and classification using logical reasoning.
<b>Recommended Text Books:</b>	
1	Dr. R. S. Aggarwal, Quantitative Aptitude, S. Chand & Company, New Delhi, 2012. <b>(Unit 1, 2, 3)</b>
2	Dr. R. S. Aggarwal, A Modern Approach to Verbal and Non-Verbal Reasoning, S. Chand & Company, New Delhi, 2022. <b>(Unit 4, 5)</b>
<b>Reference Books:</b>	
1	Praveen R.V, Quantitative Aptitude and reasoning, PHIL earning Pvt, New Delhi.
2	Abhijit Guha-Quantitative Aptitude for Competitive Examinations-6th Edition-McGraw Hill Education Pvt Ltd, Chennai.
3	U. Mohan Rao-Quantitative Aptitude for Competitive Examinations-Scitech Publications Pvt. Ltd, Chennai.
4	Arun Sharma-Teach Yourself Quantitative Aptitude- McGraw Hill Education Pvt. Ltd, Chennai.
5	Oswaal Editorial Board, Objective Quantitative Aptitude, Oswaal Books & Learning Pvt. Ltd, 2024.
<b>Website and e-Learning Sources</b>	
1	<a href="https://www.competitiveexamsindia.com/quantitative-aptitude/#google_vignette">https://www.competitiveexamsindia.com/quantitative-aptitude/#google_vignette</a>
2	<a href="https://www.indiabix.com/non-verbal-reasoning/questions-and-answers/">https://www.indiabix.com/non-verbal-reasoning/questions-and-answers/</a>

### Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	3	2	3	2	3	3	3	2	3
<b>CO2</b>	3	3	2	3	3	3	3	2	2	3	2
<b>CO3</b>	2	2	2	3	2	3	3	3	3	2	2
<b>CO4</b>	3	3	3	2	3	2	2	2	3	3	3
<b>CO5</b>	3	3	3	3	3	3	2	3	3	2	3
<b>Total</b>	14	13	13	13	14	13	13	13	14	12	13
<b>Average</b>	2.8	2.6	2.6	2.6	2.8	2.6	2.6	2.6	2.8	2.4	2.6

**3–Strong, 2–Medium, 1–Low**