NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF CHEMISTRY

COURSE PLAN – PART I			
Name of the programme and specialization	**B. Tech. (Chemical Engineering)**		
Course Title	**Chemistry III (Theory)**		
Course Code	**CLPC 12**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**Nil**		
Session	**July 2022**	**Section (if, applicable)**	**NA**
Name of Faculty	**Dr. Sarthak Mandal**	**Department**	**Chemistry**
Official Email	**smandal@nitt.edu**	**Telephone No.**	**+91-8158805377 (M)**
Name of Course Coordinator(s) (if, applicable)			
Official E-mail			
Course Type (please tick appropriately)	☑ **Core course**	☐ **Elective course**	

Syllabus (approved in BoS)

Theory (Units):

Unit I - Photochemistry and Pericyclic Reactions: Fundamentals of photochemistry, Norrish type I and II reactions, photo reduction of ketones, photochemistry of arenes. Pericyclic reactions, classification, Woodward-Hoffmann rules and FMO theory.

Unit II- Identification of organic compounds: Basics of IR spectroscopy, applications. Mass spectroscopy: Methods of desorption and ionization (EI, CI, MALDI, ESI), study of fragmentation pattern. Basic principles of 1H and 13C NMR, applications of 1H and 13C NMR (DEPT) to organic chemistry, case studies and combined problems.

Unit III - Catalysis and Kinetics: Catalysis- Homogeneous & heterogeneous catalysis, Langmuir – Hinshelwood mechanism of a bimolecular surface reaction, Elay – Rideal mechanism of a surface reaction, enzyme catalysis and kinetics, self-assembled monolayers and Langmuir-Blodgett filmsdetermination of surface area of catalysts.

Unit IV- Process development for fine chemicals: Preparation of acid chlorides from carboxylic acids, Friedel-Crafts acylation, Grignard reagents, Wittig reaction, ozonolysis, sharpless epoxidation. Hydroformylation, Wacker-smidt synthesis, Monsanto acetic acid and carbonylation processes.

Unit V- Electrochemistry Principles: Electrode processes, thermodynamics and potential, electron and mass transfer; electrochemical measurement methods and instruments; principles of electrochemical devices including batteries, super capacitors, fuel cells and electrochemical sensors.

Reference and Text Books

1. K. Jagadamba Singh, Jaya Singh, Photochemistry and Pericyclic Reactions, 3rd Edn, New Age International publications, 2009
2. R. M. Silverstein and F. X. Webster: Spectrometric Identification of Organic Compounds, 7th Edn, 2007
3. Gopala Rao M. and Marshall S., "Dryden's Outlines of Chemical Technology- for the 21st Century", Affiliated East-West Press.
4. V. S. Bagotsky, Fundamentals of electrochemistry, 2nd Edition, John Wiley and Sons,2005.
5. Bard and Faulkner, Electrochemical Methods: Fundamentals and Applications, 2nd edition, Wiley 2001, (ISBN 0-471-04372-9)
6.C. Someswara Rao "The Chemistry of Process Development in Fine Chemical and Pharmaceutical Industry" John Wiley and Sons. 2007.

COURSE OBJECTIVES

To introduce the students about basic principles of different spectroscopic tools and how to utilize these tools for structural analysis of molecules.

To familiarize the students with different photochemical and catalysis reactions, their mechanisms, and methodologies of product development for fine chemicals.

To make students understands basic working principles of electrochemical cells in reference to the development of batteries, super capacitors, fuel cells and electrochemical sensors.

MAPPING OF COs with POs

Course Outcomes	**Programme Outcomes (PO)** (Enter Numbers only)
Students will be able to	
1. apply the concepts of photophysics, photochemistry and catalysts in optimizing conditions of organic synthesis.	**PO1, PO2, PO3, PO5, PO8, PO11, PO12**
2. use advanced spectroscopic tools in characterization of the reaction products to assess purity and yield.	**PO1, PO2, PO3, PO5, PO8, PO11, PO12**
3. determine the best reaction conditions to maximize the products by applying the principles of homogeneous and heterogeneous catalysis	**PO1, PO2, PO3, PO5, PO8, PO11, PO12**

4. understand the concepts of electrochemistry principles and applications	**PO1, PO2, PO3, PO5, PO8, PO11, PO12**

COURSE PLAN – PART II

COURSE OVERVIEW

This is a three credit theory course offered to II year B.Tech. Chemical Engineering Students. Three theory classes (3 h per week) will be conducted per week. This course will provide a thorough understanding of several organo-physical, photophysical and photochemical processes which have direct relevance to industrial applicaitons.

COURSE TEACHING AND LEARNING ACTIVITIES **(** Add more rows)

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	II week of August	**Unit I Photochemistry and Pericyclic Reactions**: Introduction to the Course, electromagnetic radiation, and light-matter interactions	C&T, PPT
2	III week of August	Fundamentals of Photophysics and photochemistry and their distinction, Norrish type I and II reactions	C&T, PPT
3	IV week of August	Photo reduction of ketones, photochemistry of arenes.	C&T, PPT
4	I Week of September	Pericyclic reactions, classification, Woodward-Hoffmann rules and FMO theory.	C&T, PPT
5	II week of September	**Unit II- Identification of organic compounds**: Basics of UV-vis absorption and IR spectroscopy, their applications in identifying functional moiety in molecules.	C&T, PPT
6	III week of September	Mass spectrommetry: Methods of desorption and ionization (EI, CI, MALDI, ESI), study of fragmentation pattern.	C&T, PPT
7	IV week of September	Basic principles of 1H and 13C NMR, applications of 1H and 13C NMR (DEPT) to organic chemistry, case studies and combined problems	C&T, PPT

8	I week of October	**Unit III - Catalysis and Kinetics**: Catalysis- Homogeneous & heterogeneous catalysis, Langmuir – Hinshelwood mechanism of a bimolecular surface reaction.	C&T, PPT
9	II week of October	Elay – Rideal mechanism of a surface reaction, enzyme catalysis and kinetics, self-assembled monolayers	C&T, PPT
10	III week of October	Langmuir-Blodgett filmsdetermination of surface area of catalysts.	C&T, PPT
11	IV week of October	**Unit IV- Process development for fine chemicals**: Preparation of acid chlorides from carboxylic acids, Friedel-Crafts acylation	C&T, PPT
12	I week of November	Grignard reagents, Wittig reaction, ozonolysis, sharpless epoxidation. Hydroformylation,	C&T, PPT
13	II week of November	Wacker-smidt synthesis, Monsanto acetic acid and carbonylation processes. **Unit V- Electrochemistry Principles**: Electrode processes;	C&T, PPT
14	III week of November	Thermodynamics and potential, electron and mass transfer in electrochemistry, Electrochemical measurement methods and instruments;	C&T, PPT
15	IV week of November	Principles of electrochemical devices including batteries, super capacitors, fuel cells and electrochemical sensors	C&T, PPT

COURSE ASSESSMENT METHODS (shall range from 4 to 6**)**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
Theory				
1	Assessment I (Class Test – 1)	III Week of September	90 minutes	25

3	Assessment II (Assignment/quiz/Viva)	III Week of October	One week	20
4	Assessment III (Class Test – 2)	III Week of November	90 minutes	25
CPA	Compensation Assessment*	IV Week of November	90 minutes	25
5	Final Assessment *	II Week of December	3 hours	30

Total (100 Marks)

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

1. Feedback from students during class committee meetings
2. Anonymous feedback through questionnaire at the end of the semester.

COURSE POLICY (including compensation assessment to be specified**)**

MODE OF CORRESPONDENCE (email/ phone etc)

E-mail: smandal@nitt.edu / Phone: +91-8158805377

COMPENSATION ASSESSMENT POLICY

For those students who missed Class Test I and Class Test II due to genuine reasons, Compensation assessment will be conducted during IV week of November 2022.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

At least 75% attendance in each course is mandatory.
A maximum of 10% shall be allowed under On Duty (OD) category.
Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ACADEMIC DISHONESTY & PLAGIARISM

Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION, IF ANY
The respective faculty will be available for consultation at times as per the intimation by the faculty.
FOR APPROVAL
Course Faculty _____ 23.08.2022 **CC- Chairperson** _____ 23/8/22 **HOD** _____