Department of Chemistry

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Name of the programme and specialization	**B.Tech (Chem. Eng.)**		
Course Title	**CHEMISTRY-III**		
Course Code	**CLPC11**	**No. of Credits**	**3 (Theory)**
Course Code of Pre-requisite subject(s)	**Nil**		
Session	**July 2018**		
Name of Faculty	**Dr. Sunandan Sarkar** **Dr. Ganesh C. Nandi**	**Department**	**Chemistry**
E-mail	**ssarkar@nitt.edu** **nandi@nitt.edu**	**Mobile No.**	**9153484492 (**Dr. Sarkar) **7034458790** (Dr. Nandi)
Name of Course Coordinator			
E-mail		**Telephone No.**	
Course Type	☑ **Core course** ☐ **Elective course**		

Syllabus (approved in BOS)

Photochemistry and catalytic 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. Hydroformylation, Wacker-smidt Synthesis, Eastman-Halcon Carbonylation process, Alkene Metathesis, Pd catalyzed coupling reactions- Heck, Suzuki coupling & Ene Reaction. The Pauson- Khand Reaction.

Identification of organic compounds:

By using combined Mass, IR and NMR spectral analysis. Index of hydrogen deficiency. Mass spectroscopy: Methods of desorption and ionization (EI, CI, MALDI, ESI), study of fragmentation pattern. Basics of IR spectroscopy, applications. Basic Principles of 1H & 13C NMR, Applications of 1H and 13C NMR (DEPT) to organic chemistry, Case studies and combined problems.

Reaction Kinetics:

Rate order and molecularity of simple chemical reactions. Consecutive -Parallel and opposing reactions. Chain reactions. Energy of activation - Theories on reaction rates. Catalysis- Homogeneous & heterogeneous catalysis, Langmuir – Hinshelwood mechanism of a bimolecular surface reaction, Elay – Rideal mechanism of a surface reaction, Enzyme catalysis, zeolites as catalysts, Self-assembled monolayers and Langmuir-Blodgett films. Adsorption isotherm: Langmuir and B.E.T adsorption isotherm, Determination of surface area of solids by B.E.T. method.

Phase Equilibria:

Phase rule: Application - to one components system (water, sulphur and carbon dioxide), Two component systems (Eutetic, Intermediate compound formation and solid solutions) and simple three component

systems. Solutions: Ideal and non-ideal solutions, solubility of gases in liquids. Henry's law. Completely miscible liquids - Rauolt's law – vapour pressure and boiling point diagrams. Partially miscible liquids - Critical solution temperature - completely immiscible liquids - Nernst: distribution law -Dilute solution and their colligative properties. Molecular weight determination using these properties.

Electrical Conductance:

Debye - Huckell Onsager theory; Ostwald's dilution law - solubility of electrolytes and solubility product – Applications, common ion action - acids, bases - definitions based on proton transference, dissociation constant, amphoteric electrolyte - pH - Buffer solutions. Hydrolysis of salts. Decomposition potential, over voltage, definitions of current density, current efficiency, energy consumption; oxidation - reduction redox couple; e.m.f. and energy relations. Conductometry, Potentiometry, Voltammetry, their applications. Fuel cells.

COURSE OBJECTIVES

1. To learn the principles of photochemical reactions and catalyzed reactions in order to apply them in organic synthesis.
2. To acquire knowledge on the advanced characterization techniques in identification of compounds.
3. To understand the principles of reaction kinetics, phase equilibrium and solution chemistry.
4. To gain insight into fundamentals and applications of electrochemical systems.

COURSE OUTCOMES (CO)

Course Outcomes	**Aligned Programme Outcomes (PO)**
At the end, the students should be able to:	
1. apply the concepts of photochemistry and catalysts in optimizing the conditions of organic synthesis.	capable to apply the knowledge of photochemistry to inrerpret various organic transformations and photochemical phenomena.
2. use advanced spectroscopic tools in characterization of the reaction products to assess purity and yield.	capable to analyze and interpret the experimental findings.
3. determine the best reaction conditions to maximize the products by applying the principles of homogeneous and heterogeneous catalysis.	capable to employ the knowledge of reaction kinetics into the chemical process industries.
4. adopt phase equilibrium principles to achieve fractional distillation, steam distillation and solvent extraction.	capable to use the principle of phase equilibrium for engineering practice.
5. become familiar with the properties of electrolytes and electrodes and their use in electroanalytical techniques and electrochemical power sources.	capable to apply fundamental and practical knowledge of electrochemistry for the improvement of battery industries.

COURSE PLAN – PART II

COURSE OVERVIEW

This course is offered to II year B. Tech. (Chem. Eng.) students. This is a 3 credit theory course and three classes will be conducted per week. Extra classes may be taken on requirement.

COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week**	**Topic**	**Mode of Delivery**
1.	II week of July	**Photochemistry and catalytic reactions:** Fundamentals of Photochemistry, Norrish type I and II reactions	C&T
2.	III week of July	Norrish type II reactions, photo reduction of ketones, photochemistry of arenes.	C&T
3.	IV week of July	Pericyclic reactions, Classification, Woodward-Hoffmann rules,	C&T
4.	I week of August	Woodward-Hoffmann rules, and FMO theory. Hydroformylation,	C&T
5.	II week of August	Wacker-smidt Synthesis, Eastman-Halcon Carbonylation process, Alkene Metathesis	C&T
6.	III week of August	Pd catalyzed coupling reactions- Heck, Suzuki coupling, Ene Reaction. The Pauson- Khand Reaction.	C&T
7.	IV week of August	**Identification of organic compounds:** Index of hydrogen deficiency. Mass spectroscopy:	C&T
8.	I week of September	Methods of desorption and ionization (EI, CI, MALDI, ESI), study of fragmentation pattern.	C&T
9.	II week of September	Basics of IR spectroscopy, applications.	C&T
10.	III week of September	Basic Principles of 1H & 13C NMR,	C&T
11.	IV week of September	Applications of 1H to organic chemistry	C&T
12.	I week of October	Applications of 13C NMR (DEPT) to organic chemistry	C&T
13.	II week of October	Case studies and combined problems.	C&T
14.	III week of October	Case studies and combined problems.	C&T
15.	II week of July	**Reaction Kinetics** Rate order and molecularity of simple chemical reactions.	C&T
16.	III week of July	Consecutive -Parallel and opposing reactions. Chain reactions.	C&T
17.	IV week of July	Energy of activation - Theories on reaction rates. Catalysis- Homogeneous & heterogeneous catalysis.	C&T
18.	I week of August	Enzyme catalysis, Adsorption isotherm: Langmuir and B.E.T adsorption isotherm,	C&T
19.	II week of August	Langmuir – Hinshelwood mechanism of a bimolecular surface reaction, Elay – Rideal mechanism of a surface reaction,	C&T
20.	III week of August	Determination of surface area of solids by B.E.T. method. zeolites as catalysts, Self-assembled monolayers and Langmuir-Blodgett films.	C&T

21.	IV week of August	**Phase Equilibria** Phase rule: Application - to one components system (water, sulphur and carbon dioxide), Two component systems (Eutetic, Intermediate compound formation and solid solutions)	C&T
22.	I week of September	Simple three component systems. Solutions: Ideal and non-ideal solutions, solubility of gases in liquids. Henry's law.	C&T
23.	II week of September	Completely miscible liquids - Rauolt's law – vapour pressure and boiling point diagrams. Partially miscible liquids - Critical solution temperature - completely immiscible liquids	C&T
24.	III week of September	Nernst: distribution law - Dilute solution and their colligative properties. Molecular weight determination using these properties	C&T
25.	IV week of September	**Electrical Conductance** Debye - Huckell Onsager theory; Ostwald's dilution law - solubility of electrolytes and solubility product	C&T
26.	I week of October	Applications, common ion action - acids, bases – definitions based on proton transference, Dissociation constant, amphoteric electrolyte –pH–Buffer solutions. Hydrolysis of salts.	C&T
27.	II week of October	Decomposition potential, over voltage, definitions of current density, current efficiency, energy consumption;	C&T
28.	III week of October	Oxidation - reduction redox couple; e.m.f. and energy relations.	C&T
29.	IV week of October	Conductometry, Potentiometry, Voltammetry, their applications. Fuel cells.	C&T

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
Theory				
1	Assignment	IV week of Aug	90 minutes	10+15
2	Assignment	IV week of Sep	60 minutes	15
3	Assignment	I week of October	60 min	10
CPA	Compensation Assessment	II week of Oct	60 minutes	15
4	Final Asessment	I week of Nov	3 hours	50

COURSE EXIT SURVEY

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

COURSE POLICY

MODE OF CORRESPONDENCE (email/ phone etc)

ssarkar@nitt.edu, Tel. No.:9153484492 nandi@nitt.edu; Tel. 7034458790

COMPENSATION ASSESSMENT POLICY

1. This assessment is for those students who missed Test I due to genuine reasons.
2. Compensation assessment will be conducted during the II week of Oct 2018.

ATTENDANCE POLICY

- **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

The faculty will be available for consultation at times as per the intimation by the faculty.

FOR APPROVAL

Course Faculty S. Sarkar **CC-Chairperson** _____ **HOD** _____