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University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK4VACCHE200**				
Course Title	**SUSTAINABLE CHEMISTRY**				
Type of Course	**VAC**				
Semester	4				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3
Pre-requisites	1. Basic knowledge and interest in science				
Course Summary	The course covers biomass assessment, techniques, waste management, biofuel, bio hydrogen production, polymers from biomass, corrosion management and renewable energy resources.				

Detailed Syllabus:

Module	Unit	Content	Hrs
	SUSTAINABLE CHEMISTRY		**45**
I	**INTRODUCTION TO BIOMASS**		**6**
	1	Biomass: Biomass resources, types, production, classification, and characterisation	2
	2	Techniques for biomass assessment.	1
	3	Concept of Waste segregation, management, and treatment.	3
II	**BIOFUEL & POLYMERS FROM BIOMASS**		**15**
	4	Bio ethanol and Biodiesel Production - Economics - Recent developments. Energy farming	3
	5	Biomass to gaseous fuel production-, Biogas technology - biogas plants – design consideration – applications.	3
	6	Bio hydrogen Production, Concept of Bio refinery.	2
	7	Natural biopolymers: proteins (silk, wool, hair etc.), polysaccharides, collagen	2
	8	Biopolymers from renewable resources- casein, natural rubber, and cellulose.	2
	9	Biosynthesis of biodegradable polymers (polyhydroxyalkanoates etc). Synthetic biopolymers: polylactic acid and its co-polymers, aliphatic polyesters, polyethylene oxides.	3
III	**CORROSION MANAGEMENT**		**9**

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	10	Corrosion: Erosion and corrosion, wet corrosion and dry corrosion, Factors affecting corrosion	3
	11	Coatings as a method of corrosion prevention (Tinning, Galvanizing, Painting Electroplating, Anodising). Cathodic protection and Anodic protection.	3
	12	Corrosion resistant materials – alloys – Details different types of steel, properties and applications, anti-rest solutions	3
IV	**RENEWABLE ENERGY SOURCES**		**6**
	13	Fundamentals of Sustainable Energy & Development	1
	14	Introduction to Renewable Energy – Need of switching to Renewable Energy sources, Difference between Renewable & Non-renewable sources	2
	15	Main sources – solar, wind, tidal, biomass, geothermal - Applications, Advantages & Disadvantages of Renewable Energy.	3
V	**OPEN ENDED MODULE:**		**9**
	16	Seminar presentations, group discussions, debates, quizzes, case studies etc on the above modules –regional assessment of biomass resources available for energy production - biofuel production process using biomass feedstocks - biodegradable polymers from biomass-derived feedstocks - effective corrosion management strategies - renewable energy policies at local, national or international level, etc. **(Or any other related activities introduced by the teacher)**	

REFERENCES

1. Ted Weyland, *Bioenergy: Sustainable Perspectives*, Callisto Reference. ISBN: 978-1-632-39633-4.
2. *Corrosion and corrosion control* Ublig, H. H. Latest edition.
3. Kulkarni, V. and Ramachandra, T.V., "*Environment Management*", TERI Press. 2009.
4. *Non-conventional Energy Sources*; G.D.Rai; 2011; Fifth Edition, Khanna Publishers.
5. Capareda S, *Introduction to biomass energy conversion*, CRC Press. ISBN: 978-1-466-51333-4.
6. Brown RC and Stevens C, *Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power*, Wiley and Sons. ISBN: 978-0- 470-72111-7.
7. Vaughn C. Nelson, Kenneth L. Starcher, *Introduction to Bioenergy (Energy and the Environment*), CRC Press. ISBN: 978-1-498-71698-7.
8. Yebo Li and Samir Kumar Khanal, *Bioenergy: Principles and Applications*, Wiley-Blackwell. ISBN: 978-1-118-56831-6.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed

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CO-1	to apply fundamental concepts of biomass resources and waste management to assess biomass types, interpret characterization data, and propose appropriate methods for waste segregation, management, and treatment in real-world scenarios.	Ap	PSO-1,2,3
CO-2	To analyze various bio-based energy and material production processes by examining their scientific principles, technological pathways, economic feasibility, and sustainability implications to evaluate their efficiency, environmental impact, and applicability in modern bio-refinery frameworks.	An	PSO-1,2,3,4
CO-3	To evaluate the mechanisms and influencing factors of wet and dry corrosion, critically assess the effectiveness of various corrosion-prevention strategies and evaluate the suitability of corrosion-resistant materials for different industrial applications.	E	PSO-1,2,3,4,5
CO-4	To design simple, sustainable energy solutions by integrating the fundamentals of renewable energy sources and justify their selection based on efficiency, environmental impact, and feasibility for real-world applications.	C	PSO-1,2,3,4,5
CO-5	To design and present innovative, chemistry-based solutions or models addressing real-world challenges for energy production, development of biofuel and biodegradable polymer pathways from biomass feedstocks, formulation of effective corrosion-management strategies, and evaluation of renewable energy policies at local, national, or international levels	C	PSO-1,2,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: SUSTAINABLE CHEMISTRY

Credits: 3:0:0 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,6 PSO-1,2,3	Ap	F, C	L	-
2	CO-2	PO-1,2,3,6,8 PSO-1,2,3,4	An	C, P	L	-
3	CO-3	PO-1,2,3,6,8 PSO-1,2,3,4,5	E	P	L	-

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4	CO-4	PO-1,2,3,6,8 PSO-1,2,3,4,5	C	P	L	-
5	CO-5	PO-1,2,3,6,7,8 PSO-1,2,3	C	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	3	2	2	-	-	2	-	-	-	-	2	-	-
CO 2	2	3	3	3	-	1	2	2	-	-	2	-	2
CO 3	2	3	3	3	2	1	2	2	-	-	2	-	2
CO 4	2	3	3	3	2	2	2	2	-	-	2	-	2
CO 5	3	2	3	-	-	3	2	2	-	-	3	-	3

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓		✓	✓
CO 3	✓		✓	✓
CO 4	✓		✓	✓
CO 5	✓		✓	

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