CHEMISTRY

Syllabus

Program Code: UCH

2021-2022 onwards

MANNAR THIRUMALAI NAICKER COLLEGE

(AUTONOMOUS)

Re-accredited with "A" Grade by NAAC

PASUMALAI, MADURAI – 625 004

Eligibility for Admission

Candidate should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Education, Government of Tamil Nadu, CBSE Board with Science as one of the subjects in Higher Secondary Education.

Subjects of Study

Part I : Tamil / Company Secretarial Practice and Modern Office Management

Part II : English

Part III :

1. Core Subjects
2. Allied Subjects
3. Electives

Part IV :

1. Non Major Electives (II Year)
2. Skill Based Subjects
3. Environmental Studies - Mandatory Subject
4. Value Education - Mandatory Subject

Part V :

Extension Activities

Pattern of the question paper for the Continuous Internal Assessment

Note: Duration – 1 hour

(For Part I, Part II & Part III)

The components for continuous internal assessment are:

Part –A

Four multiple choice questions (answer all) 4 x01= 04 Marks

Part –B

Three short answers questions (answer all) 3 x02= 06 Marks

Part –C

Two questions (‘either …. or ‘type) 2 x 05=10 Marks

Part –D

Two questions out of three 1 x 10 =10 Marks

Total 30 Marks

The scheme of Examination for Part-I, II & III

The components for continuous internal assessment are:

(60 Marks of two continuous internal assessments will be converted to 15 marks)

Two tests and their average	--15 marks
Seminar /Group discussion	--5 marks
Assignment	--5 marks

Total	25 Marks

Pattern of the question paper for the Summative Examinations:

Note: Duration- 3 hours

Part –A

Ten multiple choice questions	10 x01	= 10 Marks

No Unit shall be omitted: not more than two questions from each unit.)

Part –B

Short answer questions (one question from each unit)	5 x02	= 10 Marks

Part –C

Five Paragraph questions (‘either …. or ‘type)	5 x 05	= 25 Marks

(One question from each Unit)

Part –D

Three Essay questions out of five	3 x 10	=30 Marks

(One question from each Unit)

Total	75 Marks

Part-IV- Skill Based Papers / NME:

The Scheme of Examination for Skill Based Papers: (Except Practical Lab Subjects)

Pattern of the questions paper for the continuous Internal Assessment

45 MCQs will be asked for each internal assessment tests (45 x 1=45 Marks) **and converted for 15 marks**

The components for continuous internal assessment are:

Two tests and their average	--15 marks
Seminar /Group discussion	--5 marks
Assignment	--5 marks

Total	25 Marks

Summative Examination Pattern

Pattern of the Question Paper for Skill Based Papers (External)

75 Multiple choice questions will be asked from five units (75 x 1=75 Marks)

(15MCQ's from each unit)

Part-IV- Environmental Studies and Value Education

The Scheme of Examination (Environmental Studies and Value Education)

Two tests and their average	--15 marks
Project Report	--10 marks*
Total	--25 marks

***** The students as Individual or Group must visit a local area to document environmental assets – river / forest / grassland / hill / mountain – visit a local polluted site – urban / rural / industrial / agricultural – study of common plants, insects, birds – study of simple ecosystem – pond, river, hill slopes, etc.

Question Paper Pattern

(Internal Assessment)

Pattern of the Question Paper for Environmental Studies & Value Education only) (Internal)

45 MCQs will be asked for each internal assessment tests (45 x 1=45 Marks) **and converted for 15 marks**

Two tests and their average	--	15 marks
Project	--	10 marks

Total		25 Marks

Summative Examination Pattern

Pattern of the Question Paper for Environmental Studies & Value Education only) (External)

75 Multiple choice questions will be asked from five units (75 x 1=75 Marks)

(15MCQ's from each unit)

Part V Extension Activities: (Maximum Marks: 100)

1. NCC
2. NSS
3. Physical Education
4. YRC
5. RRC
6. Health & Fitness Club
7. Eco Club
8. Human Rights Club

Pattern of the Question Paper for (Internal Examination & Summative Examination)

Internal Examinations	- - 40 Marks
Summative Examinations	- - 60 Marks
	100

Minimum Marks for a Pass

40% of the aggregate (Internal +Summative Examinations).
No separate pass minimum for the Internal Examinations.
27 marks out of 75 is the pass minimum for the Summative Examinations.

VISION

Department of Chemistry undertakes to aspires young adult to excel in Chemical Education, Research and Services to contribute to a chemically literate society through teaching, scholarship and service.

MISSION

To produce employable graduates in various areas and demonstrate science as a human endeavor and as a way to understand the natural world

The 12 Graduate Attributes*:

1. (KB) A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
2. (PA) Problem analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions
3. (Inv.) Investigation: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.
4. (Des.) Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. (Tools) Use of engineering tools: An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. (Team) Individual and teamwork: An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. (Comm.) Communication skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
8. (Prof.) Professionalism: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. (Impacts) Impact of engineering on society and the environment: An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such

interactions; and the concepts of sustainable design and development and environmental stewardship.

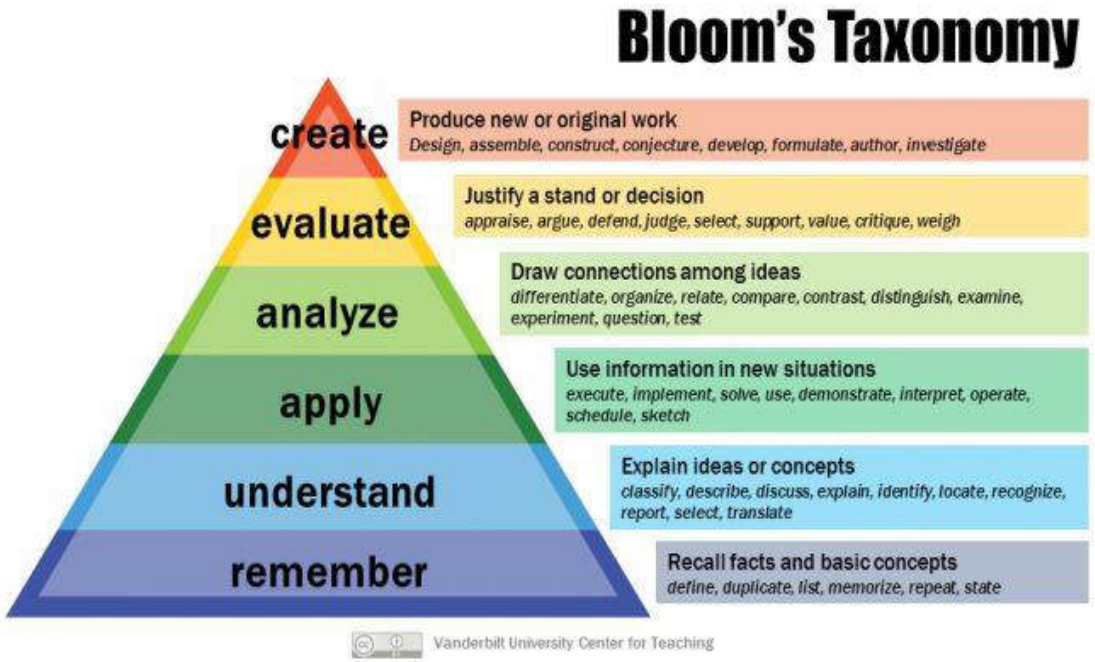
10. (Ethics) Ethics and equity: An ability to apply professional ethics, accountability, and equity.
11. (Econ.) Economics and project management: An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
12. (LL) Life-long learning: An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge

WA	Graduate Attributes	Caption as
1	A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.	**Disciplinary Knowledge**
2	An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.	**Problem Analysis**
3	An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.	**Investigation**
7	An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.	**Communication skills**
6,10	An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting. An ability to apply professional ethics, accountability, and equity.	**Individual and Team Work & Ethics**
5,12	An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations. An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge	**Use of Engineering Tools & Life-Long Learning**

PROGRAM EDUCATIONAL OBJECTIVES (PEOs) On completion of the Programme, the Student will be able to	
PEO1:	Enhance the students to nurture the requirements of industries/laboratories related to chemistry including pharmaceutical/analytical chemistry.
PEO2:	Enable the students to demonstrate information literacy skills for acquiring knowledge of chemistry, as a chemist/researcher and also as a life-long learner.
PEO3:	Develop the students to communicate effectively the scientific and research information in both written and oral formats, to both professional scientists and to the public.
PEO4:	Collaborate with Industry and Alumni to explore the new avenues in respective domains and raise the employability ratio.
PEO5:	Adhere towards the ethical and environmental sustainability to create morally upright and empowered citizens to face industry/ institution.
PEO6:	Nurture environmental awareness and develop communal harmony in respective of national integration.

PO NO	PROGRAMME OUTCOMES (POs)	
At the end of the programme, the students will be able to		
PO – 1	Demonstrate the knowledge and understanding of Science concepts and its relevant fields.	**Disciplinary Knowledge**
PO – 2	Identify, formulate, analyse complex problems and reach valid conclusions using the methodologies of Science.	**Problem Solving**
PO – 3	Employ critical and analytical thinking in understanding the concepts and apply them in various problems appearing in different branches of Science.	**Analytical Reasoning & Critical Thinking**
PO - 4	Communicate the known concepts effectively within the profession and with any forum	**Communication Skills**
PO - 5	Function successfully as a member/leader in any team and to apply ethics, accountability and equity in their life.	**Team Work and Moral/Ethical Awareness**
PO - 6	Use ICT tools in various learning situations, related information sources, suitable software to analyze data and furthermore participating in learning activities throughout life to meet the demands of work place through knowledge /up-skilling / re-skilling	**Digital Literacy & Life-long Learning**

S.No.	Graduate Attributes	PROGRAM SPECIFIC OUTCOME (PSOs)
PSO1:	Knowledge Base	Learn various concepts of organic, inorganic, physical chemistry, their biological aspects and their application in day-to-day life.
PSO2:	Problem Analysis & Investigation	Design towards executing experiments and confident handling of equipment's in Chemistry for industries.
PSO3:	Communication Skills & Design	Execute new ideas in the field of research and development using principles and techniques of science learned through activities such as expert lecturers, workshops, seminars and field projects.
PSO4:	Professionalism, Ethics and Equity	Aspire the knowledge of green environment learned through green chemistry and pollution free scenario
PSO5:	Individual & Team Work	Work effectively with a set of teams using modern technical skills and innovative research ideas in Chemistry areas
PSO6:	Lifelong learning	Develop employability and entrepreneurship skills learned through industry-based curriculum



MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS), MADURAI

B.Sc., CHEMISTRY., CURRICULUM

(For the student admitted during the academic year 2021-2022 onwards)

Course Code	Title of the Course	Hrs	Credits	Maximum Marks		
				Int	Ext	Total
FIRST SEMESTER						
Part – I	**Tamil / Alternative Course**					
21UTAG11	இக்காலக் கவிதையும் நாடகமும்	6	3	25	75	100
Part – II	**English**					
21UENG11	Communicative English - I	6	3	25	75	100
Part - III	**Core Courses**					
21UCHC11	Inorganic Chemistry -I	4	4	25	75	100
21UCHCP1	Major Chemistry Practical – I (Inorganic Semi Micro-Qualitative analysis)	2	-	-	-	
Part III	**Allied Course**					
21UPHA11	Allied Physics – I (Mechanics, Properties of Matter, Heat and Sound)	4	4	25	75	100
21UPHAP1	Allied Physics Practical – I	2	-	-	-	-
Part IV	**Skill Based Course**					
21UCHS11	Cosmetic Chemistry	2	2	25	75	100
21UCHS12	Green Chemistry	2	2	25	75	100
Part IV	**Mandatory Course**					
21UEVG11	Environmental Studies	2	2	25	75	100
	Total	**30**	**20**	**175**	**525**	**700**
SECOND SEMESTER						
Part – I	**Tamil / Alternative Course**					
21UTAG21	இடைக்கால இலக்கியமும் சிறுகதையும்	6	3	25	75	100
Part – II	**English**					
21UENG21	Communicative English -II	6	3	25	75	100
Part - III	**Core Courses**					
21UCHC21	Organic Chemistry -I	4	4	25	75	100
21UCHCP1	Major Chemistry Practical – I (Inorganic Semi Micro-Qualitative analysis)	2	2	40	60	100
Part III	**Allied Course**					
21UPHA21	Allied Physics – II (Electricity, Electronics, Optics and Modern Physics)	4	3	25	75	100
21UPHAP1	Allied Physics Practical – I	2	1	40	60	100
Part IV	**Skill Based Course**					
21UCHS21	Dairy Chemistry	2	2	25	75	100
21UCHS22	Dye Chemistry	2	2	25	75	100
Part IV	**Mandatory Course**					
21UVLG21	Value Education	2	2	25	75	100
	Total	**30**	**22**	**255**	**645**	**900**

THIRD SEMESTER						
Part – I	**Tamil / Alternative Course**					
21UTAG31	**காப்பிய இலக்கியமும் உரைநடையும்**	6	3	25	75	100
Part – II	**English**					
21UENG31	Communicative English-III	6	3	25	75	100
Part - III	**Core Courses**					
21UCHC31	Physical Chemistry – I	4	4	25	75	100
21UCHC32	Inorganic Chemistry – II	4	4	25	75	100
21UCHCP2	Major Chemistry Practical – II (Volumetric Analysis)	2	-	-	-	-
Part III	**Allied Course**					
21UMCA32 / 21UMBA32	Allied Mathematics – I / Allied Microbiology – I: Fundamentals of Microbiology	6	4	25	75	100
Part IV	**Non-Major Elective Course**					
21UCHN31	Basic Concepts in Chemistry	2	2	25	75	100
	Total	**30**	**20**	**150**	**450**	**600**
FOURTH SEMESTER						
Part – I	**Tamil / Alternative Course**					
21UTAG41	**பண்டைய இலக்கியமும் புதினமும்**	6	3	25	75	100
Part – II	**English**					
21UENG41	Communicative English -IV	6	3	25	75	100
Part - III	**Core Courses**					
21UCHC41	Organic Chemistry – II	4	4	25	75	100
21UCHC42	Physical Chemistry – II	4	4	25	75	100
21UCHCP2	Major Chemistry Practical – II (Volumetric Analysis)	2	2	40	60	100
Part III	**Allied Course**					
21UMCA43 / 21UMBA42	Allied Mathematics – II / Allied Microbiology – II: Applied Microbiology	6	4	25	75	100
Part IV	**Non-Major Elective Course**					
21UCHN41	Water Treatment	2	2	25	75	100
Part V	**Extension Activities**					
21UEAG40-21UEAG49	NSS, NCC, YRC	-	1	40	60	100
	Total	**30**	**23**	**230**	**570**	**800**

FIFTH SEMESTER						
Part - III	**Core Courses**					
21UCHC51	Organic Chemistry – III	6	6	25	75	100
21UCHCP3	Major Chemistry Practical – III (Physical Chemistry experiments)	6	5	40	60	100
21UCHCP4	Major Chemistry Practical – IV (Gravimetric Analysis and Organic Preparation)	3	-	-	-	-
21UCHCP5	Major Chemistry Practical – V (Organic Analysis and Estimation)	3	-	-	-	-
Part III	**Core Elective**					
21UCHE51	Analytical Chemistry	5	5	25	75	100
21UCHE52	Nuclear, Industrial Chemistry & Metallic State					
21UCHE53	Supramolecular Chemistry					
21UCHE54	Bioinorganic Chemistry	5	5	25	75	100
21UCHE55	Chemistry in crime investigation					
21UCHE56	Food Processing Chemistry					
Part IV	**Skill Based Course**					
21UCHS51	Drug Chemistry	2	2	25	75	100
	Total	**30**	**23**	**140**	**360**	**500**
SIXTH SEMESTER						
Part - III	**Core Courses**					
21UCHC61	Physical Chemistry – III	6	6	25	75	100
21UCHCP4	Major Chemistry Practical – IV (Gravimetric Analysis and Organic Preparation)	3	5	40	60	100
21UCHCP5	Major Chemistry Practical – V (Organic Analysis and Estimation)	3	5	40	60	100
21UCHPR1	Project and viva voce	6	4	40	60	100
Part III	**Core Elective Courses**					
21UCHE61	Applied Chemistry	5	5	25	75	100
21UCHE62	Soil and Agriculture Chemistry					
21UCHE63	Fuel Chemistry					
21UCHE64	Nano Chemistry	5	5	25	75	100
21UCHE65	Clinical and Medicinal Chemistry					
21UCHE66	Applied Electrochemistry					
Part IV	**Skill Based Course**					
21UCHS61	Polymer Chemistry	2	2	25	75	100
	Total	**30**	**32**	**220**	**480**	**700**
	Grand Total	**180**	**140**	**1170**	**3030**	**4200**


FIRST SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**INORGANIC CHEMISTRY – I**			
Course Code	21UCHC11	**L**	**P**	**C**
Category	**Core**	4	-	4

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED		**ENTREPRENEURSHIP**	✓

Course Objectives:

- To Recall the structure of atom and also know the various model of an atom for the structure of the atoms.
- To Remember the basics of periodic table and atomic properties to relate their principles
- To Compare the types of bonds to relate their relations between them.
- To Perform the chemical bonding and VSEPR theory and their applications to find the geometry of molecules.
- To Determine the various concepts on Acids and Bases and also know the positions of hydrogen and its properties.

Unit: I	**STRUCTURE OF ATOM**	12

An outline of constituents of atom (elementary idea) – Rutherford model of an atom - Mosley's determination of atomic number – mass number. Quantum theory: Black body radiation – photo electric effect – Compton effect – Bohr model of atom: postulate and hydrogen spectrum – de Broglie's equations – Heisenberg's uncertainty principle – Quantum numbers – Pauli's exclusion principle – Aufbau principle – Hund's rule – electronic configuration of atoms.

Unit: II	**PERIODIC TABLE AND ATOMIC PROPERTIES**	12

The long form of periodic table- periodic law and electronic configuration of elements- Horizontal and vertical relationship. Atomic properties- Size of atom- Atomic Volumes - Ionisation energy- electron affinity- Electronegativity- Different scales- Diagonal relationship- Classification of elements on the basis of their electronic configuration- (further extension of periodic table).

Unit: III	**CHEMICAL BONDING**	12

Cause of chemical bonding – octet rule – ionic bond – covalent bond – valence bond approach- its limitations – Fajan's rule – VSEPR theory and its limitations – application of VSEPR theory to find geometry of molecules (NH_3 and H_2O) – hybridization – sp, sp^2, sp^3, sp^3d^2 and (BeF_2, BCl_3, CH_4, SF_6, H_2O) –Molecular Orbital theory – LCAO method – MO diagram for homo nuclear and hetero nuclear diatomic molecules – H_2, He_2, Li_2, Be_2, C_2, N_2, O_2, F_2, CO and HF – determination of magnetic property and bond order

Unit: IV	**ACIDS AND BASES**	12

Arrhenius concept-Lowry Bronsted –Lewis concepts-Lux Flood solvent system concepts - Usonowich concept. Factors influencing the acidic and basis properties (steric effect, +I and –I effect, resonance effect and electronegativity effect). Oxo acids and strength of oxo acids.

Unit: V	**HYDROGEN, OZONE AND HYDROGEN PEROXIDE**	12

Hydrogen: Position of hydrogen in periodic table – resemblance of hydrogen with alkali metals – resemblance with halogens – special position of hydrogen – resemblance with carbon – preparation – manufacture – pure hydrogen – ortho and para hydrogen – occluded hydrogen – uses – Isotopes of hydrogen – Isotopic effect – hydrides – classification – examples. **Ozone**: Commercial preparation, properties, uses, structure. **Hydrogen peroxide**: Manufacture – properties – structure and uses – estimation by permanganometric and iodimetric method – strength of hydrogen peroxide.

	Total Lecture Hours	**60 Hrs**

Books for Study:

1. B.R. Puri, L.R.Sharma & K.C. Kalia, **Principles of Inorganic Chemistry** Milestone Publisher 31st edition, New Delhi 2013

Books for References:

1. Puri, Sharma & Kalia, **Principles of Inorganic Chemistry** Milestone publisher & distributor, New Delhi 2009.
2. R. D Madan S.Chand, **Modern Inorganic Chemistry** band Co.Ltd, New Delhi 2012.
3. J D.Lee, Wiley India, **Concise Inorganic Chemistry** 5th Edition, New Delhi 2009.

Web Resources:

1. https://bit.ly/3tu7P32
2. https://bit.ly/2Qev0Ac
3. https://bit.ly/3bRnjs6
4. https://bit.ly/30R8dww

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Recall the general characteristics of sub atomic particles of an atom and periodicity	**[Up to K2]**
CO2:	Discuss the long form periodic table, types of chemical bonds and concept of Acids and Bases.	**[Up to K3]**
CO3:	Prepare the hydrogen, ozone and hydrogen peroxide and compute the properties with alkali metals	**[Up to K3]**
CO4:	Examine the Quantum model of an atom and VSEPR theory to find the geometry of molecules	**[Up to K4]**
CO5:	Apply various types of bonds and quantum model of atom for the geometry of molecules	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**STRUCTURE OF ATOM** An outline of constituents of atom (elementary idea) – Rutherford model of an atom – Mosley's determination of atomic number – mass number. Quantum theory: Black body radiation – photo electric effect – Compton effect – Bohr model of atom: postulate and hydrogen spectrum – de Broglie's equations – Heizenberg's uncertainty principle – Quantum numbers – Pauli's exclusion principle – Aufbau principle – Hund's rule – electronic configuration of atoms.	12	**Chalk, Talk & Power point**
II	**PERIODIC TABLE AND ATOMIC PROPERTIES** The long form of periodic table- periodic law and electronic configuration of elements- Horizontal and vertical relationship. Atomic properties- Size of atom- Atomic Volumes - Ionisation energy- electron affinity- Electronegativity- Different scales- Diagonal relationship- Classification of elements on the basis of their electronic configuration - (further extension of periodic table).	12	**Chalk, Talk & Power point**
III	**CHEMICAL BONDING** Cause of chemical bonding – octet rule – ionic bond – covalent bond – valence bond approach- its limitations – Fajan's rule – VSEPR theory and its limitations – application of VSEPR theory to find geometry of molecules (NH_3 and H_2O) – hybridization – sp, sp^2, sp^3, sp^3d^2 and (BeF_2, BCl_3, CH_4, SF_6, H_2O)- Molecular Orbital theory – LCAO method – MO diagram for homo nuclear and hetero nuclear diatomic molecules – H_2, He_2, Li_2, Be_2, C_2, N_2, O_2, F_2, CO and HF – determination of magnetic property and bond order	12	**Chalk, Talk & Power point**
IV	**ACIDS AND BASES** Arrhenius concept-Lowry Bronsted –Lewis concepts-Lux Flood solvent system concepts -Usonowich concept. Factors influencing the acidic and basis properties (steric effect, +I and –I effect, resonance effect and electronegativity effect). Oxo acids and strength of oxo acids.	12	**Chalk, Talk & Power point**
V	**HYDROGEN, OZONE AND HYDROGEN PEROXIDE** **Hydrogen**: Position of hydrogen in periodic table – resemblance of hydrogen with alkali metals – resemblance with halogens – special position of hydrogen – resemblance with carbon – preparation – manufacture – pure hydrogen – ortho and para hydrogen – occluded hydrogen – uses – Isotopes of hydrogen – Isotopic effect – hydrides – classification – examples. **Ozone**: Commercial preparation, properties, uses, structure. **Hydrogen peroxide**: Manufacture – properties – structure and uses – estimation by permanganometric and iodimetric method – strength of hydrogen peroxide.	12	**Chalk, Talk & Power point**

Course Designed by: **Dr. V. Ramasamy Raja & Dr. J.E. Sangeetha**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K – Level	No. of. Questions	K - Level		
CI AI	CO1	Up to K2	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO2	Up to K3	2	K1 & K2	2	K2	2 (K3&K3)	2(K2 & K3)
CI AII	CO3	Up to K2	2	K1 & K2	1	K2	2 (K2&K2)	1(K2)
	CO4	Up to K4	2	K1 & K2	2	K2	2 (K3&K3)	2(K3 &K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	6.67	67
	K2	2	4	10	20	36	60	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100
CIA II	K1	2	2	-	-	4	6.67	50
	K2	2	4	10	10	26	43.33	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	10	10	16.67	17
	Marks	4	6	20	30	60	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	Cos	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K 2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Upto K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	**5**	**4**	-	**-**	**9**	**7.5**	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**MAJAOR CHEMISTRY PRACTICAL – I (Inorganic Semi Micro – Qualitative Analysis)**			
Course Code	**21UCHCP1**	**L**	**P**	**C**
Category	**Core**	-	2	-

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENEURSHIP**	✓

Course Objectives:

- To Recall the basic properties of salt mixtures.
- To Reminiscence the anionic and cationic species in the salt mixtures.
- To Apply the concept of anionic and cationic species in semi micro qualitative analysis.
- To Execute the confirmation test for the anions and cations present in the salt mixtures.
- To Construct four radicals with correct procedure during analysis of the salt mixtures.

Duration of examination: 3hrs

Analysis of a mixture containing two anions of which one is an interfering in semi-micro method two cations

Anions:

Carbonate, sulphate, nitrate, fluoride, chloride, bromide, iodide, oxalate, Borate, phosphate and chromate.

Cations: Lead, bismuth, copper, cadmium, antimony, iron (II and III), aluminium, Chromium, zinc, manganese, cobalt, nickel, barium, calcium, Magnesium and ammonium.

Distribution of marks
Max marks: 100

30

Internal : 40 marks			**External : 60 marks**		
Laboratory Performance	:	30 marks	Vivo voce	:	10 marks
Observation note book	:	10 marks	Record note book	:	10 marks
			Four radicals with correct procedure	:	40 marks
Total	:	40 marks	Total	:	60 marks

Total Lecture Hours	**30 Hrs**

Books for Study:

1. Dr. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis, National Publishing Company, 3rd edition, Chennai, 1974.

Books for References:

1. Vogel, Text book of Qualitative Analysis including Semi Micro Methods, Longman Sc & Tech, 2008.

Web Resources:		
1. https://www.youtube.com/watch?v=cEOvj6jkdDw 2. https://www.youtube.com/watch?v=T3hi_xEpaDg 3. https://www.youtube.com/watch?v=BK7rf4XE4f8 4. https://www.youtube.com/watch?v=QQo1e-BUZWs		
Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Identify the basic radical and its group in the given salt mixture.	**[Up to K2]**
CO2:	Understand the qualitative analysis skill of any given inorganic salt mixture.	**[Up to K3]**
CO3:	Develop the acid radicals present in the given inorganic salt mixture.	**[Up to K3]**
CO4:	Analyze the basic radical systematically.	**[Up to K4]**
CO5:	Apply the four radicals with correct procedure during analysis of the salt mixtures	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**11**	**10**	**9**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	INORGANIC SEMI MICRO – QUALITATIVE ANALYSIS	Hrs	Mode
I	**Duration of examination**: 3hrs Analysis of a mixture containing two anions of which one is an interfering in semi-micro method two cations **Anions:** Carbonate, sulphate, nitrate, fluoride, chloride, bromide, iodide, oxalate, Borate, phosphate and chromate. **Cations:** Lead, bismuth, copper, cadmium, antimony, iron (II and III), aluminium, Chromium, zinc, manganese, cobalt, nickel, barium, calcium, Magnesium and ammonium.	**30**	**Practical**

Course Designed by: **Dr. V. Ramasamy Raja & Dr. R. Satheesh**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**ALLIED PHYSICS–I: (Mechanics, Properties of Matter, Heat and Sound)**			
Course Code	**21UPHA11**	**L**	**P**	**C**
Category	**Allied**	4	-	4

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP	

Course Objectives:

The learners will be able:

1. To recollect Newton's law of motion
2. To understand the elasticity property and types of modulus
3. To understand the viscosity and application of Bernoulli's theorem
4. To recollect Kinetic theory of gases
5. To understand the concepts of S.H.M

Unit: I	***Mechanics***	**13**

Torque – Angular momentum –Moment of Inertia –Perpendicular and Parallel axes theorem - Kepler's laws of planetary motion - Newton's laws of gravitation–Mass and density of Earth – Boy's method for G–Compound pendulum-Expression for period-Experiment to find "g"

Unit: II	***Elasticity***	**12**

Stress and Strain - Elasticity–Different moduli of Elasticity-Poisson's ratio–Bending of beams–Expression for bending moment–Determination of Young's modulus by uniform and non uniform bending–Torsion–Expression for couple per unit twist–Work done in twisting - Torsional oscillations of a body - Workdone in twisting– Rigidity modulus by torsion pendulum

Unit: III	***Viscosity***	**11**

Coefficient of viscosity -Derivation of Poiseuille's formula - coefficient of viscosity of a liquid by Poiseuille's method – Equation of continuity-Bernoulli's theorem–derivation–Applications of Bernoulli's theorem (Venturimeter and Pitot tube).

Unit: IV	***Heat***	**12**

Kinetic theory of gases – Mean free path – Transport phenomena – Expression for the coefficient of Diffusion, viscosity and thermal conductivity – Degrees of freedom – Boltzman's law of equipartition of energy – calculation of Υ for mono atomic and diatomic gases - Thermodynamics – First and second laws of thermodynamics (statement only) – Entropy – change of entropy in Carnot's cycle – Change of entropy in conversion of ice into stream

Unit: V	***Sound***	**12**

Simple harmonic motion – Composition of two S.H.M's of equal time periods at right angles – Stationary waves – Properties of stationary waves – Melde's experiment for the frequency of electrically maintained tuning fork (Transverse and Longitudinal modes) - Ultrasonics – Production –Piezoelectric method – Detection – Kundt's tube and Piezoelectric - Properties –Applications

	Total Lecture Hours	**60 Hrs**

Books for Study:

1. R.Murugesan,Mechanics,Properties of Matter and Sound, Madurai, first edition,July2016.[B.Sc.AncillaryPhysics
   - Unit–I: 1.1, 2.1–2.7, 2.13-2.15, 3.1-3.5
   - Unit–II: 4.1-4.5, 4.7,4.8,4.10-4.13

* Unit–III: 5.2-5.7 -
* Unit-V: 6.1, 6.3,6.4, 6.7-6.9, 6.12

2. R..Murugeshan, Thermal Physics, Madurai, First edition July, 2016. (B.Sc., Ancillary Physics)
   * Unit–IV: 6.1, 6.3-6.7, 6.9-6.11, 7.4-7.7

Books for References:

1. S.L.Kakani,C.Hemarajani,S.Kakani,**Mechanics**,IIIedition,VivaBooks Ltd,NewDelhi,2011.
2. HalidayResnic,JearlWalker,**PrinciplesofPhysics**,9th Edition,WileyIndia Pvt.Ltd, New Delhi, 2012.
3. D.S.Mathur,**Mechanics**,S.ChandandCo.,NewDelhi,2008
4. Brijlaland N.Subramanyam, **Propertiesofmatter**,S.ChandandCo., New Delhi,2004
5. BrijlalandN.Subramanyam,**HeatandThermodynamics**, S.Chandand Co, New Delhi, 2004.

Web Resources:

1. https://latestcontents.com/bsc-physics-mechanics-notes/
2. www.khanacademy.org/science/physics/elasticity/surface tension
3. https://www.askiitians.com/revision-notes/physics/kinetic-theory-of-gases/
4. https://www.askiitians.com/revision-notes/physics/thermodynamics/

Course Outcomes		**K Level**
After successful completion of the course, the student is expected to		
CO1:	Understand the concepts of Newton's law of Gravitation, different modulus of elasticity, mean free path, degrees of freedom, laws of thermodynamics and stationary waves	**K2**
CO2:	Define centripetal and centrifugal force, angular velocity, moment of inertia, elasticity, Poisson's ratio, bending of beams, Bernouli's theorem, Transport Phenomena, mono and diatomic gases, S.H.M, properties of Ultrasonic waves	**K3**
CO3:	Apply torque, angular momentum, expression for bending moment, couple per unit twist, Bernouli's theorem, Boltzmann's law of equipartition of energy, change of entropy in conversion of ice to steam, applications of Ultrasonic waves	**K3**
CO4:	Analyze parallel and perpendicular axis theorem, Boy's method for G, determine and analyze uniform and non-uniform bending, Poiseuille's formula to find the coefficient viscosity of liquid	**K4**
CO5:	Analyze the change of entropy in Carnot's cycle , Kundt's tube and Piezo electric method for the production of Ultrasonic waves, Melde's experiment for the frequency of tuning fork	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	2	2	2	2
CO 2	3	2	1	2	2	2
CO 3	3	2	2	2	2	2
CO 4	3	2	2	1	2	2
CO 5	2	2	1	1	2	2

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	ALLIEDPHYSICS–I Mechanics, Properties of Matter, Heat and Sound	Hrs	Pedagogy
I	**Mechanics** Torque – Angular momentum –Moment of Inertia –Perpendicular and Parallel axes theorem - Kepler'slawsofplanetarymotion-Newton'slawsofgravitation–Massanddensityof Earth–Boy's method for G–Compound pendulum-Expression for period-Experiment to find "g"	13	Lecture method, PPT, Demonstration
II	**Elasticity** Different moduli of Elasticity-Poisson'sratio–Bendingofbeams–Expression for bending moment–Determination of Young's modulus by uniform and non uniform bending – Torsion–Expression for couple per unit twist – Workdone in twisting Torsional oscillations of a body - Workdone in twisting– Rigidity modulus by torsion pendulum	12	Lecture method, PPT, Demonstration
III	**Viscosity** Viscosity - Derivation of Poiseuille's formula - coefficient of viscosity of a liquid by Poiseuille's method – Equation of continuity - Bernoulli's theorem – derivation – Applications of Bernoulli's theorem (Venturimeter and Pitot tube)	11	Lecture method, PPT, Model
IV	**Heat** Kinetic theory of gases – Mean free path – Transport phenomena – Expression for the coefficient of Diffusion, viscosity and thermal conductivity – Degree of freedom – Boltzman's law of equipartition of energy – calculation of Υ for mono atomic and diatomic gases - Thermodynamics – First and second laws of thermodynamics (statement only) – Entropy – change of entropy in Carnot's cycle – Change of entropy in conversion of ice into stream	12	Lecture method, PPT
V	**Sound** Simple harmonic motion –- Composition of two S.H.M's of equal time periods at right angles - Stationary waves –Properties of stationary waves – Melde's experiment for the frequency of electrically maintained tuning fork (Ttransverse and Longitudinal modes) - Ultrasonics – Production – Piezo electric method – Detection – Kundt's tube and Piezo electric - Properties – Applications	12	Lecture method, PPT

Course Designed by: **1. Mrs.A.Lakshmi, 2. Dr.S.S.Jayabalakrishnan**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)											
Internal	**COs**	**K - Level**	**Unit**	**Section A**		**Section B**		**Section C (Either or Choice)**		**Section D (Open Choice)**	
				MCQs		**Short Answers**		**No. of. Questions**	**K - Level**	**No. of. Questions**	**K - Level**
				No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**				
CI AI	**CO1 to CO5**	**K1 to K4**	**I**	2	K1 & K2	1	K1	2	K2	1	K2
			II	2	K1 & K2	2	K2	2	K3	2	K3
CI AII	**CO1 to CO5**	**K1 to K4**	**III**	2	K1 & K2	1	K2	2	K3	1	K3
			IV	2	K1 & K2	2	K2	2	K4	2	K4
Question Pattern CIA I & II		No. of Questions to be asked		4		3		4		3	
		No. of Questions to be answered		4		3		2		2	
		Marks for each question		1		2		5		10	
		Total Marks for each section		4		6		10		20	

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2	2			4	6.7	50
	K2	2	4	10	10	26	43.3	
	K3			10	20	30	50.0	50
	K4							-
	Marks	4	6	20	30	60	100	100
CIA II	**K1**	2	2			4	6.7	16.7
	K2	2	4			6	10.0	
	K3			10	10	20	33.3	33.3
	K4			10	20	30	50.0	50
	Marks	4	6	20	30	60	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

UNIT-V *will be allotted for individual Assignment in* **CO5 - K4** *level which carries five marks as part of CIA component.*

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)											
S.No.	COs	K - Level	Unit	MOQs		Short Answers		Section C (Either / or Choice)		Section D (Open Choice)	
				No.of Questions	K – Level	No.of Questions	K – Level	No.of Questions	K – Level	No.of Questions	K – Level
1	CO1 - CO5	K1 to K4	I	2	K1 & K2	1	K1	2	K2 & K2	1	K2
2	CO1 - CO5	K1 to K4	II	2	K1 & K2	1	K1	2	K3 & K3	1	K3
3	CO1 - CO5	K1 to K4	III	2	K1 & K2	1	K2	2	K3 & K3	1	K3
4	CO1 - CO5	K1 to K4	IV	2	K1 &K2	1	K2	2	K4 & K4	1	K4
5	CO1 - CO5	K1 to K4	V	2	K1 & K2	1	K2	2	K4 & K4	1	K4
No. of Questions to be Asked				10		5		10		5	
No. of Questions to be answered				10		5		5		3	
Marks for each question				1		2		5		10	
Total Marks for each section				10		10		25		30	

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4			9	12	47
K2	5	6	10	10	31	34.66	
K3			20	20	40	27	27
K4			20	20	40	26.66	26
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K4	
20) b	CO5	K4	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**ALLIED PHYSICS PRACTICAL - I**			
Course Code	**21UPHAP1**	**L**	**P**	**C**
Category	**Allied**	-	2	-

Nature of course:	EMPLOYABILITY	✓	SKILL ORIENTED	✓	ENTREPRENEURSHIP	

Course Objectives:

The learners will be able:
1. To gain knowledge about the experiments based on Optics, Electricity and Electronics
2. To demonstrate modulus of elasticity
3. To understand the bending of beam, forward and reverse biasing, frequency responce
4. To understand current conduction in electrical circuits.
5. To learn about transistor amplifier, oscillator and Operational amplifier.

LIST OF EXPERIMENTS (Any Fourteen Experiments)

1.. Uniform bending	- (Pin & Microscope)
2. Torsion Pendulum	- Determination of Rigidity modulus and M.I
3. Thermal conductivity of Bad conductor	- Lee's disc
4. Sonometer	- Verification of laws
5. Calibration of low range Voltmeter	- Potentiometer
6. Carey Foster Bridge	- Resistance & resistivity of a wire.
7. Spectrometer	- Refractive indexof a Prism
8..Mirror Galvanometer	- Voltage and current sensitiveness
9.LCR – Series resonance	- Determination of L & Q factor
10.Air wedge	- Thickness of a wire
11.Grating N by λ Normal incidence	- Spectrometer
12.Single stage transistor amplifier	- CE mode
13.Hartley oscillator	- Determination of frequency
14.Logic gates – NAND and NOR	- Using Discrete Components.
15.Zener diode	- Forward & Reverse Characteristics
16.OP AMP	- Adder and Subtractor

Total Practical Hours **30 Hrs**

Books for Study:

2. Srinivasan.M.N.,Balasubramanian.S.,Ranganathan.R., **A Text Book of Practical Physics,** 2017 Edition Sultan Chand & Sons

Books for References:

1. Ouseph.C., Practical Physics and Electronics,2013.S.Viswanathan.P.Ltd
2. Practical Physics and Electronics, C.C.Ouseph, U.J.Rao, V.Vijayendran, S.Viswanathan Publishers(2007)

Web Resources:

1. https://nptel.ac.in/course.html/physics/experimental physics I, II and III
2. https://nptel.ac.in/courses/115/105/115105110/
3. https://www.youtube.com/playlist?list=PLuiPz6iU5SQ8-rZn_LgLofRX7n8z4tHYK

Course Outcomes		K Level
On successful completion of the course, the learners should be able to		
CO1:	Understand and evaluate the Young's modulus and Rigidity modulus of the given material, the ways to calibrate a low range voltmeter using potentiometer	**K4**
CO2:	Acquire the knowledge of the characteristics of an operational amplifier	**K3**
CO3:	Apply the basic principles of optics to determine the thickness of a wire	**K4**
CO4:	Analyze the electrical parameters like resistance and resistivity using Carrey Foster bridge and characteristics of Zener diode	**K4**
CO5:	Construct Amplifier and Oscillator	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**3**	**3**	**3**	**2**
CO 2	**2**	**2**	**2**	**2**	**5**	**2**
CO 3	**3**	**3**	**3**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**	**2**
CO 5	**3**	**2**	**2**	**3**	**3**	**3**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Semester	Allied Physics Practical - I	Hrs	Pedagogy
I	1. Uniform bending - Pin & Microscope 2. Torsion Pendulum - Determination of Rigidity modulus and M.I 3. Thermal conductivity of Bad conductor - Lee's disc 4. Sonometer - Verification of laws 5. Calibration of low range Voltmeter - Potentiometer 6. LCR – Series resonance - Determination of L & Q factor 7. Logic gates – NAND and NOR - (Discrete Components). 8. Zener diode - Forward & Reverse Characteristics	**30**	Demonstration

Course Designed by: **1. Mrs.A.Lakshmi, 2. Dr.R.Sangeetha**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**COSMETIC CHEMISTRY**			
Course Code	**21UCHS11**	**L**	**P**	**C**
Category	**Skill**	2	-	2

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENEURSHIP**	✓

Course Objectives:

- To Recall the basic properties of soap and detergents and also ingredients on tooth pastes.
- To Remember the preparations of hair care products.
- To Compare the consumer products with their compositions.
- To Execute the composition and physical properties of milk products.
- To Determine the adulterants in food materials and first aid and antidots for poisoned persons.

Unit: I	**COSMETICS I**	06

Dental Preparations: Tooth pastes- ingredients, their characteristics and functions. Mouth washes (Composition only). Soap and Detergents: Manufacture of Soap and Detergents. Cleansing action of Soap. Problems of Detergents as waste water in water resources.

Unit: II	**COSMETICS II**	06

Hair care preparations: shampoo; different types and formulations, Moisturizing creams, perfumes, Lip sticks, shaving creams, after shave preparations. (Composition and applications for the above).

Unit: III	**CONSUMER PRODUCTS**	06

Consumer Products: Composition and Uses of Safety Matches, Agarbattis, Naphthalene Balls, Wax candles, shoe polish, Gum, Ink, Chalk crayons.

Unit: IV	**SUGAR**	06

Preparation of bagasse-use of bagasse for the manufacture of paper and electricity- preparation of alcohol from molasses-preparation of absolute alcohol-manufacture of wine, beer, methylated spirit – power alcohol.

Unit: V	**FOOD ADULTERATION**	06

Food adulteration - Contamination of wheat, rice, dhal, milk, butter, with clay, sand, stone, water and toxic chemicals (e.g., Kasseri dhal with mentanil yellow). Food poisons: natural poisons (alkaloids, nephrotoxins), pesticides (DDT, BHC, Follidol), chemical poisons (KCN). First aid and Antidotes for poisoned persons.

	Total Lecture Hours	**30 Hrs**

Books for Study:

1. Sharma, B.K., Industrial Chemistry, Meerut: GOEL Publishing House, 1st Edition, 2008.
2. Poucher, W.A. Perfumes, Cosmetics and soaps, Vol. III, Modern Cosmetics. Simons, J.V. Chemistry and the beauty business, 2018.
3. K.S. Rangappa and K.T Acharya, Indian Dairy products, Asia Publishing House, New Delhi, 1975.
4. Chopra H.K, Panesar, P.S, "Food Chemistry" Narosa Publishing House, New Delhi, 2010.

Books for Reference:

1. R.V.Shreve, Industrial Chemical Process, Tata McGraw Hill publishing company, 2005, Mumbai.
2. Mohan Malhotra, Latest Cottage Industries, 20th Edition Edn, Vishal publishers, 1980, Meerut.
3. Robert Jenness and S. Patom, Principles of dairy chemistry, Wiley, New York.

Web Resources:		
1. https://bit.ly/3rVPCex 2. https://bit.ly/38OFFI8		
Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Relate the characteristics of tooth pastes, hair care products.	**[Up to K2]**
CO2:	Understand the concepts of manufacture of soaps, detergents, hair care and consumer products.	**[Up to K3]**
CO3:	Compare the milk and sugar products on their composition.	**[Up to K3]**
CO4:	Correlate the consumer products, sugar and food adulteration.	**[Up to K4]**
CO5:	Construct the characteristics and understand the consumer products	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**11**	**10**	**9**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COSMETIC CHEMISTRY	Hrs	Mode
I	**COSMETICS I** Dental Preparations: Tooth pastes- ingredients, their characteristics and functions. Mouth washes (Composition only). Soap and Detergents: Manufacture of Soap and Detergents. Cleansing action of Soap. Problems of Detergents as waste water in water resources.	06	Chalk & Talk, Power Point
II	**COSMETICS II** Hair care preparations: shampoo; different types and formulations, Moisturizing creams, perfumes, Lip sticks, shaving creams, after shave preparations. (Composition and applications for the above).	06	Chalk & Talk, Power Point
III	**CONSUMER PRODUCTS** Consumer Products: Composition and Uses of Safety Matches, Agarbattis, Naphthalene Balls, Wax candles, shoe polish, Gum, Ink, Chalk crayons.	06	Chalk & Talk, Power Point
IV	**SUGAR** Preparation of bagasse-use of bagasse for the manufacture of paper and electricity- preparation of alcohol from molasses-preparation of absolute alcohol-manufacture of wine, beer, methylated spirit – power alcohol.	06	Chalk & Talk, Power Point
V	**FOOD ADULTERATION** **Food adulteration -** Contamination of wheat, rice, dhal, milk, butter, with clay, sand, stone, water and toxic chemicals (e.g., Kasseri dhal with mentanil yellow). Food poisons: natural poisons (alkaloids, nephrotoxins), pesticides (DDT, BHC, Follidol), chemical poisons (KCN). First aid and Antidotes for poisoned persons.	06	Chalk & Talk, Power Point

Course Designed by: **Dr. J.E. Sangeetha & Dr. R. Satheesh**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**GREEN CHEMISTRY**							
Course Code	**21UCHS12**					**L**	**P**	**C**
Category	**Skill**					2	-	2
Nature of Course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENEURSHIP**			

Course Objectives:

- To Recollect the green environment and basic definition for green chemistry.
- To Remember the twelve principles of green chemistry and examples.
- To Compare the concept of yield and its calculation on atom economy.
- To Execute the concept of selectivity, types of selectivity and reactions using green solvents.
- To Determine the basic concepts in designing green synthesis and choice of starting materials.

Unit: I	**INTRODUCTION**	6

Definition for Green Chemistry, Need for Green Chemistry- Goals of Green Chemistry – Obstacles and Advantages of Green chemistry, Progress of Green Chemistry- Twelve principles of Green Chemistry and Examples.

Unit: II	**YIELD AND ATOM ECONOMY**	6

Concept of Yield and its calculation, Atom economy – Definition, Calculation of Atom economy in rearrangement, addition, substitution and elimination reactions.

Unit: III	**SELECTIVITY IN GREEN CHEMISTRY**	6

Concept of selectivity, Types of selectivity -Chemo-, regio-, enantio- and diastereoselectivities, Reactions using Green solvents - Super critical CO_2- Cleaner technology with CO_2.Ionic liquids-Friedel-crafts reaction, halogenation &Diels- Alder reaction. and water.

Unit: IV	**SOLVENT FREE REACTIONS**	6

Organic synthesis in solid state-Thermal reactions, rearrangements &photochemical reactions. Mode of supplying energy-microwave and ultrasonic-Advantages of MW techniques. Reactions like oxidation, reduction & rearrangements.

Unit: V	**DESIGNING OF GREEN SYNTHESIS**	6

Basic concepts in designing Green synthesis - choice of starting materials, reagents, catalysts-catalytic approach in green chemistry and solvents with suitable examples.

	Total Lecture Hours	**30 Hrs**

Books for Study:

1. V. Kumar, "An Introduction to Green Chemistry" Vishal publishing Co. Reprint Edition 2010
2. Rashmi Sanghi, M.M Srivastava "Green Chemistry" Fourth Reprint - 2009

Books for References:

1. V.K. Ahluwalia and M.R. Kidwai, New Trends in Green Chemistry, Anamalaya Publishers, 2005.
2. P.T. Anastas, and J.K. Warner: Green Chemistry - Theory and Practical, Oxford University Press, 1998.

Web Resources:

1. https://www.youtube.com/watch?v=PUisOKB6sgA
2. https://www.youtube.com/watch?v=qNHW-Pi9c9g

Course Outcomes:	**K Level**
On the completion of the course the student will be able to	
CO1: List out the twelve principles of Green Chemistry.	**[Up to K2]**

CO2:	Understand the need for green chemistry and goals of Green Chemistry.	**[Up to K3]**
CO3:	Apply Green Chemistry principles to organic synthesis.	**[Up to K3]**
CO4:	Analyze the uses of Microwave and ultrasonic radiations to carry our reaction.	**[Up to K4]**
CO5:	Construct the basic concepts and twelve principles of Green Chemistry in designing green synthesis	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**2**	**1**	**2**	**3**	**3**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**2**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**10**	**10**	**9**	**11**	**10**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	GREEN CHEMISTRY	Hrs	Mode
I	**INTRODUCTION** Definition for Green Chemistry, Need for Green Chemistry- Goals of Green Chemistry – Obstacles and Advantages of Green chemistry, Progress of Green Chemistry- Twelve principles of Green Chemistry and Examples.	**06**	**Chalk & Talk, Power Point**
II	**YIELD AND ATOM ECONOMY** Concept of Yield and its calculation, Atom economy – Definition, Calculation of Atom economy in rearrangement, addition, substitution and elimination reactions.	**06**	**Chalk & Talk, Power Point**
III	**SELECTIVITY IN GREEN CHEMISTRY** Concept of selectivity, Types of selectivity -Chemo-, regio-, enantio- and diastereoselectivities, Reactions using Green solvents - Super critical CO_2- Cleaner technology with CO_2.Ionic liquids-Friedel-crafts reaction, halogenation &Diels- Alder reaction. and water.	**06**	**Chalk & Talk, Power Point**
IV	**SOLVENT FREE REACTIONS** Organic synthesis in solid state-Thermal reactions, rearrangements &photochemical reactions. Mode of supplying energy-microwave and ultrasonic-Advantages of MW techniques. Reactions like oxidation, reduction & rearrangements.	**06**	**Chalk & Talk, Power Point**
V	**DESIGNING OF GREEN SYNTHESIS** Basic concepts in designing Green synthesis - choice of starting materials, reagents, catalysts-catalytic approach in green chemistry and solvents with suitable examples.	**06**	**Chalk & Talk, Power Point**

Course Designed by: **Dr. Ramasamy Raja & Dr. K. Muthupandi**


SECOND SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**ORGANIC CHEMISTRY – I**							
Course Code	**21UCHC21**					**L**	**P**	**C**
Category	**Core**					4	-	4
Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED		**ENTREPRENEURSHIP**			✓

Course Objectives:

- To Recall the definition of hydrocarbons and classification of organic compounds.
- To Understand the preparation, properties of hydrocarbons, alcohols, ethers, aldehydes, ketones and carboxylic acids.
- To Classify the isomerism and determine the concept of stereoisomerisms.
- To Execute the concept of geometrical and optical isomerism.
- To Construct the preparation and properties of monosaccharides, disaccharides and polysaccharides.

Unit: I	**HYDROCARBONS**	12

Hydrocarbons – Introduction – Definition and Classifications. **Alkanes** – Nomenclature - General methods of preparation and Chemical properties. **Alkenes** – Nomenclature – General methods of preparation – chemical properties – Electrophilic additions – Addition of hydrogen halide – Markownikov's rule – Antimarkovinkov's addition – Addition of H_2SO_4, H_2O, Halogen – Hydroboration – oxidation – ozonolysis – hydroxylation – polymerization. **Alkynes** – Nomenclature – General methods of preparation – physical and chemical properties – polymerization.

Unit: II	**ALCOHOLS, ETHERS, THIOALCOHOLS AND THIOETHERS**	12

Alcohols: Preparation by hydroboration; reduction of carbonyl compounds, acids and esters, by using Grignard reagents. Reaction with metals. Mechanism and reactivity towards HX, dehydration – rearrangement. Ascending and descending the alcohol series – estimation of number of hydroxyl groups. **Ethers**: Mechanism of Williamson's synthesis, mechanism of cleavage by HX, estimation of methoxy group by Zeisel method. Application of crown ethers. **Thioalcohols and thioethers**: Preparation and properties of sulphonal and mustard gas.

Unit: III	**ALDEHYDES, KETONES AND CARBOXYLIC ACIDS**	12

Aldehydes and Ketones: Nomenclature and structure of carbonyl group – Preparation of Aldehydes and Ketones – Physical properties – Chemical reactions and uses of Aldehydes and Ketones. **Carboxylic Acids**: Nomenclature and structure of carboxyl group – Methods of preparation of Carboxylic acids – Physical properties – Chemical reactions and uses of Carboxylic acids.

Unit: IV	**STEREO ISOMERISM**	12

Geometrical isomerism: Definition – geometrical isomerism of maleic and fumaric acids – aldoximes and ketoximes – determination of configuration of geometric isomers – E, Z notations – stereo chemistry of addition of bromine to double bond. **Optical isomerism**: Optical activity – specific rotation – definition of optical isomerism – elements of symmetry - Optical isomerism of compounds containing asymmetric carbon atom – racemization and resolution of racemic mixtures – Walden inversion – asymmetric synthesis – chirality – specifications of absolute configuration by R and S notations. Optical activity of compounds without asymmetric carbon atoms, allenes, spiranes and bi phenyl compounds.

Unit: V	**Carbohydrates**:	12

Definition – classification – monosaccharides – properties and uses of glucose and fructose – configuration of glucose and fructose – Haworth structure – conversion of glucose to fructose and vice versa. **Disaccharides**: Preparation, properties, constitution and configuration of sucrose. **Poly saccharides**: A general study of starch and cellulose – uses of cellulose in industries.	
	Total Lecture Hours **60 Hrs**

Books for Study:

1. B. S Bahl and Arun Bahl S.Chand, Advanced Organic Chemistry Co Ltd, New Delhi, 2012.

Books for References:

1. B-Mehta and M.Mehta, Organic Chemistry E.E Edition, New Delhi, 2010.
2. P.L Soni and H.M Chawla, Organic Chemistry, 29th Edition, Sultan Chand and sons, New Delhi, 2007.

Web Resources:

1. https://courses.lumenlearning.com/chemistryformajors/chapter/alcohols-and-ethers/
2. https://www.youtube.com/watch?v=_vq9T0htW0Y
3. https://courses.lumenlearning.com/chemistryformajors/chapter/aldehydes-ketones-carboxylic-acids-and-esters-2/
4. https://www.youtube.com/watch?v=JxK5rZxbyQY

Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Identify the basic idea of organic compounds and carbohydrates.	**[Up to K2]**
CO2:	Classify the hydrocarbons, alcohols, ethers and carbohydrates.	**[Up to K3]**
CO3:	Determine the preparation of hydrocarbons, alcohols, ethers and the given carbonyl compounds.	**[Up to K3]**
CO4:	Analyze the physical and chemical properties of hydrocarbons, alcohols, ethers and the given carbonyl compounds.	**[Up to K4]**
CO5:	Construct the basic idea of preparation, properties of organic compounds and carbohydrates.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**11**	**10**	**9**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	ORGANIC CHEMISTRY – I	Hrs	Mode
I	**HYDROCARBONS** **Hydrocarbons** – Introduction – Definition and Classifications. **Alkanes** – Nomenclature - General methods of preparation and Chemical properties. **Alkenes** – Nomenclature – General methods of preparation – chemical properties – Electrophilic additions – Addition of hydrogen halide – Markownikov's rule – Antimarkovinkov's addition – Addition of H_2SO_4, H_2O, Halogen – Hydroboration – oxidation – ozonolysis – hydroxylation – polymerization. **Alkynes** – Nomenclature – General methods of preparation – physical and chemical properties – polymerization.	12	Chalk & Talk, Power Point
II	**ALCOHOLS, ETHERS, THIOALCOHOLS AND THIOETHERS** **Alcohols**: Preparation by hydroboration; reduction of carbonyl compounds, acids and esters, by using Grignard reagents. Reaction with metals. Mechanism and reactivity towards HX, dehydration – rearrangement. Ascending and descending the alcohol series – estimation of number of hydroxyl groups. **Ethers**: Mechanism of Williamson's synthesis, mechanism of cleavage by HX, estimation of methoxy group by Zeisel method. Application of crown ethers. **Thioalcohols and thioethers**: Preparation and properties of sulphonal and mustdard gas.	12	Chalk & Talk, Power Point
III	**ALDEHYDES, KETONES AND CARBOXYLIC ACIDS** **Aldehydes and Ketones**: Nomenclature and structure of carbonyl group – Preparation of Aldehydes and Ketones – Physical properties – Chemical reactions and uses of Aldehydes and Ketones. **Carboxylic Acids**: Nomenclature and structure of carboxyl group – Methods of preparation of Carboxylic acids – Physical properties – Chemical reactions and uses of Carboxylic acids.	12	Chalk & Talk, Power Point
IV	**STEREO ISOMERISM** **Geometrical isomerism**: Definition – geometrical isomerism of maleic and fumaric acids – aldoximes and ketoximes – determination of configuration of geometric isomers – E, Z notations – stereo chemistry of addition of bromine to double bond. **Optical isomerism**: Optical activity – specific rotation – definition of optical isomerism – elements of symmetry - Optical isomerism of compounds containing asymmetric carbon atom – racemization and resolution of racemic mixtures – Walden inversion – asymmetric synthesis – chirality – specifications of absolute configuration by R and S notations. Optical activity of compounds without asymmetric	12	Chalk & Talk, Power Point

	carbon atoms, allenes, spiranes and bi phenyl compounds.		
V	**Carbohydrates**: Definition – classification – monosaccharides – properties and uses of glucose and fructose – configuration of glucose and fructose – Haworth structure – conversion of glucose to fructose and vice versa. **Disaccharides**: Preparation, properties, constitution and configuration of sucrose. **Poly saccharides**: A general study of starch and cellulose – uses of cellulose in industries.	**12**	**Chalk & Talk, Power Point**

Course Designed by**: Dr. K. Muthupandi & Dr. V. Ramasamy Raja**

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section Section C Either or Choice**	**Section Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Up to K2**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1 & K2**	2	K2	2 (K3&K3)	2(K2 & K3)
CI AII	**CO3**	**Up to K2**	**2**	**K1 & K2**	1	K2	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1 & K2**	2	K2	2 (K3&K3)	2(K3 &K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	6.67	67
	K2	2	4	10	20	36	60	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100
CIA II	K1	2	2	-	-	4	6.67	50
	K2	2	4	10	10	26	43.33	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	10	10	16.67	17
	Marks	4	6	20	30	60	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K 2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Upto K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**MAJOR CHEMISTRY PRACTICAL – I (Inorganic Semi Micro – Qualitative Analysis)**							
Course Code	**21UCHCP1**					**L**	**P**	**C**
Category	**Core**					-	2	2
Nature of Course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENEURSHIP**		✓	

Course Objectives:

- Recall the basic properties of salt mixtures.
- Reminiscence the anionic and cationic species in the salt mixtures.
- Apply the concept of anionic and cationic species in semi micro qualitative analysis.
- Execute the confirmation test for the anions and cations present in the salt mixtures.
- Construct four radicals with correct procedure during analysis of the salt mixtures.

Duration of examination: 3hrs

Analysis of a mixture containing two anions of which one is an interfering in semi-micro method two cations

Anions:

Carbonate, sulphate, nitrate, fluoride, chloride, bromide, iodide, oxalate, Borate, phosphate and chromate.

Cations: Lead, bismuth, copper, cadmium, antimony, iron (II and III), aluminium, Chromium, zinc, manganese, cobalt, nickel, barium, calcium, Magnesium and ammonium.

30

Distribution of marks
Max marks: 100

Internal : 40 marks			**External : 60 marks**		
Laboratory Performance	:	30 marks	Vivo voce	:	10 marks
Observation note book	:	10 marks	Record note book	:	10 marks
			Four radicals with correct procedure	:	40 marks
Total	:	40 marks	Total	:	60 marks

Total Lecture Hours	**30 Hrs**

Books for Study:

1. Dr. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis, National Publishing Company, 3rd edition, Chennai, 1974.

Books for References:

1. Vogel, Text book of Qualitative Analysis including Semi Micro Methods, Longman Sc & Tech, 2008.

Web Resources:

1. https://www.youtube.com/watch?v=cEOvj6jkdDw 2. https://www.youtube.com/watch?v=T3hi_xEpaDg 3. https://www.youtube.com/watch?v=BK7rf4XE4f8 4. https://www.youtube.com/watch?v=QQo1e-BUZWs	
Course Outcomes:	**K Level**
On the completion of the course the student will be able to	
CO1: Identify the basic radical and its group in the given salt mixture.	**[Up to K2]**
CO2: Understand the qualitative analysis skill of any given inorganic salt mixture.	**[Up to K3]**
CO3: Develop the acid radicals present in the given inorganic salt mixture.	**[Up to K3]**
CO4: Analyze the basic radical systematically.	**[Up to K4]**
CO5: Apply the four radicals with correct procedure during analysis of the salt mixtures	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**11**	**10**	**9**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	INORGANIC SEMI MICRO – QUALITATIVE ANALYSIS	Hrs	Mode
I	**Duration of examination**: 3hrs Analysis of a mixture containing two anions of which one is an interfering in semi-micro method two cations **Anions:** Carbonate, sulphate, nitrate, fluoride, chloride, bromide, iodide, oxalate, Borate, phosphate and chromate. **Cations:** Lead, bismuth, copper, cadmium, antimony, iron (II and III), aluminium, Chromium, zinc, manganese, cobalt, nickel, barium, calcium, Magnesium and ammonium.	**30**	**Practical**

Course Designed by: **Dr. V. Ramasamy Raja & Dr. R. Satheesh**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**ALLIED PHYSICS–II: (Electricity, Electronics, Optics and Modern Physics)**			
Course Code	**21UPHA21**	**L**	**P**	**C**
Category	**Allied**	4	-	3

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP	

Course Objectives:

The learners will be able:
1. To understand the laws of electricity
2. To recollect different types of diodes and transistors
3. To apply decimal and binary number system
4. To understand the various types of lenses, prism, aberrations, interference and diffraction
5. To understand and apply the basic concepts of laser

Unit: I	***Electricity***	**12**

Capacitors –Expression for C of a parallel plate capacitor – Energy of a charged capacitor – Loss of energy on sharing of charges between two capacitors- Kirchoff's laws – Application of Kirchhoff's laws to Wheatstone's network – Carey Foster Bridge – Measurement of resistance – Principle of Potentiometer – Calibration of ammeter and voltmeter(low range only)

Unit: II	***Electronics***	**12**

Transistor –Working of n-p-n transistor– Characteristics(CE mode only) –Common - Emitter transistor amplifier – Frequency response - Hartley oscillator –Modulation – Types of Modulation - OPAMP and its characteristics – OPAMP as adder and subtractor-– Logic circuits – Boolean algebra – De Morgan's theorem – OR, AND, NOR , NOT , NAND gates

Unit: III	***Geometrical Optics***	**12**

Deviation produced by thin lens – Focal length of two thin lenses in and out of contact – Refraction through a thin prism – Dispersion – Dispersive power – Combination of thin prisms to produce (a) Deviation without dispersion and (b) Dispersion without deviation – Direct vision spectroscope – Chromatic aberration in lenses – Spherical aberration in lenses – Theory of primary and secondary rainbows.

Unit: IV	***Physical Optics***	**12**

Interference in thin films – air wedge – Newton's rings (reflected beam only) – Determination of wavelength – Diffraction – Theory of plane transmission grating (normal incidence only) – Experiment to determine wavelengths - Double refraction – Nicol prism – Construction, action and uses – Quarter wave plate (QWP) – Half wave plate (HWP) – Optical activity – Biot's laws – Specific rotatory power – Laurent's Half shade polarimeter – Determination of specific rotatory power

Unit: V	***Lasers***	**12**

Introduction of Lasers-Spontaneous and stimulated emission-Population Inversion-Einstein's A and B coefficients-derivation. Types of lasers-Nd:YAG,CO_2 ,Semiconductor lasers-Industrial and Medical Applications.

	Total Lecture Hours	**60 Hrs**

Books for Study:

1. R. Murugesan,**Electricity and Electronics**, Madurai, First Edition, July 2016.

Unit – I : 1.5,1.6, 1.9-1.14, 1.18,1.19,2.1,2.3-2.7
Unit – II : 4.1,4.2,4.4,4.5.4.6,4.1o-4.12,4.14-4.18,4.24,4.25, 5.1-5.7,5.9-14,5.16

2. R.Murugeshan, **Optics Spectroscopy and Modern Physics,** Madurai, First Edition, July 2016.

Unit – IIII : 1.1-1.3,1.5-1.11,1.13,1.17,1.23,1.24
Unit – IV : 2.1,2.2,2.4-2.6,2.9,2.10,3.1,3.2,3.4,3.5-3.10

3. P.Mani, **A Text book of Engineering Physics**,12th edition, , Dhanam Publications, Chennai

Unit – V : 7.1 – 7.45

Books for References:

1. Kakaniand Bhandari Sultan ,**Optics and Spectroscopy,** Chand and Sons,New Delhi,2004.
2. Brijlaland Subramanyam.,**A Text book of Optics,**S.Chandand Co,New Delhi,2004.
3. B.K.Sharma, **Spectroscopy**, GOEL Publishing House, Meerut, 2006.
4. NarayanamoorthyandNagarathinam, **Electricity and Magnetism,** National Publishing Co,

Web Resources:

1. https://www.youtube.com/watch?v=ML7HcZo6IaE
2. https://www.khanacademy.org/science/physics/light-waves/introduction-to-light-
3. waves/v/polarization-of-light-linear-and-circular

Course Outcomes		**K Level**
After successful completion of the course, the student is expected to		
CO1:	Remember principle of capacitors, Kirchhoff's laws, forward and reverse bias, frequency response, modulation, focal length, dispersive power, cordinal points, double refraction, Biot's law, Principals of Laser.	**K2**
CO2:	Understand energy of a capacitor, principle of potentiometer, diode characteristics, working of npn transistor, logic circuits, basics of types of laser.	**K3**
CO3:	Apply Kirchhoff's laws, Boolean algebra, Refraction through a prism, Einstein's coefficients	**K3**
CO4:	Calibration of ammeter and voltmeter, OP AMP as an adder and subtractor, logic gates, deviation without dispersion ,dispersion without deviation, Q.W.P, H.W.P, Applications of lacer.	**K4**
CO5:	Examine parallel plate capacitor, Cary Foster bridge, transistor characteristics CE mode, frequency of Hartley oscillator, Specific rotatory power, Nd:YAG,CO_2 ,Semiconductor lasers	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**2**	**2**	**2**	**2**
CO 2	**3**	**2**	**1**	**2**	**2**	**2**
CO 3	**3**	**2**	**2**	**2**	**2**	**2**
CO 4	**3**	**2**	**2**	**1**	**2**	**2**
CO 5	**2**	**2**	**1**	**1**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN – ALLIED PHYSICS - II

Unit	Electricity, Electronics , Optics and Modern Physics	Hrs	Pedagogy
I	**Electricity** Capacitors –Expression for C of a parallel plate capacitor – Energy of a charged capacitor – Loss of energy on sharing of charges between two capacitors- Kirchoff's laws – Application of Kirchhoff's laws to Wheatstone's network – Carey Foster Bridge – Measurement of resistance – Principle of Potentiometer – Calibration of ammeter and voltmeter(low range only)	13	Lecture method, PPT, Demonstration
II	**Electronics** Transistor –Working of n-p-n transistor– Characteristics(CE mode only) –Common - Emitter transistor amplifier – Frequency response - Hartley oscillator –Modulation – Types of Modulation - OPAMP and its characteristics – OPAMP as adder and subtractor-– Logic circuits – Boolean algebra – De Morgan's theorem – OR, AND, NOR , NOT , NAND gates	12	Lecture method, PPT, Demonstration
III	**Geometrical Optics** Deviation produced by thin lens – Focal length of two thin lenses in and out of contact – Refraction through a thin prism – Dispersion – Dispersive power – Combination of thin prisms to produce (a) Deviation without dispersion and (b) Dispersion without deviation – Direct vision spectroscope – Chromatic aberration in lenses – Spherical aberration in lenses – Theory of primary and secondary rainbows.	11	Lecture method, PPT, Model
IV	**Physical Optics** Interference in thin films – air wedge – Newton's rings (reflected beam only) – Determination of wavelength – Diffraction – Theory of plane transmission grating (normal incidence only) – Experiment to determine wavelengths - Double refraction – Nicol prism – Construction, action and uses – Quarter wave plate (QWP) – Half wave plate (HWP) – Optical activity – Biot's laws – Specific rotatory power – Laurente' Half shade polarimeter – Determination of specific rotatory power	12	Lecture method, PPT
V	**Lasers** Introduction of Lasers-Spontaneous and stimulated emission-Population Inversion-Einstein's A and B coefficients-derivation. Types of lasers-Nd:YAG,CO_2 ,Semiconductor lasers-Industrial and Medical Applications.	12	Lecture method, PPT

Course Designed by: **1. Mrs.A.Lakshmi, 2. Dr.R.Sangeetha**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)											
Internal	**COs**	**K - Level**	**Unit**	**Section A**		**Section B**		**Section C (Either or Choice)**		**Section D (Open Choice)**	
				MCQs		**Short Answers**		**No. of. Questions**	**K - Level**	**No. of. Questions**	**K - Level**
				No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**				
CI AI	**CO1 to CO5**	**K1 to K4**	**I**	2	K1&K2	1	K1	2	K2	1	K2
			II	2	K1&K2	2	K2	2	K3	2	K3
CI AII	**CO1 to CO5**	**K1 to K4**	**III**	2	K1&K2	1	K2	2	K3	1	K3
			IV	2	K1&K2	2	K2	2	K4	2	K4
Question Pattern CIA I & II		No. of Questions to be asked		4		3		4		3	
		No. of Questions to be answered		4		3		2		2	
		Marks for each question		1		2		5		10	
		Total Marks for each section		4		6		10		20	

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2	2			4	6.7	50
	K2	2	4	10	10	26	43.3	
	K3			10	20	30	50.0	50
	K4							-
	Marks	4	6	20	30	60	100	100
CIA II	**K1**	2	2			4	6.7	16.7
	K2	2	4			6	10.0	
	K3			10	10	20	33.3	33.3
	K4			10	20	30	50.0	50
	Marks	4	6	20	30	60	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
UNIT-V ***will be allotted for individual Assignment in*** **CO5 - K4** ***level which carries five marks as part of CIA component.***

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)											
S.No.	**COs**	**K - Level**	**Unit**	**MOQs**		**Short Answers**		**Section C (Either / or Choice)**		**Section D (Open Choice)**	
				No.of Questions	**K – Level**	**No.of Questions**	**K – Level**	**No.of Questions**	**K – Level**	**No.of Questions**	**K – Level**
1	**CO1 - CO5**	**K1 to K4**	**I**	2	K1 & K2	1	K1	2	K2 & K2	1	K2
2	**CO1 - CO5**	**K1 to K4**	**II**	2	K1 & K2	1	K1	2	K3 & K3	1	K3
3	**CO1 - CO5**	**K1 to K4**	**III**	2	K1 & K2	1	K2	2	K3 & K3	1	K3
4	**CO1 - CO5**	**K1 to K4**	**IV**	2	K1 &K2	1	K2	2	K4 & K4	1	K4
5	**CO1 - CO5**	**K1 to K4**	**V**	2	K1 & K2	1	K2	2	K4 & K4	1	K4
No. of Questions to be Asked				10		5		10		5	
No. of Questions to be answered				10		5		5		3	
Marks for each question				1		2		5		10	
Total Marks for each section				10		10		25		30	

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	12	47
K2	5	6	10	10	31	34.66	
K3			20	20	40	27	27
K4			20	20	40	26.66	26
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a			
16) b			
17) a			
17) b			
18) a			
18) b			
19) a			
19) b			
20) a			
20) b			
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21			
22			
23			
24			
25			

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**ALLIED PHYSICS PRACTICAL - I**			
Course Code	**21UPHAP1**	**L**	**P**	**C**
Category	**Allied**	-	2	1

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP	

Course Objectives:

The learners will be able:
1. To gain knowledge about the experiments based on Optics, Electricity and Electronics
2. To demonstrate modulus of elasticity
3. To understand the bending of beam, forward and reverse biasing, frequency responce
4. To understand current conduction in electrical circuits.
5. To learn about transistor amplifier, oscillator and Operational amplifier

LIST OF EXPERIMENTS (Any Fourteen Experiments)

1. Uniform bending	- (Pin & Microscope)
2. Torsion Pendulum	- Determination of Rigidity modulus and M.I
3. Thermal conductivity of Bad conductor	- Lee's disc
4. Sonometer	- Verification of laws
5. Calibration of low range Voltmeter	- Potentiometer
6. Carey Foster Bridge	- Resistance & resistivity of a wire.
7. Spectrometer	- Refractive indexof a Prism
8..Mirror Galvanometer	- Voltage and current sensitiveness
9.LCR – Series resonance	- Determination of L & Q factor
10.Air wedge	- Thickness of a wire
11.Grating N by λ Normal incidence	- Spectrometer
12.Single stage transistor amplifier	- CE mode
13.Hartley oscillator	- Determination of frequency
14.Logic gates – NAND and NOR	- Using Discrete Components.
15.Zener diode	- Forward & Reverse Characteristics
16.OP AMP	- Adder and Subtractor

Total Practical Hours **30 Hrs**

Books for Study:

1. Srinivasan.M.N.,Balasubramanian.S.,Ranganathan.R., **A Text Book of Practical Physics,** 2017 Edition Sultan Chand & Sons

Books for References:

3. Ouseph.C., Practical Physics and Electronics,2013.S.Viswanathan.P.Ltd
4. Practical Physics and Electronics, C.C.Ouseph, U.J.Rao, V.Vijayendran, S.Viswanathan Publishers(2007)

Web Resources:

1. https://nptel.ac.in/course.html/physics/experimental physics I, II and III
2. https://nptel.ac.in/courses/115/105/115105110/
3. https://www.youtube.com/playlist?list=PLuiPz6iU5SQ8-rZn_LgLofRX7n8z4tHYK

Course Outcomes		K Level
On successful completion of the course, the learners should be able to		
CO1:	Understand and evaluate the Young's modulus and Rigidity modulus of the given material, the ways to calibrate a low range voltmeter using potentiometer	**K4**
CO2:	Acquire the knowledge of the characteristics of an operational amplifier	**K3**
CO3:	Apply the basic principles of optics to determine the thickness of a wire	**K4**
CO4:	Analyze the electrical parameters like resistance and resistivity using Carrey Foster bridge and characteristics of Zener diode	**K4**
CO5:	Construct Amplifier and Oscillator	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**2**	**1**	**2**	**2**
CO 2	**3**	**2**	**2**	**1**	**2**	**2**
CO 3	**3**	**2**	**2**	**1**	**2**	**2**
CO 4	**3**	**2**	**2**	**1**	**2**	**2**
CO 5	**3**	**2**	**2**	**1**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Semester	Allied Physics Practical - I	Hrs	Pedagogy
II	1. Carey Foster Bridge - Resistance & resistivity of a wire. 2. Spectrometer - Refractive indexof a Prism 3. Mirror Galvanometer - Voltage and current sensitiveness 4. Air wedge - Thickness of a wire 5. Grating N by λ Normal incidence - Spectrometer 6. Single stage transistor amplifier - CE mode 7. Hartley oscillator - Determination of frequency 8. OP AMP - Adder and Subtractor	**30**	Demonstration

Course Designed by: **1. Mrs.A.Lakshmi, 2. Dr.R.Sangeetha**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**DAIRY CHEMISTRY**							
Course Code	**21UCHS21**					**L**	**P**	**C**
Category	**Skill**					2	-	2
Nature of course:	EMPLOYABILITY		**SKILL ORIENTED**	✓	**ENTREPRENEURSHIP**			✓

Course Objectives:

- To Recollect the composition of milk and processing of milk
- To Remember the major milk products and its estimation.
- To Classify the special milk and fermented milk products on their ingredients
- To Execute the types of milk products and its applications.
- To Determine the composition of milk products and their physical properties.

Unit: I	**COMPOSITION OF MILK** Milk – definition – general composition of milk – constituents of milk – lipids, proteins, carbohydrate,vitamins and minerals – physical properties of milk – colour, odour, acidity, specific, gravity, viscosity and conductivity.	**6**
Unit: II	**PROCESSING OF MILK** Microbiology milk – destruction of microorganisms in milk – physico – chemical changes taking place in milk due to processing – boiling, pasteurization – types of pasteurization –Vacuum pasteurization – Ultra High Temperature Pasteurization.	**6**
Unit: III	**MAJOR MILK PRODUCTS** Cream – definition – composition – chemistry of creaming process – gravitational and centrifugal methods of separation cream – estimation of fat in cream. Butter – definition -estimation of acidity and moisture content in butter. Ghee – major constituents – common adulterants added to ghee.	**6**
Unit: IV	**SPECIAL MILK** Standardised milk – definition – merits – reconstituted milk –definition – flow diagram of manufacture – Homogenised milk – flavoured milk –condensed milk – definition composition and nutritive value.	**6**
Unit: V	**FERMENTED AND OTHER MILK PRODUCTS** Fermentation of milk – definition, condition- Indigeneous products– Gulabjamun, chana sweet, Rasogolla. Ice cream – definition – percentage composition types – Ingredients – manufacture of ice-cream -milk powder – definition – need for making milk powder. **Visit to a pasteurization factory / Milk product company and submission of a report.**	6
	Total Lecture Hours	**30 Hrs**

Books for Study:

1. Jaya Shree Ghosh, Fundamental Concepts of Applied Chemistry. 1st Edition. New Delhi: S.Chand & Company Ltd, 2013.
2. Bagavathi Sundari. K, Applied Chemistry, 1st Edition. Chennai: MJP Publishers, 2006.

Books for References:

1. Wong,N.P. Jenness,R. Keenay,M.& Matrh,E.H, Fundamentals of Dairy Chemistry. 1st Edition. New

Delhi: CBS Publishers & Distributors Pvt.Ltd., 1998.
2. Sukumar De. Outlines of Dairy Technology. 1st Edition. New Delhi: Oxford University Press, 2000.
3. K.S. Rangappa and K.T Acharya, Indian Dairy products, Asia Publishing House, 1975.

Web Resources:

1. https://www.youtube.com/watch?v=Vo8m9QvNeAU
2. https://www.youtube.com/watch?v=uYhbekSGMZY
3. https://www.youtube.com/watch?v=oHCntgYIJbE
4. https://nptel.ac.in/courses/126/105/126105013/

Course Outcomes:		K Level
On the completion of the course the student will be able to		
CO1:	Understand the chemistry of milk products.	[Up to K2]
CO2:	Outline the techniques of milk processing.	[Up to K3]
CO3:	Construct the flow chart diagram in the manufacture of special milk	[Up to K3]
CO4:	Illustrate the manufacture of various dairy products	[Up to K4]
CO5:	Determine the chemistry of milk products and manufacture of various dairy products.	[Up to K4]

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	1	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	2	3	1	3	2	1
Weightage	11	10	9	11	9	11

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	DAIRY CHEMISTRY	Hrs	Mode
I	**COMPOSITION OF MILK** Milk – definition – general composition of milk – constituents of milk – lipids, proteins, carbohydrate, vitamins and minerals – physical properties of milk – colour, odour, acidity, specific, gravity, viscosity and conductivity.	06	Chalk & Talk, Power Point
II	**PROCESSING OF MILK** Microbiology milk – destruction of microorganisms in milk – physico – chemical changes taking place in milk due to processing – boiling, pasteurization – types of pasteurization –Vacuum pasteurization – Ultra High Temperature Pasteurization.	06	Chalk & Talk, Power Point
III	**MAJOR MILK PRODUCTS** Cream – definition – composition – chemistry of creaming process – gravitational and centrifugal methods of separation cream – estimation of fat in cream. Butter – definition -estimation of acidity and moisture content in butter. Ghee – major constitutents – common adulterants added to ghee.	06	Chalk & Talk, Power Point
IV	**SPECIAL MILK** Standardised milk – definition – merits – reconstituted milk –definition – flow diagram of manufacture – Homogenised milk – flavoured milk – condensed milk – definition composition and nutritive value.	06	Chalk & Talk, Power Point
V	**FERMENTED AND OTHER MILK PRODUCTS** Fermentation of milk – definition, condition- Indigeneous products– Gulabjamun, chana sweet, Rasogolla. Ice cream – definition – percentage composition types – Ingredients – manufacture of ice-cream -milk powder – definition – need for making milk powder. **Visit to a pasteurization factory / Milk product company and submission of a report.**	06	Chalk & Talk, Power Point

Course Designed by: **Dr. V. Ramasamy Raja** & **Dr. K. Muthupandi**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**DYE CHEMISTRY**								
Course Code	**21UCHS22**						**L**	**P**	**C**
Category	**Skill**						2	-	2
Nature of course:	EMPLOYABILITY		**SKILL ORIENTED**	✓	**ENTREPRENEURSHIP**	✓			

Course Objectives:

- To Recall the constitution of colour and dyes.
- To Classify the dyes and demonstration of its various types.
- To Compare nitrogenous, triphenyl, azo and phthalein dyes with their applications
- To Execute the synthesis and applications of quinonoid dyes including vat dyes based
- To Determine the requirement of a pigment and applications and their uses.

Unit: I	**CHEMISTRY AND THEORY OF COLOURS** Colour and Constitution – Relationship of Colour observed to wavelength of light absorbed – Terms used in Colour Chemistry – Chromophores, Auxochromes, Bathochromes shift, Hypsochromic shift.	**06**
Unit: II	**DIRECT AND DISPERSE DYES** Direct or substantive dyes, mordent dyes, vat dyes, Ingrain or developed dyes, Disperse dyes, sulphur dyes, reactive dyes, oil and spirit soluble dye, food, dry and cosmetic dyes. (Definition, applications and examples only).	**06**
Unit: III	**NITROGENOUS, TRIPHENYL, AZO AND PHTHALEIN DYES** Classification according to chemical structure: a) Nitro and Nitroso dyes. b) Tripheyl methane dye -malachite green, crystal violet and its applications. c) Azo dyes –, methyl orange, and congo red. d) Phthalein dye– phenolphthalein and fluorescein. (Definition, applications and examples only)	**06**
Unit: IV	**AZINE, OXACINE AND TRIAZINE DYES** Azine, Oxazine and Triazine Dyes – Synthesis and applications of quinonoid dyes including vat dyes based on anthraquinone.	**06**
Unit: V	**PIGMENTS AND THEIR APPLICATIONS** Requirement of a pigment – Typical Organic and Inorganic pigments – Applications and their uses in paints – Applications of dyes in other areas – medicine, cosmetics, food and beverages.	**06**
	Total Lecture Hours	**30 Hrs**

Books for Study:

1. Gurdeep R.Chatwal, Synthetic Dyes – Himalaya Publishing House, 2016.

Books for References:

1. B. S. Bahl and Arun Bahl, Advanced Organic Chemistry, 2012.
2. P.L.Soni and H.M.Chawla , Text book of Organic Chemistry, Sultan & Sons Publications, 2019.
3. K.S.Tewari, N.K.Vishnol & S.N. Mehrotra, A Text book of Organic Chemistry, Vikas Publishing House, 1976.

Web Resources:		
1. https://www.youtube.com/watch?v=a6Lw7Dzwvqo 2. https://www.youtube.com/watch?v=sLcT7P-ZS4E 3. https://www.youtube.com/watch?v=SFH0iJmnTLY		
Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Identify the colour and constitution observed to wavelength of light.	**[Up to K2]**
CO2:	Outline the direct or disperse dyes and applications.	**[Up to K3]**
CO3:	Apply Azine, Oxacine, triazine dyes, pigments towards its applications.	**[Up to K3]**
CO4:	Classify the Nitro, Nitroso, Triphenyl methane, Azo and Phthalein dyes.	**[Up to K4]**
CO5:	Determine the properties of dyes and apply in medicine, cosmetics, food and beverages.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**2**	**3**	**2**	**3**	**1**	**2**
CO 2	**1**	**2**	**3**	**1**	**2**	**3**
CO 3	**2**	**2**	**2**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**10**	**11**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	DYE CHEMISTRY	Hrs	Mode
I	**CHEMISTRY AND THEORY OF COLOURS** Colour and Constitution – Relationship of Colour observed to wavelength of light absorbed – Terms used in Colour Chemistry – Chromophores, Auxochromes, Bathochromes shift, Hypsochromic shift.	06	Chalk & Talk, Power Point
II	**DIRECT AND DISPERSE DYES** Direct or substantive dyes, mordent dyes, vat dyes, Ingrain or developed dyes, Disperse dyes, sulphur dyes, reactive dyes, oil and spirit soluble dye, food, dry and cosmetic dyes. (Definition, applications and examples only).	06	Chalk & Talk, Power Point
III	**NITROGENOUS, TRIPHENYL, AZO AND PHTHALEIN DYES** Classification according to chemical structure: a) Nitro and Nitroso dyes. b) Tripheyl methane dye -malachite green, crystal violet and its applications. c) Azo dyes –, methyl orange, and congo red. d) Phthalein dye– phenolphthalein and fluorescein. (Definition, applications and examples only)	06	Chalk & Talk, Power Point
IV	**AZINE, OXACINE AND TRIAZINE DYES** Azine, Oxazine and Triazine Dyes – Synthesis and applications of quinonoid dyes including vat dyes based on anthraquinone.	06	Chalk & Talk, Power Point
V	**PIGMENTS AND THEIR APPLICATIONS** Requirement of a pigment – Typical Organic and Inorganic pigments – Applications and their uses in paints – Applications of dyes in other areas – medicine, cosmetics, food and beverages.	06	Chalk & Talk, Power Point

Course Designed by**: Dr. R. Satheesh & Dr. J.E. Sangeetha**


THIRD SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**PHYSICAL CHEMISTRY – I**					
Course Code	**21UCHC31**			**L**	**P**	**C**
Category	**Core**			4	-	4
Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	**ENTREPRENURSHIP**		✓

Course Objectives:

- To Recall the characteristics of ideal and real gases and deviations of real gases from ideal behaviour.
- To Remember the law of distribution of velocities and characteristics of colloids.
- To Compare the classification of adsorption and catalysis.
- To Perform the purification of colloids and comparison between order and molecularity of a reaction
- To Determine the effect of temperature on various velocities and applications of colloids, adsorption and catalysis.

Unit: I	**GASEOUS STATE**	12

Characteristics of Gases and its parameters. Gas laws- Boyle's law, Charles's law, The Combined Gas law, Gay Lussac's law, Avogadro's law and the Ideal Gas equation. Postulates of kinetic theory gases – Derivation of ideal gas laws from the expression on the basis of kinetic theory of gases – Maxwell – Boltzmann law of distribution of velocities (Derivation not necessary) graphical representation – Effect of temperature on various velocities – Experimental verification of Maxwell's law. Different types of molecular velocities– Average Velocity, Most Probable Velocity, Average Velocity and their calculations-Principle of equipartition of energy.

Unit: II	**COLLOIDAL STATE**	12

Introduction– Distinction between true solution, colloidal dispersion and suspension – classification of colloids. Difference between Lyophilic and Lyophobic colloids. Purification of colloids- Dialysis and Ultrafiltration. Properties of colloids-Tyndall effect, Sedimentation, Electrophoresis. Origin of Charge on Colloids- Hardy – Schulze law. Protection of Colloids – Gold Number. Application of colloids in foods, medicines, industrial goods, sewage disposal, clarification of water, smoke screens and detergent action of soap.

Unit: III	**ADSORPTION**	12

Definition – Adsorption, adsorbent, adsorbate & occlusion - types of adsorptions - Differences between physisorption and chemisorption-Langmuir's and Freundlich adsorption isotherms, positive and negative adsorption, Adsorption of gases on solids - characteristics of adsorption of gases on solids - factors influencing adsorption – adsorption isotherm – BET (Elementary idea only) – Applications of adsorption in gas masks, chromatography, cleaning of sugars, paint industry, catalysis and adsorption indicators

Unit: IV	**CATALYSIS**	12

Catalysis – Definition –- Characteristics – Types of catalysts – positive – negative - auto and induced catalyst-Theories of catalysis –The Intermediate Compound Formation theory & The Adsorption theory- Action of Promoters and Poisons with suitable examples. Enzyme Catalysis – characteristic features-Mechanism – Michaelis - Menten equation.

Unit: V	CHEMICAL KINETICS	12
Introduction – Rate of Reaction – Rate law and Rate constant – Order and Molecularity of a reaction. Derivation of rate equation and half-life period for first order- examples- Catalytic Decomposition of hydrogen peroxide – Decomposition of Dinitrogen pentoxide. Pseudo unimolecular reaction - Derivation of rate equation and half-life period. examples- inversion of cane sugar and hydrolysis of ester by acid. second, third and zero order reactions – examples – rate equation – half period (no derivation required). Methods for the determination of the order of a reaction. Influence of temperature on the rate of reaction – Arrhenius rate equation and its significance. Collision Theory of Reaction Rate and its limitations.		
	Total Lecture Hours	**60 Hrs**

Books for Study:

5. Arun Bahl, B. S Bahl & G.D. Tuli, Essentials of Physical Chemistry, S.Chand and Co, New Delhi, 2014.

Books for References:

4. Gilbert. W. Castellan, Physical Chemistry, Narosa Publishing house, third edition 1985.
5. P.W. Atkins, Physical Chemistry, 7th edition, Oxford university press, 2001.
6. S.K. Dogra and S. Dogra, Physical Chemistry Through Problems, New age international, 4th edition 1996.
7. B.R. Puri, L.R. Sharma and S.Pathania, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co, 47th edition, 2017.
8. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan limited, New York, 1966.

Web Resources:

1. https://youtu.be/u3BWeogwNN4
2. https://youtu.be/fctkOV_wdWI
3. https://youtu.be/UIVJ4JkqjaI
4. https://youtu.be/B_fg6EDNFd4
5. https://youtu.be/W8FhlGNnMkg

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Recall the postulates of kinetic theory of gases and classification of colloids	**[Up to K2]**
CO2:	Discuss the gaseous state and types of adsorptions	**[Up to K3]**
CO3:	Enumerate the properties of gaseous state, colloids, adsorption and catalysis	**[Up to K3]**
CO4:	Examine the characteristics of adsorption and catalysis	**[Up to K4]**
CO5:	Apply the order and molecularity of the reaction and derivation of order of the reactions	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	1	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	1	3	2	3	2	1
Weightage	10	10	10	11	9	11

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**GASEOUS STATE** Characteristics of Gases and its parameters. Gas laws- Boyle's law, Charles's law, The Combined Gas law, Gay Lussac's law, Avogadro's law and the Ideal Gas equation. Postulates of kinetic theory gases – Derivation of ideal gas laws from the expression on the basis of kinetic theory of gases – Maxwell – Boltzmann law of distribution of velocities (Derivation not necessary) graphical representation – Effect of temperature on various velocities – Experimental verification of Maxwell's law. Different types of molecular velocities– Average Velocity, Most Probable Velocity, Average Velocity and their calculations-Principle of equipartition of energy.	12	Chalk, Talk & Power point
II	**COLLOIDAL STATE** Introduction– Distinction between true solution, colloidal dispersion and suspension – classification of colloids. Difference between Lyophilic and Lyophobic colloids. Purification of colloids- Dialysis and Ultrafiltration. Properties of colloids-Tyndall effect, Sedimentation, Electrophoresis. Origin of Charge on Colloids- Hardy – Schulze law. Protection of Colloids – Gold Number. Application of colloids in foods, medicines, industrial goods, sewage disposal, clarification of water, smoke screens and detergent action of soap.	12	Chalk, Talk & Power point
III	**ADSORPTION** Definition – Adsorption, adsorbent, adsorbate & occlusion - types of adsorptions - Differences between physisorption and chemisorption-Langmuir's and Freundlich adsorption isotherms, positive and negative adsorption, Adsorption of gases on solids - characteristics of adsorption of gases on solids - factors influencing adsorption – adsorption isotherm – BET (Elementary idea only) – Applications of adsorption in gas masks, chromatography, cleaning of sugars, paint industry, catalysis and adsorption indicators.	12	Chalk, Talk & Power point
IV	**CATALYSIS** Catalysis – Definition –- Characteristics – Types of catalysts – positive – negative - auto and induced catalyst-Theories of catalysis –The Intermediate Compound Formation theory & The Adsorption theory-Action of Promoters and Poisons with suitable examples. Enzyme Catalysis –characteristic features-Mechanism – Michaelis - Menten equation.	12	Chalk, Talk & Power point
V	**CHEMICAL KINETICS** Introduction – Rate of Reaction – Rate law and Rate constant – Order and Molecularity of a reaction. Derivation of rate equation and half-life period for first order- examples- Catalytic Decomposition of hydrogen peroxide – Decomposition of Dinitrogen pentoxide. Pseudo unimolecular reaction - Derivation of rate equation and half-life period. examples- inversion of cane sugar and hydrolysis of ester by acid. second, third and zero order reactions – examples – rate equation – half	12	Chalk, Talk & Power point

	period (no derivation required). Methods for the determination of the order of a reaction. Influence of temperature on the rate of reaction – Arrhenius rate equation and its significance. Collision Theory of Reaction Rate and its limitations.		

Course Designed by: **Dr. V. Ramasamy Raja & Dr. A. J. Sunija**

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	Cos	K Level	Section A MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			No. of. Questions	K – Level	No. of. Questions	K - Level		
CI AI	CO1	Up to K2	2	K1&K2	1	K1	2 (K2&K2)	1(K2)
	CO2	Up to K3	2	K1&K2	2	K2	2 (K3&K3)	2(K2&K3)
CI AII	CO3	Up to K2	2	K1&K2	1	K2	2 (K2&K2)	1(K2)
	CO4	Up to K4	2	K1&K2	2	K2	2 (K3&K3)	2(K3&K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II

	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CI A I	K1	2	2	-	-	4	6.67	
	K2	2	4	10	20	36	60	67
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100
CI A II	K1	2	2	-	-	4	6.67	
	K2	2	4	10	10	26	43.33	50
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	10	10	16.67	17
	Marks	4	6	20	30	60	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	Cos	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K 2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Upto K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**INORGANIC CHEMISTRY – II**			
Course Code	**21UCHC32**	**L**	**P**	**C**
Category	**Core**	4	-	4
Nature of course:	**EMPLOYABILITY** ✓	**SKILL ORIENTED** ✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the general characteristics of s-, p- block elements and its basic properties.
- To Remember the electronic configurations of the elements and naming the coordination compounds.
- To Compare the role of transition elements in coordination compounds.
- To Execute the structure, preparation and properties of important compounds.
- To Determine the properties and uses of the elements in biological systems and EAN rule.

Unit: I	**s – Block Elements**	12

Group 1 Elements: Alkali Metals – general characteristics – atomic and ionic radii – ionization energies – electropositive character – chemical properties – complexes of alkali metals – comparison of lithium with other members of the family – resemblance of lithium and magnesium – role of Na^+ and K^+ ions in biological systems – sodium pump.
Group 2 Elements: Alkaline Earth Metals – general characteristics – atomic and ionic radii – ionization energies – chemical properties – comparison of beryllium with other elements of Group 2 – properties and uses of alkaline earth metals – Portland cement – role of Mg^{2+} and Ca^{2+} ions in biological systems.

Unit: II	**p – Block Elements – I**	12

Group 13 Elements: general characteristics - ionization energies – oxidation states – electropositive character – tendency to form ionic and covalent compounds – diagonal relationship between boron and silicon – properties of elements – relative strengths of trihalides as Lewis acids – borides – boron hydrides – boranes – preparation, properties and structure of diborane – bonding in boranes. **Group 14 Elements**: general characteristics – ionization energy – tendency to form chains, catenation – properties and structure of allotropes of carbon – Structure, preparation and properties of Nickel, Cobalt and Iron carbonyls, silicates and silicones – types of silicates – zeolites.

Unit: III	**p – Block Elements – II**	12

Group 15 Elements: general characteristics – metallic and non – metallic character – variation in physical state – anomalous properties of nitrogen – allotropic forms of phosphorus – marsh test – preparation and properties of urotropine. **Group 16 Elements**: general characteristics – oxidation states – anomalous behaviour of oxygen – structure and properties of ozone – allotropes of sulphur – preparation and properties of sulphuric acid, caros's acid, marshall's acid. **Group 17 Elements**: general characteristics – electron affinity – oxidation states - preparation and properties of chlorine – oxoacids of halogens – interhalogen compounds. **Group 18 Elements**: occurrence – general characteristics – general physical properties of noble gases – structure and shape of XeF_6, $XeOF_4$, XeO_2F_2 and XeO_2F_4 molecules.

Unit: IV	**COORDINATIN COMPOUNDS – I**	12

Double salts – coordination compounds – coordination complexes and complex ions – coordination number – unidentate, bidentate and polydentate ligands, chelating ligands and chelates – Werner's theory – Nomenclature of coordination compounds – EAN rule – stability of complex ions - factors

affecting the stability of a complex ion – isomerism in coordination compounds: structural isomerism – linkage isomerism, coordination position isomerism, ionization isomerism, hydrate isomerism - stereo isomerism – geometrical isomerism, optical isomerism.		
Unit: V	**COORDINATION COMPOUNDS – II**	12
Valence bond theory – shortcomings of valence bond theory – the crystal field theory – crystal field splitting of energy levels – crystal field stabilization energy (CFSE) – factors influencing the magnitude of crystal field splitting – colour of transition metal complexes – ligand field theory – evidence of covalent bonding in metal ligand bonding – molecular orbital theory of coordination complexes – pi bonding in octahedral complexes – sigma bonding in tetrahedral complexes – sigma and pi bonding in square planar complexes.		
	Total Lecture Hours	**60 Hrs**

Books for Study:

5. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2018.

Books for Reference:

4. J. E. Huheey, E. A. Kieter and R. L. Keiter, Inorganic Chemistry, 4th ed., Harper Collins, New York, 1993.
5. F. A. Cotton, G. Wilkinson, C. Murillo and M. Bochman, Advanced Inorganic Chemistry,6th ed., John Wiley, New York, 1999.
6. T. Moeller, Inorganic Chemistry: A Modern Introduction, Wiley, New York, 1990.
7. R. D Madan S.Chand, Modern Inorganic Chemistry band Co.Ltd, New Delhi 2012.

Web Resources:

1. https://youtu.be/1uJk4K_irP8
2. https://youtu.be/xQJOfAKgSOY
3. https://youtu.be/xMjJxjhJWj4

Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Relate the general characteristics of s-block, p-block elements.	**[Up to K2]**
CO2:	Understand the concepts of important compounds of s-, p- block and naming the coordination compounds.	**[Up to K3]**
CO3:	Compare the isomerism of coordination compounds.	**[Up to K3]**
CO4:	Correlate the diagonal relationship and anomalous properties of each group elements	**[Up to K4]**
CO5:	Construct the EAN rule, VBT, CFT on the basis of coordination compounds.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**11**	**10**	**9**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	INORGANIC CHEMISTRY – II	Hrs	Mode
I	s – BLOCK ELEMENTS Group 1 Elements: Alkali Metals – general characteristics – atomic and ionic radii – ionization energies – electropositive character – chemical properties – complexes of alkali metals – comparison of lithium with other members of the family – resemblance of lithium and magnesium – role of Na^+ and K^+ ions in biological systems – sodium pump. Group 2 Elements: Alkaline Earth Metals – general characteristics – atomic and ionic radii – ionization energies – chemical properties – comparison of beryllium with other elements of Group 2 – properties and uses of alkaline earth metals – Portland cement – role of Mg^{2+} and Ca^{2+} ions in biological systems.	12	Chalk & Talk, Power Point
II	p – BLOCK ELEMENTS Group 13 Elements: general characteristics - ionization energies – oxidation states – electropositive character – tendency to form ionic and covalent compounds – diagonal relationship between boron and silicon – properties of elements – relative strengths of trihalides as Lewis acids – borides – boron hydrides – boranes – preparation, properties and structure of diborane – bonding in boranes. Group 14 Elements: general characteristics – ionization energy – tendency to form chains, catenation – properties and structure of allotropes of carbon – Structure, preparation and properties of Nickel, Cobalt and Iron carbonyls, silicates and silicones – types of silicates – zeolites.	12	Chalk & Talk, Power Point
III	p – BLOCK ELEMENTS – II Group 15 Elements: general characteristics – metallic and non – metallic character – variation in physical state – anomalous properties of nitrogen – allotropic forms of phosphorus – marsh test – preparation and properties of urotropine. Group 16 Elements: general characteristics – oxidation states – anomalous behaviour of oxygen – structure and properties of ozone – allotropes of sulphur – preparation and properties of sulphuric acid, caros's acid, marshall's acid. Group 17 Elements: general characteristics – electron affinity – oxidation states - preparation and properties of chlorine – oxoacids of halogens – interhalogen compounds. Group 18 Elements: occurrence – general characteristics – general physical properties of noble gases – structure and shape of XeF_6, $XeOF_4$, XeO_2F_2 and XeO_2F_4 molecules.	12	Chalk & Talk, Power Point
IV	COORDINATION COMPOUNDS – I Double salts – coordination compounds – coordination complexes and complex ions – coordination number – unidentate, bidentate and polydentate ligands, chelating ligands and chelates – Werner's theory – Nomenclature of coordination compounds – EAN rule – stability of complex	12	Chalk & Talk, Power Point

	ions - factors affecting the stability of a complex ion – isomerism in coordination compounds: structural isomerism – linkage isomerism, coordination position isomerism, ionization isomerism, hydrate isomerism - stereo isomerism – geometrical isomerism, optical isomerism.		
V	COORDINATION COMPOUNDS – II Valence bond theory – shortcomings of valence bond theory – the crystal field theory – crystal field splitting of energy levels – crystal field stabilization energy (CFSE) – factors influencing the magnitude of crystal field splitting – colour of transition metal complexes – ligand field theory – evidence of covalent bonding in metal ligand bonding – molecular orbital theory of coordination complexes – pi bonding in octahedral complexes – sigma bonding in tetrahedral complexes – sigma and pi bonding in square planar complexes.	**12**	**Chalk & Talk, Power Point**

Course Designed by: **Dr. K. Muthupandi & Dr. V. Ramasamy Raja**

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Up to K2**	**2**	**K1&K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1&K2**	2	K2	2 (K3&K3)	2(K2 & K3)
CI AII	**CO3**	**Up to K2**	**2**	**K1&K2**	1	K2	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1 & K2**	2	K2	2 (K3&K3)	2(K3 &K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	6.67	67
	K2	2	4	10	20	36	60	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100
CIA II	K1	2	2	-	-	4	6.67	50
	K2	2	4	10	10	26	43.33	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	10	10	16.67	17
	Marks	4	6	20	30	60	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) Answer All Questions			(10x1=10 marks)
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

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Course Name	**Major Chemistry Practical – II (Volumetric Analysis)**				
Course Code	**21UCHCP2**	**L**	**P**	**C**	
Category	**Core Practical**	-	2	-	
Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENURSHIP	

Course Objectives:

- To recollect the theory of laboratory safety measures and strength of solutions.
- To remember the estimation of acidimetry and alkalimetry and redox titrations.
- To compare the concept of titration based on redox and hardness of water.
- To execute the concept of permanganometry and dichrometry.
- To determine the estimation of volumetric analysis.

UNIT	Theory of Volumetric Analysis and List of Experiments	Hrs
I	Theory of Volumetric Analysis and Laboratory Safety Measures: Strength of Solutions – Normality, Molarity, Molality. Handling of apparatus, glasswares and chemicals – Safety aspects	6
II	**List of Experiments**	24
	I. Acidimetry and Alkalimetry 1. Estimation of Na_2CO_3 2. Estimation of NaOH / KOH 3. Estimation of oxalic acid. II. Redox Titrations a. Permanganometry 1. Estimation of ferrous ion 2. Estimation of oxalic acid 3. Estimation of calcium (direct method) b. Dichrometry 1. Estimation of ferrous ion 2. Estimation of ferric ion using external indicator V. EDTA Titration 1. Estimation of Hardness of water using EDTA. **Distribution of marks** **Max marks: 100** **Internal : 40 marks External : 60 marks**	

Laboratory Performance	:	30 marks	Vivo voce	:		5 marks
Observation note book	:	10 marks	Record note book	:		10 marks
			Procedure writing Volumetric estimation	: :		15 marks 30 marks
Total	:	40 marks	Total	:		60 marks

For Volumetric Estimation if the student have

Less than 2% Error	-	30 marks
2-3% Error	-	25 marks
3-4% Error	-	20 marks
3-5% Error	-	15 marks
Greater than 5%	-	10 marks

Books for Study:

1. Vogel, Text book of Inorganic quantitative analysis, Longman Sc & Tech, 2008.

Books for References:

1. Jeyavathana Samuel, Chemistry Practical Book, G.G.Printers, Chennai, 2012.
2. Vickie. M.Williamson, M.Larry Peck, Lab manual for General Chemistry, Cengage Learning India Private Limited, New Delhi, 2009.

Web Resources:

1. https://youtu.be/xQDQNghs5dc

2. https://youtu.be/AdbK86BnXN8

3. https://youtu.be/dmnElKapQ00

Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Discuss the theory of safety measures in chemistry laboratory.	**[Up to K2]**
CO2:	Understand the quantitative analysis in practical chemistry.	**[Up to K3]**
CO3:	Apply the theory on quantitative titration methods.	**[Up to K3]**
CO4:	Analyze the titrated values in tabular format.	**[Up to K4]**
CO5:	Construct the estimated value of the given compounds.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	1	2	3	3	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	2	3	1	3	2	1
Weightage	10	10	9	11	10	11

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	Theory of Volumetric Analysis and Laboratory Safety Measures	Hrs	Mode
I	Theory of Volumetric Analysis and Laboratory Safety Measures: Strength of Solutions – Normality, Molarity, Molality. Handling of apparatus, glasswares and chemicals – Safety aspects	6	
	List of Experiments		
II	I. Acidimetry and Alkalimetry 1. Estimation of Na_2CO_3 2. Estimation of NaOH / KOH 3. Estimation of oxalic acid. II. Redox Titrations a. Permanganometry 1. Estimation of ferrous ion 2. Estimation of oxalic acid 3. Estimation of calcium (direct method) b. Dichrometry 1. Estimation of ferrous ion 2. Estimation of ferric ion using external indicator V. EDTA Titration 1. Estimation of Hardness of water using EDTA.	24	Practical

Course Designed by: **Dr. Ramasamy Raja & Dr. K. Muthupandi**

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Course Name	**ALLIED MATHEMATICS – I**			
Course Code	**21UMCA32**	**L**	**P**	**C**
Category	**ALLIED**	**6**	**-**	**4**
Nature of course:	**EMPLOYBILITY**	**SKILL ORIENTED**	**ENTREPRENURSHIP**	

COURSE OBJECTIVES:

- To familiarize with the concepts of theory of equations
- To develop skills in solving equations
- To teach trigonometry and Expressing Trigonometric functions
- To develop the skills in expanding Trigonometric functions.
- To apply and prove trigonometric identities.

Unit: I	Theory of Equations: Formation of Equations - Relation between the roots and coefficients	**18 hrs**
Unit: II	Reciprocal Equations - Transformation of Equations	**18 hrs**
Unit: III	Approximate solutions of Numerical Equations: Newton's Method - Horner's Method - Cardan's method	**18 hrs**
Unit: IV	Trigonometry: Applications of Demoivre's Theorem - Expression for $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ - Expression of $\sin^n \theta$ and $\cos^n \theta$ - Expansion of $\sin \theta$, $\cos \theta$ and $\tan \theta$ in powers of θ.	**18 hrs**
Unit: V	Hyperbolic Functions – Inverse Hyperbolic Functions	**18 hrs**
	Total Lecture Hours	**90 hrs**

Books for Study:

Text Book: Dr. S. Arumugam and A.Thangapandi Isaac, **Ancillary Mathematics Paper I**, New Gamma Publishing House, Palayamkottai, 2007.

Unit I : Chapter 1: Sections 1.1 & 1.2
Unit II: Chapter 1: Sections 1.3 & 1.4
Unit III: Chapter 1: Sections 1.5 (1), 1.5 (2) & 1.5 (3).
Unit IV: Chapter 4: Sections 4.1, 4.2, 4.3
Unit V: Chapter 5: Sections 5.1, 5.2

Books for Reference:

1. T. K . Manickavashagam Pillai and S.Narayanan, **Algebra – Volume I,** S.Viswanathan Printers Publishers Pvt. Ltd, Chennai, 2007.
2. T. K . Manickavashagam Pillai and S.Narayanan, **Trigonometry,** S.Viswanathan Printers Publishers Pvt. Ltd, Chennai, 2011.
3. Dr. S. Arumugam and Isaac, Classical Algebra, New Gamma Publishing House, Palayamkottai, 2003.

Web Resources:

1. https://sites.google.com/a/iitjeemathematics.com/www/conte/quadratic-equations/12-relation-between-roots-and-coefficients-of-any-polynomial-equation
2. https://onlinecourses.swayam2.ac.in/cec21_ma07/preview

Course Outcomes:		K Level
After the completion of the course, Students will be able to		
CO1:	Learn and solve system of linear equations.	K3
CO2:	Develop and maintain problem solving skills in Numerical Equations.	K4
CO3:	Solve the exponential and trigonometric equations	K3
CO4:	Recognize the relationship between $\sin\theta$, $\cos\theta$ and $\tan\theta$.	K3
CO5:	Understand the ideas about the Hyperbolic functions and Inverse Hyperbolic Functions	K3

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	3	2	3	2
CO 2	2	2	2	2	3	2
CO 3	3	3	2	3	3	2
CO 4	2	2	2	2	2	3
CO 5	3	3	2	2	2	3

***3** –Advanced Application; **2** – Intermediate Development; **1** – Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hrs	Pedagogy
I	Theory of Equations: Formation of Equations - Relation between the roots and coefficients	18	Chalk & Talk, PPT
II	Reciprocal Equations - Transformation of Equations	18	Chalk & Talk, Group Discussion
III	Approximate solutions of Numerical Equations: Newton's Method - Horner's Method & Cardan's method	18	Chalk & Talk, LCD
IV	Trigonometry: Applications of Demoivre's Theorem - Expression for $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ - Expression of $\sin^n\theta$ and $\cos^n\theta$ - Expansion of $\sin\theta$, $\cos\theta$ and $\tan\theta$ in powers of θ.	18	Chalk & Talk, Seminar
V	Hyperbolic Functions – Inverse Hyperbolic Functions	18	Chalk & Talk, Seminar

Course designed by: Mr. A. Nambi Krishna and **Dr. S. Suriyakala**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	K3	2	K1&K2	1	K1	2(K3&K3)	1 (K3)
	CO2	K4	2	K2&K2	2	K2&K2	2(K4&K4)	2 (K4)
CI AII	CO3	K3	2	K1&K2	1	K1	2(K3&K3)	2 (K3)
	CO4	K3	2	K2&K1	2	K2&K2	2(K3&K3)	1 (K3)
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	3
	No. of Questions to be answered		4		3		2	2
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	1	2	-	-	3	5	17
	K2	3	4	-	-	7	11.67	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	10	20	30	50	50
	Marks	4	6	20	30	60	100	100
CIA II	K1	2	2	-	-	4	6.67	17
	K2	2	4	-	-	6	10	
	K3	-	-	20	30	50	83.33	83
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	K3	2	K1&K2	1	K1	2 (K3& K3)	1 (K3)
2	CO2	K4	2	K1&K2	1	K1	2 (K4 &K4)	1 (K4)
3	CO3	K3	2	K1&K2	1	K2	2 (K3& K3)	1 (K3)
4	CO4	K3	2	K1&K2	1	K2	2 (K3& K3)	1 (K3)
5	CO5	K3	2	K1&K2	1	K2	2 (K3 &K3)	1 (K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	17
K2	5	6	-	-	11	9.17	
K3	-	-	40	40	80	66.67	67
K4	-	-	10	10	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K4	
17) b	CO2	K4	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K3	
22	CO2	K4	
23	CO3	K3	
24	CO4	K3	
25	CO5	K3	

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Course Name	**FUNDAMENTALS OF MICROBIOLOGY**			
Course Code	**21UMBA32**	**L**	**P**	**C**
Category	**ALLIED MICROBIOLOGY - I**	**6**	**-**	**4**

Nature of course:	EMPLOYABILITY		**SKILL ORIENTED**	✓	ENTREPRENURSHIP	

Course Objectives:

- To understand history of microbiology towards modern microbiology.
- To study the basic morphology structure, classification and biological and economic importance of bacteria.
- To interpret the characteristics and significance of Fungi.
- To explain the nomenclature and classification of Viruses.
- To enable the students to explore knowledge about the Algae and Protozoa.

Unit: I	**DEVELOPMENT OF MICROBIOLOGY AND MICROSCOPY**	**18**

Definition and scope of Microbiology. History & development of Microbiology. General principal and Binominal nomenclature of Microorganism. Microscope- Principles, Working, Mechanism and Application - Simple and Compound microscope.

Unit: II	**BACTERIOLOGY**	**18**

General characteristics of Bacteria-Classification, Ultra Structure- Gram positive and Gram negative cell wall, Reproduction, Biological and Economic importance of *Bacillus, Rhizobium, E.coli* and *Vibrio.*

Unit: III	**MYCOLOGY**	**18**

General characteristics of Fungi- Classification, Ultra structure, Reproduction, Biological and Economic importance of *Saccharomyces, Aspergillus, Agaricus, Penicillium.*

Unit: IV	**VIROLOGY**	**18**

General characteristics of Viruses-Classification, Ultra Structure, Reproduction of Plant virus – (TMV, CMV); Animal virus-(Pox and Adeno); Bacterial virus (T4 and lambda) - Antiviral agent.

Unit: V	**PHYCOLOGY AND PARASITOLOGY**	**18**

General characteristics of Algae – Classification, Ultra structure, Reproduction, Biological and Economic importance of *Chlorella, Spirulina, Chlamydomonas*, Protozoa - Classification, Ultra structure, Reproduction of *Entamoeba histolytica, Plasmodium.*

	Total Lecture Hours	**90 Hrs**

Books for Study:

1. Prescott L.M., Harley J.P & Klein D.A. **Microbiology**, 6/e, McGraw Hill Publishers, 2006.
2. Pelczar M.J., Chan E.C.S. & Kreig N.R. **Microbiology**, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 1993.

Books for reference:

1. Ananthanarayanan R & Jayaram Panicker, C.K., **Textbook of Microbiology**, Orient Longman, 2005.
2. Madigan, Michael T., Martinko., John M., Dunlap., Paul V., Clark., David P., **Brock's Biology of Microorganisms** Global Ed. Pearson Publications, 2015.
3. Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R,. **The Microbial world**, 5th Ed. Eagle Works Cliffs N.J. Prentice Hall, 1986.

Web Resources:

1. https://www.britannica.com/science/microbiology **2. https://www.brainkart.com/article/Ultrastructure-of-a-Bacterial-cell_32841/** **3. https://www.toppr.com/guides/biology/biological-classification/kingdom-fungi/** **4. https://www.toppr.com/guides/biology/plant-kingdom/algae/** **5. https://www.sciencedirect.com/topics/immunology-and-microbiology/virus-classification**

Course Outcomes		**K Level**
On Successful Completion of Course the student will be able to		
CO1:	Describe the knowledge and historical perspective of microbiology.	**Up to K2**
CO2:	Determine about the structure and classification of Bacteria.	**Up to K3**
CO3:	Illustrate about the Fungi classification, Structure and reproduction.	**Up to K4**
CO4:	Differentiate the different types of Virus structure, classification and reproduction.	**Up to K4**
CO5:	Identify the structural organization of Algae and Protozoa.	**Up to K3**

CO & PO Mapping:

CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**1**	**1**	**3**	**3**	**2**
CO 2	**3**	**2**	**3**	**2**	**2**	**2**
CO 3	**2**	**1**	**1**	**1**	**1**	**2**
CO 4	**3**	**2**	**3**	**2**	**2**	**1**
CO 5	**3**	**2**	**3**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**Development of Microbiology and Microscopy**- Definition and scope of Microbiology. History & development of Microbiology. General principal and Binominal nomenclature of Microorganism. Microscope- Principles, Working, Mechanism and Application - Simple and Compound microscope.	**18**	**Chalk &Talk**
II	**Bacteriology -** General characteristics of Bacteria-Classification, Ultra Structure- Gram positive and Gram negative cell wall, Reproduction, Biological and Economic importance of *Bacillus, Rhizobium, E.coli* and *Vibrio.*	**18**	**PPT, Chalk &Talk**
III	**Mycology** - General characteristics of Fungi- Classification, Ultra structure, Reproduction, Biological and Economic importance of *Saccharomyces, Aspergillus, Agaricus, Penicillium.*	**18**	**PPT, Chalk &Talk**
IV	**Virology** - General characteristics of Viruses-Classification, Ultra Structure, Reproduction of Plant virus – (TMV, CMV); Animal virus- (Pox and Adeno); Bacterial virus (T4 and lambda) - Antiviral agent.	**18**	**Chalk &Talk & PPT**
V	**Phycology and Parasitology -** General characteristics of Algae – Classification, Ultra structure, Reproduction, Biological and Economic importance of *Chlorella, Spirulina, Chlamydomonas,* Protozoa - Classification, Ultra structure, Reproduction of *Entamoeba histolytica, Plasmodium.*	**18**	**Chalk &Talk, Assignment**

Course Designed by: **1**. **Ms. C. Thenmozhi, Assistant Professor.**

2. Mrs. M.R.S. Saranya, Assistant Professor.

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	2(K3&K3)
CIA II	CO3	Up to K4	2	K1&K2	1	K2	2(K2&K2)	1(K4)
	CO4	Up to K4	2	K1&K2	2	K2	2(K3&K3)	2(K4&K4)
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	3
	No. of Questions to be answered		4		3		2	2
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	3.33	50
	K2	2	6	10	10	28	46.66	
	K3	-	-	10	20	30	50	50
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100
CIA II	K1	2	2	-	-	4	6.66	33
	K2	2	4	10	-	16	26.66	
	K3	-	-	10	-	10	16.66	17
	K4	-	-	-	30	30	50	50
	Marks	4	6	20	30	60	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	Cos	K - Level	Section A (MCQs)		Section B (Short Answers)		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1&K2	1	K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	05	4.16	4
K2	5	10	20	10	45	37.5	38
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) Answer All Questions			(10x1=10 marks)
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K2	
12	CO2	K2	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**BASIC CONCEPTS IN CHEMISTRY**			
Course Code	**21UCHN31**	**L**	**P**	**C**
Category	**Non Major Elective**	2	-	2

Nature of course:	**EMPLOYABILITY**	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**

Course Objectives:

- To recall the atoms and molecules and basic properties of both metals and non-metals.
- To remember the basics of pure substance and mixtures, fuels and catalysts.
- To compare the homogeneous and heterogeneous mixtures and types of catalysts.
- To perform the properties of states of matter and separation process.
- To determine the various concepts on atoms, molecules, fuels and catalysis.

Unit: I	**MATTER**	06

Atoms and Molecules – atom – molecule – subatomic particles of atom – structure of atom – valence electrons – valency – Bohr's model of an atom – states of matter – solid, liquid and gases – evaporation

Unit: II	**PURE SUBSTANCE AND MIXTURES**	06

Pure Substance – Mixtures – Homogeneous and Heterogeneous mixtures – solution – true solution, colloidal and suspension. Separation process of mixtures – evaporation, centrifugation, separating funnel, sublimation, simple distillation – difference between pure substance and mixtures.

Unit: III	**METALS AND NON-METALS**	06

Metals – physical properties of Metals – Hardness, lustrous, malleability, ductility, conduction of heat and electricity and sonorous. Non – Metals – exceptional cases of metals and non-metals – ionic bond.

Unit: IV	**FUELS**	06

Fuels – Definition – classification - Solid, liquid and gases, petroleum, refining – difference between petrol and diesel.

Unit: V	**CATALYSIS**	06

Catalyst: definition, homogeneous and heterogeneous catalysis (definitions and examples) – catalytic poisons, catalytic promoters, enzyme catalysts.

	Total Lecture Hours	**30 Hrs**

Books for Study:

1. Ramesh Kapoor, R S Chopra, Sunita Bhagat, Fundamental Chemistry, R. Chand & Co., New Delhi, 2018.

Books for References:

1. Anil Kumar Tomar and Pallabi B. Tomar, Basics of Chemistry, Pegasus Encyclopedia Library, New Delhi, 2018

Web Resources:

1. shorturl.at/gIKP6

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Ability to remember the basic concepts of atoms, molecules, fuels, catalysis.	**[Up to K2]**
CO2:	Discuss the composition of the solutions and mixtures and type of catalysts.	**[Up to K3]**

CO3:	Interpret the knowledge of atoms, molecules, fuels and catalysts.	**[Up to K3]**
CO4:	Examine the properties of metals and non-metals and role of catalysts.	**[Up to K4]**
CO5:	Distinguish between pure substance and mixtures, various types of catalysts.	**[Up to K4]**

CO & PO Mapping:

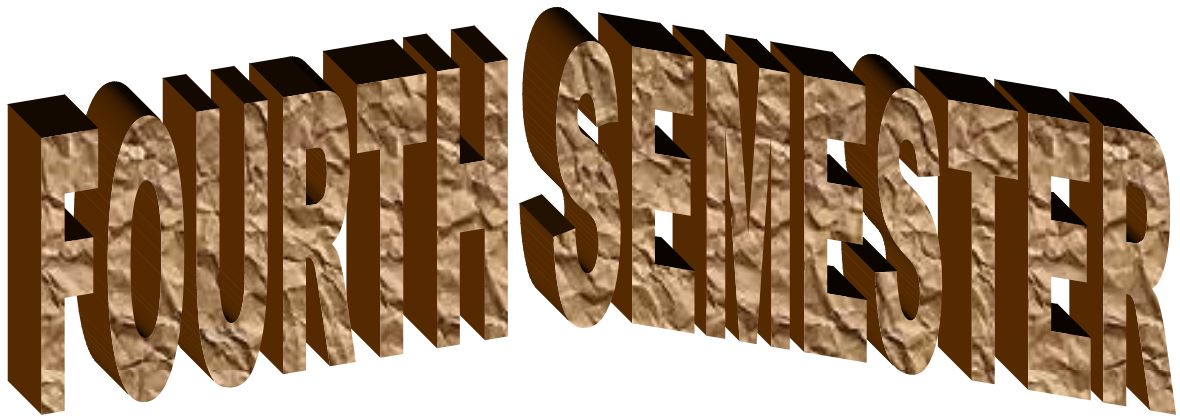
Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	1	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	1	3	2	3	2	1
Weightage	10	10	10	11	9	11

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**MATTER** Atoms and Molecules – atom – molecule – subatomic particles of atom – structure of atom – valence electrons – valency – Bohr's model of an atom – states of matter – solid, liquid and gases – evaporation	06	Chalk, Talk & Power point
II	**PURE SUBSTANCE AND MIXTURES** Pure Substance – Mixtures – Homogeneous and Heterogeneous mixtures – solution – true solution, colloidal and suspension. Separation process of mixtures – evaporation, centrifugation, separating funnel, sublimation, simple distillation – difference between pure substance and mixtures.	06	Chalk, Talk & Power point
III	**METALS AND NON-METALS** Metals – physical properties of Metals – Hardness, lustrous, malleability, ductility, conduction of heat and electricity and sonorous. Non – Metals – exceptional cases of metals and non-metals – ionic bond.	06	Chalk, Talk & Power point
IV	**FUELS** Fuels – Definition – classification - Solid, liquid and gases, petroleum, refining – difference between petrol and diesel	06	Chalk, Talk & Power point
V	**CATALYSIS** Catalyst: definition, homogeneous and heterogeneous catalysis (definitions and examples) – catalytic poisons, catalytic promoters, enzyme catalysts	06	Chalk, Talk & Power point

Course Designed by: **Dr. A. J. Sunija & Dr. R. Satheesh**


FOURTH SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**ORGANIC CHEMISTRY – II**			
Course Code	**21UCHC41**	**L**	**P**	**C**
Category	**Core**	4	-	4

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	**ENTREPRENURSHIP**	✓

Course Objectives:

- To recall the general characteristics of aromatic compounds and reaction mechanisms.
- To remember the basics of aromatic compounds and polynuclear compounds.
- To compare the preparation, properties of ortho, para, meta directing and aromatic compounds.
- To perform the mechanism of reactions and effects of substituents.
- To determine the various concepts on mechanisms and polynuclear compounds.

Unit: I	**AROMATIC COMPOUNDS – I**	12

Introduction – General characteristics of aromatic compounds – Aromaticity and Huckel's rule – Structure of benzene – Mechanism of aromatic electrophilic substitution (Halogenation, nitration, sulphonation and Friedel – Crafts reactions. Directive influence of substituents based on electronic effects (ortho/para/meta directing) –Di-substituted benzenes – Steric hindrance – Mechanism of aromatic nucleophilic substitution, unimolecular, bimolecular and benzyne mechanisms.

Unit: II	**AROMATIC COMPOUNDS – II**	12

Aromatic aldehydes: Mechanism of Cannizzaro, Perkins, Claisen, Knoevenagel reaction and Benzoin condensation – Preparation and properties of cinnamaldehyde and vanillin. Phenolic ketones: Phloroactetophenone – preparation – Houben – Hosch synthesis. Phenols: Acidity of phenols – effect of substituents on the acidity of phenol – mechanism of Kolbe's reaction.

Unit: III	**AROMATIC HYDROCARBONS, HALOGEN, NITRO AND AMINO COMPOUNDS**	12

Aromatic Hydrocarbons: Preparation, properties and uses of toluene xylene and mesitylene – Aromatic halogen compounds: preparation, Properties and uses of bromobenzene and benzyl bromide- Reactivity of aryl halides, distinction between nuclear and side chain halogenated derivatives. Aromatic nitro compounds: preparation and properties of nitrotoluenes. Aromatic amino compounds: Preparation by reduction of nitro compounds and from chlorobenzene – Effect of substituents on the basic character of aromatic amines – Comparison between aliphatic and aromatic amines – Preparation of aniline, sulphanilic acid, nitroanilines and phenylenediamines – Preparation and synthetic applications of benzene diazonium chloride.

Unit: IV	**AROMATIC ACIDS**	12

Effect of substituents on acidic character. Monocarboxylic acids: preparation, properties of salicylic acid and anthranilic acid. Dicarboxylic acids: preparation, properties of phthalic acid, phenylacetic acid, mandelic acid, cinnamic acid & coumarin. Aromatic Sulphonic acids: preparation, properties and uses of benzene sulphonic acid and saccharin.

Unit: V	**POLY NUCLEAR HYDROCARBONS AND THEIR DERIVATIVES**	12

Isolated systems: Preparation and properties of diphenyl, benzidine diphenic acid, diphenylmethane, triphenylmethane and stilbene. Condensed systems: Preparation properties, uses and structure of Naphthalene, Naphthylamines, Naphthols, Naphthaquinones, anthracene, anthraquinone, alizarin and phenanthrene.

	Total Lecture Hours	**60 Hrs**

Books for Study:

1. Soni. P.L and Chawla. H.M, Textbook of Organic Chemistry, S. Chand & Sons, 2007, New Delhi.

Books for References:

1. Jain. M.K, and Sharma. S.C, Modern Organic Chemistry, 4th Edition, Vishal Publishing Co., 2016, Jalandhar.
2. Arun Bahl and Bahl. B.S, A Textbook of Organic Chemistry, S. Chand & Co., 2012, New Delhi.
3. Jerry March, Advanced Organic Chemistry, 4th Edition, John Wiley and Sons, 1992, New York.
4. S.H. Pine, Organic Chemistry, 5th Edition, McGraw Hill International Edition, Chemistry Series, 1987, New York.
5. Morrison. R.T and Boyd. R.N, Organic Chemistry, 6th Edition, Printice-Hall of India Ltd., 1992, New Delhi.

Web Resources:

1. https://youtu.be/lVbuBY0YMu4
2. https://youtu.be/Ywgkw4vK01s
3. https://youtu.be/Ixe0swwcca0
4. https://youtu.be/A1IzmE_r7NY
5. https://youtu.be/vKmTUIKoJVM

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Recall the general characteristics of aromatic compounds and discuss the reaction	**[Up to K2]**
CO2:	Prepare the aromatic compounds like aromatic hydrocarbons, halogen, amino, substituted	**[Up to K3]**
CO3:	Examine the effect of substituents on acidic/basic character of aromatic compounds.	**[Up to K3]**
CO4:	Interpret the directive influence of substituent on electronic effects and properties of aromatic compounds.	**[Up to K4]**
CO5:	Integrate the reaction mechanism of aromatic compounds and formulate in the synthetic applications.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**AROMATIC COMPOUNDS – I** Introduction – General characteristics of aromatic compounds – Aromaticity and Huckel's rule – Structure of benzene – Mechanism of aromatic electrophilic substitution (Halogenation, nitration, sulphonation and Friedel – Crafts reactions. Directive influence of substituents based on electronic effects (ortho/para/meta directing) –Di-substituted benzenes – Steric hindrance – Mechanism of aromatic nucleophilic substitution, unimolecular, bimolecular and benzyne mechanisms.	12	Chalk, Talk & Power point
II	**AROMATIC COMPOUNDS – II** **Aromatic aldehydes:** Mechanism of Cannizzaro, Perkins, Claisen, Knoevenagel reaction and Benzoin condensation – Preparation and properties of cinnamaldehyde and vanillin. **Phenolic ketones**: Phloroactetophenone – preparation – Houben – Hosch synthesis. **Phenols:** Acidity of phenols – effect of substituents on the acidity of phenol – mechanism of Kolbe's reaction.	12	Chalk, Talk & Power point
III	**AROMATIC HYDROCARBONS, HALOGEN, NITRO AND AMINO COMPOUNDS** Aromatic Hydrocarbons: Preparation, properties and uses of toluene xylene and mesitylene –Aromatic halogen compounds: preparation, Properties and uses of bromobenzene and benzyl bromide- Reactivity of aryl halides, distinction between nuclear and side chain halogenated derivatives. Aromatic nitro compounds: preparation and properties of nitrotoluenes. Aromatic amino compounds: Preparation by reduction of nitro compounds and from chlorobenzene – Effect of substituents on the basic character of aromatic amines – Comparison between aliphatic and aromatic amines – Preparation of aniline, sulphanilic acid, nitroanilines and phenylenediamines – Preparation and synthetic applications of benzene diazonium chloride.	12	Chalk, Talk & Power point
IV	**AROMATIC ACIDS** Effect of substituents on acidic character. **Substituted acids:** preparation, properties of salicylic acid and anthranilic acid. **Mono & Dicarboxylic acids:** preparation, properties of phthalic acid, phenylacetic acid, mandelic acid, cinnamic acid & coumarin. **Aromatic Sulphonic acids:** preparation, properties and uses of benzene sulphonic acid and saccharin.	12	Chalk, Talk & Power point
V	**POLY NUCLEAR HYDROCARBONS AND THEIR DERIVATIVES** **Isolated systems:** Preparation and properties of diphenyl, benzidine diphenic acid, diphenylmethane, triphenylmethane and stilbene. **Condensed systems:** Preparation properties, uses and structure of Naphthalene, Naphthylamines, Naphthols, Naphthaquinones, anthracene, anthraquinone, alizarin and phenanthrene.	12	Chalk, Talk & Power point

Course Designed by: **Dr. K. Muthupandi & Dr. V. Ramasamy Raja**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Up to K2**	**2**	**K1&K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1&K2**	2	K2	2 (K3&K3)	2(K2 & K3)
CI AII	**CO3**	**Up to K2**	**2**	**K1&K2**	1	K2	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1&K2**	2	K2	2 (K3&K3)	2(K3 &K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**67**
	K2	**2**	**4**	**10**	**20**	**36**	**60**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**50**
	K2	**2**	**4**	**10**	**10**	**26**	**43.33**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**10**	**10**	**16.67**	**17**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S. No	Cos	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K 2	2	K1, K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Upto K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	**5**	**4**	-	**-**	**9**	**7.5**	**33**
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**PHYSICAL CHEMISTRY – II**			
Course Code	**21UCHC42**	**L**	**P**	**C**
Category	**Core**	**4**	**-**	**4**

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To recall the basic thermodynamic laws and gibbs phase rule.
- To remember the symmetry operations, absorption, emission and vibrational spectra.
- To Compare the relationship between Kp and Kc, two component system and group tables.
- To execute the group multiplication tables and phase rules.
- To Determine the Le-chatelier principle, distillation, Condon principle and point groups.

Unit: I	**CHEMICAL EQUILIBRIUM**	12

The law of mass action- Thermodynamic treatment of law of mass action, Relationship between Kp and Kc. Application of Law of mass action to Homogeneous system- Dissociation of PCl_5 and N_2O_4. Application of Law of mass action to Heterogeneous system -Calcium carbonate. Le-Chatelier Principle-Formation of Ammonia – Haber's process.

Unit: II	**PHASE RULE**	12

Gibbs phase rule – Definition of terms involved – Derivation of Gibb's phase rule – application of phase rule to one component system -water system. Two component system-simple eutectic-Pb-Ag system. Compound formation-Congruent melting point-Zn-Mg system, Incongruent melting point-Na_2SO_4-H_2O system. Liquid system – partially miscible liquid system-phenol-water system. Completely miscible system-Alcohol-water system Completely immiscible system-benzene –water system – Theory of fractional distillation - steam distillation.

Unit: III	**GROUP THEORY**	12

Molecular symmetry elements and symmetry operations – operations – production of symmetry operations – properties of a group – classes and sub groups – groups multiplication table – C_{2v}. Point groups – Classification of molecules into point groups – C_{2v}, C_{3v},C_{2h}, D_{2h}, D_{6h}, and T_d.

Unit: IV	**SPECTROSCOPY – I**	12

Introduction – Absorption and Emission spectra (Elementary ideas)-Electromagnetic radiation with relative intensities in each region. Molecular spectra – Types of molecular spectra. Rotational spectra of diatomic molecules – Rigid rotator – selection rule-determination of moment of inertia and bond length. UV Visible spectroscopy - Types of electronic transitions – Transition probability-Chromophore and Auxochrome concepts-.Absorption and Intensity shifts (Bathochromic, hypsochromic, hyperchromic and hypochromic shifts). Theory of electronic spectroscopy- -Franck and Condon principle - Applications of UV – Visible spectra.

Unit: V	**SPECTROSCOPY – II**	12

Vibrational spectra – IR spectra of diatomic molecules – Hooke's law – simple harmonic oscillator (no derivation) force constant – selection rule – Vibrational energy level diagram – Applications-force constant determination and calculation of zero-point energy. Modes of vibration in polyatomic molecules – CO_2 and H_2O molecules. Raman spectra — Quantum theory of Raman effect– Stokes and Anti - Stokes lines – experimental study – Comparison between IR and Raman spectra – Applications of Raman spectra – Rotational-vibrational Raman spectra of a diatomic molecule.

	Total Lecture Hours	**60 Hrs**

Books for Study:

1. B.S. Puri, L.R. Sharma and S. Pathania, Principles of Physical Chemistry, 47th Edition, Shoban Lal Nagin Chand & Co., New Delhi, 2012.
2. A.S. Negi, S. C. Anand, A Text Book of Physical Chemistry. 2nd Edition, New Delhi: New Age International Publishers, 1998.
3. Y. R. Sharma, Elementary Organic spectroscopy - Principles and Chemical Applications, 3rd Edition, New Delhi, 2011.

Books for Reference:

8. W. Gilbert, Castellan, Physical Chemistry, 4th Edition, Narosa Publishing House, New Delhi, 2004.
9. P.W. Atkins, Physical Chemistry, 7th Edition, Oxford University, Press, 2001.
10. S.K. Dogra, S. Dogra, Physical Chemistry through Problems, 4th Edition, New Age International Publishers, 1996.

Web Resources:

1. https://youtu.be/Ye1ZD3wEJXM
2. https://youtu.be/lrosz8N-9tA
3. https://youtu.be/Ioi6YiPGV4A
4. https://youtu.be/x56OIrdFJrw
5. https://youtu.be/i07KnMEGjS8
6. https://youtu.be/WukUvN721Ag
7. https://youtu.be/RRME2G7k4Tw

Course Outcomes:		K Level
On the completion of the course the student will be able to		
CO1:	Outline the basic principles and applications of chemistry in detail.	[Up to K2]
CO2:	Apply the concept of duality, spectroscopic techniques, symmetry aspects, theory of dilute solutions and phase equilibrium for chemical systems.	[Up to K3]
CO3:	Analyze the concept of quantum theory, the physical properties of various equilibria and spectroscopic parameters.	[Up to K3]
CO4:	Evaluate the practical utility of complicated problem-solving skill aspects.	[Up to K4]
CO5:	Develop a strategy to acquire advanced knowledge in various analytical techniques.	[Up to K4]

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	1	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	2	3	1	3	2	1
Weightage	11	10	9	11	9	11

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	PHYSICAL CHEMISTRY – II	Hrs	Mode
I	**CHEMICAL EQUILIBRIUM** The law of mass action- Thermodynamic treatment of law of mass action, Relationship between Kp and Kc. Application of Law of mass action to Homogeneous system- Dissociation of PCl_5 and N_2O_4. Application of Law of mass action to Heterogeneous system -Calcium carbonate. Le-Chatelier Principle-Formation of Ammonia – Haber's process.	12	Chalk & Talk, Power Point
II	**PHASE RULE** Gibbs phase rule – Definition of terms involved – Derivation of Gibb's phase rule – application of phase rule to one component system -water system. Two component system-simple eutectic – Pb -Ag system. Compound formation-Congruent melting point-Zn-Mg system, Incongruent melting point-Na_2SO_4-H_2O system. Liquid system – partially miscible liquid system-phenol-water system. Completely miscible system-Alcohol-water system Completely immiscible system-benzene –water system – Theory of fractional distillation - steam distillation.	12	Chalk & Talk, Power Point
III	**GROUP THEORY** Molecular symmetry elements and symmetry operations – operations – production of symmetry operations – properties of a group – classes and sub groups – groups multiplication table – C_{2v}. Point groups – Classification of molecules into point groups – C_{2v}, C_{3v}, C_{2h}, D_{2h}, D_{6h}, and T_d.	12	Chalk & Talk, Power Point
IV	**SPECTROSCOPY – I** Introduction – Absorption and Emission spectra (Elementary ideas)-Electromagnetic radiation with relative intensities in each region. Molecular spectra – Types of molecular spectra. Rotational spectra of diatomic molecules – Rigid rotator – selection rule-determination of moment of inertia and bond length. UV Visible spectroscopy - Types of electronic transitions – Transition Probability - Chromophore and Auxochrome concepts – Absorption and Intensity shifts (Bathochromic, hypsochromic, hyperchromic and hypochromic shifts). Theory of electronic spectroscopy- -Franck and Condon principle - Applications of UV – Visible spectra.	12	Chalk & Talk, Power Point
V	**SPECTROSCOPY – II** Vibrational spectra – IR spectra of diatomic molecules – Hooke's law – simple harmonic oscillator (no derivation) force constant – selection rule – Vibrational energy level diagram – Applications- force constant determination and calculation of zero-point energy. Modes of vibration in polyatomic molecules – CO_2 and H_2O molecules. Raman spectra — Quantum theory of Raman effect– Stokes and Anti - Stokes lines – experimental study – Comparison between IR and Raman spectra – Applications of Raman spectra – Rotational-vibrational Raman spectra of a diatomic molecule.	12	Chalk & Talk, Power Point

Course Designed by: **Dr. R. Satheesh & Dr. K. Muthupandi**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Up to K2**	**2**	**K1&K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1&K2**	2	K2	2 (K3&K3)	2(K2 & K3)
CI AII	**CO3**	**Up to K2**	**2**	**K1&K2**	1	K2	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1&K2**	2	K2	2 (K3&K3)	2(K3 &K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**67**
	K2	**2**	**4**	**10**	**20**	**36**	**60**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**50**
	K2	**2**	**4**	**10**	**10**	**26**	**43.33**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**10**	**10**	**16.67**	**17**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S. No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**Major Chemistry Practical – II (Volumetric Analysis)**				
Course Code	21UCHCP2		**L**	**P**	**C**
Category	**Core Practical**		-	2	2
Nature of course:	**EMPLOYABILITY**	✓ SKILL ORIENTED	ENTREPRENURSHIP		

Course Objectives:

- To recollect the theory of laboratory safety measures and strength of solutions.
- To remember the estimation of acidimetry and alkalimetry and redox titrations.
- To compare the concept of titration based on redox and hardness of water.
- To execute the concept of permanganometry and dichrometry.
- To determine the estimation of volumetric analysis.

UNIT	Theory of Volumetric Analysis and List of Experiments	Hrs
I	Theory of Volumetric Analysis and Laboratory Safety Measures: Strength of Solutions – Normality, Molarity, Molality. Handling of apparatus, glasswares and chemicals – Safety aspects	6
II	**List of Experiments**	24

I. Acidimetry and Alkalimetry

1. Estimation of Na_2CO_3

2. Estimation of NaOH / KOH

3. Estimation of oxalic acid.

II. Redox Titrations

a. Permanganometry

1. Estimation of ferrous ion
2. Estimation of oxalic acid
3. Estimation of calcium (direct method)

b. Dichrometry

1. Estimation of ferrous ion
2. Estimation of ferric ion using external indicator

V. EDTA Titration

1. Estimation of Hardness of water using EDTA.

Distribution of marks

Max marks: 100
Internal : 40 marks **External : 60 marks**

Laboratory Performance	:	30 marks	Vivo voce	:	5 marks
Observation note book	:	10 marks	Record note book	:	10 marks
			Procedure writing Volumetric estimation	: :	15 marks 30 marks
Total	:	40 marks	Total	:	60 marks

For Volumetric Estimation if the student have

Less than 2% Error - 30 marks
2-3% Error - 25 marks
3-4% Error - 20 marks
3-5% Error - 15 marks
Greater than 5% - 10 marks

TOTAL HOURS | **30 Hrs**

Books for Study:

1. Vogel, Text book of Inorganic quantitative analysis, Longman Sc & Tech, 2008.

Books for References:

1. Jeyavathana Samuel, Chemistry Practical Book, G.G.Printers, Chennai, 2012.

2. Vickie. M.Williamson, M.Larry Peck, Lab manual for General Chemistry, Cengage Learning India Private Limited, New Delhi, 2009.

3. Dr. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis, National Publishing Company, Chennai, 3rd edition, 1974.

Web Resources:

1. **https://youtu.be/xQDQNghs5dc**
2. **https://youtu.be/AdbK86BnXN8**
3. **https://youtu.be/dmnElKapQ00**

Course Outcomes:		K Level
On the completion of the course the student will be able to		
CO1:	Discuss the theory of safety measures in chemistry laboratory.	[Up to K2]
CO2:	Understand the qualitative and quantitative analysis in practical chemistry.	[Up to K3]
CO3:	Apply the theory on quantitative titration methods.	[Up to K3]
CO4:	Analyze the titrated values in tabular format.	[Up to K4]
CO5:	Construct the estimated value of the given compounds.	[Up to K4]

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	1	2	3	3	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	2	3	1	3	2	1
Weightage	10	10	9	11	10	11

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	Theory of Volumetric Analysis and Laboratory Safety Measures	Hrs	Mode
I	Theory of Volumetric Analysis and Laboratory Safety Measures: Strength of Solutions – Normality, Molarity, Molality. Handling of apparatus, glasswares and chemicals – Safety aspects	6	
	List of Experiments		
II	I. Acidimetry and Alkalimetry 1. Estimation of Na_2CO_3 2. Estimation of NaOH / KOH 3. Estimation of oxalic acid. II. Redox Titrations a. Permanganometry 1. Estimation of ferrous ion 2. Estimation of oxalic acid 3. Estimation of calcium (direct method) b. Dichrometry 1. Estimation of ferrous ion 2. Estimation of ferric ion using external indicator V. EDTA Titration 1. Estimation of Hardness of water using EDTA.	24	Practical

Course Designed by: **Dr. Ramasamy Raja & Dr. K. Muthupandi**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**Allied Mathematics – II (B.Sc., Chemistry)**			
Course Code	**21UMCA43**	**L**	**P**	**C**
Category	**Allied**	6	-	4
Nature of Course:	**EMPLOYBILITY**	**SKILL ORIENTED**	**ENTREPRENURSHIP**	

COURSE OBJECTIVES:

- To understand mathematical models used in Operations Research
- To apply these techniques constructively to make effective business decisions
- To develop the notions about Mathematical formulation and Solving Linear Programming Problem.
- To evaluate game theory and linear problems.
- To develop mathematical skills to analyze and solve network models.

Unit: I	Mathematical Formulation of a LPP: General form of a LPP – Summation notation – Matrix form – Canonical form – Standard form - Solution of LPP by Graphical Method - The Simplex Method	**23 hrs**
Unit: II	Transportation Problems: Mathematical Formulation of TP - Initial Basic Feasible Solution – North west corner rule- Least cost method- Vogels Approximation method - Optimum solution of TP (MODI Method).	**18 hrs**
Unit: III	Assignment Problems: Mathematical formulation of Assignment Problems – Solution to Assignment Problems	**15 hrs**
Unit: IV	Games and Strategies: Introduction – Two person zero sum game – The Maximin – Minimax Principle - Saddle point – Games without saddle point – Graphic Solution of 2 x n and m x 2 Games – Dominance Property	**16 hrs**
Unit: V	Network Flow Problems – Minimal Spanning Tree Problem – Shortest Route Problems	**18 hrs**
	Total Lecture Hours	**90 hrs**

Books for Study:

Text Book 1: Dr. S. Arumugam and A.Thangapandi Isaac, **Topics in Operations Research Linear Programming**, New Gamma Publishers Pvt. Ltd, Palayamkottai, Tirunelveli, March 2015.

Text Book 2: Kanti Swarup, P.K. Gupta, Man Mohan, **Operations Research**, 17th Edition, Sultan Chand and Sons, New Delhi, 2014.

Unit I : Text Book 1: Chapter 3 – Sections: 3.2, 3.4, 3.5
Unit II : Text Book 1: Chapter 4 – Section: 4.1
Unit III : Text Book 1: Chapter 5 – Sections: 5.1 & 5.2
Unit IV : Text Book 2: Chapter 17 – Sections: 17.1 – 17.7.
Unit V : Text Book 2: Chapter 24 – Sections: 24.2, 24.3 & 24.4.

Books for Reference:

1. Rathindra P. Sen, **Operations Research Algorithms and Applications**, PHI, EEE, New Delhi, 2010.
2. Sharma J.K. , **Operations Research: Problems and Solutions**, Laxmi Publications, Third Edition , 2009.

Web Resources:		
1. https://nptel.ac.in/courses/111/107/111107128/ 2. https://onlinecourses.swayam2.ac.in/cec20_ma10/preview		
Course Outcomes:		**K Level**
After the completion of the course, Students will be able to		
CO1:	Develop the notions about Mathematical formulation and Solving Linear Programming Problem.	**K4**
CO2:	Acquire the knowledge about the view of transportation and assignment problems.	**K3**
CO3:	Identify and develop the real life problems into network problems .	**K3**
CO4:	Distinguish a game situation from a pure individuals decision problems	**K4**
CO5:	Understand the Mathematical tools that are needed to solve various optimization problems.	**K3**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	3	2	2	3	2
CO 2	2	3	3	2	2	2
CO 3	2	2	2	2	2	3
CO 4	2	3	2	2	2	2
CO 5	2	2	3	2	2	3

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hrs	Pedagogy
I	Mathematical Formulation of a LPP: General form of a LPP (2 hrs) – Summation notation – Matrix form – Canonical form (4 hrs) – Standard form (2 hrs) - Solution of LPP by Graphical Method. (7 hrs) - The Simplex Method (8 hrs)	**23**	**Chalk & Talk , LCD**
II	Transportation Problems: Mathematical Formulation of TP (4 hrs)- Initial Basic Feasible Solution (all methods) (7 hrs)- Optimum solution of TP (MODI Method). (7 hrs)	**18**	**Chalk & Talk , PPT**
III	Assignment Problems : Mathematical formulation of Assignment Problems(3 hrs) – Solution to Assignment Problems. (7 hrs) – Travelling Salesman Problem (5 hrs)	**15**	**Chalk & Talk , Seminar**
IV	Games and Strategies: Introduction – Two person zero sum game (1 hr) – The Maximin – Minimax Principle(3 hrs) - Saddle point (2 hrs) – Games without saddle point (3 hrs) – Graphic Solution of 2 x n and m x 2 Games (3 hrs) – Dominance Property (4 hrs)	**16**	**Chalk & Talk , Group Discussion**
V	Network Flow Problems(5 hrs) – Minimal Spanning Tree Problem (6 hrs)– Shortest Route Problems(7 hrs)	**18**	**Chalk & Talk , PPT**

Course Designed By: Dr. S. Suriyakala and **Dr. M. Sasikala**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	K4	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K4)
	CO2	K3	2	K2 & K2	2	K2 & K2	2 (K3 & K3)	2 (K3)
CI AII	CO3	K3	2	K1& K2	1	K2	2 (K3 & K3)	2 (K3)
	CO4	K4	2	K2 & K2	2	K2 & K2	2 (K4 & K4)	1 (K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	1	-	-	-	1	1.67	16.67
	K2	3	6	-	-	9	15	
	K3	-	-	20	20	40	66.67	66.67
	K4	-	-	-	10	10	1.67	1.67
	Marks	4	6	20	30	60	100	100
CIA II	K1	1	-	-	-	1	1.67	16.67
	K2	3	6	-	-	9	15	
	K3	-	-	10	20	30	50	50
	K4	-	-	10	10	20	33.33	33.33
	Marks	4	6	20	30	60	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	K4	2	K1&K2	1	K1	2 (K3 &K3)	1 (K4)
2	CO2	K3	2	K1&K2	1	K1	2 (K3 &K3)	1 (K3)
3	CO3	K3	2	K1&K2	1	K2	2 (K3 &K3)	1 (K3)
4	CO4	K4	2	K1&K2	1	K2	2 (K4 &K4)	1 (K4)
5	CO5	K3	2	K1&K2	1	K2	2 (K3 &K3)	1 (K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	16.67
K2	5	6	-	-	11	9.17	
K3	-	-	40	30	70	58.33	58.33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**APPLIED MICROBIOLOGY**							
Course Code	**21UMBA42**					**L**	**P**	**C**
Category	**ALLIED MICROBIOLOGY - II**					6	-	4
Nature of course	EMPLOYABILITY	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To provide information regarding biofertilizers and their significance.
- To gain the Knowledge about microbes present in environments
- To learn to isolate industrially important organisms
- To understand the key concepts in food microbiology
- To acquire various basic concepts of medical microbiology

Unit: I	**Agricultural microbiology**	**18**

Soil - general properties - Soil microflora and its importance. Microbial transformation of Carbon, Nitrogen and phosphorus. Beneficial microorganisms in agriculture: Bacterial biofertilizer – *Rhizobium*, Bacterial insecticides - *Bacillus thuringiensis*.

Unit: II	**Environmental microbiology**	**18**

Microbes in air - Microbial assessment of air quality - Microbes in water - Microbial assessment of water quality - sewage water treatment-primary, secondary and tertiary - Microbes in the production of biogas.

Unit: III	**Industrial microbiology**	**18**

Industrially important microorganisms - Bioreactors / Fermenter, components of typical fermenter - applications -microbial production of Industrial products - Ethanol, Penicillin and vitamin B12.

Unit: IV	**Food microbiology**	**18**

Important microorganisms in food (bacteria, molds and yeasts). Sources of food contamination. Factors that influence microbial growth in food - Intrinsic factors -extrinsic factors. Microorganisms as food - SCP, edible mushrooms. Probiotics and their benefits.

Unit: V	**Medical microbiology**	**18**

Normal micro flora of the human body- role of normal flora – beneficial and harmful effects. Important human diseases -Typhoid, Hepatitis, Aspergillosis & Malaria.

	Total Lecture Hours	**90 Hrs**

Text Books:

1. Satyanarayana U. **Biotechnology**, 12th Edition, Books and Allied Pvt. Ltd, 2019.
2. Willey J, Sandman K AND Wood D, **Prescott's Microbiology**. 11th Edition. McGraw Hill education, 2019.
3. Crueger W and Crueger A. **Biotechnology: A textbook of Industrial Microbiology**, 2nd Edition. Panima Publishing Company, New Delhi, 2000.

Books For Reference:

1. Joseph C Daniel. **Environmental aspects of Microbiology**, 1st edition, Bright Sun publications, Chennai, 1999.
2. Mitchell R. **Introduction to Environmental Microbiology,** Printice Hall. Inc., Englewood Cliffs, New Jersey, 1974.

3. Patel A.H. **Industrial microbiology**, 2nd edition, Mac Millan India Ltd., New Delhi, 2005.
4. Sivashankar B. **Food Processing and Preservation**, Eastern Economy edition, PHI Learning Pvt. Ltd., New Delhi, 2009.
5. SubbaRao N.S. **Soil Microbiology**, 4th edition, Oxford and BH Publishing Co. Pvt. Ltd., New Delhi, 2004.

Web Resources:

1.http://www.swayam.gov.in/
2.http://www.nptel.ac.in/
3.https://www.sciencedirect.com/food-microbiology

COURSE OUTCOME		**K Level**
On successful completion of the course, the learners will be able to		
CO1:	Recognize the Beneficial microorganism in agriculture	**Up to K2**
CO2:	Experiment with the role of microbes present in air and water.	**Up to K3**
CO3:	Analyze and compare the important microorganisms in food	**Up to K4**
CO4:	Examine the Industrially important microorganisms and its products.	**Up to K4**
CO5:	Summarize the importance of microbes in human diseases	**Up to K3**

CO & PO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	3	3	3	3	2	2
CO 2	3	3	3	3	3	2
CO 3	3	3	3	3	3	1
CO 4	3	3	3	3	3	2
CO5	3	3	3	3	3	2

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Mode
I	**Agricultural microbiology** - Soil - general properties - Soil microflora and its importance. Microbial transformation of Carbon, Nitrogen and phosphorus. Beneficial microorganism in agriculture: Bacterial biofertilizer – Rhizobium, Bacterial insecticides - *Bacillus thuringiensis*	**18**	**Chalk and talk, PPT**
II	**Environmental microbiology** - Microbes in air - Microbial assessment of air quality - Microbes in water - Microbial assessment of water quality - sewage water treatment-primary, secondary and tertiary - Microbes in the production of biogas	**18**	**Chalk and talk, PPT**
III	**Industrial microbiology-**Industrially important microorganisms- Bioreactors / Fermenter-components of typical fermenter - applications -microbial production of Industrial products–Ethanol, Penicillin and vitamin B12	**18**	**Chalk and talk, PPT**
IV	**Food microbiology** -Important microorganisms in food (Bacteria, Molds and Yeasts) Sources of contamination of food. Factors that influence microbial growth in food - Intrinsic factors -extrinsic factors. Microorganisms as food - SCP, edible mushrooms. Probiotics and their benefits.	**18**	**Chalk and talk, PPT**
V	**Medical microbiology** - Normal micro flora of the human body- role of normal flora – beneficial and harmful effect. Important human diseases -Typhoid, Hepatitis, Aspergillosis & Malaria.	**18**	**Chalk and talk, PPT, Assignment**

Course Designed by: **1. Dr. S. Subramani, Assistant Professor.**
2. Ms. C. Thenmozhi, Assistant Professor.

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Up to K2	2	K1& K2	1	K2	2(K2&K2)	1(K2)
	CO2	Up to K3	2	K1 & K2	2	K2	2(K3&K3)	2(K2&K3)
CIA II	CO3	Up to K4	2	K1 & K2	1	K2	2(K2&K2)	1(K4)
	CO4	Up to K4	2	K1 & K2	2	K2	2(K3&K3)	2(K3&K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	-	-	-	2	3.33	67
	K2	2	6	10	20	38	63.34	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	30	60	100	100
CIA II	K1	2	-	-	-	2	3.33	34
	K2	2	6	10	-	18	30	
	K3	-	-	10	10	20	33.33	33
	K4	-	-	-	20	20	33.33	33
	Marks	4	6	20	30	60	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S. No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Up to K2**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K2)**
2	CO2	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
3	CO3	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Up to K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K4)**
5	CO5	**Up to K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	-	-	-	5	4.16	42
K2	5	10	20	10	45	37.5	
K3	-	-	20	20	40	33.33	33
K4	-	-	10	20	30	25	25
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K1	
16) b	CO1	K1	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**WATER TREATMENT**			
Course Code	**21UCHN41**	**L**	**P**	**C**
Category	**Non Major Elective**	2	-	2
Nature of course:	**EMPLOYABILITY**	**SKILL ORIENTED**	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the hardness of water, boiling, boiler feed water and desalination.
- To Remember the estimation of hardness of water, chlorination and membrane techniques.
- To Compare the ultraviolet treatment, internal and external conditioning and osmosis.
- To Perform the break point chlorination, difference in types of distillation.
- To Determine the water quality standards, priming, foaming and ion exchange process.

Unit: I	**HARDNESS OF WATER**	06

Introduction - Types of impurities present in water - Hardness of water - Estimation of hardness by EDTA method - Domestic water treatment - water quality standards.

Unit: II	**STERILIZATION METHODS**	06

Sterilization - Boiling - Ozone gas treatment - Ultraviolet treatment - Chlorination – Break point chlorination.

Unit: III	**BOILER TROUBLES**	06

Boiler feed water - Scale and sludge formation - Comparison of sludge and scale - Boiler corrosion - Removal of carbon dioxide and dissolved oxygen – Caustic embrittlement - Priming - Foaming - Requirements of boiler feed water

Unit: IV	**WATER CONDITIONING**	06

Internal conditioning - Colloidal conditioning - Phosphate conditioning - Calgon conditioning - Carbonate conditioning. External conditioning - Demineralization process - Regeneration of ion exchangers - Advantages and disadvantages of ion exchange process - Difference between internal conditioning and external conditioning.

Unit: V	**DESALINATION**	06

Desalination - Reverse osmosis – Electrodialysis – Thermal distillation – Solar distillation – Membrane Technologies.

	Total Lecture Hours	**30 Hrs**

Books for Study:

1. Nicholas P. Cheremisinoff, Handbook of water and wastewater treatment technologies, Boston Oxford Auckland Johannesburg Melbourne, New Delhi, 2002

Books for References:

1. B.K.Sharma, Industrial Chemistry, Goel publishing House, Meerut, 2003, New Delhi.
2. R.V.Shreve, Industrial Chemical Process, Tata McGraw Hill publishing company, 2005, Mumbai.

Web Resources:

1. https://youtu.be/ByCMhI2yi2M
2. https://youtu.be/XKNDXrlBnLM
3. https://youtu.be/aGo0GUAAeuA
4. https://youtu.be/zXKHjS_Q9wE

Course Outcomes	**K Level**

On the completion of the course the student will be able to		
CO1:	Recall the general characteristics of hardness of water and its estimation.	**[Up to K2]**
CO2:	Discuss the sterilization methods and comparison of sludge and scale.	**[Up to K3]**
CO3:	Understand the concepts of internal conditioning and external conditioning.	**[Up to K3]**
CO4:	Examine the boiler corrosion and demineralization processes.	**[Up to K4]**
CO5:	Apply the domestic water treatment and ultraviolet treatment on water analysis.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**HARDNESS OF WATER** Introduction - Types of impurities present in water - Hardness of water - Estimation of hardness by EDTA method - Domestic water treatment - water quality standards.	12	Chalk, Talk & Power point
II	**STERILIZATION METHODS** Sterilization - Boiling - Ozone gas treatment - Ultraviolet treatment - Chlorination – Break point chlorination.	12	Chalk, Talk & Power point
III	**BOILER TROUBLES** Boiler feed water - Scale and sludge formation - Comparison of sludge and scale - Boiler corrosion - Removal of carbon dioxide and dissolved oxygen – Caustic embrittlement - Priming - Foaming - Requirements of boiler feed water.	12	Chalk, Talk & Power point
IV	**WATER CONDITIONING** Internal conditioning - Colloidal conditioning - Phosphate conditioning - Calgon conditioning - Carbonate conditioning. External conditioning - Demineralization process - Regeneration of ion exchangers - Advantages and disadvantages of ion exchange process - Difference between internal conditioning and external conditioning.	12	Chalk, Talk & Power point
V	**DESALINATION** Desalination - Reverse osmosis – Electrodialysis – Thermal distillation – Solar distillation – Membrane Technologies.	12	Chalk, Talk & Power point

Course Designed by: **Dr. A. J. Sunija & Dr. K. Muthupandi**


FIFTH SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**ORGANIC CHEMISTRY – III**			
Course Code	**21UCHC51**	**L**	**P**	**C**
Category	**Core**	6	-	6

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED		**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the characteristics of alicyclic compounds, conformational analysis and Civetone and Muscone.
- To Remember the free radicals and molecular rearrangements.
- To Compare the heterocyclic compounds, alkaloids and terpenes.
- To Interpret the structure and classifications of proteins and nucleic acids.
- To Determine the principles and applications of spectroscopy.

Unit: I	**ALICYCLIC COMPOUNDS, CONFORMATIONAL ANALYSIS, CIVETONE AND MUSCONE**	18

Alicyclic compounds: General methods of preparation and properties of cycloparaffins – Baeyer's strain theory and its modification. Conformational Analysis: Difference between configuration and conformation- Fisher- Saw horse and Newman Projection formulate – Conformational analysis of ethane, n-butane 1,2– dichloroethane, cyclohexane and monosubstituted cyclohexane. Civetone and Muscone any one method of synthesis – Structure only (no Structural elucidation)

Unit: II	**MOLECULAR REARRANGEMENT AND FREE RADICALS**	18

Molecular rearrangements: Detailed mechanisms of the following: pinacol - Pinacolone, Hofmann, Curtius, benzil-benzilic acid, claisen, benzidine, Fries and Wagner-Meerwein rearrangements. Free radicals: Definition – preparation and reactions of short lived and long-lived free radicals – Reaction and Mechanism of Sand Meyer reaction, Gomberg reaction and Hofmann-Loeffler reaction – chain reactions – photochemical reactions of olefins – cis-trans isomerization.

Unit: III	**HETEROCYCLIC COMPOUNDS**	18

Heterocyclic compounds: Introduction and definition, Preparation and basic properties of pyrrole, pyridine, quinoline and isoquinoline. Alkaloids: Definition – occurrence and extraction of alkaloids – general methods for determining the structure of alkaloids – classification of alkaloids – structural elucidation – coniine, piperine and nicotine. Terpenes: Introduction, classification, occurrence and isolation – general properties – isoprene rule – general methods of determining structure. Properties, Structure of citral and terpineol.

Unit: IV	**PROTEINS AND NUCLEIC ACIDS**	18

Proteins: Definition – Classification of Amino Acids – Zwitter ion – Peptide bond - Classification of proteins – colour reactions of proteins – primary, secondary, tertiary and quaternary structure of proteins (an elementary idea only). Nucleic acids: Definition – Classification of Nucleic acids – nucleosides – nucleotides – difference between nucleosides and nucleotides – RNA and DNA general structure – Basic structure of DNA and RNA – Functions of DNA and RNA – RNA types.

Unit: V	**PRINCIPLES AND APPLICATIONS OF SPECTROSCOPY**	18

UV: Introduction– Type of electronic transition – absorption law bathochromic shift and

hypso chromic shift – hyperchromic and hypochromic effect – applications of UV to organic compounds – Woodward - Fieser calculation of λmax. IR: Introduction – Instrumentation– different regions of IR, finger print regions – fundamental, overtone, Hot bands and combination bands – applications of IR to organic compounds – effect of hydrogen bonding – NH2. NMR: Introduction – Conditions for NMR active – chemical shift – shielding and deshielding effects - factors influencing chemical shift – solvent used (TMS) – splitting of signals –NMR spectra of simple ethanol and anisole.

	Total Lecture Hours	**90 Hrs**

Books for Study:

6. Soni, P.L and Chawla. H.M, A Textbook of Organic Chemistry, S. Chand & Co., 2007, New Delhi.

Books for References:

9. Jain. M.K and Sharma. S.C, Modern Organic Chemistry, 4th Edition, Vishal Publishing CO., 2016, Jalandhar.
10. Bahl. B.S and ArunBahl, A Textbook of Organic Chemistry, S. Chand & Co., 2012, New Delhi.
11. Jerry March, Advanced Organic Chemistry, 4th Edition, John Wiley & Sons, 1992, New York.
12. Pine, S.H, Organic Chemistry, 5th Edition, McGraw Hill International Edition, Chemistry Series, 1987, New York.
13. Sehan N. Ege, Organic Chemistry – Structure and Reactivity, 3rd Edition, A.I.T.B.S., 1998, New Delhi.
14. Morrison. R.T and Boyd. R.N, Organic Chemistry, 6th Edition, Printice-Hall of India Ltd., 1992, New Delhi.

Web Resources:

1. https://youtu.be/uJWy8mPxIzw
2. https://youtu.be/12hmgzeiGo4
3. https://youtu.be/MM4IcBYZrb4
4. https://youtu.be/6OOUDOVWm0M
5. https://youtu.be/YoQORrw_5Yk

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Reminiscence the alicyclic compounds, free radicals and proteins and deliberate the reaction mechanism of aromatic compounds.	**[Up to K2]**
CO2:	Prepare the heterocyclic compounds, short lived and long-lived free radicals.	**[Up to K3]**
CO3:	Differentiate between configuration and conformation and distinguish between proteins and nucleic acids.	**[Up to K3]**
CO4:	Interpret the directive influence of substituents on electronic effects and properties of aromatic compounds.	**[Up to K4]**
CO5:	Integrate the reaction mechanism of aromatic compounds and formulate in the synthetic applications.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	1	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	1	3	2	3	2	1
Weightage	10	10	10	11	9	11

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**ALICYCLIC COMPOUNDS, CONFORMATIONAL ANALYSIS, CIVETONE AND MUSCONE** Alicyclic compounds: General methods of preparation and properties of cycloparaffins – Baeyer's strain theory and its modification. Conformational Analysis: Difference between configuration and conformation- Fisher- Saw horse and Newman Projection formulate – Conformational analysis of ethane, n-butane 1,2– dichloroethane, cyclohexane and monosubstituted cyclohexane. Civetone and Muscone any one method of synthesis – Structure only (no Structural elucidation)	18	Chalk, Talk & Power point
II	**MOLECULAR REARRANGEMENT AND FREE RADICALS** Molecular rearrangements: Detailed mechanisms of the following: pinacol - Pinacolone, Hofmann, Curtius, benzil-benzilic acid, claisen, benzidine, Fries and Wagner-Meerwein rearrangements. Free radicals: Definition – preparation and reactions of short lived and long-lived free radicals – Reaction and Mechanism of Sand Meyer reaction, Gomberg reaction and Hofmann-Loeffler reaction – chain reactions – photochemical reactions of olefins – cis-trans isomerization.	18	Chalk, Talk & Power point
III	**HETEROCYCLIC COMPOUNDS** Heterocyclic compounds: Introduction and definition, Preparation and basic properties of pyrrole, pyridine, quinoline and isoquinoline. Alkaloids: Definition – occurrence and extraction of alkaloids – general methods for determining the structure of alkaloids – classification of alkaloids – structural elucidation – coniine, piperine and nicotine. Terpenes: Introduction, classification, occurrence and isolation – general properties – isoprene rule – general methods of determining structure. Properties, Structure of citral and terpineol.	18	Chalk, Talk & Power point
IV	**PROTEINS AND NUCLEIC ACIDS** Proteins: Definition – Classification of Amino Acids – Zwitter ion – Peptide bond - Classification of proteins – colour reactions of proteins – primary, secondary, tertiary and quaternary structure of proteins (an	18	Chalk, Talk & Power point

	elementary idea only). Nucleic acids: Definition – Classification of Nucleic acids – nucleosides – nucleotides – difference between nucleosides and nucleotides – RNA and DNA general structure – Basic structure of DNA and RNA – Functions of DNA and RNA – RNA types.		
V	**PRINCIPLES AND APPLICATIONS OF SPECTROSCOPY** UV: Introduction– Type of electronic transition – absorption law bathochromic shift and hypso chromic shift – hyperchromic and hypochromic effect – applications of UV to organic compounds – Woodward - Fieser calculation of λmax. IR: Introduction – Instrumentation– different regions of IR, finger print regions – fundamental, overtone, Hot bands and combination bands – applications of IR to organic compounds – effect of hydrogen bonding – NH2. NMR: Introduction – Conditions for NMR active – chemical shift – shielding and deshielding effects - factors influencing chemical shift – solvent used (TMS) – splitting of signals –NMR spectra of simple ethanol and anisole.	**18**	**Chalk, Talk & Power point**

Course Designed by: **Dr. K. Muthupandi & Dr. A. J. Sunija**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Up to K2**	**2**	**K1**	1	**K1**	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K2**	2	**K2**	2 (K3&K3)	1(K3)
CI AII	**CO3**	**Up to K3**	**2**	**K1**	1	**K1**	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K2**	2	**K2**	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**8**	
	K2	**2**	**4**	**10**	**10**	**26**	**52**	**60**
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**8**	
	K2	**2**	**4**	**10**	**10**	**26**	**52**	**60**
	K3	**-**	**-**	**10**	**-**	**10**	**20**	**20**
	K4	**-**	**-**	**-**	**10**	**10**	**20**	**20**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	Cos	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K 2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Upto K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**MAJOR CHEMISTRY PRACTICAL – III (PHYSICAL CHEMISTRY EXPERIMENTS)**			
Course Code	**21UCHCP3**	**L**	**P**	**C**
Category	**Core**	**-**	**6**	**5**

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To learn the general methods for the determination of molecular weight.
- To analyze the concept of phase diagram, CST and potentiometric titrations.
- To study the equilibrium constant for the reaction
- To determine the relative strength of acids by hydrolysis of ester
- To interpret the cell constant and conductivity titration between as acid and a base.

List of Experiments

I. Determination of Molecular weight by

a) Transition Temperature method – Sodium thiosulphate pentahydrate

b) Rast Macro method – Naphthalene as Solvent

II. Phase diagram involving

a) Simple eutectic b) Compound formation

III. Critical solution temperature (CST)

Determination of CST of phenol – water system

IV. Potentiometric titrations

(a) HCl Vs NaOH (b) $K_2Cr_2O_7$ Vs $FeSO_4$.

V. Partition Coefficient experiments:

Study of the equilibrium constant for the reaction

$KI+I_2 \leftrightarrow KI_3$

By determining the partition Co-efficient of I_2 between water an CCl_4

Determination of strength of given KI.

VI. Kinetics: Determination of relative strength of acids by hydrolysis of ester.

VII. Conductivity: Determination of cell constant and conductivity titration between as acid and a base (HCl Vs NaOH).

Distribution of Marks (Max. marks – 100)

Duration of examination: 6 hrs

Regular Test in the Class	: 30 Marks
Observation note book	: 10 Marks
Total	: 40 Marks
Viva voce	: 10 marks
Record Note book	: 10 marks
For completion of the experiment	: 20 marks
Graph	: 2 marks
Calculation	: 5 marks
Tabulation	: 3 marks
Result	: 10 marks
Total	: 60 marks

	Total Lecture Hours	**45 Hrs**

Books for Study:

Thomas. A.O and Mani, Textbook of Practical Chemistry, 4th Revised Edition, Scientific Publication, 1976.

Books for Reference:

1. J. E. Huheey, E. A. Kieter and R. L. Keiter, Inorganic Chemistry, 4th ed., Harper Collins, New York, 1993.
2. F. A. Cotton, G. Wilkinson, C. Murillo and M. Bochman, Advanced Inorganic Chemistry,6th ed., John Wiley, New York, 1999.
3. T. Moeller, Inorganic Chemistry: A Modern Introduction, Wiley, New York, 1990.
4. R. D Madan S.Chand, Modern Inorganic Chemistry band Co.Ltd, New Delhi 2012.

Web Resources:

1. https://youtu.be/2VzEpsEZOYo
2. https://youtu.be/Xwm98B3gLPw
3. https://youtu.be/KD7amFclq4s

Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Determination of molecular weight by Transition Temperature method and Rast macro method.	**[Up to K2]**
CO2:	Involvement of phase diagram and CST.	**[Up to K3]**
CO3:	Analyze the relative strength of acids by hydrolysis of ester.	**[Up to K3]**
CO4:	Interpret the equilibrium constant for the reaction	**[Up to K4]**
CO5:	Determine the cell constant and conductivity titration between as acid and a base.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	1	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	2	3	1	3	2	1
Weightage	11	10	9	11	9	11

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	List of Experiments	Hrs	Mode
I	**I. Determination of Molecular weight by** a) Transition Temperature method – Sodium thiosulphate pentahydrate b) Rast Macro method – Naphthalene as Solvent **II. Phase diagram involving** a) Simple eutectic b) Compound formation **III. Critical solution temperature (CST)** Determination of CST of phenol – water system **IV. Potentiometric titrations** (a) HCl Vs NaOH (b) $K_2Cr_2O_7$ Vs $FeSO_4$. **V. Partition Coefficient experiments:** Study of the equilibrium constant for the reaction $KI+I_2 \leftrightarrow KI_3$ By determining the partition Co-efficient of I2 between water an CCl_4 Determination of strength of given KI. **VI. Kinetics:** Determination of relative strength of acids by hydrolysis of ester. **VII. Conductivity:** Determination of cell constant and conductivity titration between as acid and a base (HCl Vs NaOH).	**90**	**Practical**

Course Designed by: **Dr. A. J. Sunija & Dr. V. Ramasamy Raja**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**MAJOR CHEMISTRY PRACTICAL – IV (GRAVIMETRIC ANALYSIS AND ORGANIC PREPARATION)**			
Course Code	**21UCHCP4**	**L**	**P**	**C**
Category	**Core**	-	3	-

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To learn the concept of gravimetric analysis and organic preparation
- To analyze the estimation of lead, calcium, copper and nickel
- To study the organic preparation methods
- To understand the various organic preparation methods
- To interpret the gravimetric analysis and organic preparation

List of Experiments

1. Gravimetric Analysis

1. Estimation of lead as lead chromate
2. Estimation of barium as barium chromate
3. Estimation of calcium as calcium oxalate monohydrate
4. Estimation of copper as cuprous thiocyanate
5. Estimation of nickel as Ni DMG.

2. Organic Preparation

1. Nitration
a. dinitrobenzene from nitrobenzene
b. Picric acid from phenol
2. Bromination: p-bromo acetanilide from acetanilide
3. Hydrolysis : Aromatic acid from (a) an ester (b) an amide
4. Oxidation: Benzoic acid from benzaldehyde.
5. Benzoylation: (a) Amine (b) phenols.
6. Acetylation : (a) Amine (b) phenols

Distribution of Marks (Max.marks – 100)
Duration of examination: 6 hrs
Int: 40

Regular Test in the Class : 30 Marks

Observation note book : 10 Marks

Total : 40 Marks

Record Note Book	- 10 Marks	Viva Voce	- 10 Marks	Ext: 60

Organic preparation (10 Marks)

Procedure	-	2 Marks
Crude sample	-	6 Marks
Recrystallised sample	-	2 Marks

Gravimetric Estimation (30 Marks)

Procedure - 10 Marks
Estimation - 20 Marks
Less than 2 % Error – 20 Marks
2-3% Error – 18 Marks
3-4% Error – 16 Marks
4-5% Error – 14 Marks
Greater than 5% Error – 8 Marks

	Total Lecture Hours	**45 Hrs**

Books for Reference:

1. Thomas. A.O and Mani, Textbook of Practical Chemistry, 4th Revised Edition, Scientific Publication, 1976.
2. N.S. Gnana pragasam and G. Ramamurthy, Organic Chemistry Lab Manual, Viswanath. S. Printers & Publishers Pvt. Ltd., 2010, Chennai.

Web Resources:

1. https://youtu.be/tftNgFVAWCY
2. https://youtu.be/npxbO-pzUvU
3. https://youtu.be/peMyqdJ57dA

Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Relate and classify between gravimetric analysis and organic preparation	**[Up to K2]**
CO2:	Estimate lead, barium, calcium, copper and nickel.	**[Up to K3]**
CO3:	Analyze the various types of organic preparation.	**[Up to K3]**
CO4:	Interpret the organic preparation like nitration, bromination, hydrolysis, oxidation, benzoylation and acetylation.	**[Up to K4]**
CO5:	Assemble the analyzed and prepared organic compounds samples.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	1	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	2	3	1	3	2	1
Weightage	11	10	9	11	9	11

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	List of Experiments	Hrs	Mode
I	**1. Gravimetric Analysis** 1. Estimation of lead as lead chromate 2. Estimation of barium as barium chromate 3. Estimation of calcium as calcium oxalate monohydrate 4. Estimation of copper as cuprous thiocyanate 5. Estimation of nickel as Ni DMG. **2. Organic Preparation** 1. Nitration a. M-dinitrobenzene from nitrobenzene b. Picric acid from phenol 2. Bromination: p-bromo acetanilide from acetanilide 3. Hydrolysis : Aromatic acid from (a) an ester (b) an amide 4. Oxidation: Benzoic acid from benzaldehyde. 5. Benzoylation: (a) Amine (b) phenols. 6. Acetylation : (a) Amine (b) phenols	**45**	**Practical**

Course Designed by: **Dr. K. Muthupandi & Dr. V. Ramasamy Raja**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**MAJOR CHEMISTRY PRACTICAL – V (ORGANIC ANALYSIS AND ESTIMATION)**			
Course Code	**21UCHCP5**	**L**	**P**	**C**
Category	**Core**	-	3	-

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To learn the analysis of an organic compound containing one or two functional groups.
- To analyze the concept of confirmation of the prepared one or two functional organic compounds
- To study estimation of phenol, aniline and glucose
- To understand the various functional groups of organic compounds
- To interpret organic analysis and estimation of organic compounds

List of Experiments

I. Organic Analysis

Analysis of an organic compound containing one or two functional groups and confirmation by the preparation of a solid derivative – acids, phenols, aldehydes, ketone, esters, nitro compounds, amines (primary, secondary and tertiary), aniline, aliphatic diamide, side chain and nuclear halogen compounds, diamide containing sulphur and monosaccharide.

II. ORGANIC ESTIMATION

1. Estimation of phenol
2. Estimation of aniline
3. Estimation of glucose

Distribution of Marks (Max. marks – 100)

Duration of examination: 6 hrs

Regular Test in the Class : 30 Marks
Observation note book : 10 Marks

Total : 40 Marks

Organic estimation (30 Marks)

Record Note - 10 marks
Procedure - 5 marks
Estimation - 15 marks
Less than 3% Error – 15 Marks
3-4% Error – 13 Marks

Organic analysis (30 Marks)

Viva Voce – 10 marks
Preliminary reaction - 2 marks
Elements present - 4 marks
Aliphatic or aromatic - 3 marks
Saturated / Unsaturated - 3 marks

4-5% Error – 10 Marks	Functional group - 6 marks
Greater than 5% - 8 Marks	Derivative - 2 marks

	Total Lecture Hours	**45 Hrs**

Books for Reference:

3. Thomas. A.O and Mani, Textbook of Practical Chemistry, 4th Revised Edition, Scientific Publication, 1976.
4. N.S. Gnana pragasam and G. Ramamurthy, Organic Chemistry Lab Manual, Viswanath. S. Printers & Publishers Pvt. Ltd., 2010, Chennai.

Web Resources:

1. https://youtu.be/1uJk4K_irP8
2. https://youtu.be/xQJOfAKgSOY
3. https://youtu.be/xMjJxjhJWj4

Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Relate and classify between organic analysis and estimation of organic compounds	**[Up to K2]**
CO2:	Estimate the phenol, aniline and glucose	**[Up to K3]**
CO3:	Analyze the one or two functional groups of organic compounds	**[Up to K3]**
CO4:	Interpret the organic analysis and estimation of organic compounds	**[Up to K4]**
CO5:	Distinguish between analysis and estimation of one or two functional groups of organic compounds	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**11**	**10**	**9**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	List of Experiments	Hrs	Mode
I	**I. Organic Analysis** Analysis of an organic compound containing one or two functional groups and confirmation by the preparation of a solid derivative – acids, phenols, aldehydes, ketone, esters, nitro compounds, amines (primary, secondary and tertiary), aniline, aliphatic diamide, side chain and nuclear halogen compounds, diamide containing sulphur and monosaccharide. **II. ORGANIC ESTIMATION** 1. Estimation of phenol 2. Estimation of aniline 3. Estimation of glucose	**45**	**Practical**

Course Designed by: **Dr. V. Ramasamy Raja & Dr. K. Muthupandi**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**ANALYTICAL CHEMISTRY**			
Course Code	**21UCHE51**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the principle involved in the gravimetric analysis.
- To Remember the methods of precipitation and classification of errors.
- To Analysis the instrumental methods and its principles and applications.
- To Know the photocatalytic reactor and photocatalytic calorimeter.
- To Analyze theory of chromatographic technique and applications.

Unit: I	**PRINCIPLES OF GRAVIMETRIC ANALYSIS**	15

Introduction to gravimetric analysis - precipitation methods - conditions for precipitation - supersaturation and precipitate formation - the purity of the precipitate: co-precipitation - post precipitation - solubility product and precipitation - precipitation from homogeneous solution - washing of the precipitate - organic precipitants: dimethylglyoxime, cupferron, oxine and cupron.

Unit: II	**ERROR ANALYSIS**	15

Classification of errors - determinate errors (systematic errors) and indeterminate (random and accidental) - minimization of errors: calibration of apparatus, analysis of standard samples, running a blank determination and independent analysis - absolute and relative error - types of errors - correction of determinate errors and indeterminate errors - precision and accuracy: definition and difference - calculation of mean - median and standard deviation - F-test, t- test and Q-test - confidence limit - method of least squares - significant figures - rounding off the values.

Unit: III	**THERMO ANALYTICAL AND ELECTRO ANALYTICAL METHODS**	15

Thermo Analytical Methods: Thermogravimetric analysis (TGA): principle - thermal analysis – derivative thermo gravimetry (DTG) - factors affecting thermogram - TGA instrument - applications of thermo gravimetry - differential thermal analysis (DTA), DTA instrument- DTA of calcium oxalate monohydrate. **Electro Analytical Methods**: Electrogravimetry - electrolytic separation of metals - polarography - principles and applications - amperometric titrations - principles and applications.

Unit: IV	**INSTRUMENTAL METHODS OF ANALYSIS**	15

Principle, instrumentation and applications of fluorimetry - nephelometry - flame photometry - atomic absorption spectrophotometry - photocatalytic reactor and photoelectric colorimeter.

Unit: V	**CHROMATOGRAPHY**	15

History, Classification, definition of terms, principles, basic theory of chromatographic technique and sample handling. Band broadening and column efficiency: Definition, plate theory and rate theory of chromatographic technique, their limitation and applications. Basic principles of common types of Chromatography – Column Chromatography – Thin layer Chromatography – Paper Chromatography – Ion exchange Chromatography – Applications of each technique.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. R. Gopalan, P.S. Subramanian, K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand

& sons, 3rd edition 2004.
2. S.M.Khopkar, Basic concepts of Analytical Chemistry, Wiley Eastern Ltd.
3. A.I Vogel, A Text book of Qualitative Inorganic Analysis, ELBS 4th edition, 2002,
4. V.K. Srivastava, K.K. Srivastava, Introduction to Chromatography, S. Chand and Company Ltd., 3rd edition,1985.

Books for References:

2. P.L. Soni, M. Katyal, Test book of Inorganic Chemistry, Sultan Chand and Sons, Reprint, 2015
3. Chatwal Anand, Instrumental methods of chemical analysis, Himalaya Publishing House, 5th edition, 2005

Web Resources:

1. https://youtu.be/KHpRNb_38OM
2. https://youtu.be/lB3Uni2gRkA
3. https://youtu.be/NzbDEjI8IKE
4. https://youtu.be/ck0qEruFy_o

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Ability to understand the concept of chromatography	[Up to K2]
CO2:	Discuss the interplanar spacing and principles of gravimetric analysis	[Up to K3]
CO3:	Interpret the methods of obtaining precipitate and types of errors	[Up to K3]
CO4:	Examine the experimental analysis of methods	[Up to K4]
CO5:	Analyze the chromatographic technique and applications	[Up to K4]

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	1	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	1	3	2	3	2	1
Weightage	10	10	10	11	9	11

***3** – Advanced Application; **2** – Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**PRINCIPLES OF GRAVIMETRIC ANALYSIS** Introduction to gravimetric analysis - precipitation methods - conditions for precipitation - supersaturation and precipitate formation - the purity of the precipitate: co-precipitation - post precipitation - solubility product and precipitation - precipitation from homogeneous solution - washing of the precipitate - organic precipitants: dimethylglyoxime, cupferron, oxine and cupron.	15	Chalk, Talk & Power point
II	**ERROR ANALYSIS** Classification of errors - determinate errors (systematic errors) and indeterminate (random and accidental) - minimization of errors: calibration of apparatus, analysis of standard samples, running a blank determination and independent analysis - absolute and relative error - types of errors - correction of determinate errors and indeterminate errors - precision and accuracy: definition and difference - calculation of mean - median and standard deviation - F-test, t- test and Q-test - confidence limit - method of least squares - significant figures - rounding off the values.	15	Chalk, Talk & Power point
III	**THERMO ANALYTICAL AND ELECTRO ANALYTICAL METHODS** **Thermo Analytical Methods**: Thermogravimetric analysis (TGA): principle - thermal analysis – derivative thermo gravimetry (DTG) - factors affecting thermogram - TGA instrument - applications of thermo gravimetry - differential thermal analysis (DTA), DTA instrument- DTA of calcium oxalate monohydrate. **Electro Analytical Methods**: Electrogravimetry - electrolytic separation of metals - polarography - principles and applications - amperometric titrations - principles and applications.	15	Chalk, Talk & Power point
IV	**INSTRUMENTAL METHODS OF ANALYSIS** Principle, instrumentation and applications of fluorimetry - nephelometry - flame photometry - atomic absorption spectrophotometry - photocatalytic reactor and photoelectric	15	Chalk, Talk & Power point

	colorimeter.		
V	**CHROMATOGRAPHY** History, Classification, definition of terms, principles, basic theory of chromatographic technique and sample handling. Band broadening and column efficiency: Definition, plate theory and rate theory of chromatographic technique, their limitation and applications. Basic principles of common types of Chromatography – Column Chromatography – Thin layer Chromatography – Paper Chromatography – Ion exchange Chromatography – Applications of each technique.	**15**	**Chalk, Talk & Power point**

Course Designed by: **Dr. V. Ramasamy Raja & Dr. R. Satheesh**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K – Level	No. of. Questions	K - Level		
CI AI	CO1	Up to K2	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO2	Up to K3	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	CO3	Up to K3	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO4	Up to K4	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S. No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**SUPRAMOLECULAR CHEMISTRY**							
Course Code	**21UCHE53**					**L**	**P**	**C**
Category	**CORE ELECTIVE**					5	-	5
Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**			✓

Course Objectives:

- To Recall the selectivity, kinetic and thermodynamic concepts
- To Remember the ionic and dipole – dipole interactions and hydrogen bonding
- To Compare the host – guest method and cation binding
- To Analyze the anion and neutral binding and hydrogen binding interactions
- To Determine the structure of zeolite and properties of coordination polymers

Unit: I	**INTRODUCTION TO SUPRAMOLECULAR CHEMISTRY**	15

Introduction - selectivity - the lock and key principle and induced-fit model - complementarity - co-operativity and the chelate effect - preorganisation - binding constants - kinetic and thermodynamic selectivity.

Unit: II	**SUPRAMOLECULAR INTERACTIONS**	15

Supramolecular interactions: ionic and dipolar interactions - hydrogen bonding - π-interactions - van der waals interactions - hydrophobic effects - supramolecular design.

Unit: III	**HOST - GUEST CHEMISTRY AND CATION BINDING**	15

Host – Guest Chemistry: Introduction - guests in solution - macrocyclic versus acyclic hosts - high dilution synthesis - template synthesis. **Cation Binding**: Introduction, crown ethers, lariat ethers and cryptands - spherands - hemispherands - cryptaspherands - heterocrowns - heterocryptands – calixarenes.

Unit: IV	**ANION AND NEUTRAL BINDINGS**	15

Anion binding: charged receptaors, electrostatic interactions, electrostatic, hydrogen binding interactions, neutral receptors, Lewis-acid receptors and anticrowns - metal containing receptors - simultaneous cation and anion receptors - neutral binding.

Unit: V	**SOLID STATE SUPRAMOLECULAR CHEMISTRY**	15

Introduction - zeolites: structure, composition, zeolites and catalysis - clathrates - urea/thiourea clathrates - trimesic acid clathrates - hydroquinone and Dianin‟s compound - coordination polymers: metal organic frameworks and properties of coordination polymers.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Jonathan W. Steed, David R. Turner and Karl J. Wallace, Core Concepts in Supramolecular Chemistry and Nanochemistry, Johny Wiley & Sons, Ltd., 2007,

Books for References:

1. Katsuhiko Ariga, Toyoki Kunitake, Supramolecular Chemistry – Fundamentals and Applications, Advanced Textbook, Original Japanese edition published by Iwanami Shoten Publishers, Tokyo, https://doi.org/10.1007/b137036, Springer-Verlag Berlin Heidelberg 2006

Web Resources:

1. **https://youtu.be/dsJzRxnz2Qg**
2. **https://youtu.be/YbeRLkhYZM0**

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Ability to understand the ionic and dipole – dipole interactions and hydrogen bonding	**[Up to K2]**
CO2:	Discuss the host – guest method and cation binding	**[Up to K3]**
CO3:	Interpret the anion and neutral binding and hydrogen binding interactions	**[Up to K3]**
CO4:	Examine the structure of zeolite and properties of coordination polymers	**[Up to K4]**
CO5:	Distinguish between selectivity, kinetic and thermodynamic concepts	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**INTRODUCTION TO SUPRAMOLECULAR CHEMISTRY** Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions. Analysis of petroleum products. Analysis of traces of petroleum products in forensic exhibits. Comparison of petroleum products. Adulteration of petroleum products.	15	Chalk, Talk & Power point
II	**SUPRAMOLECULAR INTERACTIONS** Supramolecular interactions: ionic and dipolar interactions - hydrogen bonding - π-interactions - van der waals interactions - hydrophobic effects - supramolecular design.	15	Chalk, Talk & Power point
III	**HOST – GUEST CHEMISTRY AND CATION BINDING** Host – Guest Chemistry: Introduction - guests in solution - macrocyclic versus acyclic hosts - high dilution synthesis - template synthesis. Cation Binding: Introduction, crown ethers, lariat ethers and cryptands - spherands - hemispherands - cryptaspherands - heterocrowns - heterocryptands – calixarenes.	15	Chalk, Talk & Power point
IV	**ANION AND NEUTRAL BINDINGS** Anion binding: charged receptaors, electrostatic interactions, electrostatic, hydrogen binding interactions, neutral receptors, Lewis-acid receptors and anticrowns - metal containing receptors - simultaneous cation and anion receptors - neutral binding.	15	Chalk, Talk & Power point
V	**SOILD STATE SUPRAMOLECULAR CHEMISTRY** Introduction - zeolites: structure, composition, zeolites and catalysis - clathrates - urea/thiourea clathrates - trimesic acid clathrates - hydroquinone and Dianin‟s compound - coordination polymers: metal organic frameworks and properties of coordination polymers.	15	Chalk, Talk & Power point

Course Designed by: **Dr. A. J. Sunija & Dr. R. Satheesh**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K – Level	No. of. Questions	K - Level		
CI AI	CO1	Up to K2	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO2	Up to K3	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	CO3	Up to K3	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO4	Up to K4	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	8	
	K2	2	4	10	10	26	52	60
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2	-	-	4	8	
	K2	2	4	10	10	26	52	60
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S. No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**BIOINORGANIC CHEMISTRY**			
Course Code	**21UCHE54**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5
Nature of course:	**EMPLOYABILITY** ✓	**SKILL ORIENTED** ✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Identify the fundamentals of biomolecules and metals in biological systems and generalize their structures
- To Remember the structures of myoglobin & hemoglobin, copper & nitrogen enzymes.
- To Compare the behavior of dioxygen bound to metals and role of metals in medicine
- To Perform the structure of the active site in myoglobin & hemoglobin
- To Determine the metals containing proteins and enzymes and metal toxicity

Unit: I	**METALS IN BIOLOGY**	15

Introduction – Essential Chemical Elements – Metals in Biological Systems – Biological Metal Ion Complexation – Electronic and Geometric Structures of Metals –Metals in Biological Systems – Metals containing proteins and enzymes.

Unit: II	**FUNDAMENTALS OF BIOMOLECULES**	15

Proteins – Amino Acid Building Blocks – Protein Structure – Protein Sequencing and Proteomics – Protein Function, Enzymes, Classification of enzymes – Enzyme Kinetics – Enzyme Inhibition.

Unit: III	**MYOGLOBIN AND HEMOGLOBIN**	15

Myoglobin and Hemoglobin: Structure of the Prosthetic Group – Mechanism for Reversible Binding of Dioxygen and Cooperativity of Oxygen Binding – Behavior of Dioxygen Bound to Metals – Structure of the Active Site in Myoglobin and Hemoglobin – Binding of CO to Myoglobin, Hemoglobin.

Unit: IV	**COPPER AND NITROGEN ENZYMES**	15

Copper Enzymes: Occurrence – Structure – Function – Discussion of Specific Enzymes: Superoxide Dismutase – Hemocyanin. Enzyme Nitrogenase: Iron–Sulfur Clusters – Fe–Protein Structure – Detailed Mechanistic Studies.

Unit: V	**ROLE OF METALS IN MEDICINE**	15

Inorganic Medicinal Chemistry - Metal Toxicity and Homeostasis – Anti-cancer agents: Cisplatin and related compounds - Chelation therapy – Cancer treatment – Anti-arthritis drugs – Gadolinium MRI Imaging Agents.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Hussain Reddy. K, Bioinorganic Chemistry, New Age International, 2003, New Delhi.
2. Malik. W.U, Tuli. G.D, Madan. R.D, Selected topics in Inorganic Chemistry, 7th Edition, S. Chand & Co., 2003, New Delhi.

Books for References:

1. Rosette M. Roat Malone, Bioinorganic Chemistry: A short course, Wiley – Interscience, John Wiley & Sons, Inc., 2002.
2. Miessler. G.L and Donald A. Tarr, Inorganic Chemistry, Pearson Publication, 2002.

3. James E. Huheey, Ellen Keiter and Richard Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication, 1993.
4. Lippard. S.T and Berg. T.M, Principles of Bioinorganic Chemistry, Panima Publishing Co., 1997, New York.

Web Resources:

1. https://youtu.be/pXztk04J7u0
2. https://youtu.be/eayeaUT5fus
3. https://youtu.be/6TVI_cjBeOs
4. https://youtu.be/2Xq-x1c8PZg

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Identify the fundamentals of biomolecules in biological systems and their structures	**[Up to K2]**
CO2:	Remember the structures of myoglobin & hemoglobin, copper & nitrogen enzymes.	**[Up to K3]**
CO3:	Compare the behavior of dioxygen bound to metals and role of metals in medicine	**[Up to K3]**
CO4:	Perform the structure of the active site in myoglobin & hemoglobin	**[Up to K4]**
CO5:	Determine the metals containing proteins and enzymes and metal toxicity	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**METALS IN BIOLOGY** Introduction – Essential Chemical Elements – Metals in Biological Systems – Biological Metal Ion Complexation – Electronic and Geometric Structures of Metals –Metals in Biological Systems – Metals containing proteins and enzymes.	15	Chalk, Talk & Power point
II	**FUNDAMENTALS OF BIOMOLECULES** Proteins – Amino Acid Building Blocks – Protein Structure – Protein Sequencing and Proteomics – Protein Function, Enzymes, Classification of enzymes – Enzyme Kinetics – Enzyme Inhibition.	15	Chalk, Talk & Power point
III	**MYOGLOBIN AND HEMOGLOBIN** Myoglobin and Hemoglobin: Structure of the Prosthetic Group – Mechanism for Reversible Binding of Dioxygen and Cooperativity of Oxygen Binding – Behavior of Dioxygen Bound to Metals – Structure of the Active Site in Myoglobin and Hemoglobin – Binding of CO to Myoglobin, Hemoglobin.	15	Chalk, Talk & Power point
IV	**COPPER AND NITROGEN ENZYMES** Copper Enzymes: Occurrence – Structure – Function – Discussion of Specific Enzymes: Superoxide Dismutase – Hemocyanin. Enzyme Nitrogenase: Iron–Sulfur Clusters – Fe–Protein Structure – Detailed Mechanistic Studies.	15	Chalk, Talk & Power point
V	**ROLE OF METALS IN MEDICINE** Inorganic Medicinal Chemistry - Metal Toxicity and Homeostasis – Anti-cancer agents: Cisplatin and related compounds - Chelation therapy – Cancer treatment – Anti-arthritis drugs – Gadolinium MRI Imaging Agents.	15	Chalk, Talk & Power point

Course Designed by: **Dr. R. Satheesh & Dr. V. Ramasamy Raja**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Up to K2**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1 & K2**	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	**CO3**	**Up to K3**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1 & K2**	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**8**	**60**
	K2	**2**	**4**	**10**	**10**	**26**	**52**	
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**8**	**60**
	K2	**2**	**4**	**10**	**10**	**26**	**52**	
	K3	**-**	**-**	**10**	**-**	**10**	**20**	**20**
	K4	**-**	**-**	**-**	**10**	**10**	**20**	**20**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S. No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
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Course Name	**CHEMISTRY IN CRIME INVESTIGATION**			
Course Code	**21UCHE55**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5
Nature of course:	**EMPLOYABILITY** ✓	**SKILL ORIENTED** ✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the concept of forensic science and criminology studies
- To Remember the finger prints and classification and uses of finger prints
- To Compare the concepts of arsons, explosives and ballistics
- To Perform the biological substances in the dead clinic symptom
- To Analyze the crime through network documents

Unit: I	**CRIMINOLOGY AND FORENSIC SCIENCE**	15

Criminology – definition - nature and scope - types of crimes penology - Indian penal code - Indian evidence act - Indian criminal procedure code. Forensic science – definition - principles and uses in crime investigation.

Unit: II	**FINGER PRINTS & TRACKS-TRACES**	15

Finger prints – patterns – classification - uses of finger print in crime investigation - direct and latent prints - development by powders - other methods of development - transfer methods of finger prints. Tracks – Traces - Foot prints - casting of foot prints - residue prints - walking pattern - tire marks - miscellaneous traces & tracks - glass fracture - tool marks – paints – fibres.

Unit: III	**BIOLOGICAL SUBSTANCES AND POISONS**	15

Blood – semen – saliva – sweat – urine – hair – skin - DNA analysis. Poisons - types and classification-diagonosis of poisoning in the living and in the dead - clinical symptom - post-mortem appearances - treatment in cases of poisoning - antidotes.

Unit: IV	**ARSONS, EXPLOSIVES AND BALLISTICS**	15

Natural fires and arson - nature of action of fire - drifts and air supply - burning characteristics. Explosives – definition – classification - compostion and mechanism of explosion - bombs. Ballistics – classification - internal, external and terminal ballistics - small arms -classification and characteristics - laboratory examination of barrel washing and detection of powder residues by chemical tests.

Unit: V	**CYBER CRIMES AND DOCUMENTS**	15

Cyber crimes - crime through network Documents - Chemistry of paper and ink - writing paper - carbon paper – chalk – adhesives - sealing waxes - different types of forged signatures - simulated and traced forgeries -inherent signs of forgery models - writing of forged models - writing deliberately modified - use of ultraviolet rays - comparison of type written letters - counterfeit of currency and coins.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Saferstein, R., Criminalities and introduction to Forensic Science, Prentice Hall of India.1978

Books for References:

1. James, T.H., Forensic Science.1987

Web Resources:

1. https://youtu.be/Wtwx_uOgOUc 2. https://youtu.be/StcLHDM3Vng		
Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Ability to understand the concept of forensic science	**[Up to K2]**
CO2:	Discuss the criminological studies through finger prints	**[Up to K3]**
CO3:	Interpret the classification of finger print and biological substances	**[Up to K3]**
CO4:	Examine the relationship between arsons, explosives and ballistics	**[Up to K4]**
CO5:	Analyze the cyber crime through network documents	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**CRIMINOLOGY AND FORENSIC SCIENCE** Criminology – definition - nature and scope - types of crimes penology - Indian penal code - Indian evidence act - Indian criminal procedure code. Forensic science – definition - principles and uses in crime investigation.	**15**	**Chalk, Talk & Power point**
II	**FINGER PRINTS & TRACKS – TRACES** Finger prints – patterns – classification - uses of finger print in crime investigation - direct and latent prints - development by powders - other methods of development - transfer methods of finger prints. Tracks – Traces - Foot prints - casting of foot prints - residue prints - walking pattern - tire marks - miscellaneous traces & tracks - glass fracture - tool marks – paints – fibres.	**15**	**Chalk, Talk & Power point**
III	**BIOLOGICAL SUBSTANCES AND POISONS**	**15**	**Chalk, Talk &**

	Blood – semen – saliva – sweat – urine – hair – skin - DNA analysis. Poisons - types and classification-diagonosis of poisoning in the living and in the dead - clinical symptom - post-mortem appearances - treatment in cases of poisoning - antidotes.		**Power point**
IV	**ARSONS, EXPLOSIVES AND BALLISTICS** Natural fires and arson - nature of action of fire - drifts and air supply - burning characteristics. Explosives – definition – classification - compostion and mechanism of explosion - bombs. Ballistics – classification - internal, external and terminal ballistics - small arms - classification and characteristics - laboratory examination of barrel washing and detection of powder residues by chemical tests.	**15**	**Chalk, Talk & Power point**
V	**CYBER CRIMES AND DOCUMENTS** Cyber crimes - crime through network Documents - Chemistry of paper and ink - writing paper - carbon paper – chalk – adhesives - sealing waxes - different types of forged signatures - simulated and traced forgeries -inherent signs of forgery models - writing of forged models - writing deliberately modified - use of ultraviolet rays - comparison of type written letters - counterfeit of currency and coins.	**15**	**Chalk, Talk & Power point**

Course Designed by: **Dr. K. Muthupandi & Dr. R. Satheesh**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K – Level	No. of. Questions	K - Level		
CI AI	CO1	Up to K2	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO2	Up to K3	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	CO3	Up to K3	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO4	Up to K4	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S. No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q. No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q. No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q. No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**FOOD PROCESSING CHEMISTRY**			
Course Code	**21UCHE56**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the raw materials in food processing and its properties
- To Remember the properties and deterioration reaction in fruits and vegetables
- To Compare small scale food processing and nutritional changes
- To Perform the chemistry of sweeteners, legal aspects of food adulteration
- To Determine the adulterants in food processing

Unit: I	**INTRODUCTION TO FOOD PROCESSING**	15

Introduction- importance of raw materials in food processing-properties of raw material-raw material cleaning and classifications: dry and wet cleaning, peeling, sorting, grading, cutting, seeding, chilling and freezing- elements of food processing: food safety, food quality, convenient foods - unit operation - unit processing - common unit process: pasteurization, sterilization, drying, separation, evaporation, refrigeration, freezing.

Unit: II	**FRUITS AND VEGETABLES PROCESSING**	15

Introduction - properties of fruits and vegetables - Deterioration reactions in fruits and vegetable: changes in enzymes, chemical changes, nutritional quality changes, physical changes, biological changes - raw materials for fruits and vegetables processing.

Unit: III	**SMALL-SCALE FOOD PROCESSING**	15

Processing of cereal and pulses- grain processing: puffing, flaking, milling, doughs and batters, extrusion, baking, frying, porridge-baked products- snack foods processing- manufacture of beverages- coffee processing.

Unit: IV	**FOOD ADDITIVES**	15

Introduction-chemistry of sweeteners: intense sweetuieners, bulk sweeteners - food colours: natural colours, synthetic colours - permitted levels of colourants - list of permitted colourants - flavouring agents-antioxidants: chemistry of antioxidants, type of antioxidants and uses: ascorbic acid, tocoperols, butylated hydroxyanisole (BHA), citric acid, Beta-carotene, lutein - emulisifiers - foodstuff containing emulisifiers - types of emulsions - acidulants: acetic acid, citric acid, lactic acid, malic acid, phoaphoric acid, tartaric acid.

Unit: V	**FOOD ADULTERATION**	15

Introduction - Legal Aspects of food adulteration and prevention - common food adulterants - analysis of various food adulterants: analysis of adulterants in edible oils, ghee, coffee powder, chili powder, turmeric powder, meat and milk - harmful effect of the adulterants. **Food Products**: Wheat and wheat products- classification of wheat - wheat flour - wheat products - milk and milk products - composition of milk - milk grades - some commercial milk products.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Vikas Ahlluwalia, A text book of Food Processing Paragon International Publishers, New Delhi, 2007.

2. A text book of Food Chemistry, Alex V Ramani, MJP Publications, Chennai, 2009.
Books for References:
1. P.J. Fellows, Food Processing Technology. Principles and Practices, Second Edition, Woodland Publishing Ltd, Cambridge, England, 2002. 2. Avantina Sharma, Text Book of Food Science and Technology, International Book, Distributing Co, Lucknow, UP, 2006. 3. Sivasankar, Food Processing and Preservation, Prentice Hall of India Pvt. Ltd., New Delhi. 3rd Printing, 2005. 4. Peter Zeuthen and Leif Bogh-Sorenson, Food Preservation Techniques, Woodland Publishing Ltd., Cambridge, England, 200
Web Resources:
1. https://youtu.be/naauUbo4Ick **2. https://youtu.be/WRYoGiOobqU** **3. https://youtu.be/AMJYn3hgv3o** 4. **https://youtu.be/a4aKLHCLyD8**

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Ability to understand the raw materials in food processing	**[Up to K2]**
CO2:	Discuss the various elements of food processing and properties fruits and vegetables	**[Up to K3]**
CO3:	Interpret the study of small-scale food processing	**[Up to K3]**
CO4:	Examine the legal aspects of food adulteration and prevention	**[Up to K4]**
CO5:	Analyze the food additives, food adulterants in food processing	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**INTRODUCTION TO FOOD PROCESSING** Introduction- importance of raw materials in food processing-properties of raw material-raw material cleaning and classifications: dry and wet cleaning, peeling, sorting, grading, cutting, seeding, chilling and freezing- elements of food processing: food safety, food quality, convenient foods - unit operation - unit processing - common unit process: pasteurization, sterilization, drying, separation, evaporation, refrigeration, freezing.	15	Chalk, Talk & Power point
II	**FRUITS AND VEGETABLES PROCESSING** Introduction - properties of fruits and vegetables - Deterioration reactions in fruits and vegetable: changes in enzymes, chemical changes, nutritional quality changes, physical changes, biological changes - raw materials for fruits and vegetables processing.	15	Chalk, Talk & Power point
III	**SMALL-SCALE FOOD PROCESSING** Processing of cereal and pulses- grain processing: puffing, flaking, milling, doughs and batters, extrusion, baking, frying, porridge-baked products- snack foods processing- manufacture of beverages- coffee processing.	15	Chalk, Talk & Power point
IV	**FOOD ADDITIVES** Introduction-chemistry of sweeteners: intense sweetuieners, bulk sweeteners - food colours: natural colours, synthetic colours - permitted levels of colourants - list of permitted colourants - flavouring agents-antioxidants: chemistry of antioxidants, type of antioxidants and uses: ascorbic acid, tocoperols, butylated hydroxyanisole (BHA), citric acid, Beta-carotene, lutein - emulisifiers - foodstuff containing emulisifiers - types of emulsions - acidulants: acetic acid, citric acid, lactic acid, malic acid, phoaphoric acid, tartaric acid.	15	Chalk, Talk & Power point
V	**FOOD ADULTERATION** Introduction - Legal Aspects of food adulteration and prevention - common food adulterants - analysis of various food adulterants: analysis of adulterants in edible oils, ghee, coffee powder, chili powder, turmeric	15	Chalk, Talk & Power point

	powder, meat and milk - harmful effect of the adulterants. Food Products: Wheat and wheat products- classification of wheat - wheat flour - wheat products - milk and milk products - composition of milk - milk grades - some commercial milk products.		

Course Designed by: **Dr. V. Ramasamy Raja & Dr. K. Muthupandi**

Learning Outcome Based Education & Assessment (LOBE)
Formative Examination - Blue Print
Articulation Mapping – K Levels with Course Outcomes (COs)

Internal	Cos	K Level	Section A MCQs No. of. Questions	Section A MCQs K – Level	Section B Short Answers No. of. Questions	Section B Short Answers K - Level	Section C Either or Choice	Section D Open Choice
CI AI	CO1	Up to K2	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO2	Up to K3	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	CO3	Up to K3	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO4	Up to K4	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II

	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**DRUG CHEMISTRY**			
Course Code	**21UCHS51**	**L**	**P**	**C**
Category	**SKILL**	2	-	2
Nature of course:	**EMPLOYABILITY** ✓ **SKILL ORIENTED** ✓ **ENTREPRENURSHIP** ✓			

Course Objectives:

- To Identify the different systems of medicines and its drug actions
- To Remember the basic of anaesthetics and chemotherapy
- To Interpret the therapeutic function of synthetic drugs
- To Understand about the antibiotics and indole derivatives
- To Determine the various synthetic drugs, gaseous anaesthetics, chemotherapy and its uses

Unit: I	**INTRODUCTION TO THE DIFFERENT SYSTEMS OF MEDICINE**	06

Different systems of medicine: Ayurveda, Siddha, Homeopathy and Allopathy – History of medicinal chemistry – discovery of drugs – Introduction. Analgesics and Antipyretics – Narcotic analgesics – Morphine and derivatives. Total synthetic analgesics pethidine and methadone. Antipyretic analgesics – salicylic acid derivatives, Indole derivatives and p-amino phenol derivatives (Medicinal uses and structure only). Antibiotics – Definition, Penicillin – Tetracycline (Auromycin & Terramycin) –Streptomycin and Chloromycetin – drug action and uses.

Unit: II	**ANAESTHETICS**	06

Gaseous anaesthetics – Vinyl ether – Cyclopropane – Halo hydrocarbons – Chloroform – Haloethane– Trichloro ethylene – Intravenous anaesthetics – Thiopentone – Local anaesthetics – Cocaine and its derivatives. (Therapeutic use only)

Unit: III	**ANTIBIOTICS AND ANTIMALARIALS**	06

Sulpha drugs – Sulphadiazine, prontosil and prontosil-S. Antimalarials – quinine and its derivatives. Arsenical drugs – Salvarsan – 606 – Neosalvarsan.

Unit: IV	**SYNTHETIC DRUGS**	06

Synthetic drugs and its therapeutic function of paracetamol – Aspirin – naproxen – Amoxyllin – ciprofloxacin – Ibuprofen.
Visit to an Industry and submission of Report. For industrial visit / Assignment = 5 marks internal)
Contact District Industrial Centre (DIC for visits)

Unit: V	**HORMONES AND VITAMINS**	06

Definition and Classification Testosterone, Progesterone, Thyroxine, Vitamin C, Structure only (Structural elucidation not necessary)

	Total Lecture Hours	**30 Hrs**

Books for Study:

1. Jayashree Ghosh, A Textbook of Pharmaceutical Chemistry, S. Chand & Co., 1999, New Delhi.

Books for References:

1. Charles R. Craig and Robert E. Stitzel, Modern Pharmacology, 3rd Edition, Little Brown and Co., Boston, 1990.
2. Corwin Hansch, Peter G. Sammer, John B. Taylor and Peter D.K. Kennewell, Comprehensive Medicinal Chemistry, Pergmon Press, Great Britain, 1990.
3. Bertram G. Katzung, Basic and Clinical Pharmocology, Lange Medical Publications, Atos, 1982,

California.		
Web Resources:		
1. https://youtu.be/lUxkcEoGkVg **2. https://youtu.be/pss_sm2zaek** **3. https://youtu.be/Z63xnlDNajE** 4. **https://youtu.be/qaYBUz14B3w**		
Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Ability to know the basic of anaesthetics and chemotherapy	**[Up to K2]**
CO2:	Discuss various synthetic drugs, gaseous anaesthetics, chemotherapy and its uses	**[Up to K3]**
CO3:	Interpret the different systems of medicines and its drug actions	**[Up to K3]**
CO4:	Examine the antibiotics and indole derivatives	**[Up to K4]**
CO5:	Analyze the therapeutic function of synthetic drugs	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**INTRODUCTION TO THE DIFFERENT SYSTEMS OF MEDICINE** Different systems of medicine: Ayurveda, Siddha, Homeopathy and Allopathy – History of medicinal chemistry – discovery of drugs – Introduction. Analgesics and Antipyretics – Narcotic analgesics – Morphine and derivatives. Total synthetic analgesics pethidine and methadone. Antipyretic analgesics – salicylic acid derivatives, Indole derivatives and p-amino phenol derivatives (Medicinal uses and structure only). Antibiotics – Definition, Penicillin – Tetracycline (Auromycin & Terramycin) –Streptomycin and Chloromycetin – drug action and uses.	06	Chalk, Talk & Power point
II	**ANAESTHETICS** Gaseous anaesthetics – Vinyl ether – Cyclopropane – Halo hydrocarbons – Chloroform – Haloethane– Trichloro ethylene – Intravenous anaesthetics – Thiopentone – Local anaesthetics – Cocaine and its derivatives. (Therapeutic use only)	06	Chalk, Talk & Power point
III	**ANTIBIOTICS AND ANTIMALARIALS** Sulpha drugs – Sulphadiazine, prontosil and prontosil-S. Antimalarials – quinine and its derivatives. Arsenical drugs – Salvarsan – 606 – Neosalvarsan.	06	Chalk, Talk & Power point
IV	**SYNTHETIC DRUGS** Synthetic drugs and its therapeutic function of paracetamol – Aspirin – naproxen – Amoxyllin – ciprofloxacin – Ibuprofen. Visit to an Industry and submission of Report. For industrial visit / Assignment = 5 marks internal) Contact District Industrial Centre (DIC for visits)	06	Chalk, Talk & Power point
V	**HORMONES AND VITAMINS** Definition and Classification Testosterone, Progesterone, Thyroxine, Vitamin C, Structure only (Structural elucidation not necessary)	06	Chalk, Talk & Power point

Course Designed by: **Dr. R. Satheesh & Dr. A.J. Sunija**


SIXTH SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**PHYSICAL CHEMISTRY – III**							
Course Code	**21UCHC61**					**L**	**P**	**C**
Category	**Core**					6	-	6
Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED		**ENTREPRENURSHIP**			✓

Course Objectives:

- To Recall the general characteristics of aromatic compounds and reaction mechanisms.
- To Remember the basics of aromatic compounds and polynuclear compounds.
- To Compare the preparation, properties of ortho, para, meta directing and aromatic compounds.
- To Perform the mechanism of reactions and effects of substituents.
- To Determine the various concepts on mechanisms and polynuclear compounds.

Unit: I	**THERMODYNAMICS – I**	18

Definition of thermodynamic terms: system, surroundings – types of systems, intensive and extensive properties – State and path functions and their differentials – Thermodynamic process – Concept of heat and work – Definition of internal energy and enthalpy. Heat capacity – Heat capacities at constant volume and pressure and their relationship – Joule-Thomson effect – Joule-Thomson coefficient and inversion temperature – Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process – Hess's Law of constant heat summation and its applications

Unit: II	**THERMODYNAMICS - II**	18

Need for the second law-different statements of the second law-Carnot cycle and efficiency. Entropy as state function – entropy as a function of pressure and volume – Entropy changes of an ideal gas – physical significances of entropy – Clausius inequality – entropy as criteria of spontaneity and equilibrium. Gibbs function (G) and Helmholts function (H) as thermodynamics quantities – Gibbs-Helmholts equation. Clausius Clapeyron equation-Application of Clausius- Clapeyron equation – Limitations of second law.

Unit: III	**PHOTOCHEMISTRY**	18

Definition of photochemical reactions – comparative study of thermal and photochemical reactions – laws of photochemistry – Lambert and Beer Law – Grothus – Draper law – Stark – Einstein law – quantum efficiency and its determination – Jablonski diagram – Photophysical processes – fluorescence phosphorescene and other deactivating processes. Photochemical processes – kinetics of photochemical reactions (H_2/Br_2 reaction) – Photochemical equilibrium (Dimerisation of anthracene)– flash photolysis – photosensitization- chemiluminescence – bioluminescence.

Unit: IV	**ELECTROCHEMISTRY – I**	18

Conductance-definition and determination of Specific conductance, equivalent conductance and molar conductance – variation of equivalent conductance with dilution – Migration of ions - Kohlrausch's law – Arrhenius theory of electrolyte dissociation and its limitations - Ostwald's dilution law – Debye Huckel-Onsagar's equation for strong electrolytes (elementary treatment only) – Definition of transport number – determination by Hittorfs method – Application of conductivity measurements- determination of solubility products of sparingly soluble salts and conductometric titrations – HCl Vs NaOH, CH_3COOH Vs NaOH.

Unit: V	**ELECTROCHEMISTRY – II**	18

a) Single electrode potential, sign convention, Reversible and irreversible cells, conditions for a cell to be a reversible and irreversible – Nernst Equation – measurement of Emf (Poggendorff's method) types of electrodes – reference electrode (SHE, Calomel electrode, Ag-AgCl electrode) Potentiometric titrations – HCl Vs NaOH and $K_2Cr_2O_7$ Vs $FeSO_4$. b) Commercial cells: Primary and secondary batteries – dry cell – lead storage cell – fuel cell – Hydrogen-Oxygen fuel cell	
Total Lecture Hours	**90 Hrs**

Books for Study:

2. B.R. Puri, L.R. Sharma and S. Pathania, Principles of Physical Chemistry, 47th Edition, Shoban Lal Nagin Chand & Co., 2017.

Books for References:

6. Gilbert W. Castellan, Physical Chemistry, 3rd Edition, Narosa Publishing House, 1985.
7. S. Glasstone, Textbook of Physical Chemistry, McMillan and Co., London, 1974.
8. P.L. Soni and Dharmarha, Textbook of Physical Chemistry, S. Chand & Co., New Delhi, 1991.
9. Arun Bahl, B.S. Bahl and G.D. Tuli, Essentials of Physical Chemistry, S. Chand & Co., New Delhi, 2014.
10. S.K. Dogra and S. Dogra, Physical Chemistry through Problems, 4th Edition, New Age International, New Delhi 1996.

Web Resources:

1. https://youtu.be/hEZeQ_HSnOU
2. https://youtu.be/fHfv41HmIK0
3. https://youtu.be/BECSYfYhJGk
4. https://youtu.be/fM8hwkW8bIw
5. https://youtu.be/tJj-ilJTo6Y
6. https://youtu.be/uHoKGy704jk
7. https://youtu.be/4swtYzEbl64
8. https://youtu.be/q9c3-8CE_ro

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	To acquire elaborate the basic knowledge in thermodynamics.	**[Up to K2]**
CO2:	To get more knowledge second law of thermodynamics, entropy.	**[Up to K3]**
CO3:	To learn about the photochemical reactions and photochemical processes.	**[Up to K3]**
CO4:	To determine the concept of conductance and conductometric titrations.	**[Up to K4]**
CO5:	To analysis the basic knowledge in electrodes, electrode potentials and potentiometric titrations	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**THERMODYNAMICS – I** Definition of thermodynamic terms: system, surroundings – types of systems, intensive and extensive properties – State and path functions and their differentials – Thermodynamic process – Concept of heat and work – Definition of internal energy and enthalpy. Heat capacity – Heat capacities at constant volume and pressure and their relationship – Joule-Thomson effect – Joule-Thomson coefficient and inversion temperature – Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process – Hess's Law of constant heat summation and its applications	18	Chalk, Talk & Power point
II	**THERMODYNAMICS – II** Need for the second law-different statements of the second law-Carnot cycle and efficiency. Entropy as state function – entropy as a function of pressure and volume – Entropy changes of an ideal gas – physical significances of entropy – Clausius inequality – entropy as criteria of spontaneity and equilibrium. Gibbs function (G) and Helmholts function (H) as thermodynamics quantities – Gibbs-Helmholts equation. Clausius Clapeyron equation- Application of Clausius- Clapeyron equation – Limitations of second law.	18	Chalk, Talk & Power point
III	**PHOTOCHEMISTRY** Definition of photochemical reactions – comparative study of thermal and photochemical reactions – laws of photochemistry – Lambert and Beer Law – Grothus – Draper law – Stark – Einstein law – quantum efficiency and its determination – Jablonski diagram – Photophysical processes – fluorescence phosphorescene and other deactivating processes. Photochemical processes – kinetics of photochemical reactions (H_2/Br_2 reaction) – Photochemical equilibrium (Dimerisation of anthracene)– flash photolysis – photosensitization-chemiluminescence – bioluminescence.	18	Chalk, Talk & Power point
IV	**ELECTROCHEMISTRY – I** Conductance-definition and determination of Specific conductance,	18	Chalk, Talk & Power

	equivalent conductance and molar conductance – variation of equivalent conductance with dilution – Migration of ions - Kohlrausch's law – Arrhenius theory of electrolyte dissociation and its limitations - Ostwald's dilution law – Debye Huckel-Onsagar's equation for strong electrolytes (elementary treatment only) – Definition of transport number – determination by Hittorfs method – Application of conductivity measurements- determination of solubility products of sparingly soluble salts and conductometric titrations – HCl Vs NaOH, CH3COOH Vs NaOH.		**point**
V	**ELECTROCHEMISTRY – II** a) Single electrode potential, sign convention, Reversible and irreversible cells, conditions for a cell to be a reversible and irreversible – Nernst Equation – measurement of Emf (Poggendorff's method) types of electrodes – reference electrode (SHE, Calomel electrode, Ag-AgCl electrode) Potentiometric titrations – HCl Vs NaOH and $K_2Cr_2O_7$ Vs $FeSO_4$. b) Commercial cells: Primary and secondary batteries – dry cell – lead storage cell – fuel cell – Hydrogen-Oxygen fuel cell	**18**	**Chalk, Talk & Power point**

Course Designed by: **Dr. R. Satheesh & Dr. A.J. Sunija**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CIA I	**CO1**	**Up to K2**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1 & K2**	2	K2	2 (K3&K3)	2(K2 & K3)
CIA II	**CO3**	**Up to K3**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1 & K2**	2	K2	2 (K3&K3)	2(K3 &K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	3
		No. of Questions to be answered	4		3		2	2
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	20

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**67**
	K2	**2**	**4**	**10**	**20**	**36**	**60**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**6.67**	**50**
	K2	**2**	**4**	**10**	**10**	**26**	**43.33**	
	K3	**-**	**-**	**10**	**10**	**20**	**33.33**	**33**
	K4	**-**	**-**	**-**	**10**	**10**	**16.67**	**17**
	Marks	**4**	**6**	**20**	**30**	**60**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	Cos	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K 2	2	K1, K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Upto K 3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K 3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K 4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**MAJOR CHEMISTRY PRACTICAL – IV (GRAVIMETRIC ANALYSIS AND ORGANIC PREPARATION)**			
Course Code	**21UCHCP4**	**L**	**P**	**C**
Category	**Core**	-	3	5

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To learn the concept of gravimetric analysis and organic preparation
- To analyze the estimation of lead, calcium, copper and nickel
- To study the organic preparation methods
- To understand the various organic preparation methods
- To interpret the gravimetric analysis and organic preparation

List of Experiments

1. Gravimetric Analysis

1. Estimation of lead as lead chromate
2. Estimation of barium as barium chromate
3. Estimation of calcium as calcium oxalate monohydrate
4. Estimation of copper as cuprous thiocyanate
5. Estimation of nickel as Ni DMG.

2. Organic Preparation

1. Nitration
   a. M-dinitrobenzene from nitrobenzene
   b. Picric acid from phenol
2. Bromination: p-bromo acetanilide from acetanilide
3. Hydrolysis : Aromatic acid from (a) an ester (b) an amide
4. Oxidation: Benzoic acid from benzaldehyde.
5. Benzoylation: (a) Amine (b) phenols.
6. Acetylation : (a) Amine (b) phenols

Distribution of Marks (Max.marks – 100)
Duration of examination: 6 hrs
Int: 40

Regular Test in the Class : 30 Marks

Observation note book : 10 Marks

Total : 40 Marks

Record Note Book - 10 Marks Viva Voce - 10 Marks Ext: 60

Organic preparation (10 Marks)

Procedure - 2 Marks
Crude sample - 6 Marks
Recrystallised sample - 2 Marks

Gravimetric Estimation (30 Marks)

Procedure - 10 Marks
Estimation - 20 Marks
Less than 2 % Error – 20 Marks
2-3% Error – 18 Marks
3-4% Error – 16 Marks
4-5% Error – 14 Marks
Greater than 5% Error – 8 Marks

	Total Lecture Hours	**45 Hrs**

Books for Reference:

5. Thomas. A.O and Mani, Textbook of Practical Chemistry, 4th Revised Edition, Scientific Publication, 1976.
6. N.S. Gnana pragasam and G. Ramamurthy, Organic Chemistry Lab Manual, Viswanath. S. Printers & Publishers Pvt. Ltd., 2010, Chennai.

Web Resources:

1. https://youtu.be/tftNgFVAWCY
2. https://youtu.be/npxbO-pzUvU
3. https://youtu.be/peMyqdJ57dA

Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Relate and classify between gravimetric analysis and organic preparation	**[Up to K2]**
CO2:	Estimate lead, barium, calcium, copper and nickel.	**[Up to K3]**
CO3:	Analyze the various types of organic preparation.	**[Up to K3]**
CO4:	Interpret the organic preparation like nitration, bromination, hydrolysis, oxidation, benzoylation and acetylation.	**[Up to K4]**
CO5:	Assemble the analyzed and prepared organic compounds samples.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**11**	**10**	**9**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	List of Experiments	Hrs	Mode
I	**1. Gravimetric Analysis** 1. Estimation of lead as lead chromate 2. Estimation of barium as barium chromate 3. Estimation of calcium as calcium oxalate monohydrate 4. Estimation of copper as cuprous thiocyanate 5. Estimation of nickel as Ni DMG. **2. Organic Preparation** 1. Nitration a. M-dinitrobenzene from nitrobenzene b. Picric acid from phenol 2. Bromination: p-bromo acetanilide from acetanilide 3. Hydrolysis : Aromatic acid from (a) an ester (b) an amide 4. Oxidation: Benzoic acid from benzaldehyde. 5. Benzoylation: (a) Amine (b) phenols. 6. Acetylation : (a) Amine (b) phenols	**45**	**Practical**

Course Designed by: **Dr. K. Muthupandi & Dr. V. Ramasamy Raja**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**MAJOR CHEMISTRY PRACTICAL – V (ORGANIC ANALYSIS AND ESTIMATION)**			
Course Code	**21UCHCP5**	**L**	**P**	**C**
Category	**Core**	-	3	5
Nature of course:	**EMPLOYABILITY** ✓	**SKILL ORIENTED** ✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To learn the analysis of an organic compound containing one or two functional groups.
- To analyze the concept of confirmation of the prepared one or two functional organic compounds
- To study estimation of phenol, aniline and glucose
- To understand the various functional groups of organic compounds
- To interpret organic analysis and estimation of organic compounds

List of Experiments

I. Organic Analysis

Analysis of an organic compound containing one or two functional groups and confirmation by the preparation of a solid derivative – acids, phenols, aldehydes, ketone, esters, nitro compounds, amines (primary, secondary and tertiary), aniline, aliphatic diamide, side chain and nuclear halogen compounds, diamide containing sulphur and monosaccharide.

II. ORGANIC ESTIMATION

1. Estimation of phenol
2. Estimation of aniline
3. Estimation of glucose

Distribution of Marks (Max. marks – 100)

Duration of examination: 6 hrs

Regular Test in the Class : 30 Marks
Observation note book : 10 Marks

Total : 40 Marks

Organic estimation (30 Marks)

Record Note - 10 marks
Procedure - 5 marks
Estimation - 15 marks
Less than 3% Error – 15 Marks
3-4% Error – 13 Marks

Organic analysis (30 Marks)

Viva Voce – 10 marks
Preliminary reaction - 2 marks
Elements present - 4 marks
Aliphatic or aromatic - 3 marks
Saturated / Unsaturated - 3 marks

4-5% Error – 10 Marks	Functional group - 6 marks
Greater than 5% - 8 Marks	Derivative - 2 marks

	Total Lecture Hours	**45 Hrs**

Books for Reference:

1. Thomas. A.O and Mani, Textbook of Practical Chemistry, 4th Revised Edition, Scientific Publication, 1976.
2. N.S. Gnana pragasam and G. Ramamurthy, Organic Chemistry Lab Manual, Viswanath. S. Printers & Publishers Pvt. Ltd., 2010, Chennai.

Web Resources:

1. https://youtu.be/1uJk4K_irP8
2. https://youtu.be/xQJOfAKgSOY
3. https://youtu.be/xMjJxjhJWj4

Course Outcomes:		**K Level**
On the completion of the course the student will be able to		
CO1:	Relate and classify between organic analysis and estimation of organic compounds	**[Up to K2]**
CO2:	Estimate the phenol, aniline and glucose	**[Up to K3]**
CO3:	Analyze the one or two functional groups of organic compounds	**[Up to K3]**
CO4:	Interpret the organic analysis and estimation of organic compounds	**[Up to K4]**
CO5:	Distinguish between analysis and estimation of one or two functional groups of organic compounds	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**2**	**1**
Weightage	**11**	**10**	**9**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	List of Experiments	Hrs	Mode
I	**I. Organic Analysis** Analysis of an organic compound containing one or two functional groups and confirmation by the preparation of a solid derivative – acids, phenols, aldehydes, ketone, esters, nitro compounds, amines (primary, secondary and tertiary), aniline, aliphatic diamide, side chain and nuclear halogen compounds, diamide containing sulphur and monosaccharide. **II. ORGANIC ESTIMATION** 1. Estimation of phenol 2. Estimation of aniline 3. Estimation of glucose	**45**	**Practical**

Course Designed by: **Dr. V. Ramasamy Raja & Dr. A.J. Sunija**

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**PROJECT AND VIVA - VOCE**			
Course Code	**21UCHPR1**	**L**	**P**	**C**
Category	**Project**	6	-	4
Nature of course:	**EMPLOYABILITY**	**SKILL ORIENTED**	ENTREPRENURSHIP	

Course Objectives:

To identify, describe the problem and scope of project

- To collect, analyse and present data into significant form using appropriate tools.
- To choose, plan and implement a proper approach in problem solving.
- To work with team and ethically.
- To present the findings in both oral and written form

Course Description

- The Project is conducted by the following Course Pattern.

Internal
Presentation
Submission } 40

External
Project Report
Viva Voce } 60

Total - 100

COURSE OUTCOMES		
On the successful completion of the course , the students will be able to		
CO1:	Apply the skill of presentation and communication techniques	**K3**
CO2:	Motive as an individual or in a team in development of projects.	**K4**
CO3:	Analyze the available resources and to select most appropriate one	**K4**
CO4:	Make use of the fundamentals of Chemistry to search the related literature survey	**K3**
CO5:	Explain the real life problems by using Chemistry and its Application.	**K4**

Course Designed by: Dr. V. Ramasamy Raja, & Dr. A.J. Sunija

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	2	2	1	3
CO 2	1	2	2	1	2	3
CO 3	2	2	2	2	2	1
CO 4	3	2	2	2	1	2
CO 5	3	2	2	1	2	3

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**APPLIED CHEMISTRY**			
Course Code	**21UCHE61**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the water treatment and quality analysis of water
- To Remember the insecticides, pesticides and preparation of chemicals
- To Compare the knowledge of match and silicate industry
- To Perform the elemental study of petrochemicals and lacquer paint
- To Determine the nutrients for plants and know the fertilizer industry in India

Unit: I	**WATER AND SEWAGE TREATMENT**	15

Water Treatment: Water Quality Analysis – Chemical and Physical Analysis of water - Quality Parameters – Standards prescribed for Water Quality by WHO and other Indian standards – Sea Water as a source of Drinking Water – Electro dialysis method and Reverse osmosis method for purifications of water. Sewage Treatment: Municipal Waste Water – Sewage Treatment – Aerobic and Anaerobic process – Miscellaneous Method of Sewage Treatment

Unit: II	**INSECTICIDES, PESTICIDES AND PREPARATION OF CHEMICALS**	15

Insecticides and Pesticides: Definition – Classification – Inorganic pesticides: lead arsenate, Paris green, lime, sulphur, hydrocyanic acid – Organic pesticides, natural, synthetic (DDT, Gammaxene) – Fungicides – repellants.

Unit: III	**MATCH AND SILICATE INDUSTRY**	15

Match Industry: Pyrotechnics and explosives – Raw materials needed for match industry – Manufacturing process – Pyrotechniques – Coloured smokes. Silicate Industry: Cement Glass and Ceramics, Raw materials and manufacture of Cement, Glass and Ceramics.

Unit: IV	**PETROCHEMICALS AND LACQUER PAINT**	15

Petrochemicals: Elementary study – Definition – Origin – Composition – Chemicals from natural gas, Petroleum, Light Naphtha and Kerosene – Synthetic Gasoline. Paints and lacquers: Pigments – Paints – Ingredients in Paints – Manufacture – Lacquers – Varnishes.

Unit: V	**FERTILIZERS**	**15**

Definition – nutrients for plants – role of various elements in plants growth – natural and chemical fertilizers-classification of chemical fertilizers –urea, super phosphate and potassium nitrate-mixed fertilizer-fertilizer industry in India.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Sharma. B.K, Industrial Chemistry including Chemical Engineering, Goel Publishing House – 13th Revised and enlarged Edition, 2009, New Delhi.

Books for References:

1. Srilakshmi. B, Food Science, 3rd Edition, New Age International Pvt. Ltd., Publishers, 2002.
2. Jayashree Ghosh, Fundamental concepts of Applied Chemistry, S. Chand & Co., Publishers, 1998.
3. Thanlamma Jacob, Text Books of Applied Chemistry for Home Science and Allied Sciences,

Macmillan, 2000.		
Web Resources:		
1. https://youtu.be/FY7z9ymxXFQ **2. https://youtu.be/cLZ_PQhOnDY**		
Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Define insecticides, pesticides, petrochemicals and fertilizers and discuss their classification.	**[Up to K2]**
CO2:	Determine water quality, raw materials needed for match and silicate industries.	**[Up to K3]**
CO3:	Distinguish between water and sewage treatment and chemicals used between petrochemicals and paints and lacquers.	**[Up to K3]**
CO4:	Interpret the preparation of domestically useful chemical products.	**[Up to K4]**
CO5:	Integrate the method of sewage treatment and fertilizer industries in India.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**WATER AND SEWAGE TREATMENT** Water Treatment: Water Quality Analysis – Chemical and Physical Analysis of water - Quality Parameters – Standards prescribed for Water Quality by WHO and other Indian standards – Sea Water as a source of Drinking Water – Electro dialysis method and Reverse osmosis method for purifications of water. Sewage Treatment: Municipal Waste Water – Sewage Treatment – Aerobic and Anaerobic process – Miscellaneous Method of Sewage Treatment	15	Chalk, Talk & Power point
II	**INSECTICIDES, PESTICIDES AND PREPARATION OF CHEMICALS** Insecticides and Pesticides: Definition – Classification – Inorganic pesticides: lead arsenate, Paris green, lime, sulphur, hydrocyanic acid – Organic pesticides, natural, synthetic (DDT, Gammaxene) – Fungicides – repellants.	15	Chalk, Talk & Power point
III	**MATCH AND SILICATE INDUSTRY** Match Industry: Pyrotechnics and explosives – Raw materials needed for match industry – Manufacturing process – Pyrotechniques – Coloured smokes. Silicate Industry: Cement Glass and Ceramics, Raw materials and manufacture of Cement, Glass and Ceramics.	15	Chalk, Talk & Power point
IV	**PETROCHEMICALS AND LACQUER PAINT** Petrochemicals: Elementary study – Definition – Origin – Composition – Chemicals from natural gas, Petroleum, Light Naphtha and Kerosene – Synthetic Gasoline. Paints and lacquers: Pigments – Paints – Ingredients in Paints – Manufacture – Lacquers – Varnishes.	15	Chalk, Talk & Power point
V	**FERTILIZERS** Definition – nutrients for plants – role of various elements in plants growth – natural and chemical fertilizers-classification of chemical fertilizers –urea, super phosphate and potassium nitrate-mixed fertilizer-fertilizer industry in India.	15	Chalk, Talk & Power point

Course Designed by: **Dr. V. Ramasamy Raja & Dr. R. Satheesh**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Up to K2**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1 & K2**	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	**CO3**	**Up to K3**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1 & K2**	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**8**	**60**
	K2	**2**	**4**	**10**	**10**	**26**	**52**	
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**8**	**60**
	K2	**2**	**4**	**10**	**10**	**26**	**52**	
	K3	**-**	**-**	**10**	**-**	**10**	**20**	**20**
	K4	**-**	**-**	**-**	**10**	**10**	**20**	**20**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**SOIL AND AGRICULTURE CHEMISTRY**			
Course Code	**21UCHE62**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Realize the volume and composition of soil and its importance on agriculture
- To Remember the properties of soil
- To Discuss the various types of micronutrients needed to the soil
- To Analyze the chemical composition of biofertilizer and soil
- To Formulate the methods of analyzing the soil and applying the fertilizers.

Unit: I	**SOIL COMPONENTS**	15

Definition - volume, composition - uses - mineral soil - chemical ions - soil colloids - importance - nature - properties of inorganic and organic soil colloid - general characteristics - properties and importance - types - silicate clays - silicates - silicon oxygen tetrahedron.

Unit: II	**SOIL SALINITY AND ALKALINITY**	15

Saline and alkaline soil - nature - classification - characteristics - formation of saline and alkaline soil - effects - quality of irrigation water: introduction - criteria - irrigation water resources - water quality - classification of water.

Unit: III	**ANALYSIS OF SOIL**	15

i) Estimation of Ca, Mg, K and nitrate
ii) Analysis of soluble salt.
iii) Analysis of NPK in fertilizer.
iv) Determination of soil pH and electrical conductivity.
v) Estimation of organic matter content of soil.

Unit: IV	**VERMICOMPOSTING**	15

Vermicomposting: Economic implications - materials - preliminary treatment - types of vermicomposting - requirements for vermicomposting. Eco-Friendly Farming System: organic farming - concept – options.

Unit: V	**BIOFERTILIZERS**	15

Biofertilizers: Soil biota in sustainable agriculture - biodiversity - management strategies - comparison of chemical fertilizer and biofertilizer. Methods of applying fertilizers - application of fertilizer in solid form - liquid fertilizer - nitrogenous fertilizer - types - phosphatic fertilizers: forms - classification- potassic fertilizers: Potassium sulphate: production – properties.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Shivanand Tolanur, Soil Chemistry, International Book Distributing Co., 1st edition, 2006. (Unit I and II)
2. P.K.Gupta, A Handbook of Soil, Fertilizer and Manure, Agrobios (India), 2nd edition, 2012. (Unit III and IV)
3. A. K. Mani, R. Santhi and M. Sellamuthu, A Handbook of Laboratory Analysis, AE Publication, Coimbatore, 2007. (Unit V

Books for References:	
1. S. P. Majumdar and R. A. Singh, Analysis of Soil Physical Properties, Agrobios (India), 2012. 2. Pooja Kashyap, Agricultural Chemistry, Rajat Pubublications, New Delhi, 1st Published, 2009.	
Web Resources:	
1. https://youtu.be/iaQjEDYyWKw **2. https://youtu.be/brKftIwoPjw** **3. https://youtu.be/xEvo9udghgw** **4. https://youtu.be/oJCBVfr3Mxw**	
Course Outcomes	**K Level**
On the completion of the course the student will be able to	
CO1: Ability to understand the soil components and its composition	**[Up to K2]**
CO2: Discuss the soil salinity and alkalinity and formation of saline and alkaline soil	**[Up to K3]**
CO3: Interpret the chemical composition of soil	**[Up to K3]**
CO4: Examine the vermicomposting and ecofriendly farming	**[Up to K4]**
CO5: Analyze the biofertilizers and methods of applying fertilizers	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**SOIL COMPONENTS** Definition - volume, composition - uses - mineral soil - chemical ions - soil colloids - importance - nature - properties of inorganic and organic soil colloid - general characteristics - properties and importance - types - silicate clays - silicates - silicon oxygen tetrahedron.	15	Chalk, Talk & Power point
II	**SOIL SALINITY AND ALKALINITY** Saline and alkaline soil - nature - classification - characteristics - formation of saline and alkaline soil - effects - quality of irrigation water: introduction - criteria - irrigation water resources - water quality - classification of water.	15	Chalk, Talk & Power point
III	**ANALYSIS OF SOIL** i) Estimation of Ca, Mg, K and nitrate ii) Analysis of soluble salt. iii) Analysis of NPK in fertilizer. iv) Determination of soil pH and electrical conductivity. v) Estimation of organic matter content of soil.	15	Chalk, Talk & Power point
IV	**VERMICOMPOSTING** Vermicomposting: Economic implications - materials - preliminary treatment - types of vermicomposting - requirements for vermicomposting. Eco-Friendly Farming System: organic farming - concept – options	15	Chalk, Talk & Power point
V	**BIOFERTILIZERS** Biofertilizers: Soil biota in sustainable agriculture - biodiversity - management strategies - comparison of chemical fertilizer and biofertilizer. Methods of applying fertilizers - application of fertilizer in solid form - liquid fertilizer - nitrogenous fertilizer - types - phosphatic fertilizers: forms - classification- potassic fertilizers: Potassium sulphate: production – properties.	15	Chalk, Talk & Power point

Course Designed by: **Dr. K. Muthupandi & Dr. A.J. Sunija**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K – Level	No. of. Questions	K - Level		
CI AI	CO1	Up to K2	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO2	Up to K3	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	CO3	Up to K3	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO4	Up to K4	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**FUEL CHEMISTRY**			
Course Code	**21UCHE63**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the knowledge of fuel sources and its types
- To Remember the types of solid fuels and its advantages and disadvantages
- To Compare the knowledge of solid, liquid, gaseous and bio fuels
- To Perform the petroleum and petrochemical fuels and its refining process
- To Determine the manufacture of fuels and catalysts used in petroleum industry

Unit: I	**ENERGY SOURCES**	15

Renewable energy sources: solar, wind and geothermal energy – bioenergy hydropower and ocean energy - non-renewable energy sources: fossil fuels and nuclear fuels - definition and examples - fuel - definition - calorific value - determination of calorific value - classification of fuels: primary and secondary - criterion for selection of fuel - properties: ignition temperature - flame temperature - flash point - fire point.

Unit: II	**SOLID FUELS**	15

Natural - artificial - industrial solid fuels - Coal: formation - properties - classification - coking - non coking and pulverisation of coal - role of sulphur and ash in coal - analysis of coal: proximate and ultimate - advantages and disadvantages of solid fuels - fractional distillation of coal tar - uses of coal tar-based chemicals.

Unit: III	**LIQUID FUELS**	15

Petroleum and petrochemicals - refining of petroleum - composition and uses of main petroleum fractions - cracking - thermal - catalytic cracking - advantages - octane rating - anti knock agents - unleaded petrol - cetane rating - antidiesel knock agents - hydrocarbons from petroleum - petrochemicals - direct and indirect petrochemicals - catalysts used in petroleum industry.

Unit: IV	**GASEOUS FUELS**	15

Classification: natural - artificial gaseous fuels - examples and their importance - water gas-producer gas - semi water gas - LPG - manufacture - composition and uses - gobar gas - biogas generation-advantages and disadvantages.

Unit: V	**BIO FUELS**	15

Definition - sources and classification: biodiesel - bioethanol - hydrogen fuel from biomass - uses manufacture of biodiesel - advantages of biofuels.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. B.K. Sharma, Industrial Chemistry, Goel Publishing House, 13th Edition, 2002.
2. P.C. Jain & Jain, Engineering Chemistry, Dhanpat Rai Publishing Company (P) LTD, 16th Edition, 2015.

Books for References:

3. Andrey Gorbatovskiy, Fuel Chemistry and Technology, LAMBERT Academic Publishing, 6th June 2013, India.

Web Resources:		
1. https://en.m.wikipedia.org/wiki/Biofuels 2. https://www.studentenergy.org/topics/biofuels		
Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Ability to remember the basic concepts of atoms, molecules, fuels, catalysis.	**[Up to K2]**
CO2:	Discuss the composition of the solutions and mixtures and type of catalysts.	**[Up to K3]**
CO3:	Interpret the knowledge of atoms, molecules, fuels and catalysts.	**[Up to K3]**
CO4:	Examine the properties of metals and non-metals and role of catalysts.	**[Up to K4]**
CO5:	Distinguish between pure substance and mixtures, various types of catalysts.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**ENERGY SOURCES** Renewable energy sources: solar, wind and geothermal energy – bioenergy hydropower and ocean energy - non-renewable energy sources: fossil fuels and nuclear fuels - definition and examples - fuel - definition - calorific value - determination of calorific value - classification of fuels: primary and secondary - criterion for selection of fuel - properties: ignition temperature - flame temperature - flash point - fire point.	15	**Chalk, Talk & Power point**
II	**SOLID FUELS** Natural - artificial - industrial solid fuels - Coal: formation - properties - classification - coking - non coking and pulverisation of coal - role of sulphur and ash in coal - analysis of coal: proximate and ultimate - advantages and disadvantages of solid fuels - fractional distillation of coal tar - uses of coal tar-based chemicals.	15	**Chalk, Talk & Power point**
III	**LIQUID FUELS** Petroleum and petrochemicals - refining of petroleum - composition and uses of main petroleum fractions - cracking - thermal - catalytic cracking - advantages - octane rating - anti knock agents - unleaded petrol - cetane rating - antidiesel knock agents - hydrocarbons from petroleum - petrochemicals - direct and indirect petrochemicals - catalysts used in petroleum industry.	15	**Chalk, Talk & Power point**
IV	**GASEOUS FUELS** Classification: natural - artificial gaseous fuels - examples and their importance - water gas- producer gas - semi water gas - LPG - manufacture - composition and uses - gobar gas - biogas generation- advantages and disadvantages.	15	**Chalk, Talk & Power point**
V	**BIO FUELS** Definition - sources and classification: biodiesel - bioethanol - hydrogen fuel from biomass - uses manufacture of biodiesel - advantages of biofuels.	15	**Chalk, Talk & Power point**

Course Designed by: **Dr. A. J. Sunija & Dr. K. Muthupandi**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K – Level	No. of. Questions	K - Level		
CI AI	CO1	Up to K2	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO2	Up to K3	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	CO3	Up to K3	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO4	Up to K4	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**NANO CHEMISTRY**			
Course Code	**21UCHE64**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5
Nature of course:	**EMPLOYABILITY** ✓	**SKILL ORIENTED** ✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Understand the basic concept of nanomaterials and its types.
- To Identify the nanoparticles and its synthetic methods of nanomaterials
- To Analyze the classical colloid theory of nanomaterials
- To Perform the optical characterization methods on prepared nanomaterials
- To Determine the application of nanomaterials and its environmental safety measures

Unit: I	**INTRODUCTION TO NANOCHEMISTRY**	15

Nanomaterials – Definition – Bulk materials and Nanochemistry; Basics Nanomaterials - Types(0D,1D,2D,3D), compositions, and structures (nanowire, nano rod, nanosphere, nanocube, nanoparticle)- properties of nanomaterials-Optical, mechanical, magnetic,electrical and thermal properties-Bonding in nanostructures (Graphene, fullerene, carbon nanotubes).

Unit: II	**NANOPARTICLES AND SYNTHESIS**	15

Metal and semiconductor nanocrystals, Porous inorganic nanoparticles. Basic synthesis - Topdown approach-Ball milling, Bottom up-Chemical vapour deposition (CVD), Chemical reduction, Sol gel method- Microwave and Sonochemical method.

Unit: III	**CARBON, METAL AND METAL OXIDE NANOMATERIALS**	15

Carbon based materials: Preparation, properties and uses-carbon nanotube (CNT), Graphene, Carbon black. Metal nanomaterials: preparation ,properties and uses of Au, Mo nanoparticles and TiO_2 - nanomaterial.

Unit: IV	**CHARACTERIZATION OF NANOSTRUCTURED MATERIALS**	15

Structural characterization: Ultraviolet-Visible and DRS, Fourier Transform Infrared Spectroscopy, X-ray diffraction, Scanning electron microscope (SEM), Transmission electron miscroscope(TEM). Nanomechanical Characterization – Thermogravimetry analysis (TGA).

Unit: V	**APPLICATIONS OF NANOMATERIALS**	15

Applications of nanomaterials- Electronics, Biosensors, Medicine, Solar cells, Water treatment, Food, Fabric Industries, Automobiles, ceramic industry, Batteries and Fuel cells.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. M. A. Shah, Tokeer Ahmad, Principles of Nanoscience and Nanotechnology, Narosa Publishing group, 2010, ISBN-978-81-8487-072-5.
2. N. Arumugam, Nanotechnology, Saras publication, 1st edition, 2016, ISBN-978-93-84826-95-6.

Books for References:

1. Charles P. Poole, Frank. J. Owens, Introduction to nanotechnology, Wiley India Pvt.Ltd, 2019 reprint. ISBN-978-81-265-1099-3.
2. M. A. Shah and Tokeer Ahmad, Principles of Nanoscience and Nanotechnology,

NarosaPublishing House, 2nd Reprint, 2013.
Web Resources:
1. https://youtu.be/BLNwNkdRiTI **2. https://youtu.be/LbVg58LfvJc** **3. https://youtu.be/evE08ycZfnM** **4. https://youtu.be/41zegz4APPs**

Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Define nanomaterials and its types of nanomaterials	**[Up to K2]**
CO2:	Understand the nanoparticles and synthetic methods of nanomaterials	**[Up to K3]**
CO3:	Analyze the classical colloid theory on nanomaterials	**[Up to K3]**
CO4:	Interpret the optical characterization of prepared nanomaterials	**[Up to K4]**
CO5:	Distinguish the application of nanomaterials	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	**Programme Outcomes (POs)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	Nanomaterials – Definition – Bulk materials and Nanochemistry; Basics Nanomaterials -Types(0D,1D,2D,3D), compositions, and structures (nanowire, nano rod, nanosphere, nanocube, nanoparticle)-properties of nanomaterials-Optical, mechanical, magnetic,electrical and thermal properties-Bonding in nanostructures (Graphene, fullerene, carbon nanotubes)	15	Chalk, Talk & Power point
II	Metal and semiconductor nanocrystals, Porous inorganic nanoparticles. Basic synthesis - Topdown approach-Ball milling, Bottom up-Chemical vapour deposition (CVD), Chemical reduction, Sol gel method- Microwave and Sonochemical method.	15	Chalk, Talk & Power point
III	Carbon based materials: Preparation, properties and uses-carbon nanotube (CNT), Graphene, Carbon black. Metal nanomaterials: preparation ,properties and uses of Au, Mo nanoparticles and TiO_2 -nanomaterial.	15	Chalk, Talk & Power point
IV	Structural characterization: Ultraviolet-Visible and DRS, Fourier Transform Infrared Spectroscopy, X-ray diffraction, Scanning electron microscope (SEM), Transmission electron miscroscope(TEM). Nanomechanical Characterization – Thermogravimetry analysis (TGA).	15	Chalk, Talk & Power point
V	Applications of nanomaterials- Electronics, Biosensors, Medicine, Solar cells, Water treatment, Food, Fabric Industries, Automobiles, ceramic industry, Batteries and Fuel cells.	15	Chalk, Talk & Power point

Course Designed by: **Dr. K. Muthupandi & Dr. V. Ramasamy Raja**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Up to K2**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1 & K2**	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	**CO3**	**Up to K3**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1 & K2**	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**8**	**60**
	K2	**2**	**4**	**10**	**10**	**26**	**52**	
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**8**	**60**
	K2	**2**	**4**	**10**	**10**	**26**	**52**	
	K3	**-**	**-**	**10**	**-**	**10**	**20**	**20**
	K4	**-**	**-**	**-**	**10**	**10**	**20**	**20**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**CLINICAL AND MEDICINAL CHEMISTRY**			
Course Code	**21UCHE65**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the definitions of health, sterilization of surgical instrument and biochemical analysis.
- To Remember the concept of drugs and learn the manufacture of common drugs.
- To Compare the enzymes and its classification.
- To Perform the concept of blood volume, blood group and coagulation of blood.
- To Determine the knowledge on heredity and recombinant DNA and its possible hazards.

Unit: I	**CLINICAL HYGIENE AND BIOCHEMICAL ANALYSIS**	15

Definition of health, Sterilization of surgical instruments, disinfectants, antiseptics and Sanitation. Biochemical analysis of urine, serum and fecal matter. Treatment for specific poisons-acids, alkalis, arsenic and mercury compounds.

Unit: II	**COMMON TESTING OF DRUGS**	15

Manufacture of drugs (e.g. quinine, reserpine, atopside and d – tubocurarine) from Indian medicinal plants. Testing of drugs: biological variation – screening and toxicity – Use of pharmacopeia and therapeutic index – Types of drugs and their modes of action – Depressant drugs (special reference to sedatives and hypnotics) – Anticonvulsant drugs (sodium valproate, hydantoins) – Acting at spinal cord alone (glyceryl guaiacolate, diazepam). Cardiovascular drugs-nitrates, beta blockers (propranolol and atenolol) and calcium channel blockers.

Unit: III	**ENZYMES**	15

Classification, specificity – factors influencing enzymes – Coenzymes – Cofactor, ATP, Mechanism of enzyme action and Immobilization of enzymes. Applications of enzymes.

Unit: IV	**BODY FLUID**	15

Blood volume, blood groups, coagulation of blood. Plasma lipoproteins. Blood pressure Arteriosclerosis, diseases affecting red cells: Hyperchromic and hypochromic anemia. Blood transfusion. Blood sugar and diabetes.

Unit: V	**BIOTECHNOLOGY**	15

Heredity, recombinant DNA, Genetic engineering and its possible hazards, Gene splicing, manufacture of interferon and human insulin (Humulin), Drug manufacture based on fermentation (only antibiotics)

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. Jayashree Ghosh, A Textbook of Pharmaceutical Chemistry, S. Chand & Co., New Delhi, 1999.
2. Rastogi. S.C, Biochemistry, Tata McGraw Hill Publishing Co., 1993.
3. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Ltd., 1993, New Delhi.

Books for References:

1. Le Roy, O, Natural and Synthetic Organic Medicinal Compounds, Ealemi, 1976.
2. Oser, B.L, Hawk's Physiological Chemistry, 14th Edition, Tata McGraw Hill Publishing Co., 1965.

3. Kleiner. O and Martin. J, Biochemistry, Prentice-Hall of India, 1974, New Delhi.	
Web Resources:	
1. https://youtu.be/lUxkcEoGkVg **2. https://youtu.be/pss_sm2zaek** **3. https://youtu.be/Z63xnlDNajE** **4. https://youtu.be/qaYBUz14B3w**	
Course Outcomes	**K Level**
On the completion of the course the student will be able to	
CO1: Remember the basic definitions of clinical hygiene and biochemical analysis.	**[Up to K2]**
CO2: Discuss the manufacture of common drugs from medicinal plants and type of drugs.	**[Up to K3]**
CO3: Interpret the knowledge of enzymes and its classification	**[Up to K3]**
CO4: Examine the properties of blood volume, blood group and coagulation of blood.	**[Up to K4]**
CO5: Determine the heredity and recombinant DNA and its possible hazards.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	1	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	1	3	2	3	2	1
Weightage	10	10	10	11	9	11

***3** – Advanced Application; **2** – Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**CLINICAL HYGIENE AND BIOCHEMICAL ANALYSIS** Definition of health, Sterilization of surgical instruments, disinfectants, antiseptics and Sanitation. Biochemical analysis of urine, serum and fecal matter. Treatment for specific poisons-acids, alkalis, arsenic and mercury compounds.	15	Chalk, Talk & Power point
II	**COMMON TESTING OF DRUGS** Manufacture of drugs (e.g. quinine, reserpine, atopside and d – tubocurarine) from Indian medicinal plants. Testing of drugs: biological variation – screening and toxicity – Use of pharmacopeia and therapeutic index – Types of drugs and their modes of action – Depressant drugs (special reference to sedatives and hypnotics) – Anticonvulsant drugs (sodium valproate, hydantoins) – Acting at spinal cord alone (glyceryl guaiacolate, diazepam). Cardiovascular drugs-nitrates, beta blockers (propranolol and atenolol) and calcium channel blockers.	15	Chalk, Talk & Power point
III	**ENZYMES** Classification, specificity – factors influencing enzymes – Coenzymes – Cofactor, ATP, Mechanism of enzyme action and Immobilization of enzymes. Applications of enzymes.	15	Chalk, Talk & Power point
IV	**BODY FLUID** Blood volume, blood groups, coagulation of blood. Plasma lipoproteins. Blood pressure Arteriosclerosis, diseases affecting red cells: Hyperchromic and hypochromic anemia. Blood transfusion. Blood sugar and diabetes.	15	Chalk, Talk & Power point
V	**BIOTECHNOLOGY** Heredity, recombinant DNA, Genetic engineering and its possible hazards, Gene splicing, manufacture of interferon and human insulin (Humulin), Drug manufacture based on fermentation (only antibiotics)	15	Chalk, Talk & Power point

Course Designed by: **Dr. R. Satheesh & Dr. K. Muthupandi**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K – Level	No. of. Questions	K - Level		
CI AI	CO1	Up to K2	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO2	Up to K3	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	CO3	Up to K3	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
	CO4	Up to K4	2	K1 & K2	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks with out choice)	Consolidate of %
CIA I	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	10	20	40	40
	K4	-	-	-	-	-	-	-
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2	-	-	4	8	60
	K2	2	4	10	10	26	52	
	K3	-	-	10	-	10	20	20
	K4	-	-	-	10	10	20	20
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**APPLIED ELECTROCHEMISTRY**			
Course Code	**21UCHE66**	**L**	**P**	**C**
Category	**CORE ELECTIVE**	5	-	5

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the basic concept of electrochemical cells and electrodes
- To Remember the electrolytes and determine of activity coefficients of electrolytes
- To Interpret the electrodes and energy conservation
- To Perform the basic components of electroplating and metal finishing
- To Determine the electrochemical properties on corrosion science

Unit: I	**ELECTROMOTIVE FORCE**	15

EMF and Equilibrium constant (K) of a cell reaction - Nernst equation - concentration cells - electrode concentration cells without transference - electrolyte concentration cells without transference - concentration cells with transference - liquid junction potential (ELJP), electrolyte concentrations cells with salt bridge - application of EMF measurements.

Unit: II	**ELECTROLYTES, ELECTRODES AND ENERGY CONSERVATION**	15

Electrolytes – Determination of activity coefficients of electrolyte - determination of transport number - determination of pH of a solution using hydrogen electrode, quine hydrone electrode and glass electrode - potentiometric titrations. Energy Conservation: principals of energy conservation - electrochemical energy conservation - thermodynamic reversibility - Gibb‟s equation.

Unit: III	**ELCTROPLATING AND FUEL CELLS**	15

Electroplating – definition – factors affecting electroplating – components of electroplating process – working process of electroplating – basic applications of electroplating – pocket plates and sintered plates - vented and sealed maintenance free designs – fuel cells -introduction, types of fuel cells, advantages - photo electrochemical cells.

Unit: IV	**ENDUSTRIAL METAL FINISHING**	15

Introduction - objectives of electroplating - characteristics of electrodeposit and factors - copper electroplating - alkaline and acid bath - chromium electroplating - zinc electroplating - gold plating - anodizing and electroforming.

Unit: V	**CORROSION SCIENCE**	**15**

Introduction - types of corrosion - theories of corrosion - mechanism of corrosion - dry corrosion - electrochemical corrosion - types - passivity - factors influencing rate of corrosion - nature of metal, environment - phorbaix diagram - corrosion control techniques - inhibitors - cathodic protection methods - corrosion monitoring techniques.

	Total Lecture Hours	**75 Hrs**

Books for Study:

1. B.R. Puri, L.R. Sharma, Madan. S Pathaniya and B.S. Lark, Graduate of physical Chemistry (Volume II), Vishal Publishing Co.
2. Bard & Faulkner, Electrochemical Methods: Fundamentals and Applications, Second edition.

Books for References:

1. Fritz Scholz, Electroanalytical Methods - Guide to Experiments and Applications, 2nd Ed, Springer-Verlag Berlin Heidelberg 2010.
2. Joseph Wang, Analytical Electrochemistry, third edition 2006, John Wiley & Sons.

Web Resources:

1. https://youtu.be/rHMZ1Dpk5Fc
2. https://youtu.be/fHfv41HmIK0
3. https://youtu.be/BECSYfYhJGk
4. https://youtu.be/fM8hwkW8bIw
5. https://youtu.be/tJj-ilJTo6Y
6. https://youtu.be/uHoKGy704jk
7. https://youtu.be/4swtYzEbl64
8. https://youtu.be/q9c3-8CE_ro

Course Outcomes		K Level
On the completion of the course the student will be able to		
CO1:	Remember the basic concepts of electrochemical cells and electrodes	[Up to K2]
CO2:	Discuss the electrolytes, electrodes and energy conservation	[Up to K3]
CO3:	Interpret the knowledge of electroplating and fuel cells	[Up to K3]
CO4:	Examine the objective and characteristics of metal finishing	[Up to K4]
CO5:	Analyze the electrochemical properties on corrosion science	[Up to K4]

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	2	3	1	2
CO 2	1	3	1	1	2	3
CO 3	2	2	3	2	3	3
CO 4	3	1	2	2	1	2
CO5	1	3	2	3	2	1
Weightage	10	10	10	11	9	11

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**ELECTROMOTIC FORCE** EMF and Equilibrium constant (K) of a cell reaction - Nernst equation - concentration cells - electrode concentration cells without transference - electrolyte concentration cells without transference - concentration cells with transference - liquid junction potential (ELJP), electrolyte concentrations cells with salt bridge - application of EMF measurements.	**15**	**Chalk, Talk & Power point**
II	**ELECTROLYTES, ELECTRODES AND ENERGY CONSERVATION** Electrolytes – Determination of activity coefficients of electrolyte - determination of transport number - determination of pH of a solution using hydrogen electrode, quine hydrone electrode and glass electrode - potentiometric titrations. Energy Conservation: principals of energy conservation - electrochemical energy conservation - thermodynamic reversibility - Gibb‟s equation.	**15**	**Chalk, Talk & Power point**
III	**ELECTROPLATING AND FUEL CELLS** Electroplating – definition – factors affecting electroplating – components of electroplating process – working process of electroplating – basic applications of electroplating – pocket plates and sintered plates - vented and sealed maintenance free designs – fuel cells -introduction, types of fuel cells, advantages - photo electrochemical cells.	**15**	**Chalk, Talk & Power point**
IV	**INDUSTRIAL METAL FINISHING** Introduction - objectives of electroplating - characteristics of electrodeposit and factors - copper electroplating - alkaline and acid bath - chromium electroplating - zinc electroplating - gold plating - anodizing and electroforming.	**15**	**Chalk, Talk & Power point**
V	**CORROSION SCIENCE** Introduction - types of corrosion - theories of corrosion - mechanism of corrosion - dry corrosion -electrochemical corrosion - types - passivity - factors influencing rate of corrosion - nature of metal, environment - phorbaix diagram - corrosion control techniques - inhibitors - cathodic protection methods - corrosion monitoring techniques.	**15**	**Chalk, Talk & Power point**

Course Designed by: **Dr. K. Muthupandi & Dr. R. Satheesh**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K – Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Up to K2**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO2	**Up to K3**	**2**	**K1 & K2**	2	K2 & K2	2 (K3&K3)	1(K3)
CI AII	**CO3**	**Up to K3**	**2**	**K1 & K2**	1	K1	2 (K2&K2)	1(K2)
	CO4	**Up to K4**	**2**	**K1 & K2**	2	K2 & K2	2 (K3&K3)	1(K4)
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	**2**	**2**	**-**	**-**	**4**	**8**	**60**
	K2	**2**	**4**	**10**	**10**	**26**	**52**	
	K3	**-**	**-**	**10**	**10**	**20**	**40**	**40**
	K4	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	**2**	**2**	**-**	**-**	**4**	**8**	
	K2	**2**	**4**	**10**	**10**	**26**	**52**	**60**
	K3	**-**	**-**	**10**	**-**	**10**	**20**	**20**
	K4	**-**	**-**	**-**	**10**	**10**	**20**	**20**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Up to K2	2	K1,K2	1	K1	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1&K2	1	K1	2 (K3&K3)	1(K3)
3	CO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4	-	-	9	7.5	33
K2	5	6	10	10	31	25.83	
K3	-	-	40	20	60	50	50
K4	-	-	-	20	20	16.67	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
(For those who joined in 2021-2022 and after)

Course Name	**POLYMER CHEMISTRY**			
Course Code	**21UCHS61**	**L**	**P**	**C**
Category	**SKILL**	2	-	2

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENURSHIP**	✓

Course Objectives:

- To Recall the concept of polymerization and its classification and stereochemistry
- To Remember the types of polymerizations and its techniques
- To Compare the glass transition temperature and its associated properties
- To Determine the molecular weight methods of polymers
- To Analyze the polymers and its degradation

Unit: I	**BASIC CONCEPT OF POLYMERS**	06

Definition – Polymerization - Monomer - Repeat unit - degree of polymerization - Classification of polymers -Stereochemistry of polymer - Nomenclature of stereo regular polymers - Chain polymerization, free radical polymerization - Ionic polymerization.

Unit: II	**TYPES OF POLYMERIZATIONS**	06

Different Types of Polymerizations - Coordination polymerization - Ziegler Natta catalyst And Co-Polymerization -Random, Alternate, Block and Graft Polymerization. Polymerization techniques; bulk, solution, suspension and emulsion polymerization.

Unit: III	**GLASS TRANSITION TEMPERATURE**	06

Glass transition temperature and its associated properties- i) Mechanical Properties ii) Thermal Stability- iii) Flame Resistance iv) Chemical Resistance v) Degradability vi) Electrical Conductivity.

Unit: IV	**DETERMINATION OF MOLECULAR WEIGHT METHODS**	06

Molecular Weight of Polymers-Number Average and Weight Average Molecular Weight Methods.
Number Average Molecular Weight Methods-1. Osmometry (Vapour) 2. Viscometry
Weight Average Molecular Weight Methods-1. Light scattering 2. Ultra-centrifugation

Unit: V	**TYPES OF POLYMERS AND POLYMER DEGRADATION**	06

Synthetic resins and plastics - Manufacture and applications of polyethylene, PVC, Teflon, poly styrene, polymethylmethacrylate, poly urethane, phenol – formaldehyde resins, urea- formaldehyde resins and epoxy polymers.

	Total Lecture Hours	**30 Hrs**

Books for Study:

1. R.V. Gowariker, Polymer Science, New Age International Publication, 2006.

Books for References:

1. R.J. Young and P.A. Powell, Introduction to Polymers, 3rd Edition, CRC Press, 1991.
2. A. Ravve, Principles of Polymer Chemistry, 3rd Edition, Springer, New York, 2012.
3. Fred W. Billmeyer, Textbook of Polymer Science, 3rd Edition, John Wiley & Sons, 2007.

Web Resources:

1. **https://youtu.be/jSNlmOwpxYg**
2. **https://youtu.be/d8GMePE18SA**

3. https://youtu.be/2KDPGQ4Gg_0 4. https://youtu.be/IagyR3ayOPA 5. https://youtu.be/xacD9zJCqZ4 6. https://youtu.be/f7550UvWnLg 7. https://youtu.be/OPJAvbF6xMs		
Course Outcomes		**K Level**
On the completion of the course the student will be able to		
CO1:	Ability to understand the concept of polymers and types of polymerizations	**[Up to K2]**
CO2:	Discuss the types of polymerizations and glass transition temperature	**[Up to K3]**
CO3:	Interpret the associated properties of glass transition temperature and molecular weight of polymers	**[Up to K3]**
CO4:	Examine the two types of average molecular weight methods	**[Up to K4]**
CO5:	Analyze the polymers and its applications.	**[Up to K4]**

CO & PO Mapping:

Course Outcomes (COs)	Programme Outcomes (POs)					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**1**	**2**	**3**	**1**	**2**
CO 2	**1**	**3**	**1**	**1**	**2**	**3**
CO 3	**2**	**2**	**3**	**2**	**3**	**3**
CO 4	**3**	**1**	**2**	**2**	**1**	**2**
CO5	**1**	**3**	**2**	**3**	**2**	**1**
Weightage	**10**	**10**	**10**	**11**	**9**	**11**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

Unit	Course Name	Hrs	Pedagogy
I	**BASIC CONCEPT OF POLYMERS** Definition – Polymerization - Monomer - Repeat unit - degree of polymerization - Classification of polymers -Stereochemistry of polymer - Nomenclature of stereo regular polymers - Chain polymerization, free radical polymerization - Ionic polymerization.	06	Chalk, Talk & Power point
II	**TYPES OF POLYMERIZATIONS** Different Types of Polymerizations - Coordination polymerization - Ziegler Natta catalyst And Co-Polymerization -Random, Alternate, Block and Graft Polymerization. Polymerization techniques; bulk, solution, suspension and emulsion polymerization.	06	Chalk, Talk & Power point
III	**GLASS TRANSITION TEMPERATURE** Glass transition temperature and its associated properties- i) Mechanical Properties ii) Thermal Stability- iii) Flame Resistance iv) Chemical Resistance v) Degradability vi) Electrical Conductivity.	06	Chalk, Talk & Power point
IV	**DETERMINATION OF MOLECULAR WEIGHT METHODS** Molecular Weight of Polymers-Number Average and Weight Average Molecular Weight Methods. Number Average Molecular Weight Methods-1. Osmometry (Vapour) 2. Viscometry. Weight Average Molecular Weight Methods-1. Light scattering 2. Ultra-centrifugation	06	Chalk, Talk & Power point
V	**TYPES OF POLYMERS AND POLYMER DEGRADATION** Synthetic resins and plastics - Manufacture and applications of polyethylene, PVC, Teflon, poly styrene, polymethylmethacrylate, poly urethane, phenol – formaldehyde resins, urea- formaldehyde resins and epoxy polymers.	06	Chalk, Talk & Power point

Course Designed by: **Dr. R. Satheesh & Dr. A.J. Sunija**