

THE MAHATMA GANDHI UNIVERSITY
UNDERGRADUATE PROGRAMMES
(HONOURS) SYLLABUS
MGU-UGP (Honours)
(2024 Admission Onwards)



Faculty: Science
Expert Committee: Chemistry
Subject: Petroleum Engineering

Mahatma Gandhi University
Priyadarshini Hills
Kottayam – 686560, Kerala, India

Syllabus Index

Name of Minor: **Petroleum Engineering**

Semester: 1

| Course Code | Title of the Course | Type of the Course DSC, MDC, SEC etc. | Credit | Hours/ week | Hour Distribution /week | | | |
|--------------|---|--|--------|----------------|----------------------------|---|---|---|
| | | | | | L | T | P | O |
| MG1DSCPEG100 | Fundamentals of Petroleum Geochemistry | DSC B | 4 | 5 | 3 | | 2 | |

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

Semester: 2

| Course Code | Title of the Course | Type of the Course DSC, MDC, SEC etc. | Credit | Hours/ week | Hour Distribution /week | | | |
|--------------|---|--|--------|----------------|----------------------------|---|---|---|
| | | | | | L | T | P | O |
| MG2DSCPEG100 | Drilling, Transportation and Refining Techniques | DSC B | 4 | 5 | 3 | | 2 | |

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Syllabus

Semester: 3

| Course Code | Title of the Course | Type of the Course DSC, MDC, SEC etc. | Credit | Hours/ week | Hour Distribution /week | | | |
|--------------|--|--|--------|----------------|----------------------------|---|---|---|
| | | | | | L | T | P | O |
| MG3DSCPEG200 | ATF and Latest Development in Fuel Technology | DSC B | 4 | 5 | 3 | | 2 | |

Semester: 4

| Course Code | Title of the Course | Type of the Course DSC, MDC, SEC etc. | Credit | Hours/ week | Hour Distribution /week | | | |
|--------------|--|--|--------|----------------|----------------------------|---|---|---|
| | | | | | L | T | P | O |
| MG4DSCPEG200 | ATF and Latest Development in Fuel Technology | DSC C | 4 | 5 | 3 | | 2 | |

**MGU-UGP (HONOURS)****Syllabus**



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|-------------------------------|---|---------|----------|-----------|--------|-------------|
| Programme | | | | | | |
| Course Name | Fundamentals of Petroleum Geochemistry | | | | | |
| Type of Course | DSC B | | | | | |
| Course Code | MG1DSCPEG100 | | | | | |
| Course Level | 100-199 | | | | | |
| Course Summary | This is a basic course in fundamentals of petroleum geochemistry. The students will be exposed to the origin of petroleum, different oil exploration techniques and composition of crude oil. | | | | | |
| Semester | I | Credits | | | 4 | Total Hours |
| Course Details | Learning Approach | Lecture | Tutorial | Practical | Others | |
| | | 3 | | 1 | | 75 |
| Pre-requisites, if any | NIL | | | | | |

Syllabus

COURSE OUTCOMES (CO)

| CO No. | Expected Course Outcome | Learning Domains * | PO No |
|--------|--|--------------------|-------|
| 1 | Formulate theories regarding the origin of petroleum | C | 1,3 |
| 2 | Develop an idea of the Resource, reserves and mechanics of accumulation. | A | 1,3 |
| 3 | Categorise various exploration techniques of crude oil | An | 1,3 |
| 4 | Outline the composition of crude oil | U | 1,2,3 |

| | | | |
|--|---|---|------|
| 5 | Explain the properties of hydrocarbon | U | 2 |
| 6 | Develop an idea about the analysis of quality parameters of different fuels | A | 2,10 |
| <i>*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate I, Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i> | | | |

COURSE CONTENT

Content for Classroom transaction (Units)

| Module | Units | Course description | Hrs | CO No. |
|----------------------------|-------|--|-----|--------|
| Origin of petroleum | | | | |
| 1 | 1.1 | <p>Petroleum: A natural resource, Historical overview of petroleum. Theories of origin of petroleum—biogenic and abiogenic theory. Berthelot's view, Mendeleeff's view, Engler's theory and modern theory. Nature of source material. Transformation of organic matter into petroleum—diagenesis, catagenesis, metagenesis. In situ transformation of petroleum—thermal alteration, deasphalting, biodegradation and water washing.</p> <p>Factors controlling the occurrence of petroleum.</p> <p>Petroleum reserves: Proved, probable, possible and unproved reserves. Geological framework of migration and accumulation of petroleum—migration from source rock to the carrier beds—carrier beds to reservoir rock.</p> <p>Mechanics of entrapment of petroleum.</p> | 5 | 1 |

| | | | | |
|--|-----|---|----|---|
| | 1.2 | <p>Petroleum reservoirs: Source rock, reservoir rock-clastic and non elastic reservoir rock, development and types of porosity in these rocks, control of permeability. Hydrocarbon trap: Classification and types of hydrocarbon traps-structural, stratigraphic and combination traps. Structural Traps-Anticline traps, fault traps, fracture traps, salt domes.</p> <p>Kerogen: source material and formation, composition and distribution. Catagenesis of kerogen into petroleum and natural gas. Oil window concept.</p> | 10 | 2 |
| Oil Exploration- Petroleum exploration techniques | | | | |
| 2 | 2.1 | <p>Surface exploration-Geological exploration, photogeology, remote sensing and geographic information system, geochemical exploration, geobotanical exploration. Subsurface exploration – gravity method, magnetic method, electrical method, Self-Potential method (SP), Resistivity method, electromagnetic method, seismic method, pitting, trenching, drilling and borehole logging. Borehole logging-radioactive logging, acoustics logging, density logging, core sampling.</p> | 15 | 3 |
| Composition of crude oil | | | | |
| 3 | 3.1 | <p>Paraffins, cycloparaffins or naphthenes, aromatic hydrocarbons, olefins, sulphur compounds, nitrogen compounds, oxygen compounds, metallic constituents, organometallic hydrocarbons. Classification of crude oils: physical, chemical and genetic classification. Unconventional resources of hydrocarbons: gas hydrates, shale gas, basin centric gas, coal bed methane, tight gas.</p> | 10 | 4 |

| | | | | |
|---|---|---|----|---|
| | 3.2 | Properties of hydrocarbons: Density, viscosity, surface tension, cloud point, pour point, aniline point, diesel index, flash point, refractive index and calorific value. | 5 | 5 |
| | Fundamentals of Petroleum Geochemistry Practical | | | |
| 4 | | <ol style="list-style-type: none"> 1. Determination of density of light oils 2. Determination of density of medium type oils 3. Determination of Aniline point of diesel fuel 4. Determination of Diesel Index and API gravity 5. Determination of surface tension of kerosene 6. Determination of Viscosity of Diesel 7. Determination of Pour point. 8. Determination of Cloud point. | 30 | 6 |
| 5 | Teacher Specific Content | | | |

MGU-UGP (HONOURS)

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|---------------------------------------|---|
| Teaching and Learning Approach | Classroom procedure (mode of transaction) Lecture Tutorial Hybrid ICT enabled teaching and learning Demonstration |
|---------------------------------------|---|

| | |
|-------------------------|--|
| Assessment Types | MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory (25 marks) Assignments/MCQ/ viva /class test Practical (15 marks) Lab involvement and report/Lab test |
| | Semester end examination Theory(50 marks) -1.5 hrs. MCQ 10 questions: 10 X 1 = 10 Short answer 4 questions (out of 6): 4 X 3 =12 Short essay 4 questions (out of 6): 4 X 7 = 28 Practical (35 marks)- 1hr. Lab report: 10 Viva: 10 Writing procedure: 15 |

References

1. S. G James, M. Dekker, *The Chemistry and Technology of Petroleum*, 1991.
2. G .N.Tripathi, *Indian Petroleum Directory*, Indian Petroleum Publishers, 2007.
3. B. K Sharma, *Industrial Chemistry* , Goyal Publication, 2000.
4. P.T. Sawant, *Engineering and General Geology*, New India Publishing Agency, New Delhi 2011.
5. M. B. Roger, *Geological methods in mineral exploration and mining*, Springer Publications, 2nd Edition, 2010.
6. D. S. J. Jones, *Elements of Petroleum Processing*, 1996.
7. R. C. Selly, *Elements of Petroleum Geology*, Academic press, London, 2016.
8. *ASTM Methods*, Indian standards (Methods of test for petroleum and its Products).

SUGGESTED READINGS

1. S. Maiti, *Introduction to Petrochemicals*, 2002.
2. K. B. Manjooran, *Modern Petroleum Chemistry–An Overview*, 2016.

3. J.M. Hunt, *Petroleum Geochemistry and Geology*, 2nd Edn W H Freeman, San Francisco. 1996.
4. S. L. Sah, *Encyclopedia of petroleum science and engineering: Exploration*, Vol.1. 2010.
5. S L Sah, *Encyclopedia of petroleum science and engineering: Processing, interpretation and reservoir engineering*, Vol.2 2003.
6. P. H Splitz, *Petrochemicals: The Rise of an Industry*, 1988.
7. Z. Sajid, *Practical Handbook on Fuel Properties and Testing*, Lap Lambert Academic Publishing 2014.
8. J. G Speight, *Handbook of Petroleum Product Analysis*, Second edition, Wiley 2014.



MGU-UGP (HONOURS)

Syllabus



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|-------------------------------|---|---------|----------|-----------|-------------|
| Programme | | | | | |
| Course Name | Drilling, Transportation and Refining Techniques | | | | |
| Type of Course | DSC B | | | | |
| Course Code | MG2DSCPEG100 | | | | |
| Course Level | 100-199 | | | | |
| Course Summary | This is a basic course in drilling operation and transportation techniques of petroleum products. The students will be exposed to drilling operations, oil field brines, transportation and refining of petroleum | | | | |
| Semester | II | Credits | | | Total Hours |
| Course Details | Learning Approach | Lecture | Tutorial | Practical | Others |
| | | 3 | | 1 | |
| Pre-requisites, if any | NIL | | | | |

Syllabus

COURSE OUTCOMES (CO)

| CO No. | Expected Course Outcome | Learning Domains * | PO No |
|--------|---|--------------------|-------|
| 1 | Categorise various drilling operations of crude oil | An | 1,2,3 |
| 2 | Explain Transportation of crude oil | U | 1,2 |
| 3 | Develop Crude oil distillation procedures | A | 1,2 |
| 4 | Assess composition of different distillates | E | 1,2 |

| | | | |
|--|--|----|-----|
| 5 | Classify different types Heat exchangers | U | 1,2 |
| 6 | Examine various Hydrocarbon testing methods | An | 1,2 |
| 7 | Make use of evaluation methods of various fuel | A | 1,2 |
| <i>*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i> | | | |

COURSE CONTENT

Content for Classroom transaction (Units)

| Module | Units | Course description | Hrs | CO No. |
|-------------------------------|--|---|-----|--------|
| 1 | Drilling Operations & Transportation of Crude Oil | | | |
| | 1.1 | Basic drilling operations, rig and rig site, methods of drilling-cable tool method, rotary method, offshore drilling, Rig safety and environmental concerns. | 5 | 1 |
| | 1.2 | Recovery of oil - natural method (primary oil recovery) - dissolved gas drive, gas cap drive, water drive, gravity drive. Applied flow method (secondary oil recovery) - gas flood method, water flood method. Other sources of petroleum. Petroleum from coal, natural gas and its constitution. Oil field Brines: Composition, classifications, origin and alteration of oil field brines. Importance of oil field water analysis. Effects of water circulation on hydrocarbons. | 5 | 1 |
| | 1.3 | Oil and gas transportation-truck, tankers, pipeline transfer and railway. Type of storage tanks - cone roof and floating roof, nitrogen blanketing. | 5 | 2 |
| Crude oil Distillation | | | | |

| | | | | |
|---|-----|--|----|---|
| | 2.1 | Function of refineries: simple refinery, complex refinery, integrated refinery. | 6 | 3 |
| 2 | 2.2 | Sour gas and Sweet gas, sweetening process. Distillation of crude oil- distillation procedures, separation of products from crude oil, fractional distillation, vacuum distillation, stripping. Composition of different distillates (LPG, Propylene, Naphtha, Gasoline, Aviation fuel, Kerosene, Diesel, Fuel oil, Bitumen, Heating Oil (LDO), lubricating oil)-specifications and their significance. Natural rubber modified bitumen and bitumen emulsion. | 6 | 4 |
| | 2.3 | Heat exchangers-types of heat exchangers. | 3 | 5 |
| Hydrocarbon and its testing | | | | |
| 3 | 3.1 | Testing methods: Density, atmospheric distillation, vacuum distillation, chloride content, viscosity, elemental analysis (S, Cl, N), specific gravity, sulphur content, mercaptan sulphur, existent gum, potential gum, oxidation stability, cloud point, pour point, pour point depressants, Reid vapour pressure, Cetane Index, API gravity, copper corrosion, research octane number (RON), Doctor solution test, flash point(Abel and PMC method), penetration, elastic recovery, ductility, softening point and calorific value. | 15 | 6 |
| Drilling, Transportation and Refining Techniques Practical | | | | |

| | | | |
|---|---|----|---|
| 4 | <p>Test Methods of Petroleum Products</p> <ol style="list-style-type: none"> 1. Distillation of Petrol 2. Distillation of Kerosene 3. Distillation of Diesel 4. Determination of water content in diesel –Dean Stark Method 5. Determination of moisture content(ppm) in diesel- Potentiometric method 6. Determination of water content in furnace oil-Dean Stark Method 7. Determination of Flash point- PMC method. 8. Determination of Flash point- Abel’s method. 9. Determination of Smoke point of kerosene 10. Determination of softening point of bitumen 11. Determination of penetration of bitumen 12. Determination of Ductility of Bitumen 13. Determination of Reid Vapour pressure | 30 | 7 |
| 5 | Teacher Specific content | | |

| | |
|--|---|
| <p>Teaching and Learning Approach</p> | <p>Classroom procedure (mode of transaction)</p> <p>Lecture sessions, interactive sessions including discussions, demonstrations, and experiments to engage students actively and visual aids like presentations, videos, and models to enhance understanding. Encourage students to ask questions during or after the lectures. Begin with safety instructions and guidelines for lab work. Allow students to conduct experiments under supervision (for lab work).</p> |
| <p>Assessment Types</p> | <p>MODE OF ASSESSMENT</p> <p>A.</p> <p>Continuous Comprehensive Assessment (CCA)</p> <p>Theory (25 marks)</p> <p>Assignments/ MCQ/Viva/Involvement in classroom activities</p> <p>Practical (15 marks)</p> <p>Lab involvement and report /Lab test</p> |

B.

Semester end examination

Theory (50 marks)-1.5 hrs.

MCQ 10 questions : 10 X 1 = 10

Short answer 4 questions (out of 6): 4 X 3 = 12

Short essay 4 questions (out of 6): 4 X 7 = 28

Practical (35 marks)-1 hr.

Lab report: 10

Viva: 10

Writing procedure: 15

References

1. S. G. James, *The Chemistry and Technology of Petroleum*, Marcel Dekker, 1991.
2. G.N. Tripathi, *Indian Petroleum Directory*, Indian Petroleum Publishers, 2007.
3. Asphalt institute, *The Asphalt handbook*, Manual series, 1989.
4. W.L. Nelson, *Petroleum refinery engineering*, Mc.Graw-Hill Education, 1958.
5. R.A. Meyers, *Handbook of Petroleum Refining Process*, 4th Edition, 2016.
6. B.K Sharma, *Industrial Chemistry*, Goel Publication, 2000.
7. S. Maiti, *Introduction to Petrochemicals*, 2002.
8. D.S. J. Jones, *Elements of Petroleum Processing*, 1995.
9. Dr. K. B. M., *Modern Petroleum Chemistry—An Overview*, 2016.
10. ASTM Methods, Indian standards (Methods of test for petroleum and its Products).

SUGGESTED READINGS

1. S. Chanda, *Petroleum Pipelines: A Handbook for Onshore Oil and Gas Pipelines*, 2013.
2. R. Rathi, *Petroleum Refining Processes*, 2007.
3. B. B. Rao, *Modern petroleum refining processes*, 6th Edition, 2018.
4. R. C. Selly, *Elements of Petroleum Geology*, Academic press, London, 2014.
5. H. J. M., *Petroleum Geochemistry and Geology*, 2nd Edn, W H Freeman, San Francisco, 1996.
6. P. H. Splitz, *Petrochemicals: The Rise of an Industry*, 1988.
7. Z. Sajid, *Practical Handbook on Fuel Properties and Testing*, Lap Lambert Academic Publishing 2014.
8. J. G Speight, *Handbook of Petroleum Product Analysis*, Second edition, Wiley 2014.
9. Methods of Test for Petroleum and its Products. Automotive Fuels. Assessment of Petrol and Diesel Quality-Fuel Quality monitoring System, British Standards Institute, BSI Standard Publishers.



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|-------------------------------|--|----------------|-----------------|------------------|--------------------|
| Programme | | | | | |
| Course Name | ATF and Latest Development in Fuel Technology | | | | |
| Type of Course | DSC B | | | | |
| Course Code | MG3DSCPEG200 | | | | |
| Course Level | 200-299 | | | | |
| Course Summary | This course deals with ATF and latest developments in fuel technology. The students will be exposed to drilling operations, oil field brines, transportation and refining of petroleum | | | | |
| Semester | III | Credits | | | Total Hours |
| Course Details | Learning Approach | Lecture | Tutorial | Practical | Others |
| | | 3 | | 1 | |
| Pre-requisites, if any | NIL | | | | |

MGU-UGP (HONOURS)

COURSE OUTCOMES (CO)

| CO No. | Expected Course Outcome | Learning Domains * | PO No |
|--------|--|--------------------|-----------|
| 1 | Summarise the advantages of biofuels | U | 3 |
| 2 | Utilise ethanol as a biofuel | A | 1,2,3,6,7 |
| 3 | Classify the types of aviation fuels | U | 2,3 |
| 4 | Examine the test methods of aviation fuel | An | 1,2,3,6,7 |
| 5 | Design the manufacturing methods of aviation fuels | C | 1,2,3,6,7 |
| 6 | Discover alternative aviation fuels | An | 1,2,3,6,7 |
| 7 | Solve different test methods for aviation fuels | C | 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 Biofuels | | | |
| 1 | 1.1 | Biofuels-key advantages of biofuels, development of biological conversion technologies, integration of biofuels into biorefineries, environmental and economic sustainability of biofuels. | 5 | 1 |
| | 1.2 | Ethanol as a biofuel-commercial production technology (dry milling/wet milling), properties, engine performance and ethanol-fuel testing, E-85 fuels. Environmental aspects of ethanol as a biofuel-significance in the aviation sector and its concerns. | 10 | 2 |
| 2 | Aviation Fuels | | | |
| | 2.1 | Aviation fuels: Chemical composition and methods of obtaining ATF from crude oil, physico- chemical and functional properties of aviation fuels -AV Gas for piston engines, aviation kerosene and broad fraction fuels for turbine engines. Technology of fuel preparation before application to aircraft tanks. Sustainable aviation fuels (SAF), Bio-Aviation Turbine fuel (Bio-ATF). | 5 | 3 |

| | | | | |
|----------|--------------------------------------|---|----|---|
| | 2.2 | Aviation biofuels and technologies for their production. Different types of Aviation fuels and analysis: copper corrosion, aromatics, naphthalene content, silver corrosion, Water Separo meter Index, JFTOT, anti-oxidants, Static Dissipative Additives (SDA), distillation, total sulphur, mercaptans, lubricity, smoke point, freezing point, specific energy value. Anti-knock performance, research octane number, motor octane number, road octane number. | 10 | 4 |
| 3 | Manufacture of Aviation Fuels | | | |
| | 3.1 | Different methods of manufacture: hydro desulphurization, merox process, hydro treating process, atmospheric distillation. Main components in Jet (Turbine) fuel, performance criteria of ATF. Physical and chemical properties of ATF. | 5 | 5 |
| | 3.2 | Additives- lubricity additives, conductivity additives, multi-functional additives (MFA) and other additives | 5 | 5 |
| | 3.3 | Alternative Aviation fuels-First vs second generation biofuels-advantages of second generation biofuels-success criteria for biofuels in aviation. | 5 | 6 |
| 4 | Aviation Fuel Practical | | | |

Syllabus

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|---|--|----|---|
| | Distillation of blended aviation fuels 1. Acidity of Aviation fuels 2. Copper corrosion test 3. Silver corrosion test 4. Freezing point of aviation fuels 5. Smoke point of aviation fuels 6. Flash point of aviation fuels 7. Existent gum testing 8. Doctor test using sodium plumbite 9. H ₂ S test using 5% lead acetate 10. Test for water reaction 11. Test for mercaptans of fuel | 30 | 7 |
| 5 | Teacher Specific Content | | |

| | |
|---------------------------------------|---|
| Teaching and Learning Approach | Classroom procedure (mode of transaction) Lecture, assignments and seminars |
| Assessment Types | MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory (25 marks) Assignment MCQ Viva Involvement in classroom activities Practical (15 marks) Lab involvement / report/ Lab test |

B. Semester end examination

Theory (50 marks)- 1.5 hrs.

MCQ 10 questions : 10 X 1 = 10

Short answer 4 questions (out of 6): 4 X 3 =12

Short essay 4 questions (out of 6): 4 X 7 = 28

Practical (35 marks)-1 hr.

Lab report: 10

Viva: 10

Writing procedure: 15

References

1. R. Luque, J. Campelo, J. Clark, *Handbook of biofuels production: Processes and technologies*. Wood head Publishing Limited 2011.
2. B. Khandelwal, *Aviation Fuels*, 2021.
3. V.K. Gupta, M.G. Touhy, *Biofuel Technologies*, Springer 2013.
4. C. T. Chong, N. G. Jo-Han, *Biojet Fuels in Aviation Applications: Production, usage and impact of biofuels*, 2021.
5. D. Tuli, S. Kasture, A. Kuila, *Advanced Biofuel Technologies: Present status, challenges and future prospects*, 2021.
6. *Fundamentals of petroleum*, fifth edition, The petroleum extension service, ISBN:0-88698-231-6, 2011.
7. N. Naderpour, *Petrochemical Production Process*, S. B. S Publishers, 2008.
8. K. B. Manjooran, *Modern Petroleum Chemistry–An Overview*, 2016.
9. ASTM Methods, Indian standards (Methods of test for petroleum and its Products).

SUGGESTED READINGS

Syllabus

1. S. Sahay, *Handbook of Biofuels*, 2021.
2. R. Luque, C. Lin, K. Wilson, C. Du, *Handbook of Biofuels Production: Processes and Technologies*, 2022.
3. J. Love, J. A. Bryant, *Biofuels and Bioenergy*, 2017.
4. A. Demirbas, *Biofuels: Securing the Planet's Future energy needs*, 2010.
5. A. Dahiya, *Bioenergy: Biomass to biofuels and waste to energy*, 2nd edition, 2020.
6. B. Gurunathan, R. Sahadevan, Z. A. Zakaria, *Biofuels and Bioenergy: Opportunities and Challenges*, 2021.

7. M. Smith, *Aviation Fuels*, 1970.
8. A. Yousuf, C. G. Fernandez, *Sustainable Alternatives for Aviation Fuels*, 2022.
9. C. Chunk, *Biofuels for Aviation: Feedstocks, Technology and Implementation*, 2016.
10. J. G. Speight, *Handbook of Petroleum Product Analysis*, 2nd Edn, Wiley 2014.
11. B. Khandelwal, *Aviation Fuels*, Academic press, UK, 2021.
12. J. Gammon, *Aviation Fuel Quality Control Procedures*, 3rd edition, ASTM international publishers, 2004.



MGU-UGP (HONOURS)

Syllabus



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Kottayam

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|-------------------------------|--|---------|----------|-----------|--------|-------------|
| Programme | | | | | | |
| Course Name | ATF and Latest Development in Fuel Technology | | | | | |
| Type of Course | DSC C | | | | | |
| Course Code | MG4DSCPEG200 | | | | | |
| Course Level | 200-299 | | | | | |
| Course Summary | This course deals with ATF and latest developments in fuel technology. The students will be exposed to drilling operations, oil field brines, transportation and refining of petroleum | | | | | |
| Semester | III | Credits | | | | Total Hours |
| Course Details | Learning Approach | Lecture | Tutorial | Practical | Others | |
| | | 3 | | 1 | | 75 |
| Pre-requisites, if any | NIL | | | | | |

MGU-UGP (HONOURS)

COURSE OUTCOMES (CO)

| CO No. | Expected Course Outcome | Learning Domains * | PO No |
|--------|--|--------------------|-----------|
| 1 | Summarise the advantages of biofuels | U | 3 |
| 2 | Utilise ethanol as a biofuel | A | 1,2,3,6,7 |
| 3 | Classify the types of aviation fuels | U | 2,3 |
| 4 | Examine the test methods of aviation fuel | An | 1,2,3,6,7 |
| 5 | Design the manufacturing methods of aviation fuels | C | 1,2,3,6,7 |
| 6 | Discover alternative aviation fuels | An | 1,2,3,6,7 |
| 7 | Solve different test methods for aviation fuels | C | 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 Biofuels | | | |
| 1 | 1.1 | Biofuels-key advantages of biofuels, development of biological conversion technologies, integration of biofuels into biorefineries, environmental and economic sustainability of biofuels. | 5 | 1 |
| | 1.2 | Ethanol as a biofuel-commercial production technology (dry milling/wet milling), properties, engine performance and ethanol-fuel testing, E-85 fuels. Environmental aspects of ethanol as a biofuel-significance in the aviation sector and its concerns. | 10 | 2 |
| 2 | Aviation Fuels | | | |
| | 2.1 | Aviation fuels: Chemical composition and methods of obtaining ATF from crude oil, physico- chemical and functional properties of aviation fuels -AV Gas for piston engines, aviation kerosene and broad fraction fuels for turbine engines. Technology of fuel preparation before application to aircraft tanks. Sustainable aviation fuels (SAF), Bio-Aviation Turbine fuel (Bio-ATF). | 5 | 3 |
| | 2.2 | Aviation biofuels and technologies for their production. Different types of Aviation fuels and analysis: copper corrosion, aromatics, naphthalene content, silver corrosion , Water Separo meter Index, JFTOT, anti-oxidants, Static Dissipative Additives (SDA), distillation, total sulphur, mercaptans, lubricity, smoke point, freezing point, specific energy value. Anti-knock performance, research octane number, motor octane number, road octane number. | 10 | 4 |

| | | | | |
|-----|--|--|----|---|
| 3 | Manufacture of Aviation Fuels | | | |
| | 3.1 | Different methods of manufacture: hydro desulphurization, merox process, hydro treating process, atmospheric distillation. Main components in Jet (Turbine) fuel, performance criteria of ATF. Physical and chemical properties of ATF. | 5 | 5 |
| | 3.2 | Additives- lubricity additives, conductivity additives, multi-functional additives (MFA) and other additives | 5 | 5 |
| 3.3 | Alternative Aviation fuels-First vs second generation biofuels-advantages of second generation biofuels-success criteria for biofuels in aviation. | 5 | 6 | |
| 4 | Aviation Fuel Practical | | | |
| | | Distillation of blended aviation fuels 1. Acidity of Aviation fuels 2. Copper corrosion test 3. Silver corrosion test 4. Freezing point of aviation fuels 5. Smoke point of aviation fuels 6. Flash point of aviation fuels 7. Existent gum testing 8. Doctor test using sodium plumbite 9. H ₂ S test using 5% lead acetate 10. Test for water reaction 11. Test for mercaptans of fuel | 30 | 7 |
| 5 | Teacher Specific content | | | |

| | |
|---------------------------------------|---|
| Teaching and Learning Approach | Classroom procedure (mode of transaction) Lecture, assignments and seminars |
|---------------------------------------|---|

| | |
|-------------------------|---|
| Assessment Types | MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory (25 marks) Assignment MCQ Viva Involvement in classroom activities Practical (15 marks) Lab involvement / report/ Lab test |
| | B. Semester end examination Theory (50 marks)- 1.5 hrs. MCQ 10 questions : 10 X 1 = 10 Short answer 4 questions (out of 6): 4 X 3 =12 Short essay 4 questions (out of 6): 4 X 7 = 28 Practical (35 marks)-1 hr. Lab report: 10 Viva: 10 Writing procedure: 15 |

References

1. R. Luque, J. Campelo, J. Clark, *Handbook of biofuels production: Processes and technologies*. Wood head Publishing Limited 2011.
2. B. Khandelwal, *Aviation Fuels*, 2021.
3. V.K. Gupta, M.G. Touhy, *Biofuel Technologies*, Springer 2013.
4. C. T. Chong, N. G. Jo-Han, *Biojet Fuels in Aviation Applications: Production, usage and impact of biofuels*, 2021.
5. D. Tuli, S. Kasture, A. Kuila, *Advanced Biofuel Technologies: Present status, challenges and future prospects*, 2021.
6. *Fundamentals of petroleum*, fifth edition, The petroleum extension service, ISBN:0-88698-231-6, 2011.
7. N. Naderpour, *Petrochemical Production Process*, S. B. S Publishers, 2008.
8. K. B. Manjooran, *Modern Petroleum Chemistry–An Overview*, 2016.
9. ASTM Methods, Indian standards (Methods of test for petroleum and its Products).

SUGGESTED READINGS

1. S. Sahay, *Handbook of Biofuels*, 2021.
2. R. Luque, C. Lin, K. Wilson, C. Du, *Handbook of Biofuels Production: Processes and Technologies*, 2022.
3. J. Love, J. A. Bryant, *Biofuels and Bioenergy*, 2017.
4. A. Demirbas, *Biofuels: Securing the Planet's Future energy needs*, 2010.
5. A. Dahiya, *Bioenergy: Biomass to biofuels and waste to energy*, 2nd edition, 2020.
6. B. Gurunathan, R. Sahadevan, Z. A. Zakaria, *Biofuels and Bioenergy: Opportunities and Challenges*, 2021.
7. M. Smith, *Aviation Fuels*, 1970.
8. A. Yousuf, C. G. Fernandez, *Sustainable Alternatives for Aviation Fuels*, 2022.
9. C. Chunk, *Biofuels for Aviation: Feedstocks, Technology and Implementation*, 2016.
10. J. G. Speight, *Handbook of Petroleum Product Analysis*, 2nd Edn, Wiley 2014.
11. B. Khandelwal, *Aviation Fuels*, Academic press, UK, 2021.
12. J. Gammon, *Aviation Fuel Quality Control Procedures*, 3rd edition, ASTM international publishers, 2004.

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