MAHATMA GANDHI UNIVERSITY, KERALA

Abstract

Petroleum Engineering (Minor) - Third Semester - Substitution of Discipline Specific Course and approval of the syllabus for the same - Approved - Orders Issued.

ACA 16

No. 5366/ACA 16/2026/MGU Priyadarsini Hills,Dated: 29.05.2026

Read:-1. U.O.No.5797/AC A16/2024/MGU, dated.27.06.2024.

2. Minutes of the meeting of the Expert Committee on Chemistry (UG).

3. Orders of the Professor in charge of the Vice Chancellor under Section 10(17), Chapter III of the Mahatma Gandhi University Act 1985, dated. 26.05.2025.

ORDER

The syllabi of various Honours Under Graduate Programmes coming under The MGU-UGP (Honours) Regulations, 2024, have been approved vide paper read as (1) above and published on the website of the University.

The Expert Committee on Chemistry (UG), deliberated on substituting the course **MG3DSCPEG200: ATF and Latest Development in Fuel Technology,** with **MG3DSCPEG200: Fundamentals of Biofuels and Clean Energy,** in the **Third Semester** syllabus of **Petroleum Engineering (Minor)** from the academic year 2026 - 2027 (2025 admission onwards) and has submitted recommendations, vide paper read as (2) above. (**Syllabus for the new course is attached as Annexure).**

Considering the urgency of the matter, sanction has been accorded by the Professor in charge of the Vice Chancellor, in exercise of the powers of the Academic Council vested upon him under Section 10(17), Chapter III of the Mahatma Gandhi University Act 1985, vide paper read as (3) above, to approve the aforementioned recommendations.

Orders are issued accordingly.

SUDHA MENON J

ASSISTANT REGISTRAR III
(ACADEMIC)
For REGISTRAR

Copy To

1. PS to VC
2. PA to Registrar/CE
3. Convenor, Expert Committee, Chemistry (UG)
4. JR 2 (Admin)/DR 2, AR 3 (Academic)
5. JR/DR/AR (Exam)
6. Tabulation/Academic Sections concerned
7. AC C1/AC C2 Sections
8. IT Cell 3/OQPM1Sections
9. PRO/IQAC/Records Sections
10. Stock File/File Copy

File No. 41127/AC A16-1/2026/AC A16.

Forwarded / By Order

Section Officer

Mahatma Gandhi University

Kottayam

Programme						
Course Name	**Fundamentals of Biofuels and Clean Energy**					
Type of Course	DSC B					
Course Code	**MG3DSCPEG200**					
Course Level	**200-299**					
Course Summary	This minor course introduces the fundamentals of biofuels and clean energy, focusing on sustainable feedstocks, modern production technologies, and recent advancements in biofuel generations to reduce carbon footprint and enhance energy security.					
Semester	III	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any	NIL					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the types and importance of modern biofuels.	U	3
2	Analyze and compare major biofuel feedstocks for sustainability.	An	1,6,7
3	Apply key biofuel production processes like fermentation and transesterification.	A	1,2,3

4	Analyse basic laboratory tests to determine essential biofuel properties.	An	1,2,3,6,7

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
	Overview of Modern Biofuels			
1	1.1	Definition and scope of biofuels, Types of biofuels: Bioethanol, Biodiesel, Biogas, and Bio-oil, Importance of biofuels in global and Indian energy scenario, Role of biofuels in reducing carbon footprint and enhancing energy security.	5	1
	1.2	Generations of Biofuels: First-generation: Food-based, Second-generation: Lignocellulosic biomass, Third-generation: Microalgae-based fuels, Fourth-generation: Genetically engineered organisms & carbon-capturing biofuel systems, Advantages and limitations of each generation.	10	1
	Sustainable Feedstocks and Resources			
2	2.1	Feedstocks for Biofuel Production: Plant-based feedstocks: sugar crops, starch crops, oil seeds. Waste-based feedstocks: used cooking oil, agricultural residues, municipal solid waste, Algal biomass as a high-potential feedstock, Criteria for selecting	6	2

		feedstocks: availability, cost, yield, sustainability.		
	2.2	Biofuels vs Fossil Fuels, Fuel property comparison: calorific value, emissions, engine compatibility. Environmental comparison: greenhouse gas savings, air pollutants, life-cycle impacts. Economic comparison: production cost, EROI, market competitiveness. Advantages and challenges of shifting from fossil fuels to biofuels.	9	2
	Production Technologies			
3	3.1	Biological and Chemical Conversion Technologies: Fermentation for Ethanol Production-Principles of fermentation, types of fermenters, process parameters, downstream processing, ethanol purity and fuel-grade specifications. Transesterification for Biodiesel Production-Chemistry of transesterification, catalysts (alkaline, acid, enzyme), process steps, purification of biodiesel, fuel properties, environmental aspects. Anaerobic digestion for biogas- microbial pathways, stages of digestion (hydrolysis, acidogenesis, acetogenesis, methanogenesis), digester types, operating parameters, gas upgrading and utilization.	10	3
	3.2	Biotechnological Advancements in Biofuels-Study of modern biotechnological tools used to improve biofuel production, application of	5	3

		CRISPR-Cas systems, genetic engineering strategies for enhancing lipid, starch, and sugar accumulation, Development of high-yield and stress-tolerant strains of plants, algae, or microbes for more efficient biofuel feedstocks.		
	Biofuels Practical			
4	4.1	1. Blending of Biofuels 2. Determination of Density 3. Determination of Flash Point 4. Determination of Sulphur Content 5. Determination of Aromatics Content 6. Determination of Viscosity 7. Determination of Octane Number	30	4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Assignments, Seminars
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory (25 Marks)** Test Paper MCQ Viva Involvement in classroom activities Assignment **Practical (15 Marks)** Lab involvement/Report/Lab Test

	A. End Semester Evaluation **Theory (50 Marks)-1.5 hrs** MCQ 10 questions: 10 X 1=10 Short Answer 4 questions (Out of 6): 4X 3=12 Short Essay 4 questions (Out of 6): 4 X 7=28 **Practical (35 Marks)-3 hrs** Analysis and Procedure: 30 Viva : 5

References

1. Luque R, Campelo J, Clark J, *Handbook of biofuels production: Processes and technologies*. Wood head Publishing Limited (2011).
2. Gupta V.K, Touhy M.G, *Biofuel Technologies*, Springer (2013).
3. Deepak Tuli, Sangita Kasture, Arindam Kuila, *Advanced Biofuel Technologies: Present status, challenges and future prospects*, (2021).
4. Navid Naderpour, *Petrochemical Production Process*, S. B. S Publishers, (2008).
5. Dr. Kochu Baby Manjooran, *Modern Petroleum Chemistry–An Overview*, (2016).
6. ASTM Methods, Indian standards (Methods of test for petroleum and its Products).

SUGGESTED READINGS

1. Sanjay Sahay, *Hand Book of Biofuels*, (2021).
2. Rafael Luque, Carol sze ki Lin, Karen Wilson, Chenyu Du, *Hand Book of Biofuels Production: Processes and Technologies*, (2022).
3. John Love, John A Bryant, *Biofuels and Bioenergy*, (2017).
4. Ayhan Demirbas, *Biofuels: Securing the Planet's future energy needs*, (2010).
5. Anju Dahiya, *Bioenergy: Biomass to biofuels and waste to energy*, 2nd edition, (2020).
6. Baskar Gurunathan, Renganathan sahadevan, Zainul Akmar Zakaria, *Biofuels and Bioenergy: Opportunities and Challenges*, (2021).