MARUDHAR KESARI JAIN COLLEGE FOR WOMEN (AUTONOMOUS)

Vaniyambadi – 635 751

PG & Research Department of Mathematics

for

Undergraduate Programme

Bachelor of Science in Mathematics

From the Academic Year 2024 – 25

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 /Allied Chemistry 1	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 Professional Ethics	1	1	0	0	2
					30	**23**

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/ 24UCHS41P	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-5 Python Programming	1	0	1	0	2
24UAEC41	AEC -3 Environmental Studies and Disaster Management	1	1	0	0	2
					30	**23**

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmudalvan within the 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*.

Part – 1 & 2	Tamil & English	8	SEC	Skill Elective Course	5
CC	Core Course	15	FC	Foundation Course	1
EC-AL	Elective Course – Applied	7	AEC	Ability Enhancement Course	4
EC	Elective Course - Major	4	SLC	Self-Learning Course	1

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

Learning Objectives	
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. **Chapter I : Sections 1 - 3, Chapter II: Sections 1 - 6.3**	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. **Chapter IV: Sections:1-3.1** **Chapter V: Sections: 1- 4**	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. **Chapter VI : Section: 6** **Chapter VIII: Sections: 1- 4**	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. **Chapter XII: Sections: 1- 4**	15
5	Partial differential equations of the first order(continuation): Special methods – Standard forms - Charpit's Method –Applications. **Chapter XII: Sections: 5 and 6**	15
Total		75

Theory-20% Problem-80%

CO	Course Outcomes **The student will be able to**
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
Textbooks:	
1	S.Narayanan and T.K. Manickavachagom Pillay, Differential Equations and its Applications, S. Viswanathan Printers and Publishers Pvt. Ltd, 2007.
Reference Books:	
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
Web resources:	
1	https://nptel.ac.in

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	2	1	3	2	2
CO2	3	2	3	2	1	2	3	1	3	2	2
CO3	3	1	3	2	1	1	2	2	3	3	2
CO4	3	3	3	2	2	2	2	2	3	3	2
CO5	3	3	3	2	2	2	1	2	3	3	2
Total	15	12	15	10	7	9	10	8	15	13	10
Average	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

Learning Objectives	
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	**Linear Programming Problem** Introduction-Concept of Linear Programming Model-Development of LP Models-Graphical Method- Linear Programming Methods (Simplex Method only)-Duality **Chapter 2: Sections 2.1 - 2.5(2.5.1only), 2.7(2.7.1,2.7.2)**	15
2	**Transportation Problem** Introduction- Mathematical Model for Transportation Problem- Types of Transportation Problem-Methods to Solve Transportation Problem. Assignment Problem: Introduction-Types of Assignment Problem- Hungarian Method. **Chapter 3: Sections: 3.1-3.4; Chapter 4: Sections: 4.1-4.4**	15
3	**Sequencing Problem** Introduction-Problems with n jobs through 2 machines - Problems with n jobs through 3 machines- Problems with n jobs through k machines. **Chapter: 12 (12.1-12.6)**	15
4	**Inventory Control** Inventory Control: Introduction- Cost associated with inventories-Factors affecting Inventory Control- Deterministic Inventory Problems with and without shortages-Probabilistic Inventory Problems. **Chapter 19: Sections: 19.1 to 19.7, 19.12.**	15
5	**Network Scheduling by PERT/CPM** Introduction- Network and Basic Components-Logical Sequencing- Rules of Network Construction- Critical Path Method (CPM)- Programme Evaluation and Review Technique (PERT) **Chapter: 21**	15
	Total	75

Theory-20% Problem-80%

CO	Course Outcomes **The student will be able to**
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.
Textbooks:	
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)
Reference Books:	
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
CO1	2	3	2	3	3	3	3	3	3	3	2
CO2	3	3	2	2	2	3	2	2	2	2	2
CO3	3	2	2	2	3	3	2	3	3	2	2
CO4	3	3	2	3	3	3	2	3	3	3	2
CO5	3	2	2	3	3	2	2	3	3	2	2
Total	14	13	10	13	14	14	11	14	14	12	10
Average	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

Learning Objectives	
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 **Chapter: V Sections: 5.1-5.4.2**	12
2	Mathematical Expectation: Introduction - Expected value of function of a random variable – Properties of expectation -Properties of variance – Covariance **Chapter: VI Sections: 6.1-6.6**	12
3	Generating Functions**:** Moment generating function – Cumulants - Chebychev's inequality. **Chapter: VII Sections: 7.1,7.2 and 7.5**	12
4	Discrete probability distribution: Introduction (Bernoulli distribution)- Binomial distribution-Poisson distribution – Geometric distribution **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**	12
5	Normal distribution: Introduction - Normal distribution - Gamma distribution - Exponential distribution. **Chapter IX: Sections: 9.1, 9.2 (9.2.1-9.2.10, 9.2.14), 9.5, 9.8**	12
	Total	60

Theory-60% Problem-40%

CO	Course Outcomes **The student will be able to**
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.
Textbooks:	
1	S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co, New Delhi, Reprint 2019.
Reference Books:	
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, Freunds, Probability and statistics for engineers, 6-e Pearson Education Pvt. Ltd. Delhi, 2001
Web resources:	
1	https://nptel.ac.in

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	1	2	3	3	2	2
CO2	3	3	2	2	2	1	2	3	3	2	2
CO3	3	2	2	2	2	2	2	3	3	2	2
CO4	3	3	2	2	3	2	3	3	3	2	3
CO5	3	3	3	2	2	2	2	3	3	2	2
Total	15	14	11	10	11	7	11	15	15	10	11
Average	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

Learning Objectives	
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

	Content	Hours
	1. Measures of Central Tendency for individual data (Mean, Median, Mode) 2. Measures of Central Tendency for discrete data (Mean, Median, Mode) 3. Measures of Central Tendency for Continuous data (Mean, Median, Mode) 4. Measures of Central Tendency for individual data (Geometric Mean, Harmonic Mean) 5. Measures of Central Tendency for discrete data (Geometric Mean, Harmonic Mean) 6. Measures of Central Tendency for continuous data (Geometric Mean, Harmonic Mean) 7. Measures of dispersion for Individual data 8. Measures of dispersion for discrete data 9. Measures of dispersion for Continuous data 10. Graphical Presentation of data (Histogram, Subdivided bar diagram) 11. Graphical Presentation of data (Pie chart) 12. Graphical Presentation of data (Frequency polygon)	6

CO	Course Outcomes **The student will be able to**
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.

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

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	1	1	3	3	2	2
CO2	3	3	2	2	2	1	1	3	3	2	2
CO3	3	2	2	2	2	2	1	3	3	2	2
CO4	3	3	2	2	3	2	1	3	3	2	2
CO5	3	3	3	2	2	2	1	3	3	2	3
Total	15	14	11	10	11	7	5	15	15	10	11
Average	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

Learning Objectives	
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	**Chemical Bonding and Nuclear Chemistry:** 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	**Industrial Chemistry:** 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	**Fundamental Concepts in Organic Chemistry:** Hybridization: Orbital overlap, hybridization and geometry of CH4, C2H4 and C6H6. 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	**Thermodynamics and Phase Equilibria:** 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-Helmoholtz equation - derivation. Phase equilibria: Gibb's phase rule, terms involved, phase diagram of water system	12
5	**Analytical Chemistry:** Principles of volumetric analysis. Separation and purification techniques – extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography	12
Total		60

Theory - 100

CO	Course Outcomes **The student will be able to**
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.
Textbooks:	
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.
Reference Books:	
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.
Web resources:	
1	https://www.khanacademy.org/science/hs chemistry/x2613d8165d88df5e:nuclearchemistry- hs
2	https://pubs.acs.org/journal/enfuem
3	https://m.youtube.com/watch?v=8c4urO_h1Ds
4	https://www.energy.gov/nnsa/national-nuclear-security-administration
5	https://en.wikipedia.org/wiki/Molecular_orbital

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	3	2	3	3	3
CO2	2	3	3	3	2	3	3	2	3	3	3
CO3	3	3	3	2	3	3	3	2	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3
CO5	3	2	3	3	3	3	3	2	3	3	3
Total	14	14	15	14	14	15	15	10	15	15	15
Average	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

Learning Objectives	
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.

	Content	Hours
	1. Estimation of sodium hydroxide using standard sodium carbonate 2. Estimation of sodium carbonate using standard sodium hydroxide 6 3. Estimation of hydrochloric acid using standard oxalic acid 4. Estimation of ferrous sulphate using standard Mohr's salt 5. Estimation of oxalic acid using standard ferrous sulphate 6. Estimation of potassium permanganate using standard sodium hydroxide 7. Estimation of Ca (II) using EDTA solution 8. Estimation of Mg (II) using EDTA solution 9. Estimation of total hardness of water 10. Estimation of ferrous ion using diphenyl amine as indicator	6

CO	Course Outcomes The student will be able to
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

Textbooks:	
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.
Reference Books:	
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, 5thed., 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
Web resources:	
1	https://webbook.nist.gov/chemistry/
2	https://www.organic-chemistry.org/
3	https://www.routledge.com/Advanced-Practical-Organic-Chemistry/Leonard-Lygo-Procter/p/book/978143986097
4	https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_Lab_Techniques_(Nichols)
5	https://www.academia.edu/43215226/Advanced_Practical_Organic_Chemistry_Third_Edi

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	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	15	15	15	15	15	15	15	15	15	15
Average	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

Learning Objectives	
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

	COURSE OUTCOMES
	The student will be able to
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
Practice	
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()
Textbooks:	
1	Andrie Devries And Jorismeys , "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.
Reference Books:	
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
Web resources:	
1	https://www.tutorialspoint.com/r/index.htm
2	https://www.youtube.com/watch?v=_V8eKsto3Ug
3	https://www.youtube.com/watch?v=SYYUBytX1ng

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
Total	15	14	14	13	14	14	13	15	13	13	12
Average	**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**

Learning Objectives	
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	**Vector Differentiation:** 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	**Divergence and Curl:** Divergence and Curl of a vector valued function- Solenoidal and Irrotational Vectors - Vector identities - Laplacian operator - Applications.	15
3	**Line and Surface Integrals:** Introduction--Line Integral-Applications of Line integral- Surface integral-simple problems.	15
4	**Volume integral and Integral Theorem:** Volume Integral - Applications- Gauss Divergence theorem (Statement only) – Simple problems.	15
5	**Integral Theorem (Cont...) :** Stoke's Theorem and Green's Theorem (Statement Only)-Simple Problems.	15
	Total	75

Theory 20% Problem 80%

CO	Course Outcomes 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.

Recommended Text:	
1	P.R. Vittal and V. Malini, Vector Analysis, Margham Publications, Chennai, 2004.
Reference Books:	
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 (40th Edition), 2007.
Website and e-Learning Source	
1	https://tutorial.math.lamar.edu
2	https://betterexplained.com

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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
24UMAC42	Mechanics	Core	3	1	1	0	4	5	25	75	100

Learning Objectives	
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	**Force:** Newton's laws of motion – Resultant of two forces on a particle. **Equilibrium of a Particle:** Equilibrium of a particle under three forces. Chapter:2 Sections 2.1 - 2.2 Chapter: 3 Sections 3.1(3.1.1)	15
2	**Forces on a Rigid Body:** 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	**Work, Energy and Power:** Work – Conservative field of force – Power. **Rectilinear Motion under Varying Force:** 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	**Projectiles:** Forces on a projectile – Projectile projected on an inclined plane. Chapter: 13 Sections 13.1- 13.2	15
5	**Central Orbits:** General orbits – Central orbit – Conic as a centered orbit. Chapter: 16 Sections 16.1-16.3	15
	Total	75
	Theory 20% problem 80%	

CO	Course Outcomes 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.

Recommended Text:	
1	P. Duraipandiyan , Laxmi Duraipandian, Muthamizh Jayapragasam, Mechanics, S.Chand Publications Pvt. Ltd, New Delhi, 2005.
Reference Books:	
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, 8th edition, Wiley and sons Pvt ltd., New York, 2015.
Website and e-Learning Source	
1	https://nptel.ac.in//

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	3	2	2	3
CO2	3	2	3	2	2	2	3	3	2	3	2
CO3	3	2	3	2	2	3	3	3	2	2	2
CO4	3	2	3	2	3	2	3	3	2	3	2
CO5	3	2	3	2	3	2	3	3	2	2	3
Total	15	10	15	10	12	11	15	15	10	12	12
Average	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**

Learning Objectives	
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 *t*-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 t - distribution: Fisher's t-Limiting form, critical value- -Applications of t distribution: Single mean-differen0ce of means-Paired t 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
	Total	60
	Theory 60% problem 40%	

CO	Course Outcomes 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 *t*-distribution for small samples.
CO5	Apply the F-distribution to compare sample variances in statistical problems.
Recommended Text:	
1	S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Co, New Delhi, Reprint 2019.
Reference Books:	
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.
Website and e-Learning Source	
1	https://nptel.ac.in//

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	2	3	2	2	3	3	2
CO5	3	2	2	2	3	2	2	2	3	3	2
Total	15	11	11	11	13	12	10	11	15	15	10
Average	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**

Learning Objectives	
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	**Co-ordination Chemistry and Water Technology** Co-ordination Chemistry: Definition of terms-IUPAC Nomenclature - Werner's theory - EAN rule - Pauling's theory – Postulates - Applications to [Ni(CO)4], [Ni(CN)4]2-,[Co(CN)6]3- Chelation - Biological role of Hemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis. **Water Technology:** Hardness of water, determination of hardness of water using EDTA method, zeolite method	12
2	**Carbohydrates and Amino acids Carbohydrates:** 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).	12
3	**Electrochemistry** 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.	12
4	**Kinetics and Catalysis** 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.	12
5	**Photochemistry** Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-Chloride and Hydroge-Bromide reaction. Jablonski Diagram - Phosphorescence,	12

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

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.
Textbooks:	
1.	F. Albert Cotton, Geoffrey Wilkinson, Paul L. Gaus, "*Basic Inorganic Chemistry*", 3rd 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.
Reference Books:	
1.	James E. Huheey, Ellen A. Keiter, Richard L. Keiter, "*Inorganic Chemistry: Principles of Structure and Reactivity*", 4th 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, "*Organic Chemistry*", 8th 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.
Web resources:	
1.	www.khanacademy.org/science/chemistry
2.	https://chem.libretexts.org
3.	https://chem.libretexts.org/Bookshelves/Organic_Chemistry
4.	https://ocw.mit.edu/courses/chemistry/
5.	https://chem.libretexts.org/Bookshelves/Analytical_Chemistry

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	1	2	2	3	3	3
CO2	3	3	3	2	3	1	2	3	2	3	3
CO3	3	3	3	2	2	1	2	2	3	3	3
CO4	3	3	3	2	2	1	2	2	3	2	3
CO5	3	3	3	2	3	1	2	3	2	3	2
Total	15	13	13	10	13	05	10	12	13	14	14
Average	**3.0**	**3.0**	**3.0**	**2.0**	**2.6**	**1.0**	**2.8**	**2.4**	**2.6**	**2.8**	**2.8**

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	**Mathematical Statistics II Practical Using R Programming**	**Elective**	**0**	**0**	**2**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
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
	Total	30
	Problem 100%	

CO	Course Outcomes 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.

Recommended Text:	
1	Tilman M. Davies, The Book of R : A First Course in Programming and Statistics - No starch Press, San Francisco.
Reference Books:	
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.
Website and e-Learning Source	
1	https://spoken-tutorial.org

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
Total	15	11	11	11	13	12	10	11	15	15	10
Average	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**

Learning Objectives	
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.

	Content	**Hours**
	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.
Textbooks:	
1.	Venkateswaran V, Veerasamy R and Kulandaivelu A. R, “Basic Principles of Practical Chemistry”, Sultan Chand & Sons, 2 nd ed., 1997.
2.	J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas, “*Vogel's Textbook of Quantitative Chemical Analysis”*, 6th 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.
Reference Books:	
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.
Web resources:	
1	https://webbook.nist.gov/chemistry/
2	https://www.organic-chemistry.org/
3	https://www.routledge.com/Advanced-Practical-Organic-Chemistry/Leonard-Lygo-Procter/p/book/9781439860977
4	https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_Lab_Techniques_(Nichols)
5	https://www.academia.edu/43215226/Advanced_Practical_Organic_Chemistry_Third_Edition

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
Total	14	15	13	14	13	15	15	10	13	14	14
Average	**2.8**	**3.0**	**2.6**	**2.8**	**2.6**	**3.0**	**3.0**	**2.0**	**2.6**	**2.8**	**2.8**

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**

Learning Objectives	
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
	Total	30
	Theory 100%	

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.
Recommended Text:	
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" , 1st Edition, CRC Press /Taylo 76 r & Francis, 2018. ISBN-13: 978-0815394372.
Reference Books:	
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.
Website and e-Learning Source	
1	https://www.geeksforgeeks.org/python/python-programming-language-tutorial/
2	https://www.youtube.com/watch?v=K5KVEU3aaeQ

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
Total	15	11	11	11	13	12	10	11	15	15	10
Average	3	2.2	2.2	2.2	2.6	2.4	2	2.2	3	3	2

3 – Strong, 2- Medium, 1- Low