NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF CHEMISTRY

COURSE PLAN – PART I			
Name of the programme and specialization	B.Tech. MINOR (MI)		
Course Title	Chemistry for Engineering application		
Course Code	CHMI12	No. of Credits	3
Course Code of Pre-requisite subject(s)	NA		
Session	~~July~~ / January 2019	Section (if, applicable)	~~A / B~~
Name of Faculty	Dr. M.P. Karthikayini Dr. Nitin Padalwar	Department	Chemistry
Official Email	karthikayini.mp@gmail.com nitinbpadalwar@gmail.com	Telephone No.	+918903017760 +919444377376
Name of Course Coordinator(s) (if, applicable)	Dr. M.P. Karthikayini		
Official E-mail	Karthikayini.mp@gmail.com	Telephone No.	+918903017760
Course Type (please tick appropriately)	☐ Core course ☑ Elective course		

Syllabus (approved in BoS)

Electrochemical sensors: Electrochemical sensors (amperometric, potentiometric, conductimetric); Semiconductor transducers (ISFET, ENFET); Optical transducers (absorption, fluorescence, bio/chemiluminescence, SPR); Piezoelectric and acoustic wave transducers; Limitations & problems to be addressed; An Overview of Performance and Applications.

Photoelectrochemical Cells for hydrogen Production: Photoelectrochemical electrolysis, photoelectrochemical cells for hydrogen production, solar-to hydrogen efficiency; Hydrogen storage, hydrogen economy, Review of electrochemical cells, Numerical calculations, Batteries: Rechargeable batteries (Lead acid, Ni-Cd, Lithium Ion Batteries).Dye sensitized solar cells.

Fuel Cell Electrocatalysis: Different fuel cell technologies – catalysts used, Hydrogen oxidation (anode) electrocatalysis in a PEFC, Effect of impurities on anode electrocatalysis in a PEFC, Oxygen reduction (cathode) electrocatalysis in a PEFC,Electrocatalysts used at the anode and cathode in a PEFC – supported and unsupported catalysts, The electrode structure – importance of three phase contact, Half cell experiments to estimate catalytic activity – Voltammetry, Full cell experiments to determine cathode catalytic activity and anode polarization – Voltammetry, Arriving at an optimal electrode structure – parameters to be evaluated

Green Chemistry: Definition, the twelve basic principles of green chemistry . Green synthetic methods: Microwavesynthesis, electro-organic synthesis, The design and

development of environmentally friendly chemical pathways: challenges and opportunities. High-yield and zero-waste chemical processes. Representative processes. Materials for green chemistry and technology: Catalysis, environmental friendly catalysts, Biocatalysis, biodegradable polymers, alternative solvents, ionic liquids

Bio-energy: Thermo-chemical conversion: direct combustion, gasification, pyrolysis and liquefaction; Biochemical conversion: anaerobic digestion, alcohol production from biomass; Chemical conversion process: hydrolysis and hydrogenation; Biophotolysis: Hydrogen generation from algae biological pathways; Storage and transportation; Applications.

Textbooks/Reference Books

1. Chemical Sensors and Biosensors, Brian Eggins, John Willey & Sons, 2002.
2. Applied Photovoltaics, Stuart Wenham, Martin Green, and Muriel Watt, Earthscan, 2007, ISBN 1- 84407-407-3
3. J. Larminie and A. Dicks, Fuel Cell Systems Explained, 2nd Edition, Wiley (2003)
4. Green Reaction Media in Organic Synthesis by Mikami Koichi Wiley-Blackwell 2005
5. Maartje F. Kemmere and Thierry Meyer Supercritical Carbon Dioxide: in Polymer Reaction Engineering Green Chemistry Wiley VCH 2005.

COURSE OBJECTIVES

To introduce the students to the fundamentals of Electrochemical sensors, Photoelectrochemical Cells for hydrogen Production, Fuel Cell Electrocatalysis, Green Chemistry and Bio-energy.

MAPPING OF COs with POs

Course Outcomes Students will learn about the:	**Programme Outcomes (PO)** (Enter Numbers only)
1. Fundamentals and applications of Electrochemical sensors.	
2. Importance of Photoelectrochemical Cells for hydrogen Production	
3. Role of Electrocatalysis in Fuel Cell..	
4. Basic concepts of Green chemistry	
5. Theory and applications of Bio-energy.	

COURSE PLAN – PART II

COURSE OVERVIEW

This is a three credit minor course offered to the B.Tech. Students. Three theory classes (3 h per week) will be conducted per week. This course provides a thorough understanding of the subject through lectures, and tutorials.

COURSE TEACHING AND LEARNING ACTIVITIES (Add more rows)

S. No.	Week/Contact Hours	Topic	Mode of Delivery
1	II week of January	**Unit 1:** Electrochemical sensors (amperometric, potentiometric, conductimetric); Semiconductor transducers (ISFET, ENFET);	C&T, PPT

2	III week of January	Optical transducers (absorption, fluorescence, bio/chemiluminescence, SPR);	C&T, PPT
3	IV week of January	Piezoelectric and acoustic wave transducers; Limitations & problems to be addressed; An Overview of Performance and Applications.	C&T, PPT
4	I week of February	**Unit 2: Photoelectrochemical Cells for hydrogen Production**: Photoelectrochemical electrolysis,photoelectrochemical cells for hydrogen production, solar-to hydrogen efficiency	C&T, PPT
5	II week of February	Hydrogen storage, hydrogen economy, Review of electrochemical cells, Numerical calculations, Batteries: Rechargeable batteries. DSSCs	C&T, PPT
6	III week of February	**Unit 3: Fuel Cell Electrocatalysis:** Different fuel cell technologies – catalysts used, Hydrogen oxidation (anode) electrocatalysis in a PEFC, Effect of impurities on anode electrocatalysis in a PEFC	C&T, PPT
7	IV week of February	Oxygen reduction (cathode) electrocatalysis in a PEFC,Electrocatalysts used at the anode and cathode in a PEFC – supported and unsupported catalysts, The electrode structure – importance of three phase contact	C&T, PPT
8	I week of March	Half cell experiments to estimate catalytic activity – Voltammetry, Full cell experiments to determine cathode catalytic activity and anode polarization – Voltammetry, Arriving at an optimal electrode structure – parameters to be evaluated.	C&T, PPT
9	II week of March	**Unit 4: Green Chemistry**: Definition, the twelve basic principles of green chemistry . Green synthetic methods: Microwavesynthesis, electro-organic synthesis.	C&T, PPT
10	III week of March	The design and development of environmentally friendly chemical pathways: challenges and opportunities. High-yield and zero-waste chemical processes. Representative processes.	C&T, PPT
11	IV week of March	Materials for green chemistry and technology: Catalysis, environmental friendly catalysts, Biocatalysis, biodegradable polymers, alternative solvents, ionic liquids.	C&T, PPT

12	I week of April	**Unit 5: Bio-energy**: Thermo-chemical conversion: direct combustion, gasification, pyrolysis and liquefaction;	C&T, PPT
13	II week of April	Biochemical conversion: anaerobic digestion, alcohol production from biomass; Chemical conversion process: hydrolysis and hydrogenation	C&T, PPT
14	III week of April	Biophotolysis: Hydrogen generation from algae biological pathways; Storage and transportation; Applications.	C&T, PPT

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Quiz/seminar/assignment	II week of February	1 week	10
2	Test-1	III week of February	60 minutes	20
3	Quiz/seminar/assignment	II week of March	1 week	10
4	Test 2	III week of April	60 minutes	20
CPA	Compensation Assessment*	III week of April	60 minutes	20
5	Final Assessment *	IV week of April	3 hours	40

***mandatory; refer to guidelines on page 4**

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: karthikayini.mp@gmail.com / Phone: +91-8903017760

COMPENSATION ASSESSMENT POLICY
For those students who missed Test I and Test II due to genuine reasons, Compensation assessment will be conducted during 15-19, April 2019 with the combined syllabus of Test I and Test II.

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

FOR APPROVAL

Course Faculty _____ **CC- Chairperson** _____ **HOD** _____