PRESIDENCY UNIVERSITY

Private University Estd. in Karnataka State by Act No. 41 of 2013

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

PRESIDENCY GROUP OVER 40 YEARS OF ACADEMIC WISDOM

SCHOOL OF ENGINEERING

DEPARTMENT OF PETROLEUM ENGINEERING

Details of SKILL DEVELOPMENT Courses

Course Code: **PET1001**	**Course Title:** **Petroleum Geology** **Type of Course:** **1] Program Core** **2] Laboratory Integrated**	**L- P- C**	3	2	4
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	The course will deal with different essential aspects of Petroleum Geology like evaluating petroleum systems by analyzing the properties of the source, reservoir, and cap rocks; understanding the processes of generation, migration, and entrapment of hydrocarbon at different environmental conditions; visualizing the mechanisms of formation of sedimentary basins and differentiate their types based on hydrocarbon prospect, etc. This course will also discuss its implications at different stages in the oil and gas industry.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Petroleum Geology and attain **Skill Development** through **Experiential Learning** techniques.				
Course Outcomes:	On successful completion of the course, the student shall be able to: CO1: describe different processes acting below and above the surface of the earth, CO2: explain the role of petroleum system in the oil and gas industry, CO3: recognize different types of sedimentary basins and sedimentary environments, CO4: apply basic knowledge of geology while performing laboratory experiments.				
Course Content:					

Module 1:	Overview of Geology and Geological Processes	e-resource Review / Report Writing	Writing Communication / Analytical Skills Development	08 Periods

Topics:
Introduction to Geology: Definition of Geology, Branches of Geology, Importance of Geology in Petroleum Engineering.
The Solar System and the Earth: Orbital Characteristics of the Earth, Shape of the Earth, Physical Characteristics of the Earth, Origin of the Earth, Envelopes of the Earth, Internal Structure of the Earth, Chemical Composition of the Earth, Origin of Heat of the Earth, Age of the Earth.
Dynamic Processes of the Earth: Internal Processes - Plate Tectonics, Continental Drift, Earthquake, and Volcanism, External Processes - Weathering, Erosion, Transportation, and Deposition.

Module 2:	Petroleum Geology and Petroleum Systems	Poster Designing and Presentation	Verbal Communication Skill Development	18 Periods

Topics:
Petroleum Geology: Definition of Petroleum Geology, Responsibilities of Petroleum Geologists.
Petroleum Systems: Definition, Concept of Petroleum System, Essential Elements of Petroleum System - Source Rock - Definition, Origin of Petroleum, Organic rich Sediments, Source Rock Materials, Nature and Types of Source Rocks, Conversion of Organic Materials to Hydrocarbons, Generation of Hydrocarbons, Kerogen, Evaluation of Petroleum Source Rock Potential, Subsurface condition for Petroleum Generation, Oil Window. Reservoir Rock - Definition, Characteristics of Reservoir Rocks, Principle properties of Reservoir Rocks, Clastic Reservoirs, Carbonate Reservoirs, Conventional and Unconventional Reservoirs, Fractures Reservoirs, Properties of Reservoir, Understanding the parameters to evaluate Reservoirs. Seal (Cap) Rock - Definition, Mechanism of Sealing, Factors affecting the effectiveness of Cap Rocks. Overburden Rock. Processes of Petroleum System – Generation of Hydrocarbons. Migration of Hydrocarbons - Definition, Types of Migration, Processes of Migration, Oil and Gas Seepages, Factors affecting Primary and Secondary Migrations – Buoyancy, Surface Tension, Capillary Pressure, Tilted Oil-Water Contact – Spill Point, Lateral Migration, Vertical Migration. Accumulation of Hydrocarbons - Definition, Pre-requisites for Formation and Accumulation of Hydrocarbons, Entrapment of Hydrocarbons - Definition, Classification of Traps, Traps associated with diapir.

Module 3:	Sedimentary Basins and Depositional Environments	Quiz / Written Tests	Preparedness for Competitive Exams	07 Periods

Topics:

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Sedimentary Basin: Definition, Mechanisms of Basin Formation, Plate Tectonics and Sedimentary Basins; Classification of Sedimentary Basins; Sedimentary Basins of India.
Depositional Environments: Continental Environments, Marginal-Marine Environments, Siliciclastic Marine Environments, Carbonate and Evaporite Environments.

Module 4:	Laboratory Experiments	Quiz / Viva-Voce / Lab Performance Test	Evaluation for Real-life Situations	22 Periods

Topics:
Introduction to Mapping: Definition, Purpose of Maps, Types of Maps, Analysis of Contour Maps, Interpretation of Geological Maps. Related Experiment No.: 1A, 1B, 1C, 1D, 1E, and 2.
Mineralogy: Definition of Mineral, Importance of study of minerals, Different methods to identify minerals, Identification of minerals in hand specimen. Related Experiment No.: 3A, and 3B.
Petrology: Definition of Rock, Classification of rocks, Rock Cycle, Distinguishing properties of Rocks. Related Experiment No.: 4A, 4B, and 4C.
Introduction to Geological Structures and their Measurements: Folds, Faults, Joints, Fractures, Unconformity, Measurement of Planar and Linear features. Related Experiment No. 5, and 6.

List of Laboratory Tasks:

Experiment No. 1: Analysis of different Contour Profiles
Level 1: To draw and interpret the contour profile in the given map along Section line A-A′ (Exp. No. 1A)
Level 2: To draw and interpret the contour profile in the given map along the Section line A-B (Exp. No. 1B)
Level 3: To draw and interpret the contour profile along Section X-Y (Exp. No. 1C)
Level 4: To draw and interpret the contour profile in the map along Section A-B (Exp. No. 1D)
Level 5: To interpret the 3-D schematic diagrams and the contour profiles given for six V-shaped valleys (Exp. No. 1E)

Experiment No. 2: Interpretation of Geological Maps
Level 1: In the given map, a part of the geological outcrops are shown. Complete the geological outcrops.
Level 2: In the given map, the geological outcrops are shown. Explain the relationship between lithological boundary and contour lines and determine the dip of the bed.
Level 3: In the given map, the geological outcrops are shown. Draw a vertical column showing each bed to scale: 1cm:100m and draw a section along Section line A-B (Contours in meters).

Experiment No. 3: Identification of minerals in the hand specimen
Level 1: To study the physical properties of any given mineral in the hand specimen
Level 2: To study the physical properties of rock-forming minerals
Level 3: To study the physical properties of ore minerals

Experiment No. 4: Identification of rocks in the hand specimen
Level 1: To study the physical properties of any given rock in the hand specimen
Level 2: To study the physical properties of igneous rocks
Level 3: To study the physical properties of sedimentary rocks
Level 4: To study the physical properties of metamorphic rocks

Experiment No. 5: Estimation of Dip and Strike of Planer Surface using Clinometer Compass
Level 1: To estimate the dip and strike of a given planar surface in the laboratory
Level 2: To identify a suitable planer surface in the field and estimate the attitude of the same planer surface

Experiment No. 6: Estimation of Plunge and Trend of Linear Features using Clinometer Compass
Level 1: To estimate plunge and trend of given linear feature in laboratory
Level 2: To identify suitable linear feature in the field and estimate attitude of the same planer surface

Targeted Application and Tools that can be used:
Application: Geoscientist or Wellsite Geologist at Oil & Gas industry.
Tools: Microsoft Excel and other Data Analysis Tools

Text Book:
T1: Knut Bjørlykke, Petroleum Geoscience: From Sedimentary Environments to Rock Physics, Springer Berlin Heidelberg, 2nd Edition, 2015.
T2: Richard C. Selley, and Stephen A. Sonnenberg, Elements of Petroleum Geology, 3rd Edition, Elsevier Science, 2014.
T3: Richard J. Lisle, Peter J. Brabham, and John W. Barnes, Basic Geological Mapping, 5th Edition, Wiley-Blackwell, 2011.
T4: Maurice E. Tucker, Sedimentary Rocks in the Field – The Geological Field Guide Series, 3rd Edition, Wiley, 2003
T5: R.E. Chapman, Petroleum Geology, Elsevier Science, 2000.

References:
R1: Caineng Zou, Unconventional Petroleum Geology, Elsevier Science, 2017.
R2: D.H. Welte, B. Harsfieldand and D. R. Baker (Eds.), Petroleum and Basin Evolution – Insights from Petroleum Geochemistry, Geology and Basin Modeling, Springer-Verlag, Berlin Heidelberg, 2012.
R3: Arville Irving Levorsen, Geology of Petroleum, 2nd Edition (Reprint), CBS Publishers & Distributors, 2004.
R4: Richard J. Lisle, Geological Structures and Maps – A Practical Guide, 3rd Edition, Elsevier Butterworth – Heinemann,

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2004.

e-resources:

1. Link for PU e-resources: https://puniversity.informaticsglobal.com/login
2. Link for DGH Website: https://dghindia.gov.in/
3. An Introduction to Geology (YouTube Video): https://www.youtube.com/watch?v=rAYiBSo3JKY
4. From Black Oil to Green Gas (TEDx Talk): https://www.youtube.com/watch?v=Pd4BqGXHxy8
5. What if fossil fuels had never existed? (TEDx Talk): **https://www.youtube.com/watch?v=K67Qou3m4_E**
6. Why renewables can't save the planet (TEDx Talk): **https://www.youtube.com/watch?v=N-yALPEpV4w**
7. Can 100% renewable energy power the world? (TED Ed): **https://www.youtube.com/watch?v=RnvCbquYeIM**
8. CNBC Exclusive Interview with Chevron CEO Mike Wirth: **https://www.youtube.com/watch?v=PG1q8cohcMU**
9. The future of oil & gas: Interview with Head of Research at OPEC: **https://www.youtube.com/watch?v=RCN1hRHq32o**

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. The course attainment will be assessed through assessment component mentioned in course handout.

Catalogue prepared by:	Dr. Suman Paul, Dr. Deepjyoti Mech, and Dr. Kalpajit Hazarika
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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Course Code: **PET1002**	**Course Title: Introduction to Oil and Gas Industry** **Type of Course: 1] Program Core** **2] Theory Only**		**L-P-C**	3	0	3
Version No.:	1.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	The aim of the course is to provide a broad overview of the Oil and Gas industry so that advanced courses can be understood within a broader Petroleum engineering context. The concepts such as oil and gas production, reservoir energy and forces, petroleum deposit drainage, development systems, well operation techniques will be covered. The course will develop an understanding of field life cycle and interdisciplinary approach to petroleum field development and operation.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Introduction to Oil and Gas Industry and attain **Skill Development** through **Participative Learning** techniques.				
Course Outcomes:	Upon successful completion of the course the students shall be able to: CO1: Describe the Oil and Gas industry, CO2: Outline the life cycle of a well, CO3: Summarize Oil and Gas processing facilities, CO4: Review the climate change				
Course Content:					
Module 1:	Introduction to the Oil & Gas Industry	Assignment / Quiz	Literature Survey	08 Periods	
Topics: Introduction to the energy business: energy resources; energy demand and supply. Energy security. Scope of the Oil & Gas industry: producer and consumer countries; national/ independent/ international oil companies; services companies; international organizations. Risks related to the Oil & Gas industry					
Module 2:	Life Cycle of a Well	Assignment / Quiz	Programming	09 Periods	
Topics: Drilling: Organization on well site, Various designation at well site, Drilling rigs, Drilling operations chronology, Reservoir-wellbore interface, Offshore wells					
Module 3:	Oil & Gas Processing Facilities	Assignment, Quiz	Project work	08 Periods	
Topics: Produced fluid properties, well head assembly, Gathering system, Crude oil treatment, Storage, metering and shipment transportation.					
Module 4:	Petroleum and the Environment	Quiz / Team Activity	Literature Survey and Report Submission	10 Periods	
Topics: Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Environmental Pollution, Classification of pollution, Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS) Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montreal Protocol.					
Targeted Applications and Tools that can be used: Application: Oil and Gas Industry Tools: MS Office					
Text Book: T1 John R. Fanchi, Richard L. Christiansen, Introduction to Petroleum Engineering, Wiley; 1st edition, November, https://www.wiley.com/en-us/Introduction+to+Petroleum+Engineering-p-9781119193449 T2 Samir Dalvi, Fundamentals of Oil & Gas Industry for Beginners, Notion Press, First edition, 2015, https://books.google.co.in/books?id=gYfZCgAAQBAJ&source=gbs_similarbooks					
Reference Book(s) R1 Mohamed A. Fahim, Taher A. Al-Sahhaf, Amal Elkilani, Fundamentals of Petroleum Refining, Elsevier Science; 1st edition (December 28, 2009), https://www.elsevier.com/books/fundamentals-of-petroleum-refining/fahim/978-0-444-52785-1 R2 F.A. Giuliano, Introduction to Oil and Gas Technology, Springer Netherlands, 1981, https://books.google.co.in/books/about/Introduction_to_Oil_and_Gas_Technology.html?id=efBvtQAACAAJ&redir_esc=y R3 Havard Devold, Oil and Gas Production Handbook: An Introduction to Oil and Gas Production, Lulu.com, 2013, https://books.google.co.in/books/about/Oil_and_Gas_Production_Handbook_An_Intro.html?id=nJ2XAwAAQBAJ&redir_esc=y					
Case Study: 1. A case study of electrostatic accidents in the process of oil-gas storage and transportation, https://iopscience.iop.org/article/10.1088/1742-6596/418/1/012037 2. Prevention of Major Accidents in the Oil & Gas Industry, https://www.grin.com/document/176591					

e-Resource: 1. Presidency University e-resource Remote Access (KNIMBUS) portal through the shared link: https://presiuniv.knimbus.com/user#/home 2. Introduction to the Oil and Gas Sector (https://youtu.be/k4cVxGndh9g) 3. Oil and Gas Industry Overview (https://youtu.be/O-qiUD9TEtQ) 4. Conflict in the Middle-East OPEC's 1970's Oil Embargo (https://youtu.be/FiLnj5WD0ao) 5. Birth of an oil field 1949 shell oil industrial film (https://youtu.be/uPUC-GDfYO8)	
Topics relevant to "**SKILL DEVELOPMENT**": Energy resources; energy demand and supply for **Skill Development** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by:	Mr. Bhairab Jyoti Gogoi, Dr. Suman Paul, Dr. Deepjyoti Mech, and Dr. Kalpajit Hazarika
Recommended by the Board of Studies on:	12th Meeting of the Board of Studies held on 9th August 2021
Date of Approval by the Academic Council:	16th Meeting of the Academic Council held on 23rd October 2021

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Course Handout: AY 2022-2023

Date of Issue: 07-09-2022
Revised On: N.A.

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2021-25
Semester / Year	:	III / 2nd
Course Code / Title	:	PET1002 / Introduction to Oil and Gas Industry
Course Credit Structure	:	3L-0P-3C
Contact Hours	:	40
Course Instructor In-charge	:	Mr. Bhairab Jyoti Gogoi
Course Instructor	:	Mr. Bhairab Jyoti Gogoi
Course URL	:	N.A.
Program Outcomes (POs)	:	

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable

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development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:

NIL

Course Description:

The aim of the course is to provide a broad overview of the Oil and Gas industry so that advanced courses can be understood within a broader Petroleum engineering context. Participants will learn such concepts as Oil and Gas production, reservoir energy and forces, petroleum deposit drainage, development systems, well operation techniques. Each participant in the course will develop an understanding of field life cycle and interdisciplinary approach to Petroleum field development and operation.

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Introduction to Oil and Gas Industry and attain **Skill Development** through **Participative Learning** techniques.

Course Outcomes (COs):

On successful completion of the course, the student shall be able to:

CO1: Describe the Oil and Gas industry,
CO2: Outline the life cycle of a well,
CO3: Summarize Oil and Gas processing facilities,
CO4: Review the climate change

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	L				M	M	M	M	L	L		M
CO2	H				M	M	M	M	H	L		M
C03	H				M	M	M	M	H	L		M
CO4	H				M	M	M	M	H	L		M
H = High, M = Moderate, L = Low												

Course Content (Syllabus):

Module I: Introduction to the Oil & Gas Industry [8 hours] [Knowledge]

Introduction to the energy business: energy resources; energy demand and supply. Energy security. Scope of the Oil & Gas industry: producer and consumer countries; national/ independent/ international oil companies; services companies; international organizations. Risks related to the Oil & Gas industry

Module II: Life Cycle of a Well [9 hours] [Knowledge]

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Drilling: Organization on well site, Various designation at well site, Drilling rigs, Drilling operations chronology, Reservoir-wellbore interface, Offshore wells

Module III: Oil & Gas Processing Facilities [8 hours] [Comprehension]
Produced fluid properties, well head assembly, Gathering system, Crude oil treatment, Storage, metering and shipment transportation.

Module IV: Petroleum and the Environment [10 hours] Comprehension
Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Environmental Pollution, Classification of pollution, Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS) Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montreal Protocol.

Delivery Procedure (Pedagogy):

This is a theory based course. Most of the lectures will be taken with the help of Power Point Presentations and White Board. Videos will be shown for the better understanding of selective topics. Flip Class Room sessions will be conducted on selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. Assignments, Quiz Competition and Poster Presentation will carry 25% weightage under Continuous Internal Assessment (CIA). Review classes will be conducted to clear doubts and to evaluate the level of understanding of the each student individually.
Following procedures will be adopted in the course for delivering the content:

I. Experiential learning:

1. Article review (Module II) [Foundation/Skill Development/Environment and sustainability]

- "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://presiuniv.knimbus.com/user#/home). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)
- There is no make up for this component

2. Report writing/Social awareness (Module IV) [Foundation/Skill Development/Environment and sustainability]

- This activity comprise of a social awareness program where students will be given a task of going out in the public and aware them about the deteriorating environment and aware them about its ill effect. After the event a report need to be submitted to the Instructor In-charge along with event photos.
- There is no make up for this component

II. Participative learning:

QUIZ (Module I, II, III, IV & V) [Employability]

- After completion of each module a QUIZ will be conducted. The mode of conduction can be either ONLINE or OFFLINE which will be intimated 2-3 day prior to the date of conduction. After completion of all four quiz, marks of the "best of four" will be considered for evaluation.
- There is no make up for this component.

III. Problem solving:

Root cause analysis (Module I) [Skill/Employability]

- A case study/problem statement will be provided to the students and they have to perform root cause analysis with a collection of principles, techniques and methodologies that can all be leveraged to identify the root cause of the event or trend. A final report should be submitted to the Instructor In-Charge on or before the due date.
- There is no make up for this component

Reference Materials:

(a) Textbook(s)

T1 John R. Fanchi, Richard L. Christiansen, Introduction to Petroleum Engineering, Wiley; 1st edition, November, https://www.wiley.com/en-us/Introduction+to+Petroleum+Engineering-p-9781119193449

T2 Samir Dalvi, Fundamentals of Oil & Gas Industry for Beginners, Notion Press, First edition, 2015, https://books.google.co.in/books?id=gYfZCgAAQBAJ&source=gbs_similarbooks

(b) Reference Book(s)

R1 Mohamed A. Fahim, Taher A. Al-Sahhaf, Amal Elkilani, Fundamentals of Petroleum Refining, Elsevier Science; 1st edition (December 28, 2009), https://www.elsevier.com/books/fundamentals-of-petroleum-refining/fahim/978-0-444-52785-1

R2 F.A. Giuliano, Introduction to Oil and Gas Technology, Springer Netherlands, 1981, https://books.google.co.in/books/about/Introduction_to_Oil_and_Gas_Technology.html?id=efBvtQAACAAJ&redir_esc=y

R3 Havard Devold, Oil and Gas Production Handbook: An Introduction to Oil and Gas Production, Lulu.com, 2013, https://books.google.co.in/books/about/Oil_and_Gas_Production_Handbook_An_Intro.html?id=nJ2XAwAAQBAJ&redir_esc=y

(c) Case study:

1. A case study of electrostatic accidents in the process of oil-gas storage and transportation, https://iopscience.iop.org/article/10.1088/1742-6596/418/1/012037
2. Prevention of Major Accidents in the Oil & Gas Industry, https://www.grin.com/document/176591

(d) e-Resource:

1. Presidency University e-resource Remote Access (KNIMBUS) portal through the shared link: https://presiuniv.knimbus.com/user#/home
2. Introduction to the Oil and Gas Sector (https://youtu.be/k4cVxGndh9g)
3. Oil and Gas Industry Overview (https://youtu.be/O-qiUD9TEtQ)
4. Conflict in the Middle-East OPEC's 1970's Oil Embargo (https://youtu.be/FiLnj5WD0ao)
5. Birth of an oil field 1949 shell oil industrial film (https://youtu.be/uPUC-GDfYO8)

Guideline to Students:

(a) About the Course:

This is a theory based course which will provide fundamental concepts of oil and gas industry processes. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students.

(b) Notification / Announcement related to the Course:

All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulations

The students are advised to download the 'Academic Regulations, 2021', Regulation No. PU/AC-15/10/06_2021, from Presidency University, Bengaluru website and go through the Section Nos. 1.0 through 25.0 (https://presidencyuniversity.in/wp-content/uploads/2022/09/Academic-Regulations-2021.pdf).

Course Schedule:

Model-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
01	Over View of the course	12-09-2022	12-09-2022	1
02	Module I	14-09-2022	29-09-2022	8
03	Continuous Internal Assessment (CIA)-***Quiz-1***	30-09-2022	30-09-2022	-

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04	Continuous Internal Assessment (CIA)-***Root cause analysis***	29-09-2022	15-10-2022	-
05	Module II	10-10-2022	9-11-2022	9
06	Continuous Internal Assessment (CIA)-***Quiz-2***	10-11-2022	10-11-2022	-
07	Continuous Internal Assessment (CIA)-***Article review***	10-11-2022	10-11-2022	
08	Discussion of MID TERM syllabus and pattern	02-09-2022	02-09-2022	-
09	Mid Term examination	3-11-2022	7-11-2022	-
10	Discussion of MID TERM question paper	09-09-2022	09-09-2022	
11	Module III	20-11-2022	27-11-2022	8
12	Continuous Internal Assessment (CIA)-***Quiz-3***	28-11-2022	28-11-2022	-
13	Module IV	30-11-2022	21-12-2022	10
14	Continuous Internal Assessment (CIA)-***Quiz-4***	25-12-2022	25-12-2022	-
15	Continuous Internal Assessment (CIA)-***Report writing/Social awareness***	-	-	-
16	End Term Examinations	06-01-2023	25-01-2023	-

Schedule of Instruction:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	**Session No./Date**	**Lesson Title**	**Topics**	**Course Outcome Number**	**Delivery Mode**	**Reference**
Sl. No.	**Session No./Date**	**Lesson Title**	**Topics**	**Course Outcome Number**	**Delivery Mode**	**Reference**
1	L01/ 12-09-2022	Program Integration	Overview of the course	-	Lecture / Presentation/White board/White board	N.A.
Module I						
2	L02/ 14-09-2022	Introduction to Oil and Gas industry	Introduction to the energy business: energy resources	CO1	Lecture / Presentation/White board/White board	T1 Ch01/Class Notes
3	L03/ 15-09-2022		Energy demand and supply	CO1	Lecture / Presentation/White board/White board	T1 Ch01/Class Notes
4	L04/ 19-09-2022		Energy security	CO1	Lecture / Presentation/White board	T1 Ch01/Class Notes
5	L05/21-09-2022		Scope of the Oil & Gas industry	CO1	Lecture / Presentation/White board	T1 Ch01/Class Notes
6	L06/ 22-09-2022		Producer and consumer countries	CO1	Lecture / Presentation/White board	T1 Ch01/Class Notes
7	L07/ 26-09-2022		National/ independent/ international oil companies	CO1	Lecture / Presentation/White board	T1 Ch01/Class Notes

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8	L08/ 28-09-2022		Services companies, International organizations	CO1	Lecture / Presentation/White board	T1 Ch01/Class Notes
9	L09/ 29-09-2022		Risks related to the Oil & Gas industry	CO1	Lecture / Presentation/White board	T1 Ch01/Class Notes
-	-		Continuous Internal Assessment (CIA)- ***Quiz-1***	CO1	-	-
-	-		Continuous Internal Assessment (CIA)-***Root cause analysis***	CO1	-	-
Module II						
10	L10/ 06-10-2022	Life cycle of a well	Organization of well sites	CO2	Lecture / Presentation/White board	T1 Ch02/Class notes
11	L11/ 10-10-2022		Organization of well sites	CO2	Lecture / Presentation/White board	T1 Ch02/Class notes
12	L12 / 12-10-2022		Various designation at well site	CO2	Lecture / Presentation/White board	T1 Ch02/Class notes
13	L13/ 13-10-2022		Drilling rigs	CO2	Lecture / Presentation/White board	T1 Ch02/Class notes
14	L14/17-10-2022		Drilling operation technology	CO2	Lecture / Presentation/White board	T1 Ch02/Class notes
15	L15/ 19-10-2022		Drilling operation chronology	CO2	Lecture / Presentation/White board	T1 Ch02/Class notes
16	L16/ 20-10-2022		Reservoir well bore interface	CO2	Lecture / Presentation/White board	T1 Ch02/Class notes
17	L17/ 27-10-2022		Reservoir well bore interface	CO2	Lecture / Presentation/White board	T1 Ch02/Class notes
18	L18/ 02-11-2022		*Discussion of MID TERM syllabus and pattern*	-	Lecture / Presentation/White board	-
-	-		*MID TERM Examination*	-	-	-
19	L19/ 09-11-2022		*Discussion of MID TERM question paper*	-	Lecture / Presentation/White board	-
20	L20/ 10-11-20222		Offshore wells	CO2	Lecture / Presentation/White board	T1 Ch02/Class notes
-	-		Continuous Internal Assessment (CIA)- ***Quiz-2***	-	-	-
-	-		Continuous Internal Assessment (CIA)- ***Article Review***	-	-	-
Module III						
21	L21/ 14-11-2022		Produce fluid properties			
22	L22/ 16-11-2022	Oil & Gas Processing Facilities	Produce fluid properties	CO3	Lecture / Presentation/White board	T1 Ch03/Class Notes

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23	L23/17-11-2022		Well head assembly	CO3	Lecture / Presentation/White board	T1 Ch03/Class Notes
24	L24/21-11-2022		Gathering system	CO3	Lecture / Presentation/White board	T1 Ch03/Class Notes
25	L25/ 23-11-2022		Crude oil treatment	CO3	Lecture / Presentation/White board	T1 Ch03/Class Notes
26	L26/ 24-11-2022		Storage	CO3	Lecture / Presentation/White board	T1 Ch03/Class Notes
27	L27/ 28-11-2022		Metering	CO3	Lecture / Presentation/White board	T1 Ch03/Class Notes
28	L28/ 28-11-2022		Transportation	CO3	Lecture / Presentation/White board	T1 Ch03/Class Notes
			Continuous Internal Assessment (CIA)- ***Quiz-3***	-	-	-
Module IV						
29	L29/ 30-11-2022		Definition, Scope and Importance of ecosystem			
30	L30/ 01-12-2022	Petroleum and the Environment	Classification, structure, and function of an ecosystem	CO4	Lecture / Presentation/White board	Class notes
31	L31/5-12-2022		Environmental Pollution	CO4	Lecture / Presentation/White board	Class notes
32	L32/ 07-12-2022		Classification of pollution	CO4	Lecture / Presentation/White board	Class notes
33	L33/ 08-12-2022		Climate change and impacts on human environment	CO4	Lecture / Presentation/White board	Class notes
34	L34/ 12-12-2022		Ozone depletion and Ozone depleting substances (ODS) Deforestation and desertification	CO4	Lecture / Presentation/White board	Class notes
35	L35/ 14-12-2022		International conventions / Protocols	CO4	Lecture / Presentation/White board	Class notes
36	L36/ 15-12-2022		Earth summit	CO4	Lecture / Presentation/White board	Class notes
37	L37/ 19-12-2022		Kyoto protocol	CO4	Lecture / Presentation/White board	Class notes
38	L38/ 21-12-2022		Montreal Protocol	CO4	Lecture / Presentation/White board	Class notes
-	-		Continuous Internal Assessment (CIA)- ***Quiz-4***	-	-	-
-	-		Continuous Internal Assessment (CIA)-	-		-

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		Report writing/Social awareness			
39	L39/ 22-12-2022	Course Integration	-	-	-
40	L40/ 29-12-2022	Discussion on END Term Question paper and Pattern	-	-	-

Topics relevant to "**SKILL DEVELOPMENT**": Energy resources; energy demand and supply for **Skill Development** through **Participative Learning** techniques. This is attained through the Presentation as mentioned in the assessment Schedule.

Assessment Schedule:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time
01	**Continuous Internal Assessment (CIA)**- *Root cause analysis*	L02-L09	CO1	-	10	5%	-
02	Mid Term	L03 – L17	CO1, CO2	2	50	25%	03-11-2022 to 07-11-2022
03	Assignment: Report – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://presiuniv.knimbus.com/user#/home). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.	L30 - L38	CO4	-	10	5%	-
04	**Continuous Internal Assessment (CIA)-** Social awareness/report submission	L30-L38	CO4	-	10	10%	-
05	**Continuous Internal Assessment (CIA)**- *Quiz-1,2,3,4*	L02-L37	CO1, CO2, CO3, CO4	-	10	5%	-
06	End Term Examinations	L03 - L38	CO1, CO2, CO3, CO4	3	100	50%	06-01-2023 to 25-01-2023

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Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2021', Regulation No. PU/AC-15/10/06_2021, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2022/09/Academic-Regulations-2021.pdf) and go through the Section Nos. 1.0 through 25.0. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, Head of the Department, and Dean (School of Engineering) for further assistance.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1	If you were the Rig Supervisor of the Deep Water Horizon rig, then what difference you would have made to prevent the extent the disaster.	10	CO1	Comprehension
2	"*Timelines and actors in the oil and gas industry lifecycle*", Illustrate the quoted sentence.	10	CO2	Comprehension
3	Throughout the world there has been an increase in the use of renewable energy sources such as solar, wind, geothermal, biomass etc for electrical power generation. These renewable energy sources provide many benefits especially on the environmental aspects. In Malaysia, PV systems are most suitable as the country receives a rather high level of irradiance. However, the use of renewable energy in Malaysia is still low despite the potential. 1. Discuss some of the issues or concerns that contribute to this. Try to consider the issues in terms of cost, environment, safety, policy etc. 2. Propose a suitable PV system if you are to consider installing the system to one of the lecture rooms in the Engineering Faculty. You may use the following plans: 1. Conduct a simple survey of the power consumption based on the available electrical equipment/apparatus/appliances etc and hours of usage	10	CO3	Comprehension
4	Given that renewable sources provide only a small percentage of our energy and that nuclear power is so expensive, what can we realistically do to get off fossil fuels as soon as possible?	10	C04	Comprehension

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Describe the Oil and Gas industry	55
2	CO2	Outline the life cycle of a well,	55
3	CO3	Summarize Oil and Gas processing facilities	50

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4	CO4	Review the climate change	50

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

Signature of the Chairperson DAC:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
01	Continuous Internal Assessment (CIA)-***Root cause analysis***	-		
02	Mid Term	03-11-2022 to 07-11-2022		
03	Assignment: Report – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://presiuniv.knimbus.com/user#/home). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)	-		
04	Continuous Internal Assessment (CIA)-***Quiz-1,2,3,4***	-		
05	Continuous Internal Assessment (CIA)-***Report writing/Social awareness***			
06	End Term Examinations	05-01-2023 to 25-01-2023		

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

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Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Describe the Oil and Gas industry	55		
2	CO2	Outline the life cycle of a well,	55		
3	CO3	Summarize Oil and Gas processing facilities,	50		
4	CO4	Review the geology of ocean.	60		

Name and Signature of the Course Instructor:

DAC Observation and Approval:

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Course Code: **PET1005**	**Course Title:** **Geology for Engineers** **Type of Course:** **1] Open Elective** **2] Theory Only**	**L-P-C**	2	0	2
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	This conceptual course is designed so that students will be able to grasp the integrated dynamic processes acting on/beneath the Earth's surface, link the deep Earth with its crust, and visualize the associated environments. This knowledge is applied to contemporary geological and socio-environmental problems, including natural and anthropogenic change and the sustainable development of resources. A structured approach would be adopted to engage, relate and contextualize the fundamentals of the Earth System. The level of understanding will be tested through Geology Laboratory / Field visits and assignments.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Geology for Engineers and attain **Skill Development** through **Participative Learning** techniques.				
Course Outcomes:	Upon successful completion of the course the students shall be able to: CO1: describe planet earth and its dynamic processes, CO2: explain various geological resources of the Earth, CO3: relate different geological structures and geomorphological features, and CO4: summarize the implications of climate change.				
Course Content:					
Module 1:	Introduction to Geology and the Planet Earth	e-resource Review / Report Writing	Writing Communication / Analytical Skills Development	05 Periods	
Topics: Introduction to Geology: Definition, Branches of Geology, Scope of Geology for Engineers. Planet Earth: Origin, Shape, Physical Characteristics, Envelopes, Internal Structure, Chemical Composition, Internal Heat Source, and Age of the Earth, Uniformitarianism and Catastrophism, Geologic Time, Dynamic Processes - Introduction, Internal Dynamic Processes - Plate Tectonics, Continental Drift, Earthquake, Volcanism, External Dynamic Processes – Weathering, Erosion, Transportation, Deposition, Burial, Diagenesis.					
Module 2:	Minerals, Rocks, and Geological Resources	Poster Designing and Presentation	Verbal Communication Skill Development	04 Periods	
Topics: Minerals: Definition; Importance of Study of Minerals; Methods of Mineral Identification. Rocks: Definition; Classification of Rocks - Igneous Rocks, Sedimentary Rocks, and Metamorphic Rocks; Rock Cycle; Uses of Rocks; Visit to Geology Laboratory. Geological Resources: Introduction, Metal Deposits, Industrial Materials, Fossil Fuels, Diamonds.					
Module 3:	Geological Structures and Geomorphology	Quiz / Written Tests	Preparedness for Competitive Exams	05 Periods	
Topics: Geological Structures: Introduction, Horizontal and Dipping Strata – Dip, and Strike, Unconformity, Folds, Faults, Joints. Geomorphology: Introduction, Geomorphic Processes and Form, Geomorphic System, Plate Tectonics and associated Structural Landforms, Volcanoes, Impact Craters, Weathering and associated Landforms.					
Module 4:	Geology of the Oceans and Climate Change	Quiz / Team Activity	Literature Survey and Report Submission	05 Periods	
Topics: Geology of the Ocean: Introduction, Topography of the Sea Floor, Geology of the Oceanic Crust, Sea-Floor Sediments, Ocean Water. Climate Change: Introduction, Greenhouse Gas, Natural Climate Forcing, Climate Feedbacks, Anthropogenic Climate Change, Implications of Climate Change.					
Targeted Applications and Tools that can be used: **Application:** Mineral Resource Analyst in Mineral Exploration Company **Tools:** Clinometer Compass / GPS, Geological Hammer, Hand Lens, Magnet, and Mohs Hardness Testing Kit.					
Text Book: T1. Blyth, F.G.H., "A Geology for Engineers", 7th Edition, Elsevier, 2005. T2. Mahapatra, G.B., "Text Book of Physical Geology", CBS Publishers and Distributors Pvt. Ltd., New Delhi, 2019. T3. Graham R. Thompson, Jonathan Turk, "Introduction to Physical Geology", Saunders College, Pub., The University of California, 1998. T4. Richard John Huggett, "Fundamentals of Geomorphology", Routledge (Taylor & Francis Group), 2nd Edition, 2007.					
References: R1. Dasgupta, A., "An Introduction to Earth Science", The World Press Private Limited, Kolkata, 2013. R2. Sam Boggs, Jr., "Principles of Sedimentology and Stratigraphy" 4th Edition, Pearson Prentice Hall, 2006. R3. Thomas McGuire, "Earth Science – The Physical Setting", Amsco School Publications, Inc, 2009					

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R4. Francisco Borrero, Frances Scelsi Hess, Juno Hsu Gerhard Kunze, Stephen A. Leslie, Stephen Letro Michael Manga, Len Sharp, Theodore Snow, Dinah Zike, "Earth Science – Geology, the Environment, and the Universe", McGraw Hill Companies, Inc. 2008.
R5. Edward J. Tarbuck, Frederick K. Lutgens, "Earth Science", Pearson Education, Inc., 14th Edition, 2015.
R6. Diane H. Carlson, Charles C. Plummer, Lisa Hammersley, "Physical Geology: Earth Revealed", McGrill Hill Companies, Inc. 9th Edition, 2011.

e-resources:
1. Link for PU e-resources: https://puniversity.informaticsglobal.com/login
2. Rocks and Minerals: https://www.youtube.com/watch?v=qFEBPD3JEOM
3. Geological Resources: https://www.youtube.com/watch?v=wxQE11QxRrQ
4. Climate Change: https://www.youtube.com/results?search_query=climate+change
5. Geology Writing Guide: https://libraryguides.oswego.edu/c.php?g=587313&p=4069077

Topics relevant to "SKILL DEVELOPMENT": Geomorphology for **Skill Development** through **Participative Learning** techniques**.** This is attained through assessment component mentioned in course handout.

Catalogue prepared by:	Dr. Suman Paul, Dr. Deepjyoti Mech, and Dr. Kalpajit Hazarika
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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PRESIDENCY UNIVERSITY

(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Handout

Date of Issue: 05-08-2019
Revised On:

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2019-23
Semester / Year	:	V / 3rd
Course Code / Title	:	PET 1005 / Geology for Engineers
Course Credit Structure	:	2L-0P-2C
Contact Hours	:	43
Course Instructor In-charge	:	Dr. Suman Paul
Course Instructor	:	Dr. Suman Paul
Course URL	:	

Program Outcomes (POs):

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO 01: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 02: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 03: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 04: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 05: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 06: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 07: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 08: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 09: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

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Course Prerequisites:

NIL

Course Description:

This conceptual course is designed so that students will be able to grasp the integrated dynamic processes acting on/beneath the Earth's surface, link the deep Earth with its crust, and visualize the associated environments. This knowledge is applied to contemporary geological and socio-environmental problems, including natural and anthropogenic change and the sustainable development of resources. A structured approach would be adopted to engage, relate and contextualize the fundamentals of the Earth System. The level of understanding will be tested through Geology Laboratory / Field visits and assignments.

Course Outcome:

The objective of the course is to familiarize the learners with the concepts of Geology for Engineers and attain **Skill Development** through **Participative Learning** techniques.

Course Outcomes (COs):

Upon successful completion of the course the students shall be able to:
CO1: describe planet earth and its dynamic processes,
CO2: explain various geological resources of the Earth,
CO3: relate different geological structures and geomorphological features, and
CO4: summarize the implications of climate change.

Mapping of COs with POs:

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	P0 10	PO 11	PO 12
CO1	L					L			L	L		M
CO2	M	M			L	L	L	L	M	M		M
C03	M	M			L	L	L	L	M	M		M
CO4	M	H			M	M	L	L	H	H		H
CO5	H	H			H	M	M	M	H	H		H
H = High, M = Moderate, L = Low												

Course Content (Syllabus):

Module1: Introduction to Geology and the Planet Earth [05 Periods] – Knowledge Level

Introduction to Geology: Definition, Branches of Geology, Scope of Geology for Engineers.

Planet Earth: Origin, Shape, Physical Characteristics, Envelopes, Internal Structure, Chemical Composition, Internal Heat Source, and Age of the Earth, Uniformitarianism and Catastrophism, Geologic Time, Dynamic Processes - Introduction, Internal Dynamic Processes - Plate Tectonics, Continental Drift, Earthquake, Volcanism, External Dynamic Processes – Weathering, Erosion, Transportation, Deposition, Burial, Diagenesis.

Module 2: Minerals, Rocks, and Geological Resources [4 Periods] – Application Level

Minerals: Definition; Importance of Study of Minerals; Methods of Mineral Identification.

Rocks: Definition; Classification of Rocks - Igneous Rocks, Sedimentary Rocks, and Metamorphic Rocks; Rock Cycle; Uses of Rocks; Visit to Geology Laboratory.

Geological Resources: Introduction, Metal Deposits, Industrial Materials, Fossil Fuels, Diamonds.

Module 3: Geological Structures and Geomorphology [5 Periods] – Application Level

Geological Structures: Introduction, Horizontal and Dipping Strata – Dip, and Strike, Unconformity, Folds, Faults, Joints.

Geomorphology: Introduction, Geomorphic Processes and Form, Geomorphic System, Plate Tectonics and associated Structural Landforms, Volcanoes, Impact Craters, Weathering and associated Landforms.

Module 4: Geology of the Oceans and Climate Change [5 Periods] – Application Level

Geology of the Ocean: Introduction, Topography of the Sea Floor, Geology of the Oceanic Crust, Sea-Floor Sediments, Ocean Water.

Climate Change: Introduction, Greenhouse Gas, Natural Climate Forcing, Climate Feedbacks, Anthropogenic Climate Change, Implications of Climate Change.

Delivery Procedure (Pedagogy):

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This is a theory-based course. Most of the lectures will be taken with the help of Power Point Presentations and White Board. Videos will be shown for the better understanding of selective topics. Exercises will be discussed specific topics and home assignments will be given to judge the understanding level of the students. Assignments / Mini Project will be given to the students after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. Report Submission, Quiz Competition, Poster Presentation, and Group Discussion will carry 20% weightage under Continuous Assessment 3 (CA 3). Review classes will be conducted to clear doubts and to evaluate the level of understanding of each student individually.

Following procedures will be adopted in the course for delivering the content:

(a) Self Learning Topics (SLT):
- Volumetric Gas-in-Place Calculations for CBM Reservoir (Unit III)
- Material Balance Calculation for CBM Reservoir (Unit III)
- Petrophysical Evaluation of Gas Shale Reservoirs – Key Properties of Gas Shale Evaluation (Unit IV)
- Geomechanics of Gas Shales – Mechanical Properties of Gas Shales, Wellbore Instability of Gas Shale Reservoirs (Unit IV)

(b) Experiential Learning Topics (ELT):
- Identification of Coal Beds and Estimation of Stress Magnitudes using Well Log Data (Unit III)

(c) Participative Learning Topics (PLT):
- Coal Bed Methane (Unit III) – Poster Presentation
- Shale Gas (Unit IV) – Poster Presentation
- Natural Gas Hydrates (Unit V) – Poster Presentation

(d) Technology Enabled Learning Topics (TET):
- Determination of Stress Orientation using Cleat Study Data (Unit III) – Use of 'GeoRose' software

(e) Problem Based Learning Topics (PBLT):
- Natural Gas Hydrate Exploration Strategy Discussion

Reference Materials:

Textbook:

T1. Blyth, F.G.H., "A Geology for Engineers", 7th Edition, Elsevier, 2005.
T2. Mahapatra, G.B., "Text Book of Physical Geology", CBS Publishers and Distributors Pvt. Ltd., New Delhi, 2019.
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R2. Sam Boggs, Jr., "Principles of Sedimentology and Stratigraphy" 4th Edition, Pearson Prentice Hall, 2006.
R3. Thomas McGuire, "Earth Science – The Physical Setting", Amsco School Publications, Inc, 2009
R4. Francisco Borrero, Frances Scelsi Hess, Juno Hsu Gerhard Kunze, Stephen A. Leslie, Stephen Letro Michael Manga, Len Sharp, Theodore Snow, Dinah Zike, "Earth Science – Geology, the Environment, and the Universe", McGraw Hill Companies, Inc. 2008.
R5. Edward J. Tarbuck, Frederick K. Lutgens, "Earth Science", Pearson Education, Inc., 14th Edition, 2015.
R6. Diane H. Carlson, Charles C. Plummer, Lisa Hammersley, "Physical Geology: Earth Revealed", McGrill Hill Companies, Inc. 9th Edition, 2011.

e-resources:

1. Link for PU e-resources: https://puniversity.informaticsglobal.com/login
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3. Geological Resources: https://www.youtube.com/watch?v=wxQE11QxRrQ
4. . Climate Change: https://www.youtube.com/results?search_query=climate+change
5. Geology Writing Guide: https://libraryguides.oswego.edu/c.php?g=587313&p=4069077

Guideline to Students:

(a) About the Course:

Understanding of different unconventional energy resources plays pivotal role in modern Oil and Gas industry because it is visible that the industry is shifting from exploration of conventional reservoirs to unconventional reservoirs like coal bed methane, shale gas, gas hydrates, etc. considering the present energy scenario. This course will focus mainly on coal bed methane exploration and production related topics and also provide basic knowledge about the shale gas and gas hydrate. Basic understanding of Petroleum Geology, Well Logging and Formation Evaluation, Drilling

Engineering, Reservoir Engineering, and Production Engineering will help understanding this course. Hands-on training (use of basic tool) will be provided for calculation of stresses observed in sedimentary basins.

(b) Notification / Announcement related to the Course:

All the announcements will be made during the regular lecture hours. All the course related notifications will be displayed on the Department Notice Board.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2019', Regulation No. PU/AC-11/20/06_2019, from Presidency University, Bengaluru website and go through the Section Nos. 1.0 through 24.0.

Course Schedule:

Unit-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
01	Overview of the Programme and Course			L01
02	Unit I			L02 – L05
	Continuous Assessment 3: e-resource Review on Unit I			-
03	Unit II			L06 – L15
	Continuous Assessment 3: Report Writing on Unit II			
04	Discussion on Test 1 Question Pattern and Review			L16
05	Discussion on Test 1 Questions and Answers			L17
	Unit III			L18 – L23
	Continuous Assessment 3: Poster Designing and Presentation on Unit III			-
07	Unit IV			L24 – L31
	Continuous Assessment 3: Quiz on Unit IV			-
08	Discussion on Test 2 Question Pattern and Review			L32
09	Discussion on Test 2 Questions and Answers			L33
10	Unit V			L34 – L41
	Continuous Assessment 3: Written Test on Unit V			
11	Course Integration			L42
12	Discussion of End Term Examination Question Pattern			L43

Schedule of Instruction:

Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No.	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
01	L01	Overview of the Programme and the Course		-	Power Point Presentation	Class Note
Module 1						
02	L02		Introduction to Geology: Definition, Branches of Geology, Scope of Geology for Engineers.	CO1	Power Point Presentation	Class Note

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			Planet Earth: Origin, Shape, Physical Characteristics, Envelopes, Internal Structure, Chemical Composition, Internal Heat Source, and Age of the Earth, Uniformitarianism and Catastrophism, Geologic Time, Dynamic Processes - Introduction, Internal Dynamic Processes - Plate Tectonics, Continental Drift, Earthquake, Volcanism, External Dynamic Processes – Weathering, Erosion, Transportation, Deposition, Burial, Diagenesis.			
03	L03			CO1	Audio – Video Session	Class Note
04	L04			CO1	Power Point Presentation	Class Note
05	L05			CO1	Power Point Presentation	Class Note
		Continuous Assessment 3		CO1		
Module 2						
06	L06		Minerals: Definition; Importance of Study of Minerals; Methods of Mineral Identification. Rocks: Definition; Classification of Rocks - Igneous Rocks, Sedimentary Rocks, and Metamorphic Rocks; Rock Cycle; Uses of Rocks; Visit to Geology Laboratory. Geological Resources: Introduction, Metal Deposits, Industrial Materials, Fossil Fuels, Diamonds.	CO2	Audio – Video Session	Class Note
07	L07			CO2	Power Point Presentation	Class Note
08	L08			CO2	Audio – Video Session	Class Note
09	L09			CO2	Power Point Presentation	Class Note
10	L10			CO2	Power Point Presentation	Class Note
11	L11			CO2	Power Point Presentation	Class Note
12	L12			CO2	Power Point Presentation	Class Note
13	L13			CO2	Power Point Presentation	Class Note
14	L14			CO2	Audio-Video Sessions	Class Note
15	L15			CO2	Power Point Presentation	Class Note
		Continuous Assessment 3	Report Writing on Unit II			

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16	L16	TEST 1	Discussion on Question Pattern and Review	CO1 & CO2	White Board	
			TEST 1 Examination	CO1 & CO2		
17	L17		Discussion on Questions and Answers	CO1 & CO2	White Board	
Module 3						
18	L18			CO3	Power Point Presentation	Class Note
19	L19		Geological Structures: Introduction, Horizontal and Dipping Strata – Dip, and Strike, Unconformity, Folds, Faults, Joints. Geomorphology: Introduction, Geomorphic Processes and Form, Geomorphic System, Plate Tectonics and associated Structural Landforms, Volcanoes, Impact Craters, Weathering and associated Landforms.	CO3	Power Point Presentation	Class Note
20	L20			CO3	Power Point Presentation	Class Note
21	L21			CO3	Power Point Presentation	Class Note
22	L22			CO3	Power Point Presentation	Class Note
23	L23			CO3	Power Point Presentation	Class Note
		Continuous Assessment 3	Poster Designing and Presentation on Unit III	CO3		
Module 4						
24	L24		Geology of the Ocean: Introduction, Topography of the Sea Floor, Geology of the Oceanic Crust, Sea-Floor Sediments, Ocean Water. Climate Change: Introduction, Greenhouse Gas, Natural Climate Forcing, Climate Feedbacks, Anthropogenic Climate Change, Implications of Climate Change.	CO4	Audio – Video Session	Class Note
25	L25			CO4	Power Point Presentation	Class Note
26	L26			CO4	Power Point Presentation	Class Note
27	L27			CO4	Power Point Presentation	Class Note
28	L28			CO4	Power Point Presentation	Class Note
29	L29			CO4	Power Point Presentation	Class Note
30	L30			CO4	Power Point Presentation	Class Note
31	L31			CO4	Power Point Presentation	Class Note
		Continuous Assessment 3	Quiz on Unit IV	CO4		

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32	L32	TEST 2	Discussion on Question Pattern and Review	CO3 & CO4	White Board	
			TEST 2 Examination	CO3 & CO4		
33	L33		Discussion on Questions and Answers	CO3 & CO4	White Board	

Topics relevant to "**SKILL DEVELOPMENT**": Geomorphology for **Skill Development** through **Participative Learning** techniques. This is attained through the Presentation as mentioned in the assessment Schedule.

Assessment Schedule:

Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time
01	Continuous Assessment 3: e-resource Review	Unit I	CO1	-	5	2.5%	-
02	Continuous Assessment 3: Report Writing on Unit II	Unit II	CO2	-	5	2.5%	-
03	TEST 1	Unit I and Unit II	CO1 and CO2	1.0	30	15%	-
04	Continuous Assessment 3: Poster Designing and Presentation on Unit III	Unit III	CO3	-	10	5%	-
05	Continuous Assessment 3: Quiz on Unit IV	Unit IV	CO4	-	10	5%	-
06	TEST 2	Unit III and Unit IV	CO3 and CO4	1.0	30	15%	-
07	Continuous Assessment 3: Written Test on Unit V	Unit V	CO5	-	10	5%	
08	END TERM EXAMINATION	Unit I through Unit V and SLT	CO1 through CO5	3.0	100	50%	-

Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2019', Regulation No. PU/AC-11/20/06_2019, from Presidency University, Bengaluru website and go through the Section Nos. 1.0 through 24.0.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1	The plate tectonics theory provides a unifying explanation for earthquakes, volcanoes, mountain building, moving continents, and many other manifestations of the Earth's dynamic nature. Like most great, unifying scientific ideas, the plate tectonics theory is simple. Briefly, it describes the Earth's outer layer, called the lithosphere, as a shell of the hard, strong rock. This shell is broken into seven large (and several smaller) segments called tectonic plates. They are also called lithospheric plates, and the two terms are	10	CO1	Comprehension

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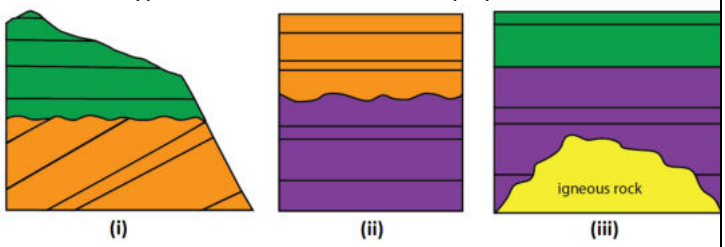
	interchangeable. The tectonic plates float on the layer below, called the asthenosphere. The asthenosphere, like the lithosphere, is rock. But the asthenosphere is so hot that 1 to 2 percent of it is melted. As a result, it is plastic, and weak. The lithospheric plates glide slowly over the asthenosphere like sheets of ice drifting across a pond. Continents and ocean basins make up the upper parts of the plates. As a tectonic plate glides over the asthenosphere, the continents and oceans move with it. Most of the Earth's major geological activity occurs at plate boundaries, the zones where tectonic plates meet and interact. Illustrate any two of the consequences of plate tectonics processes.			
2	Geologists have identified thousands of minerals. In fact, new minerals are discovered and named all the time. The wide variety of minerals makes it difficult to define exactly what a mineral is. Most of the newly discovered minerals are rare and have no practical use. Chemical composition and crystal structure determine a mineral's properties, including density, shape, hardness, and color. Because each mineral forms under specific conditions, examining minerals helps scientists understand the history of the earth and the other planets within our solar system. However, geologists do study certain characteristics that identify minerals. Is the study of minerals playing any role in day-to-day human life? Explain your answer logically.	10	CO2	Comprehension
3	An unconformity is a buried erosional or non-depositional surface separating two rock masses or strata of different ages, indicating that sediment deposition was not continuous. Schematic diagrams of different types of unconformities are displayed below.  (a) Identify the types of unconformities displayed above. (b) Explain the formation of any two unconformities identified above with diagrams.	10	CO3	Comprehension
4	Except for steep areas of the continental slope and areas near the crest of the mid-ocean ridge, the ocean floor is covered with sediment. Part of this material has been deposited by turbidity currents, and the rest has slowly settled to the seafloor from above. The thickness of this carpet of debris varies greatly. In some trenches, which act as traps for sediments originating on the continental margin, accumulations may approach 10 kilometers (6 miles). In general, however, sediment accumulations are considerably less. (a) Classify the seafloor sediments as per their origin. (b) Compare the seafloor sediments classified above based on their origin.	10	CO4	Comprehension

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	To describe planet earth and its dynamic processes	40

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2	CO2	To explain various geological resources of the Earth	40
3	C03	To relate different geological structures and geomorphological features	40
4	CO4	To summarize the implications of climate change.	40

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

This course has been duly verified and approved by the D.A.C.

Signature of the Chairperson D.A.C.:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1				

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2				
3				
4				
5				
6				
7				
8				
9				
10				

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment

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1	CO1	To describe planet earth and its dynamic processes	40		
2	CO2	To explain various geological resources of the Earth	40		
3	C03	To relate different geological structures and geomorphological features	40		
4	CO4	To summarize the implications of climate change	40		

Name and Signature of the Course Instructor:

D.A.C. Observation and Approval:

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Course Code: **PET2002**	**Course Title: Fundamentals of Geophysical Logging Techniques** **Type of Course: 1] Program Core** **2] Theory only**		**L-P-C**	4	0	4
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	Geophysical Logging is very crucial to be carried out during the life cycle of any oilfield drilling operation. It provides data to answer fundamental questions associated with petrophysical, geological, and mechanical properties required to evaluate, develop, and produce a field. The purpose of this course is to provide a broad understanding of various geophysical logging techniques used for the determination of lithology, porosity, fluid content, saturation, permeability, etc., and applications of these results in formation evaluation. This course is both conceptual and analytical in nature and requires knowledge of basic science and engineering. The students will learn how to interpret well log data through exercises and assignments.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Geophysical Logging Techniques and attain **Skill Development** through **Participative Learning** techniques.				
Course Outcomes:	Upon successful completion of the course the students shall be able to: CO1: discuss the importance of geophysical logging in the petroleum industry, CO2: explain various geophysical logging techniques, CO3: interpret basic geophysical logging tools, CO4: describe special and advanced logging tools, and CO5: demonstrate different cross-plotting techniques.				
Course Content:					
Module 1:	An Overview of Well Logging	e-resource Review / Report Writing	Writing Communication / Analytical Skills Development	08 Periods	
Topics: Well Logging: Definition, Objectives and Principles of Log Interpretation, Applications of Well Logging; Well Log Analysts / Petrophysicists – Job Description; Basic Log Types – Logging While Drilling, Wireline Open Hole Logging, Wireline Cased Hole Logging, Pipe-Conveyed Logging; Operational Decisions – Tool Failure, Stuck Tools.					
Module 2:	Basic Concepts of Well Logging and Measurement Techniques	Interpretation of Oil Field Charts	Exercises	12 Periods	
Topics: Basic Concepts of Well Logging: Properties of Rocks – Composition, Texture and Structure; Relationship between Porosity and Resistivity (Formation Factor), Relationship between Saturation and Resistivity (Archie's Equation), Effect of Shaliness on the Resistivity, Effect of Shale distribution, Permeability, Thickness and internal structure of strata. Measurement Techniques: Classification of Log Measurements - Natural Phenomena, Physical properties measured by inducing responses from the formation; Problems specific to Well Log Measurements - Borehole Effects (Invasion), Effect of Tool Geometry, Logging Speed, Hostile Environments; Logging Equipment (Surface and Downhole) - Logging Truck and Offshore Units, Cable, Logging Tool, Recording Equipment, Tool Combinations, Memorization; Log Presentation; Repeatability and Calibrations. *Related Exercise No.: 2.1 through 2.4.*					
Module 3:	Basic Logging Tools	Analysis of Well Log Data	Exercises	14 Periods	
Topics: Resistivity Log, Induction Log, Spontaneous Potential (SP) Log, Gamma Ray (GR) Log, Sonic Log, Density Log, and Neutron Log - Principle, Types of Tools used, Limitations, and Applications; Caliper Log; Temperature Log. *Related Exercise No.: 3.1 through 3.5.*					
Module 4:	Special and Advanced Logging Tools	Poster Designing and Presentation	Verbal Communication Skill Development	06 Periods	
Topics: Principles, Limitations, and Applications of Production Logging; CBL / VDL, USIT, SFT, and RFT; NMR Log, and FMS Log.					
Module 5:	Cross-plots and their Applications	Analysis of Cross-Plots	Exercises	03 Periods	
Topics: Cross-plots and their applications, Neutron – Density, Sonic – Neutron, Sonic – Density.					
Targeted Application and Tools that can be used: **Application:** Well Log Analyst / Petrophysicist in Petroleum / Mineral Exploration industry **Tools:** Microsoft Excel (Basics), Python, MatLab, Grapher, DecisionSpace G1 Edition (Halliburton Software)					
Project work / Assignment: Mention the Type of Project /Assignment proposed for this course:					
Text Book: T1. Darling, Toby, "Well Logging and Formation Evaluation", 1st Edition, Elsevier, Gulf Professional Publishing, 2005.					

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T2. Serra, Oberto, "Fundamentals of Well Log Interpretation - 1. The Acquisition of Logging Data", 1st Edition, Elsevier Science Publisher B V, 1984.

References:

R1. Rider, M., "The Geological Interpretation of Well Logs", Rider-French Consulting Ltd., 2004
R2. Ellis, Darwin V., and Singer, Julian M., "Well Logging for Earth Scientists", 2nd Edition, Springer, 2007.
R3. Boyer, Sylvain and Mari, Jean-Luc, "Seismic Surveying and Well Logging", 1st Edition, Editions Technip, Paris, 1997.
R4. Ransom, Robert C., "Practical Formation Evaluation", John Wiley and Sons Ltd., 1996.
R5. Bateman, Richard M., "Openhole Log Analysis and Formation Evaluation", 2nd Edition, Society of Petroleum Engineers, 1986.

e-resources:

1. Link for PU e-resources: https://puniversity.informaticsglobal.com/login
2. Reservoir Petrophysics: https://www.youtube.com/watch?v=iubNxQLKcow
3. An Overview of Well Logging: https://www.youtube.com/watch?v=A5MEEX_pwys
4. Cross-plots and their Applications: https://www.youtube.com/watch?v=IkRygF3MORw&t=2243s
5. Research Article: https://www.sciencedirect.com/topics/earth-and-planetary-sciences/formation-evaluation

Skill Sets:

Topics relevant to **"SKILL DEVELOPMENT":** Resistivity Log, Induction Log, Spontaneous Potential (SP) Log, Gamma Ray (GR) Log and Sonic Log for **Skill Development** through **Participative Learning** techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by:	Dr. Suman Paul, Dr. Deepjyoti Mech, Dr. Kalpajit Hazarika
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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PRESIDENCY UNIVERSITY

(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Handout

Date of Issue: 05-08-2019
Revised On:

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2019-23
Semester / Year	:	V / 3rd
Course Code / Title	:	PET 2002 / Fundamentals of Geophysical Logging Techniques
Course Credit Structure	:	4L-0T-0P-4C
Contact Hours	:	43
Course Instructor In-charge	:	Dr. Suman Paul
Course Instructor	:	Dr. Suman Paul
Course URL	:	

Program Outcomes (POs):

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO 01: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 02: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 03: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 04: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 05: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 06: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 07: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 08: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 09: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

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Course Prerequisites:

NIL

Course Description:

Geophysical Logging is very crucial to be carried out during the life cycle of any oilfield drilling operation. It provides data to answer fundamental questions associated with petrophysical, geological, and mechanical properties required to evaluate, develop, and produce a field. The purpose of this course is to provide a broad understanding of various geophysical logging techniques used for the determination of lithology, porosity, fluid content, saturation, permeability, etc., and applications of these results in formation evaluation. This course is both conceptual and analytical in nature and requires knowledge of basic science and engineering. The students will learn how to interpret well log data through exercises and assignments.

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Fundamentals of Geophysical Logging Techniques and attain **Skill Development** through **Participative Learning** techniques.

Course Outcomes (COs):

Upon successful completion of the course the students shall be able to:

CO1: discuss the importance of geophysical logging in the petroleum industry,
CO2: explain various geophysical logging techniques,
CO3: interpret basic geophysical logging tools,
CO4: describe special and advanced logging tools, and
CO5: demonstrate different cross-plotting techniques.

Mapping of COs with POs:

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	P0 10	PO 11	PO 12
CO1	L					L			L	L		M
CO2	M	M			L	L	L	L	M	M		M
C03	M	M			L	L	L	L	M	M		M
CO4	M	H			M	M	L	L	H	H		H
CO5	H	H			H	M	M	M	H	H		H
H = High, M = Moderate, L = Low												

Course Content (Syllabus):

Module1: An Overview of Well Logging [8 Periods] – Knowledge Level

Well Logging: Definition, Objectives and Principles of Log Interpretation, Applications of Well Logging; Well Log Analysts / Petrophysicists – Job Description; Basic Log Types – Logging While Drilling, Wireline Open Hole Logging, Wireline Cased Hole Logging, Pipe-Conveyed Logging; Operational Decisions – Tool Failure, Stuck Tools.

Module 2: Basic Concepts of Well Logging and Measurement Techniques [12 Periods] – Application Level

Basic Concepts of Well Logging: Properties of Rocks – Composition, Texture and Structure; Relationship between Porosity and Resistivity (Formation Factor), Relationship between Saturation and Resistivity (Archie's Equation), Effect of Shaliness on the Resistivity, Effect of Shale distribution, Permeability, Thickness and internal structure of strata.
Measurement Techniques: Classification of Log Measurements - Natural Phenomena, Physical properties measured by inducing responses from the formation; Problems specific to Well Log Measurements - Borehole Effects (Invasion), Effect of Tool Geometry, Logging Speed, Hostile Environments; Logging Equipment (Surface and Downhole) - Logging Truck and Offshore Units, Cable, Logging Tool, Recording Equipment, Tool Combinations, Memorization; Log Presentation; Repeatability and Calibrations.
Related Exercise No.: 2.1 through 2.4.

Module 3: Basic Logging Tools [14 Periods] – Application Level

Resistivity Log, Induction Log, Spontaneous Potential (SP) Log, Gamma Ray (GR) Log, Sonic Log, Density Log, and Neutron Log - Principle, Types of Tools used, Limitations, and Applications; Caliper Log; Temperature Log.
Related Exercise No.: 3.1 through 3.5.

Module 4: Special and Advanced Logging Tools [6 Periods] – Application Level

Principles, Limitations, and Applications of Production Logging; CBL / VDL, USIT, SET, and RFT; NMR Log, and FMS Log.

Module 5: Cross-plots and their Applications [3 Periods] – Application Level

Cross-plots and their applications, Neutron – Density, Sonic – Neutron, Sonic – Density.

Delivery Procedure (Pedagogy):

This is a theory-based course. Most of the lectures will be taken with the help of Power Point Presentations and White Board. Videos will be shown for the better understanding of selective topics. Exercises will be discussed specific topics and home assignments will be given to judge the understanding level of the students. Assignments / Mini Project will be given to the students after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. Report Submission, Quiz Competition, Poster Presentation, and Group Discussion will carry 20% weightage under Continuous Assessment 3 (CA 3). Review classes will be conducted to clear doubts and to evaluate the level of understanding of each student individually.

Following procedures will be adopted in the course for delivering the content:

(a) Self Learning Topics (SLT):

- Volumetric Gas-in-Place Calculations for CBM Reservoir (Unit III)
- Material Balance Calculation for CBM Reservoir (Unit III)
- Petrophysical Evaluation of Gas Shale Reservoirs – Key Properties of Gas Shale Evaluation (Unit IV)
- Geomechanics of Gas Shales – Mechanical Properties of Gas Shales, Wellbore Instability of Gas Shale Reservoirs (Unit IV)

(b) Experiential Learning Topics (ELT):

- Identification of Coal Beds and Estimation of Stress Magnitudes using Well Log Data (Unit III)

(c) Participative Learning Topics (PLT):

- Coal Bed Methane (Unit III) – Poster Presentation
- Shale Gas (Unit IV) – Poster Presentation
- Natural Gas Hydrates (Unit V) – Poster Presentation

(d) Technology Enabled Learning Topics (TET):

- Determination of Stress Orientation using Cleat Study Data (Unit III) – Use of 'GeoRose' software

(e) Problem Based Learning Topics (PBLT):

- Natural Gas Hydrate Exploration Strategy Discussion

Reference Materials:

Textbook:

T1. Darling, Toby, "Well Logging and Formation Evaluation", 1st Edition, Elsevier, Gulf Professional Publishing, 2005.
T2. Serra, Oberto, "Fundamentals of Well Log Interpretation - 1. The Acquisition of Logging Data", 1st Edition, Elsevier Science Publisher B V, 1984.

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3. An Overview of Well Logging: https://www.youtube.com/watch?v=A5MEEX_pwys
4. Cross-plots and their applications: https://www.youtube.com/watch?v=IkRygF3MORw&t=2243s
5. Research Article: https://www.sciencedirect.com/topics/earth-and-planetary-sciences/formation-evaluation

Guideline to Students:

(a) About the Course:

Understanding of different unconventional energy resources plays pivotal role in modern Oil and Gas industry because it is visible that the industry is shifting from exploration of conventional reservoirs to unconventional reservoirs like coal bed methane, shale gas, gas hydrates, etc. considering the present energy scenario. This course will focus mainly on coal bed methane exploration and production related topics and also provide basic knowledge about the shale gas and gas hydrate. Basic understanding of Petroleum Geology, Well Logging and Formation Evaluation, Drilling Engineering, Reservoir Engineering, and Production Engineering will help understanding this course. Hands-on training (use of basic tool) will be provided for calculation of stresses observed in sedimentary basins.

(b) Notification / Announcement related to the Course:

All the announcements will be made during the regular lecture hours. All the course related notifications will be displayed on the Department Notice Board.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2019', Regulation No. PU/AC-11/20/06_2019, from Presidency University, Bengaluru website and go through the Section Nos. 1.0 through 24.0.

Course Schedule:

Unit-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
01	Overview of the Programme and Course			L01
02	Unit I			L02 – L05
	Continuous Assessment 3: e-resource Review on Unit I			-
03	Unit II			L06 – L15
	Continuous Assessment 3: Report Writing on Unit II			
04	Discussion on Test 1 Question Pattern and Review			L16
05	Discussion on Test 1 Questions and Answers			L17
	Unit III			L18 – L23
	Continuous Assessment 3: Poster Designing and Presentation on Unit III			-
07	Unit IV			L24 – L31
	Continuous Assessment 3: Quiz on Unit IV			-
08	Discussion on Test 2 Question Pattern and Review			L32
09	Discussion on Test 2 Questions and Answers			L33
10	Unit V			L34 – L41
	Continuous Assessment 3: Written Test on Unit V			
11	Course Integration			L42
12	Discussion of End Term Examination Question Pattern			L43

Schedule of Instruction:

Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No.	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
01	L01	Overview of the Programme and the Course		-	Power Point Presentation	Class Note
Module 1						
02	L02		Well Logging: Definition, Objectives and Principles of Log Interpretation, Applications of Well Logging; Well Log Analysts / Petrophysicists – Job Description; Basic Log Types –	CO1	Power Point Presentation	Class Note

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			Logging While Drilling, Wireline Open Hole Logging, Wireline Cased Hole Logging, Pipe-Conveyed Logging; Operational Decisions – Tool Failure, Stuck Tools.			
03	L03			CO1	Audio – Video Session	Class Note
04	L04			CO1	Power Point Presentation	Class Note
05	L05			CO1	Power Point Presentation	Class Note
		Continuous Assessment 3		CO1		
Module 2						
06	L06		Basic Concepts of Well Logging: Properties of Rocks – Composition, Texture and Structure; Relationship between Porosity and Resistivity (Formation Factor), Relationship between Saturation and Resistivity (Archie's Equation), Effect of Shaliness on the Resistivity, Effect of Shale distribution, Permeability, Thickness and internal structure of strata. Measurement Techniques: Classification of Log Measurements - Natural Phenomena, Physical properties measured by inducing responses from the formation; Problems specific to Well Log Measurements - Borehole Effects (Invasion), Effect of Tool Geometry, Logging Speed, Hostile Environments; Logging Equipment (Surface and Downhole) - Logging Truck and Offshore Units, Cable, Logging Tool, Recording Equipment, Tool Combinations, Memorization; Log Presentation; Repeatability and Calibrations.	CO2	Audio – Video Session	Class Note
07	L07			CO2	Power Point Presentation	Class Note
08	L08			CO2	Audio – Video Session	Class Note
09	L09			CO2	Power Point Presentation	Class Note
10	L10			CO2	Power Point Presentation	Class Note
11	L11			CO2	Power Point Presentation	Class Note
12	L12			CO2	Power Point Presentation	Class Note

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13	L13			CO2	Power Point Presentation	Class Note
14	L14			CO2	Audio-Video Sessions	Class Note
15	L15			CO2	Power Point Presentation	Class Note
		Continuous Assessment 3	Report Writing on Unit II			
16	L16	TEST 1	Discussion on Question Pattern and Review	CO1 & CO2	White Board	
			TEST 1 Examination	CO1 & CO2		
17	L17		Discussion on Questions and Answers	CO1 & CO2	White Board	
Module 3						
18	L18			CO3	Power Point Presentation	Class Note
19	L19		Resistivity Log, Induction Log, Spontaneous Potential (SP) Log, Gamma Ray (GR) Log, Sonic Log, Density Log, and Neutron Log - Principle, Types of Tools used, Limitations, and Applications; Caliper Log; Temperature Log. Related Exercise No.: 3.1 through 3.5.	CO3	Power Point Presentation	Class Note
20	L20			CO3	Power Point Presentation	Class Note
21	L21			CO3	Power Point Presentation	Class Note
22	L22			CO3	Power Point Presentation	Class Note
23	L23			CO3	Power Point Presentation	Class Note
		Continuous Assessment 3	Poster Designing and Presentation on Unit III	CO3		
Module 4						
24	L24		Principles, Limitations, and Applications of Production Logging; CBL / VDL, USIT, SFT, and RFT; NMR Log, and FMS Log.	CO4	Audio – Video Session	Class Note
25	L25			CO4	Power Point Presentation	Class Note
26	L26			CO4	Power Point Presentation	Class Note
27	L27			CO4	Power Point Presentation	Class Note
28	L28			CO4	Power Point Presentation	Class Note
29	L29			CO4	Power Point Presentation	Class Note
30	L30			CO4	Power Point Presentation	Class Note
31	L31			CO4	Power Point Presentation	Class Note
		Continuous Assessment 3	Quiz on Unit IV	CO4		

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32	L32	TEST 2	Discussion on Question Pattern and Review	CO3 & CO4	White Board	
			TEST 2 Examination	CO3 & CO4		
33	L33		Discussion on Questions and Answers	CO3 & CO4	White Board	
			MODULE 5			
			Cross-plots and their applications, Neutron – Density, Sonic – Neutron, Sonic – Density.			

Topics relevant to "**SKILL DEVELOPMENT**": Resistivity Log, Induction Log, Spontaneous Potential (SP) Log, Gamma Ray (GR) Log and Sonic Log for **Skill Development** through **Participative Learning** techniques. This is attained through the Presentation as mentioned in the assessment Schedule.

Assessment Schedule:

Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time
01	Continuous Assessment 3: e-resource Review	Unit I	CO1	-	5	2.5%	-
02	Continuous Assessment 3: Report Writing on Unit II	Unit II	CO2	-	5	2.5%	-
03	TEST 1	Unit I and Unit II	CO1 and CO2	1.0	30	15%	-
04	Continuous Assessment 3: Poster Designing and Presentation on Unit III	Unit III	CO3	-	10	5%	-
05	Continuous Assessment 3: Quiz on Unit IV	Unit IV	CO4	-	10	5%	-
06	TEST 2	Unit III and Unit IV	CO3 and CO4	1.0	30	15%	-
07	Continuous Assessment 3: Written Test on Unit V	Unit V	CO5	-	10	5%	
08	END TERM EXAMINATION	Unit I through Unit V and SLT	CO1 through CO5	3.0	100	50%	-

Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2019', Regulation No. PU/AC-11/20/06_2019, from Presidency University, Bengaluru website and go through the Section Nos. 1.0 through 24.0.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

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Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1	The data acquired from Open Hole Logging, either via wireline or logging while drilling is then interpreted to reveal the rock and fluid properties. Its complexity can vary depending on the formation. The Open Hole data is recorded using a variety of principles and has to be interpreted to obtain the rock and fluid properties. Gather the information expected to attain from Open Hole Log data and also cite examples of at least two Open Hole Logs.	10	CO1	Comprehension
2	While the logging program will aim to cover most eventualities during the logging job, often instant decisions have to be made where it is not possible to call everyone into a meeting and get the approval of all parties concerned. Discuss the situations where some of the things are likely to happen and the well logging team is expected to take immediate action without calling a meeting to save Non-Productive Time (NPT).	10	CO2	Comprehension
3	The Formation Resistivity Factor (F_R) is defined as the ratio of the resistivity of the rock saturated with brine (R_o) to the resistivity of the brine (R_w). (a) Will it be possible to determine F_R for available porosity, cementation factor, and lithology coefficient as 7.5%, 1.8, and 0.95 respectively? If yes, then write down the formula and calculate F_R using the same formula. If no, then write down the process for determining F_R. (b) Is it possible to determine F_R from any of the available charts (1 through 10)? If yes, then choose the correct chart and determine F_R by plotting the available data. If no, then explain any other method used to determine F_R.	10	CO2	Comprehension
4	(a) In log interpretation, the Bottom Hole Temperature (BHT) is taken as the maximum recorded temperature during a logging run or preferably the last of series of runs during the same operation. BHT is the temperature used for the interpretation of logs at total depth. If the BHT at 11000 ft is 200°F (Point A) in shared Chart 1, then list down the information that can be recorded from Point X marked in the same Chart. Submit Chart 1 for evaluation. (b) The more you increase your concentration, the higher the amount of species that can contribute to conduction. Hence, resistance decreases with increasing concentration. If the resistivity of a water sample is 2 ohm-m at 40°C, then find NaCl concentration at 40°C from Chart 2. Suppose the NaCl concentration is kept constant at 150°C, then discuss the information that can be extracted additionally from the same Chart. Submit Chart 2 for evaluation.	10	CO2	Comprehension
5	Borehole corrections of the slimhole 23/4-in. FGT formation density log can be made automatically by the logging unit. To determine if corrections have been made, refer to the log. "ALLO" (for allowed) following the constant "MWCO" indicates the FGT log was recorded with borehole correction. "DISA" (for disallowed) indicates that no borehole corrections were made. In case the FGT log was recorded without automatic borehole correction, Chart No. 2 (shared at the end) provides the correction. From the given Chart, estimate the corrected formation density of the slimhole where formation density (ρ_b), borehole diameter (d_h), and mud density (ρ_m) are recorded as 2.25 g/cm^3, 150 mm, and 1.65 g/cm^3 respectively.	10	CO2	Comprehension

Target Set for Course Outcome attainment:

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Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	To discuss the importance of geophysical logging in the petroleum industry	40
2	CO2	To explain various geophysical logging techniques	40
3	C03	To interpret basic geophysical logging tools	40
4	CO4	To describe special and advanced logging tools	40
5	CO5	To demonstrate different cross-plotting techniques	

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

This course has been duly verified and approved by the D.A.C.

Signature of the Chairperson D.A.C.:

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Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

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Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	To discuss the importance of geophysical logging in the petroleum industry	40		
2	CO2	To explain various geophysical logging techniques	40		
3	C03	To interpret basic geophysical logging tools	40		
4	CO4	To describe special and advanced logging tools	40		
5	CO5	To demonstrate different cross-plotting techniques	40		

Name and Signature of the Course Instructor:

D.A.C. Observation and Approval:

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Course Code: **PET2004**	**Course Title:** **Fundamentals of Petroleum Reservoir Engineering** **Type of Course:** **1] Program Core** **2] Laboratory Integrated**	**L- P-C**	3	2	4
Version No.	2.0				
Course Pre-requisites	NIL				
Anti-requisites	NIL				
Course Description	The purpose of this lab integrated course is to get hands on experience on flow of fluids through the reservoir. This course is both conceptual and analytical in nature and require the knowledge on basic science. This course develops the critical thinking, analytical skills and programming abilities through assignments. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to correlate with the real time field experiment.				
Course Description	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Petroleum Reservoir Engineering and attain **Skill Development** through **Experiential Learning** techniques.				
Course Outcomes	**On successful completion of this course the students shall be able to:** CO1: explain the reservoir rock and fluid properties of a hydrocarbon reservoir CO2: compare the flow behavior of reservoir fluid through porous media CO3: differentiate various drive mechanisms CO4: apply the concept of different reserve estimation methods				
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Petroleum Reservoir and attain Skill Development through Experiential Learning techniques.				
Course Content:					
Module 1	Fundamentals of Reservoir Rock Properties	Assessment 1: Assignment	Quiz	09 Periods	
Topics: Porosity: absolute porosity, effective porosity, Saturation, Wettability, Surface and interfacial tension, capillary pressure, Permeability (K): relative permeability: two phase relative permeability: drainage, imbibition problems, Saturation-K relationship. **Related Experiment: Experiment No**-1, 6, 7 and 8					
Module 2	Fundamentals of Reservoir Fluid Flow	Assessment 2: Assignment / Quiz	Programming	09 Periods	
Topics: Types of fluids, flow regimes, reservoir geometry, Fluid flow through porous media: Application of Darcy's law, Different types of flow. **Related Experiment:** Experiment No 2, 3, 4, 5 and 9					
Module 3	Oil Recovery Mechanisms	Assessment 3: Assignment / Quiz	Data analysis task	06 Periods	
Topics: Primary recovery mechanisms: Expansion of the individual rock grains and Formation compaction, Solution gas drive, gas cap with little or no water drive, water drive, gravity drainage drive, combination drive mechanisms					
Module 4	Reserve Estimation Technique	Assessment 4: Term Paper	Programming	10 Periods	
Topics: Volumetric estimation of reserve, The material balance equation and Decline curve analysis					
List of Laboratory Tasks: **Exp. No 1:** Bulk volume measure measurement using Vernier caliper Level 1: To determine the bulk volume of core sample using Vernier Calliper Level 2: To compare the calibrations before and after the experiment **Exp. No 2:** To determine Fluid Density of a given sample using Pycnometer Level 1: Determine the density of liquid sample at ambient temperature Level 2: Compare the density of liquid sample at different temperature **Exp. No 3:** To prepare Core Sample using Soxhlet Apparatus Level 1: Clean the core sample and remove the organic and inorganic present inside the pore space. Level 2: Extract the dissolved solid in liquid sample **Exp. No 4:** To estimate Surface Tension of a given liquid(s) sample using Ring Tensiometer Level 1: Determine the surface tension for liquid sample Level 2: Find the relationship of Surface tension with temperature **Exp. No 5:** To estimate Interfacial Tension of a given liquid(s) sample using Ring Tensiometer Level 1: Determine the interfacial tension for liquid sample Level 2: Find the relationship of interfacial tension with temperature and concentration of surfactant **Exp. No 6:** To estimate Effective Porosity of a given Core Sample using saturation method Level 1: Estimate Effective Porosity of a given Core Sample					

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Level 2: Estimate Effective Porosity of a Core Samples from different depth and correlate the porosity with respect to depth.

Exp. No 7: To estimate Absolute Permeability of Water for a given Core Sample using Liquid Permeameter

Level 1: Estimate the Absolute Permeability of Water for a given Core Sample

Level 2: Estimate the relative permeability of oil, water and injection fluid

Exp. No 8: To estimate Permeability of Air for a given Core Sample using Gas Permeameter

Level 1: Estimate the air Permeability for a given Core Sample

Level 2: Determine the Klinkenberg effect.

Exp. No 9: To determine the viscosity of given fluid by using Cannon Fansky Viscometer

Level 1: Determine the viscosity of given fluid

Level 2: Determine the viscosity of given fluid with respect to temperature

Targeted Application & Tools that can be used:

Application Area: Reservoir Engineer in Oil and Gas industry

Professionally Used Software: Eclipse, Petrel

Text Book:

T1. Abhijit Y. Dandekar, "Petroleum Reservoir Rock and Fluid Properties", CRC Press.

T2. Tarek Ahmed, "Reservoir Engineering Handbook" Elsevier, 5th Edition, 2019.

References

R1. L. P. Dake, "Fundamentals of Reservoir Engineering", Elsevier, 17th Impression, 1998.

R2. SM1 "Reservoir Engineering Lab Manual", Presidency University

E-resources:

1. Presidency University Link- https://puniversity.informaticsglobal.com/login
2. Reservoir rock properties- https://www.youtube.com/watch?v=iubNxQLKcow
3. Fundamentals of reservoir fluid flow- https://wiki.aapg.org/Fluid_flow_fundamentals
4. Oil recovery mechanisms- http://large.stanford.edu/courses/2015/ph240/zerkalov2/docs/sino.pdf
5. Reserve estimation technique- https://wiki.aapg.org/Reserves_estimation

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. The course attainment will be assessed through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Kalpajit Hazarika, Dr. Deepjyoti Mech, Mr. Bhairab Jyoti Gogoi
Recommended by the Board of Studies on	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council	18th Meeting of the Academic Council held on 3rd August 2022

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Course Handout

Date of Issue: 11-03-2022

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2020-24
Semester / Year	:	$4^{th}/2^{nd}$
Course Code / Title	:	PET 2004 / Fundamentals of Reservoir Engineering
Course Credit Structure	:	3L 2P 4C
Contact Hours	:	35 L + 20 P = 55
Course Instructor In-charge	:	Dr. Deepjyoti Mech
Course Instructor	:	Dr. Deepjyoti Mech
Course URL of Edhitch	:	https://www.edhitch.com/gotodashboard

Program Outcomes (POs) :

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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PO08: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO09: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:

Nil

Course Description as approved in P.R.C.:

The purpose of this lab integrated course is to get hands on experience on flow of fluids through the reservoir. This course is both conceptual and analytical in nature and require the knowledge on basic science. This course develops the critical thinking, analytical skills and programming abilities through assignments. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to correlate with the real time field experiment.

Course Objectives

The objective of the course is to familiarize the learners with the concepts of Fundamentals of Petroleum Reservoir Engineering and attain **Skill Development** through **Experiential Learning** techniques.

Course Outcomes (COs):

On successful completion of the course, the student shall be able to:
CO1: explain the reservoir rock and fluid properties of a hydrocarbon reservoir
CO2: compare the flow behavior of reservoir fluid through porous media
CO3: differentiate various drive mechanisms
CO4: apply the concept of different reserve estimation methods

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	L	L	L	L	M	M	M	L	-	M	-	-
CO2	H	H	H	M	L	L	L	H	H	M	-	H
C03	L	L	L	L	M	M	M	L	H	M	-	H
CO4	H	H	H	M	L	L	L	H	H	M	-	H

H = High, M = Moderate, L = Low

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Course Content (Syllabus):

Module I: Fundamentals of reservoir rock properties [9 Classes] [Comprehension]

Porosity: absolute porosity, effective porosity, Saturation, Wettability, Surface and interfacial tension, capillary pressure, Permeability (K): relative permeability: two phase relative permeability: drainage, imbibition problems, Saturation-K relationship.

Module II: Fundamentals of reservoir fluid flow [9 Classes] [Comprehension]

Types of fluids, flow regimes, reservoir geometry, Fluid flow through porous media: Application of Darcy's law, Different types of flow.

Module III: Oil recovery mechanisms [6 Classes] [Comprehension]

Primary recovery mechanisms: Expansion of the individual rock grains and Formation compaction, Solution gas drive, gas cap with little or no water drive, water drive, gravity drainage drive, combination drive mechanisms

Module IV: Reserve estimation technique [10 Classes] [Application]

Volumetric estimation of reserve, The material balance equation and Decline curve analysis

SKILL SETS TO BE DEVLOPED:

1. **An attitude of enquiry.**
2. **Confidence and ability to tackle new problems.**
3. **Ability to interpret events and results.**
4. **Ability to work as a leader and as a member of a team.**
5. **Assess errors in systems/processes/programs/computations and eliminate them.**
6. Observe and measure physical phenomena.
7. **Write reports.**
8. **Select suitable equipment, instrument, materials & software**
9. Locate faults in system/Processes/software.
10. **Manipulative skills for setting and handling systems/Process/ Issues**
11. **The ability to follow standard /Legal procedures.**
12. **An awareness of the Professional Ethics.**
13. **Need to observe safety/General precautions**.
14. To judge magnitudes/Results/issues without actual measurement/actual contacts

COURSE CONTENT &TASK SCHEDULE FOR LABORATORY COMPONENT:

Sl. No	Session Number and Date	Task No	Task	Level 1	Level 2	Number of Lab Sessions required to complete the task	Skills to be developed	Course Outcome to be developed

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1	1	P1	Bulk volume measure measurement using Vernier caliper	To determine the bulk volume of core sample using Vernier Calliper	To compare the calibrations before and after the experiment	1	2, 7, 8, 10, 11, 12, 13	CO1
2	2	P2	To determine Fluid Density of a given sample using Pycnometer	Determine the density of liquid sample at ambient temperature	Compare the density of liquid sample at different temperature	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1
3	3	P3	To prepare Core Sample using Soxhlet Apparatus	Clean the core sample and remove the organic and inorganic present inside the pore space.	Extract the dissolved solid in liquid sample	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1, CO2
4	4	P4	To estimate Surface Tension of a given liquid(s) sample using Ring Tensiometer	Determine the surface tension for liquid sample	Find the relationship of Surface tension with temperature	1	1, 2, 3, 4, 5, 8, 10, 11, 12, 13	CO1, CO2, CO3
5	5	P5	To estimate Interfacial Tension of a given liquid(s) sample using Ring Tensiometer	Determine the interfacial tension for liquid sample	Find the relationship of interfacial tension with temperature and concentration of surfactant	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1, CO2, CO3
6	6	P6	To estimate Effective Porosity of a given Core Sample using saturation method	Estimate Effective Porosity of a given Core Sample	Estimate Effective Porosity of a Core Samples from different depth and correlate the porosity with respect to depth	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1,CO3, CO4

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7	7	P7	To estimate Absolute Permeability of Water for a given Core Sample using Liquid Permeameter	Estimate the Absolute Permeability of Water for a given Core Sample	Estimate the relative permeability of oil, water and injection fluid	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1, CO2,CO3, CO4
8	8	P8	To estimate Permeability of Air for a given Core Sample using Gas Permeameter	Estimate the air Permeability for a given Core Sample	Determine the Klinkenberg effect	1	1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13	CO1, CO2,CO3, CO4
9	9	P9	To determine the viscosity of given fluid by using Cannon Fansky Viscometer	Determine the viscosity of given fluid	Determine the viscosity of given fluid with respect to temperature	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1, CO2,CO3, CO4, CO5

Delivery Procedure (Pedagogy):

This is an integrated lab based theory course. Most of the lectures will be taken with the help of Microsoft teams/Offline mode. Videos will be shown for the better understanding of selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. During the lab session a problem statement will be given to the students and based on their understanding they have to prepare the solution. Most of the lectures will be delivered either through Offline mode / Microsoft Team platform based on the current pandemic situation.

Following procedures will be adopted in the course for delivering the content:

Assessment 1- Assignment (Module 1)- Foundation (F): Experiential Learning Topics-
Quiz on Classification of reservoir based on phase diagram
Assessment 2- Assignment / Quiz (Module 2)- Foundation (F), Skill Development (S), Employability (EM): Problem Solving Topics-
Programming on to determine the flow rate of a given reservoir sample / Use excel to understand the klinkenberg effect by collecting the Permeability data from laboratory validate with experimental investigation.
Assessment 3- Assignment / Quiz (Module 3)- Employability (EM): Experiential Learning Topics-
Data analysis task on various driving mechanisms of a field.
Assessment 4- Term paper (Module 4)- Employability (EM): Problem Solving Topics-
Write a code to calculate the reserve volume.

Reference Materials:

a. Text Book(s):

T1. Abhijit Y. Dandekar, "Petroleum Reservoir Rock and Fluid Properties", CRC Press, 2nd Edition, 2013.
T2. Tarek Ahmed, "Reservoir Engineering Handbook" Elsevier, 5th Edition, 2019.

b. Reference Book(s):

R1 L. P. Dake, "Fundamentals of Reservoir Engineering", Elsevier, 17th Impression, 1998.
R2 SM1 "Reservoir Engineering Lab Manual", Presidency University

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c. Class Notes

d. E-resources

1. **Presidency University Link-** https://puniversity.informaticsglobal.com/login
2. **Reservoir rock properties-** https://www.youtube.com/watch?v=iubNxQLKcow
3. **Fundamentals of reservoir fluid flow-** https://wiki.aapg.org/Fluid_flow_fundamentals
4. **Oil recovery mechanisms-** http://large.stanford.edu/courses/2015/ph240/zerkalov2/docs/sino.pdf
5. **Reserve estimation technique**- https://wiki.aapg.org/Reserves_estimation

Guideline to Students:

(a) About the Course:

Reservoir Engineering is one of the major core subject in Petroleum Engineering. Without the knowledge of this subject student will face many difficulties in future. Basic awareness about this course may help understanding few other courses like Well Testing, Enhanced oil etc. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students.

(b) Notification / Announcement related to the Course:

All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0.

Course Schedule:

Unit-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course	-	-	01
2	Module: 01	-	-	12
3	CIA-I	-	-	09
4	Discussion of Test 1 Question Pattern	-	-	06
5	Test-1	-	-	10
6	Discussion of Test 1 Questions and Answers	-	-	03
7	Module: 02	-	-	01
8	CIA-II	-	-	-
9	Module: 03	-	-	01
10	CIA-III	-	-	01

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11	Discussion of Test 2 Question Pattern	-	-	-
12	Test-2	-	-	01
13	Discussion of Test 2 Questions and Answers	-	-	-
14	Module: 04	-	-	-
15	CIA-IV	-	-	-
18	Discussion of Mid-Term Questions and Answers	-	-	01
19	Course Integration	-	-	01
20	Discussion of End term Question Pattern	-	-	-
21	End term Final examination	-	-	-

*****Dates as per the academic calendar***

COURSE SCHEDULE FOR LABORATORY COMPONENT

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course	23-03-2022	23-03-2022	1
2	Laboratory Familiarization	23-03-2022	23-03-2022	1
3	Conduct of first set of experiments	30-03-2022	30-03-2022	9
4	Project work	-	-	-
5	Conduct of second set of experiments	06-04-2022	06-04-2022	9
6	Summary of the Laboratory tasks	-	-	-
7	End Term Evaluation	-	-	-

Schedule of Instruction:

Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No.	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
1	L1	**Programme Integration-1**			**Presentation**	
2	L2	Introduction to Reservoir Engineering	Type of reserve, oil reservoir and Gas reservoir	CO1	Presentation/Lecture	RB2 Ch 4
3	L3	Porosity	Definition and its types	CO1	Presentation/Lecture	RB2 Ch 4
4	L4	Wettability	Mechanism	CO1	Presentation/Lecture	RB2 Ch 4

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5	L5	Surface and interfacial tension	Mechanism	CO1	Presentation/Lecture	RB2 Ch 4
6	L6	Capillary pressure	Mechanism	CO1	Problem solving	RB2 Ch 4
7	L7	Permeability	Relative permeability concept	CO1	Problem solving	RB2 Ch 4
8	L8	Drainage, imbibition	Problems	CO1	Presentation/Lecture	RB2 Ch 4
9	L9	Saturation-K relationship	Saturation & Fluid distribution of Reservoir rock	CO1	Presentation/Lecture	RB2 Ch 4
UNIT-I Completed						
14	L10	Flow characteristics	Flow regions and Reservoir geometry	CO2	Presentation/Lecture	RB 2 Ch 6
15	L11	Diffusivity equation	Derivation of Diffusivity equation	CO2	Lecture	RB 2 Ch 6
16	L12	Diffusivity equation	Application of diffusivity equation	CO2	Lecture	RB 2 Ch 6
17	L13	Flow models	Linear horizontal model for a single phase fluid	CO2	Presentation/Lecture	RB 2 Ch 6
18	L14	Flow models	The radial flow model	CO2	Presentation/Lecture	RB 2 Ch 6
19	L15	Flow models	Characterization of flow regions by their dependence on time	CO2	Presentation/Lecture	RB 2 Ch 6
20	L16	Flow models	The steady state solution	CO2	Presentation/Lecture	RB 2 Ch 6
21	L17	Different types of Flow	Non steady state flow regimes and dimensionless variable	CO2	Presentation/Lecture	RB 2 Ch 6
22	L18	Different types of Flow	Unsteady & Semi steady state solution	CO2	Presentation/Lecture	RB 2 Ch 6
UNIT-II Completed						
23	L19	Introduction to recovery mechanism	Types of recovery: Primary, Secondary and Tertiary	CO3	Lecture	RB 2 Ch 11
24	L20	Primary recovery mechanism	Expansion of the individual rock grains and Formation compaction	CO3	Lecture	RB 2 Ch 11
25	L21	Primary recovery mechanism	Solution gas drive, gas cap with little or no water drive	CO3	Presentation/Lecture	RB 2 Ch 11
26	L22	Primary recovery mechanism	Natural water drive mechanism	CO3	Presentation/Lecture	RB 2 Ch 11
27	L23	Primary recovery mechanism	Combination drive mechanism	CO3	Presentation/Lecture	RB 2 Ch 11

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28	L24	Primary recovery mechanism	Gravity drainage drive mechanism	CO3	Presentation/Lecture	RB 2 Ch 11
UNIT-III Completed						
29	L25	Material balance equation	Derivation of Material Balance equation	CO4	Presentation/Lecture	RB 2 Ch 11
30	L26	Material balance equation	Derivation of Material Balance equation	CO4	Presentation/Lecture	RB 2 Ch 11
31	L27	Material balance equation	Straight line form of MBE,	CO4	Presentation/Lecture	RB 2 Ch 11
32	L28	Material balance equation	Applications of straight line form of the MBE in solving reservoir engineering solutions	CO4	Presentation/Lecture	RB 2 Ch 11
33	L29	Material balance equation	Numerical related to MBE	CO4	Presentation/Lecture	RB 2 Ch 11
34	L30	Material balance equation	Numerical related to MBE	CO4	Presentation/Lecture	RB 2 Ch 11
35	L31	Volumetric reserve estimation	Volumetric method	CO4	Presentation/Lecture	CN
36	L32	Volumetric reserve estimation	Problems related to volumetric methods	CO4	Presentation/Lecture	CN
37	L33	Decline curve analysis	Decline curve analysis method	CO4	Presentation/Lecture	CN
38	L34	Decline curve analysis	Problem related to Decline curve analysis method	CO4	Presentation/Lecture	CN
UNIT-IV Completed						

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. This is attained through the Lab Experiments as mentioned in the assessment Schedule.

Assessment Schedule:

Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time
1	Mid Term exam	L2-L18	CO1 & CO2	1	60	30%	-
2	Lab conduction	P1 to P8	C01 – CO5	-	-	-	-
4	Lab midterm exam	P1 to P4	CO1,CO2, CO3	2	20	-	-

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5	End Term final examination	L2-L47	C01 – CO5	3	100	30%	-
6	End Term Lab examination	P1 to P8	C01 – CO5	3	60	20%	
6	Assignments (CIA-I, II, III, IV)	L2-L47	C01 – CO5	3	40	10%	-

ASSESSMENT DETAILS FOR LABORATORY COMPONENT:

Sl. No	Assessment type	List of Tasks	Course outcome number	Duration (In hours)	Marks	Weightage	Venue, DATE &TIME
1	Lab records	After conduction of experiment student has to write the entire experiment on lab record	CO1-CO5	2	20	5	-
2	Results and discussion	Calculation of values and discussion on the results	CO1-CO5	2	20	5	-

Assessment Matrix for Daily Task Evaluation for Laboratory component:

Sl. No.	Task No.	Marks for activity 01 [Mention the activity]	Marks for activity 02 [Mention the activity]	Marks for activity 03 [Mention the activity]	Total Marks		

Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through

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24.0. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, Head of the Department, and Dean (School of Engineering) for further assistance.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1	When a viscosity of a fluid is depending on the pressure difference of a two points, so it affected by area. How the area affect discharge of a fluid? (i) Do the dimensional analysis of Darcy's law. (ii) Differentiate Absolute and Effective and Relative permeability. (iii) What are the assumption of Darcy's Law?	12	1	Comprehension
2	Pressure difference exist based on the height of the liquid column. What is this pressure is known as? Explain with a suitable diagram that "NON-WETTING" decrease with the increment of "SWETTING PHASE ".	10	2	Comprehension

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	To explain the reservoir rock and fluid properties of a hydrocarbon reservoir	**30**
2	CO2	To predict the maximum flow rate that can be assigned to a completed well without the simultaneous production of water and/or free-gas	**20**
3	C03	To describe the principle of water influx and water coning	**25**
4	CO4	To discuss different Oil recovery mechanism	**20**

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

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Signature of the Chairperson DAC:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1				
2				
3				
4				
5				
6				
7				

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	To explain the reservoir rock and fluid properties of a hydrocarbon reservoir	**30**		

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2	CO2	To predict the maximum flow rate that can be assigned to a completed well without the simultaneous production of water and/or free-gas	**20**		
3	C03	To describe the principle of water influx and water coning	**25**		
4	CO4	To discuss different Oil recovery mechanism	**20**		

Name and Signature of the Course Instructor:

DAC Observation and Approval:

BLOOM'S TAXONOMY

Learning Outcomes Verbs at Each Bloom Taxonomy Level to be used for writing the course Outcomes.

Cognitive Level	Illustrative Verbs	Definitions
Knowledge	arrange, define, describe, duplicate, identify, label, list, match, memorize, name, order, outline, recognize, relate, recall, repeat, reproduce, select, state	remembering previously learned information
Comprehension	classify, convert, defend, discuss, distinguish, estimate, explain, express, extend, generalize, give example(s), identify, indicate, infer, locate, paraphrase, predict, recognize, rewrite, report, restate, review, select, summarize, translate	grasping the meaning of information
Application	apply, change, choose, compute, demonstrate, discover, dramatize, employ, illustrate, interpret, manipulate, modify, operate, practice, predict, prepare, produce, relate schedule, show, sketch, solve, use write	applying knowledge to actual situations
Analysis	analyze, appraise, breakdown, calculate, categorize, classify, compare, contrast, criticize, derive, diagram, differentiate, discriminate, distinguish, examine, experiment, identify, illustrate, infer, interpret, model, outline, point out, question, relate, select, separate, subdivide, test	breaking down objects or ideas into simpler parts and seeing how the parts relate and are organized
Synthesis	arrange, assemble, categorize, collect, combine, comply, compose, construct, create, design, develop, devise, explain, formulate, generate, plan, prepare, propose,	rearranging component ideas into a new whole

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	rearrange, reconstruct, relate, reorganize, revise, rewrite, set up, summarize, synthesize, tell, write	
Evaluation	appraise, argue, assess, attach, choose, compare, conclude, contrast, defend, describe, discriminate, estimate, evaluate, explain, judge, justify, interpret, relate, predict, rate, select, summarize, support, value	making judgments based on internal evidence or external criteria

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Course Code: **PET2005**	**Course Title:** **Fundamentals of Instrumentation and Control Engineering** **Type of Course:** **1] Program Core** **2] Laboratory integrated**	**L- P- C**	2	2	3
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	The purpose of this course is to enable the student to understand the different process control methods used in the industry. It will help the student in selection of the different control method for different types of processes in industry. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematics. The course develops the critical thinking and analytical skills. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to correlate with the real time experiment.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Instrumentation and Control Engineering and attain **Skill Development** through **Experiential Learning** techniques.				
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: Illustrate the dynamic behavior and feedback loops for linear systems, CO2: Apply the concept of various response of first and second order systems, CO3: Analyze the open and closed loop stability and performance of simple processes.				
Course Content:					
Module 1:	Introduction to Process Control	Team Exercise	Presentation	10 Periods	
Topics: Introductory Concepts: Introduction, Technique of control, Feedback control system-Advantage and disadvantage, Block diagram, Open and Closed loop system, Ideal control actions, Control Strategies **Related Experiment No:** 1, 2 ,3, 4 and 5					
Module 2:	Linear Open-Loop System	Quiz	Online Quiz	12 Periods	
Topics: Response of first order systems- Physical examples of First-Order systems- Response of first order systems in series- Higher Order systems: Second-Order and transportation lag **Related Experiment No:** 1, 2 ,3, 4 and 5					
Module 3:	Linear Closed-Loop System	Team Activity	Poster Presentation	12 Periods	
Topics: Control System- Controllers and Final Control Elements- Block Diagram of a Chemical-Reactor Control System- Closed-Loop Transfer Functions- Transient response of Simple Control Systems. **Related Experiment No:** 6, 7 and 8					

List of Laboratory Tasks:

Experiment No. 1: To study the Dynamics and Compare Theoretical Response with Actual Response in a single tank system for step input.
Level 1: To find the time constant of single tank system for single step input,
Level 2: To plot the response graph for single tank.

Experiment No. 2: To study the dynamics and compare theoretical response with actual response in a Two Tank Interacting System for step input.
Level 1: To find the time constant of Two Tank Interacting System for single step input,
Level 2: To plot the response graph of Two Tank Interacting.

Experiment No. 3: To study the dynamics and compare theoretical response with actual response in a Two Tank Non Interacting System for step input.
Level 1: To find the time constant of Two Tank Non Interacting System for single step input,
Level 2: To plot the response graph of Two Tank Non Interacting System.

Experiment No. 4: To study the dynamics and compare theoretical response with actual response in a Two Tank Interacting System for multi-step input.
Level 1: To find the time constant of Two Tank Interacting System for multi-step input,
Level 2: To plot the response graph of Two Tank Interacting.

Experiment No. 5: To study the dynamics and compare theoretical response with actual response in a Two Tank Non Interacting System for multi-step input.
Level 1: To find the time constant of Two Tank Non Interacting System for multi-step input,
Level 2: To plot the response graph of Two Tank Non Interacting System.

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Experiment No. 6: To determine the time constant of a second order system (Mercury manometer).
Level 1: To find the time constant of Mercury manometer,
Level 2: To plot the response graph Mercury manometer.

Experiment No. 7: To calibrate the given thermocouple using resistance temperature detector.
Level 1: To find out the error and error% of the thermocouple,
Level 2: Plot the graph for error and error %.

Experiment No. 8: To study of Characteristics of Diaphragm actuated pneumatic Linear control valve and Equal percentage valve.
Level 1: To find the flow rate for the valve Characteristics,
Level 2: To plot the valve trip characteristics graph.

Targeted Application and Tools that can be used:
Application: Process Engineer in various Chemical and Petrochemical Industry.
Tools: Grapher

Text Book:
T1."Process systems analysis and control", Donald R. Coughanowr, Steven E. LeBlanc. 3rd Edition, 2009, Mcgraw-Hill Chemical Engineering Series.
T2. Process Control And Instrumentation, R. P. Vyas,7th Edition,2015, Denett & Co

References:
R1. "Process Dynamics and Control", Sudheer S.Bhagade, First Edition, 2011, PHI Learning.
R2. "Instrumentation and Process Control", M.N.Jayaswal, First Edition, 2009 IK International House Pvt. Ltd.

e- References:
1. https://puniversity.informaticsglobal.com/login
2. https://nptel.ac.in/courses/103/103/103103037
3. https://ch503ns.wordpress.com/a-to-z/lecture-notes/

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. The course attainment will be assessed through assessment component mentioned in course handout.

Catalogue prepared by:	Dr. Suman Paul, Dr. Deepjyoti Mech, Dr. Kalpajit Hazarika, Mr. Ankur Neog
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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PRESIDENCY UNIVERSITY

(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Hand Out

Date of Issue: 07-09-2022

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2021-25
Semester / Year	:	III / 3rd
Course Code / Title	:	PET2005 / Fundamentals of Instrumentation and Control Engineering
Course Credit Structure	:	2L-2P-3C
Contact Hours	:	38 (28L+ 10P)
Course Instructor In-charge	:	Mr. Ankur Neog / Dr. Sourav Mukherjee
Course Instructor	:	Mr. Ankur Neog/ Dr. Sourav Mukherjee
Course URL	:	
Program Outcomes (POs)	:	

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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PO08: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO09: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:

Nil

Course Description:

The purpose of this course is to enable the student to understand the different process control methods used in the industry. It will help the student in selection of the different control method for different types of processes in industry. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematics. The course develops the critical thinking and analytical skills. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to correlate with the real time experiment.

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Fundamentals of Instrumentation and Control Engineering and attain **Skill Development** through **Experiential Learning** techniques.

Course Outcomes (COs):

On successful completion of the course, the student shall be able to:

CO1: Illustrate the dynamic behavior and feedback loops for linear systems,
CO2: Apply the concept of various response of first and second order systems,
CO3: Analyze the open and closed loop stability and performance of simple processes

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	M	H	M	L	M	M	M	H		H	L	L
CO2	H	M	M	H	M	M	H	L		M	M	L
C03	H	L	H	M	L	H	L	M		M	L	L
H = High, M = Moderate, L = Low												

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Course Content (Syllabus):

Module I: Introduction to Process Control [8 Classes] [Application]

Introductory Concepts: Introduction, Technique of control, Feedback control system-Advantage and disadvantage, Block diagram, Open and Closed loop system, Ideal control actions, Control Strategies

Related Experiment No: 1, 2 ,3, 4 and 5

Module II: Linear Open-Loop System [7 Classes] [Application]

Response of first order systems- Physical examples of First-Order systems- Response of first order systems in series- Higher Order systems: Second-Order and transportation lag

Related Experiment No: 1, 2 ,3, 4 and 5

Module III: Linear Closed-Loop System [7 Classes] [Application]

Control System- Controllers and Final Control Elements- Block Diagram of a Chemical-Reactor Control System- Closed-Loop Transfer Functions- Transient response of Simple Control Systems.

Related Experiment No: 6, 7 and 8

SKILL SETS TO BE DEVLOPED:

1. **An attitude of enquiry.**
2. **Confidence and ability to tackle new problems.**
3. **Ability to interpret events and results.**
4. **Ability to work as a leader and as a member of a team.**
5. **Assess errors in systems/processes/programs/computations and eliminate them.**
6. **Observe and measure physical phenomena**.
7. **Write reports.**
8. **Select suitable equipment, instrument, materials & software**
9. Locate faults in system/Processes/software.
10. **Manipulative skills for setting and handling systems/Process/ Issues**
11. **The ability to follow standard /Legal procedures.**
12. **An awareness of the Professional Ethics.**
13. **Need to observe safety/General precautions**.
14. To judge magnitudes/Results/issues without actual measurement/actual contacts

COURSE CONTENT &TASK SCHEDULE FOR LABORATORY COMPONENT:

Sl. No	Session Number and Date	Task No	Task	Level 1	Level 2	Number of Lab Sessions required to	Skills to be developed	Course Outcome to be developed
1	15/09/22	P1	Familiarization with Process Control Lab			1		
2	22/09/22	P1	Familiarization with Process Control Lab			1		

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3	29/09/22	P2	To study the Dynamics and Compare Theoretical Response with Actual Response in a single tank system for step input.	To find the time constant of single tank system for single step input	To plot the response graph for single tank.	1	2, 7, 8, 10, 11, 12, 13	CO1, CO2
4	06/10/22	P3	To study the dynamics and compare theoretical response with actual response in a Two Tank Interacting System for step input.	To find the time constant of Two Tank Interacting System for single step input	To plot the response graph of Two Tank Interacting	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1, CO2
5	13/10/22	P4	To study the dynamics and compare theoretical response with actual response in a Two Tank Non Interacting System for step input.	To find the time constant of Two Tank Non Interacting System for single step input	To plot the response graph of Two Tank Non Interacting System	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1, CO2
6	20/10/22	P5	To study the dynamics and compare theoretical response with actual response in a Two Tank Interacting System for multi-step input	To find the time constant of Two Tank Interacting System for multi-step input	To plot the response graph of Two Tank Interacting	1	1, 2, 3, 4, 5, 8, 10, 11, 12, 13	CO1, CO2
7	27/10/22	P6	To study the dynamics and compare theoretical response with actual response in a Two Tank Non Interacting System for multi-step input.	To find the time constant of Two Tank Non Interacting System for multi-step input	To plot the response graph of Two Tank Non Interacting System	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1

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8	10/11/22	P7	To determine the time constant of a second order system (Mercury manometer).	To find the time constant of Mercury manometer	To plot the response graph Mercury manometer	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1,CO3
9	17/11/22	P8	To calibrate the given thermocouple using resistance temperature detector	To find out the error and error% of the thermocouple	Plot the graph for error and error %.	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO2,CO3
10	24/12/22	P9	Revision					
11	08/12/22	P10	Revision					

Delivery Procedure (Pedagogy):
This is an integrated lab based theory course. Most of the lectures will be taken with the help of Power Point Presentation and White board. Videos will be shown for the better understanding of selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. During the lab session a problem statement will be given to the students and based on their understanding they have to prepare the solution. If required, classes may take through virtual mode. Following procedures will be adopted in the course for delivering the content:

Experiential learning (Module I) (Foundation Skill)
Article writing on the following topic:

- Types of controller used in process industry.
- Literature Review of Digital/e-resources from Presidency University link shared below. It is mandatory to submit a screenshot accessing digital resources, otherwise, it will not be evaluated. Link to Presidency University e-resources: https://puniversity.informaticsglobal.com/login.

Participative learning (Module II, Module III) (Skill Development/ Human Values and Professional Ethics):
Poster Presentation on the topic:
- Implementation of Process Control in Industry.

Problem solving (Module III) (Employability):

- Simplification of transfer function loop

Reference Materials:

(a) Text Book:
T1. "Process Dynamics and Control", Sudheer S.Bhagade, First Edition, 2011, PHI Learning
T2. Process Control And Instrumentation, R. P. Vyas,7th Edition,2015, Denett & Co
(b) Reference Book(s):
R1: "Process systems analysis and control", Donald R. Coughanowr, Steven E. LeBlanc. 3rd Edition, 2009, Mcgraw-Hill Chemical Engineering Series.
R2: "Instrumentation and Process Control", M.N.Jayaswal, First Edition, 2009 IK International House Pvt. Ltd.

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(c) Case study:

1. Case Study on Process Control and Root Cause Analysis: https://www.mt.com/in/en/home/library/case-studies/process-analytics/process-control.html

(d) e- References:

1. Link for Knimbus remote login: https://presiuniv.knimbus.com
2. NPTEL resource on Process Control: https://nptel.ac.in/courses/103/103/103103037
3. NPTEL resource on Modes of Heat Transfer: https://ch503ns.wordpress.com/a-to-z/lecture-notes/

Guideline to Students:

(a) About the Course:

The course will equip the students with the knowledge and skills required to solve problems of heat and mass transfer processes. The types of problems solved in the course focus on industrial and real-life applications in the process industries. The associated laboratory experiments provides an opportunity to validate the concepts taught and enhances the ability to correlate with the real time experiment.

(b) Notification / Announcement related to the Course:

All the course related notifications will be displayed on the Department Notice Board only. All the announcements will be made during the regular lecture hours.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2017', Regulation No. PU/AC-11/20/06_2019, from Presidency University, Bengaluru website and go through the Section Nos. 1.0 through 24.0.

(d) Any other information

- Students are requested to collect the books related to this course from the library and start reading the chapters mention in the handout
- It is a request to all the students not to rely entirely on class notes and presentation. To clear concepts they need to go through the books which is recommended here
- Students are requested to be serious about their Assignments, Quiz and Poster presentation. These all are part of continuous evaluation and no make up for any of these components
- All assignments should be submitted on or before the given day. No assignments will be accepted.

COURSE SCHEDULE FOR THEORY COMPONENT

Module-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course	13-09-22	13-09-22	1
2	Module 01:	16-09-22	14-10-22	8
3	Literature Review on Module I	-	-	-
4	Module 02:	18-10-22	25-11-22	7
6	Poster Presentation on Module II	-	-	-
7	Mid Term Syllabus and question pattern discussion	28-10-22	28-10-22	1
8	Mid term	03-11-22	07-11-22	-
9	Mid Term Question Paper discussion	08-11-22	08-11-22	1
10	Module 03:	29-11-22	30-12-22	7
10	Quiz on Module III	-	-	-

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11	Course Integration	27-12-22	27-12-22	1
12	End Term Syllabus and Question Paper Pattern Discussion	29-12-22	29-12-22	1
13	End Term Final Examination	05-01-23	25-01-23	-

*****Dates as per the academic calendar***

COURSE SCHEDULE FOR LABORATORY COMPONENT

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course	15-09-2022	15-09-2022	1
2	Laboratory Familiarization	15-09-2022	15-09-2022	1
2	Demonstration of first set of Experiments/Skills	22-09-2022	22-09-2022	1
4	Conduct of first set of experiments	22-09-2022	06-09-2022	4
5	Project work	-	-	-
6	Conduct of second set of experiments	13-10-2022	6-12-2022	4
7	Summary of the Laboratory tasks	-	-	-
8	End Term Evaluation	-	-	-

Schedule of Instruction:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No.	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
1	L1 / 13/09/22	**Programme Integration-1**	Overview of the course		PPT/White board	
Module I						
2	L2 / 16/09/22	Introduction to Process Control	Introductory Concepts: Introduction,	CO1	PPT/White board	T1,Ch01
3	L3 / 20/09/22	Introduction to Process Control	Technique of control	CO1	PPT/White board	T1,Ch01
4	L4 / 23/09/22		Feedback control system-	CO1	PPT/White board	T1,Ch01
5	L5 / 27/09/22		Advantage and disadvantage,	CO1	PPT/White board	T1,Ch01

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6	L6 / 30/09/22		Block diagram, Open and Closed loop system,	CO1	PPT/White board	T1,Ch01
7	L7 / 07/10/22		Ideal control actions,	CO1	PPT/White board	T1,Ch01
8	L8 / 11/10/22		Control Strategies	CO1	PPT/White board	T1,Ch01
9	L9 / 14/10/22		Control Strategies	CO1	PPT/White board	T1,Ch01
Article writing on Module I				CO1		
Module II						
10	L10 / 18/10/22	Linear Open-Loop System	Response of first order systems-	CO2	PPT/White board	T1,Ch03
11	L11 / 21/10/22		Response of first order systems-	CO2	PPT/White board	T1,Ch03
12	L12 / 28/10/22	Mid Term Syllabus and question pattern discussion		C01, CO2		
13	L13 / 08/11/22	Mid Term question paper discussion		C01, CO2		
14	L14 / 11/11/22	Linear Open-Loop System	Physical examples of First-Order systems-	CO2	PPT/White board	T1,Ch03
15	L15 / 15/11/22		Physical examples of First-Order systems-	CO2	PPT/White board	T1,Ch03
16	L16 / 18/11/22		Response of first order systems in series-	CO2	PPT/White board	T1,Ch03
17	L17 / 22/11/22		Higher Order systems: Second-Order and transportation lag	CO2	PPT/White board	T1,Ch03
18	L18 / 25/11/22		Higher Order systems: Second-Order and transportation lag	CO2	PPT/White board	T1,Ch03
Quiz on Module I				CO2		
Module III						
19	L19 / 29/11/22	Linear Closed-Loop System	Control System-Controllers and	CO3	PPT/White board	T1,Ch07
20	L20 / 02/12/22		Control System-Controllers and	CO3	PPT/White board	T1,Ch07
21	L21 / 06/12/22		Final Control Elements- Block Diagram of a Chemical-Reactor	CO3	PPT/White board	T1,Ch07
22	L22 / 09/12/22		Final Control Elements- Block Diagram of a Chemical-Reactor	CO3	PPT/White board	T1,Ch07

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23	L23 / 13/12/22		Control System-Closed-Loop Transfer Functions-	CO3	PPT/White board	T1,Ch09
24	L24 / 16/12/22		Control System-Closed-Loop Transfer Functions-	CO3	PPT/White board	T1,Ch09
25	L25 / 20/12/22		Transient response of Simple Control Systems.	CO3	PPT/White board	T1,Ch09
26	L26 / 23/12/22		Transient response of Simple Control Systems.	CO3	PPT/White board	T1,Ch09
27	L27 / 27/12/22		Course Summary and Relation with other Courses of the Program	CO3	PPT/White board	T1,Ch09
Poster Presentation on Module III						
28	L28 / 30/12/22	End Term Question paper discussion		CO1-CO3		

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. This is attained through the Lab Experiments as mentioned in the assessment schedule.

ASSESSMENT SCHEDULE FOR THEORY COMPONENT:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time
1	Assignment: Report – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://puniversity.informaticsglobal.com/login). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)	L02-L09	CO1	-	20	-	

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2	Quiz Module II	L10-L18	CO2	-	20	-	
3	Mid term	L02-L11	CO1, CO2	2	60	30	
4	Poster on Module III	L20-L28	CO3	-	10	-	
5	End term final examination	L02-L28	CO1 – CO3	3	100	50	

ASSESSMENT DETAILS FOR LABORATORY COMPONENT:

Sl. No	Assessment type	List of Tasks	Course outcome number	Duration (In hours)	Marks	Weightage	Venue, DATE &TIME
1	Sample composition calculation and preparation	After conduction of experiment student has to write the entire experiment on lab record	CO1, CO2 and CO3	2	2	1	Day wise evaluation
2	Experiment conduction	Students need to follow the API standards and perform the experiment	CO1, CO2 and CO3	2	20	10	
3	Results and Discussion	Calculation of values and discussion on the results	CO1, CO2 and CO3	2	6	3	
4	Recent Development	Students need to write any recent development regarding the apparatus	CO1, CO2 and CO3	2	2	1	
5	VIVA	-	CO1, CO2 and CO3	2	10	5	

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Assessment Matrix for Daily Task Evaluation for Laboratory component:

Sl. No.	Task No.	Marks for activity 01 [Mention the activity]	Marks for activity 02 [Mention the activity]	Marks for activity 03 [Mention the activity]	Total Marks		

Course Clearance Criteria :

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website and go through the Section Nos. 1.0 through 24.0. Website: https://presidencyuniversity.in/university-document/. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, and Head of the Department, for further assistance.

Minimum requirements for clearing any Course are mentioned below:

- **Minimum Attendance Requirement:**
  In order to maintain high standards and academic excellence, all students must attend every lecture, tutorial, field work, laboratory, practical classes and all other such curricular sessions as prescribed by the Program requirements.
  - To account for approved leave of absence (for instance, representing the University in State/National/International Competitions/Events/Conferences, etc.) and/or other contingencies like medical emergencies, the attendance requirement shall be a minimum of 75% of the classes actually conducted in every Course the student has registered for in the Academic Term.
  - If attendance is more than 65% but less than 75%, then the concerned student may be given relaxation in attendance requirement as per the Section No. 7.0 of the 'Academic Regulations, 2019'.
  - If attendance is less than 65%, then the student shall not be eligible for the special provision as mention in Section No. 7.0 of the 'Academic Regulations, 2019'. In this case, the student will be marked as 'NP' or 'Not Permitted' student for that particular course.
  - If any student is getting 'NP' grade in **MORE THAN ONE (01) Course** in the concerned Semester, **shall not be permitted to appear in the End Term Final Examinations of ALL Courses** that the students has registered for in the concerned Semester. In this case, **the student will lose ONE ACADEMIC YEAR** as per the Section No. 7.0 of the 'Academic Regulations, 2019'.

- **Minimum Performance Criteria:**
  In a Program of study, where the concerned Program Regulations and Curriculum prescribes components of Continuous Assessments including an End Term Final Examination, (with the weightages/ marks associated for Continuous Assessments and End Term Final Examination) to evaluate performance in a Course, a student shall satisfy the following minimum performance criteria to be eligible to complete the concerned Course:
  - A student must obtain a minimum of 40% of the total marks / weightage assigned for Continuous Assessments (other than the End Term Final Examination) in that Course, AND;

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- The student must obtain a minimum of 30% of the total marks / weightage assigned for End Term Final Examination in that Course, AND;
- The Student must have secured a minimum of 40% of the AGGREGATE of the marks / weightage of the components of the Continuous Assessments and the End Term Final Examination in the concerned Course.
- For Non-Teaching Credit Courses (NTCC) without a prescribed L-T-P structure (refer Clause 5.2 of the 'Academic Regulations, 2019'), the student must have secured a minimum of 40% of the AGGREGATE of the marks / weightage of the components of the Continuous Assessments prescribed for the concerned Course.

- **Make-up Exam Policy:**
  - In general, there will be no make-up for Test 1, Test 2 and Continuous Assessment 3.
  - Make-up may be permitted for genuine cases only with prior permission from the Instructor In-charge, and approval from the Class Coordinator, the HOD, and the Dean, SOE.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1	The javlin throw competition is going on in the Olympics. J. Vadlejch of Czech Republic made a throw of a distance 86.5 m and is leading the table . Neeraj Chopra is the main contender for gold and aims for gold this Olympics, his last throw distance was 86 m. He has one final throw . The Process is Neeraj Chopra winning Gold.Explain all the process variable and state what will be the process variables in this particular example.	10	C01	Application
2	Imagine you as a Controller ,what are the different types of input you can give to the single Tank System. Explain the inputs by giving example of how exactly you will give those inputs (taking a specific value) to the single tank system.	10	C01	Application

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Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Illustrate the dynamic behavior and feedback loops for linear systems,	20
2	CO2	Apply the concept of various response of first and second order systems,	25
3	CO3	Analyze the open and closed loop stability and performance of simple processes	20

Signature of the Course Instructor In-charge: Mr. Ankur Neog

Signature of the Course Instructor: Mr. Ankur Neog

Signature of the Chairperson DAC:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

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Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Illustrate the dynamic behavior and feedback loops for linear systems,	20		
2	CO2	Apply the concept of various response of first and second order systems,	25		
3	CO3	Analyze the open and closed loop stability and performance of simple processes	20		

Name and Signature of the Course Instructor:

DAC Observation and Approval:

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Course Code: **PET2006**	**Course Title:** **Fundamentals of Oil and Gas Production Technology** **Type of Course:** **1] Program Core** **2] Theory only**	**L- P- C**	3	0	3
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	This course deals with the various processes dealing with production of petroleum from the subsurface. The course also discuss the well performance analysis through inflow and tubing performance relationships, multiphase fluid flow regimes; productivity index, well potential, flow rate variation with pressure drawdown, nodal analysis and choke performance; Artificial lift systems and their working; Flow assurance techniques applicable in the petroleum industry.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Oil and Gas Production Technology and attain **Skill Development** through **Problem Solving** techniques.				
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: apply the knowledge of IPR, TPR and nodal analysis for determining various well performance parameters, CO2: illustrate different pumps for artificial lift techniques, CO3: compute various operating parameters of gas lift technique, CO4: discuss ESP and other pumps along with their components and working principle.				
Course Content:					
Module 1:	Well Performance	Assignment 1	Quiz	10 Periods	
Topics: Basic surface equipment**;** Productivity index; IPR: Vogel/Fetkovich; Absolute open flow potential; Future IPR; Tubing performance relationship; Well potential; Choke Performance; Nodal Analysis.					
Module 2:	Artificial Lift Introduction and SRP	Assignment 2	Course Based Problems	08 Periods	
Topics: Definition and purpose of artificial lift; Type of artificial lifts: SRP, Gas lift, ESP, Hydraulic pumps. SRP - Introduction; Surface components; Wellhead equipment; Type of pump; working mechanism; subsurface components; Dynamometer; Operating parameter description and calculation.					
Module 3:	Gas Lift	Assignment 3	Quiz	09 Periods	
Topics: Introduction; Working mechanism; Types of gas lifts: Continuous gas lift, intermittent gas lift; Gas lift valves: Valve mechanism, Type of valves, Valve selection, Valve pressure calculation; Gas lift mandrel; Type of installations; Surface components; Basic design calculation; Plunger and chamber gas lifts.					
Module 4:	ESP and Other Pump	Assignment 4	Article Review	09 Periods	
Topics: ESP - Introduction; ESP system; Subsurface components; Wellhead equipment; surface components; Working principle; Basic design calculations. Other Pumps - Hydraulic pumps: Components and working principle; PCP: Components and working principle. Comparison Between Various Artificial Lift Techniques.					
Targeted Application and Tools that can be used: Applications: Oil and Gas Industries- Production engineer Tools: PROSPER and OLGA Multi Phase Flow Simulator					
Text Book: T1. BoyunGuo, Xinghui Liu, Xuehao Tan, "Petroleum production engineering", Gulf Professional Publishing. (2 Edition, 2017) T2. Tan Nguyen, "Artificial Lift Methods: Design, Practices and Applications", Springer.(1st Edition, March 2020)					
References: R1. Boyun Guo Ali Ghalambor William C. Lyons,"Petroleum Production Engineering, A Computer-Assisted Approach", Gulf Professional Publishing. (1 Edition, 2007) R2. Kermit E Brown, "The Technology of Artificial Lift Methods", PennWell Books. (Volume: 3B, 1983) **E-resources:** 1. Presidency University e-access portal: https://presiuniv.knimbus.com/user#/home 2. Petrowiki Forum: https://petrowiki.spe.org/Oil_well_performance 3. Well Performance Model One Petro: https://onepetro.org/JPT/article-abstract/44/02/220/107815/Well-Performance-Model?redirectedFrom=PDF					

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4. Petrowiki: https://petrowiki.spe.org/Gas_lift#:~:text=Gas%20lift%20is%20a%20method,scrubbing%E2%80%9D%20action%20on%20the%20liquids. 5. Kimray Official Website: https://kimray.com/training/5-common-methods-artificial-lift 6.Oil and Gas IQ Website: https://www.oilandgasiq.com/oil-and-gas-production-and-operations/news/what-is-flow-assurance	
Topics relevant to "**SKILL DEVELOPMENT**": Gas lift valves: Valve mechanism, Type of valves, Valve selection, Valve pressure calculation for **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by:	Dr. Deepjyoti Mech, Mr. Ankur Neog, Mr. Indraneel Agasty, Mr. Anmol Bhargava, Mr. Sugat Srivastava
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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PRESIDENCY UNIVERSITY

(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Handout (AY 2022-2023)

Date of Issue: 07-09-2022
Revised on: N/A

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech.in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2020-24
Semester / Year	:	V / 3rd
Course Code / Title	:	PET2006 / Fundamentals of Oil and Gas Production Technology
Course Credit Structure	:	3L – 0P – 3C
Contact Hours	:	40
Course Instructor In-charge	:	Mr. Bhairab Jyoti Gogoi
Course Instructor	:	Mr. Utkarsh Lall

Program Outcomes (POs):

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:
NIL

Course Description:

This course deals with the various processes dealing with production of petroleum from the subsurface. The course also discuss the well performance analysis through inflow and tubing performance relationships, multiphase fluid flow regimes; productivity index, well potential, flow rate variation with pressure drawdown, nodal analysis and choke performance; Artificial lift systems and their working; Flow assurance techniques applicable in the petroleum industry.

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Fundamentals of Oil and Gas Production Technology and attain Skill Development through Problem Solving techniques.

Course Outcomes (COs):

Upon successful completion of the course the students shall be able to:
CO1: Apply the knowledge of IPR, TPR and nodal analysis for determining various well performance parameters,
CO2: Illustrate different pumps for artificial lift techniques,
CO3: Compute various operating parameters of gas lift technique,
CO4: Discuss ESP and other pumps along with their components and working principle.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	H	M	M	L	L		L	L	L	H	L	L
CO2	H	H	M	L	L		L	L	L	H	L	L
CO3	H	H	L	M	M		M	M	M	H	M	M
CO4	H	H	L	M	M		H	M	M	H	M	L
H = High, M = Moderate, L = Low												

Course Content (Syllabus):

Module I: Well Performance [9 Classes] – Application Level
Basic surface equipment; Productivity index; IPR: Vogel/Fetkovich; Absolute open flow potential; Future IPR; Tubing performance relationship; Well potential; Choke Performance; Nodal Analysis.

Module II: Artificial Lift Introduction and SRP [8 Classes] – Comprehension Level
Definition and purpose of artificial lift; Type of artificial lifts: SRP, Gas lift, ESP, Hydraulic pumps. SRP - Introduction; Surface components; Wellhead equipment; Type of pump; working mechanism; subsurface components; Dynamometer; Operating parameter description and calculation.

Module III: Gas Lift [9 Classes] – Application Level
Introduction; Working mechanism; Types of gas lifts: Continuous gas lift, intermittent gas lift; Gas lift valves: Valve mechanism, Type of valves, Valve selection, Valve pressure calculation; Gas lift mandrel; Type of installations; Surface components; Basic design calculation; Plunger and chamber gas lifts.

Module IV: ESP and Other Pump [9 Classes] – Comprehension Level
ESP - Introduction; ESP system; Subsurface components; Wellhead equipment; surface components; Working principle; Basic design calculations.

Other Pumps - Hydraulic pumps: Components and working principle; PCP: Components and working principle. Comparison Between Various Artificial Lift Techniques.

Delivery Procedure (Pedagogy):

This is a theory based course. Most of the lectures will be taken with the help of Power Point Presentations and White Board. Videos will be shown for the better understanding of selective topics. Flip Class Room sessions will be conducted on selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. Assignments, Quiz Competition and Poster Presentation will carry 20% weightage under Continuous Internal Assessment (CIA). Review classes will be conducted to clear doubts and to evaluate the level of understanding of the each student individually. If required some classes may be engaged in virtual mode under unavoidable circumstances.

Following procedures will be adopted in the course for delivering the content:

(a) Self Learning Topics (SLT):

- Working of reciprocating pump. (Module II)
- Components of pressure drop in tubing. (Module I)
- Working of centrifugal pump. (Module IV)

(b) Experiential Learning Topics (ELT):

-Article Review [Module IV] [Foundation/Skill Development]

(1) Production Performance Prediction of an Oil Well using Machine Learning(Team Activity)
(2) Problems of Rock Mechanics in Petroleum Production Engineering (Team Activity)

-Students need to access the e-resource website for reviewing of article.They are required to make a report and submit before the due date.

(c) Participative Learning Topics (PLT):

- Quiz [Module I, II and III][Skill Development]
- The average of all the quizzes will be considered for evaluation.

(d) Problem Based Learning Topics (PBLT):

- Numerical Problems on "ESP Design, Installation and Troubleshooting in Oil Wells"(Team Activity)
- Student needs to submit the problem assignments before the due date.

Reference Materials:

Text Book:

T1. Boyun Guo, Xinghui Liu, Xuehao Tan, "Petroleum production engineering", Gulf Professional Publishing. (2nd Edition, 2017)
T2. Tan Nguyen, "Artificial Lift Methods: Design, Practices and Applications", Springer.(1st Edition, March 2020)

References:

R1. Boyun Guo Ali Ghalambor William C. Lyons,"Petroleum Production Engineering, A Computer-Assisted Approach", Gulf Professional Publishing. (1st Edition, 2007)
R2. Kermit E Brown, "The Technology of Artificial Lift Methods", PennWell Books.(Volume: 3B, 1983)

E-resources:

1.Presidency University e-access portal:https://presiuniv.knimbus.com/user#/home
2.Petrowiki Forum: https://petrowiki.spe.org/Oil_well_performance
3.Well Performance Model One Petro: https://onepetro.org/JPT/article-abstract/44/02/220/107815/Well-Performance-Model?redirectedFrom=PDF
4.Petrowiki:https://petrowiki.spe.org/Gas_lift#:~:text=Gas%20lift%20is%20a%20method,scrubbing%E2%80%9D%20action%20on%20the%20liquids
5.Kimray Official Website: https://kimray.com/training/5-common-methods-artificial-lift
6.Oil and Gas IQ Website:https://www.oilandgasiq.com/oil-and-gas-production-and-operations/news/what-is-flow-assurance

Guideline to Students:

(a) About the Course:

This course deals with various concepts of artificial lift techniques for hydrocarbon production. The course will introduce methods to analyze well performance and improve it using artificial lifts. The course is both conceptual and problem solving. It develops the critical thinking and analytical skills. The course will develop the basic programming skills through assignments.

(b) Notification / Announcement related to the Course:

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All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0.

Course Schedule:

Module-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
01	Overview of the Program and Course	12-09-2022	12-09-2022	L1
02	Module I	13-09-2022	04-10-2022	L2-L10
03	Continuous Internal Assessment 1: Quiz			-
04	Module II	06-10-2022	31-10-2022	L11-L21
05	Continuous Internal Assessment 2a: Quiz			-
06	Continuous Internal Assessment 2b: Course based problems			-
07	Discussion of Mid Term Exam Question Pattern	01-11-2022	01-11-2022	L19
08	Mid Term Exam	03-11-2022	07-11-2022	-
09	Discussion of Mid Term Exam Questions and Answers	08-11-2022	08-11-2022	L20
10	Module III	10-11-2022	29-11-2022	L22-L30
11	Continuous Internal Assessment 3: Quiz			-
12	Module IV	01-12-2022	19-12-2022	L31-L38
13	Continuous Internal Assessment 4: Article Review			-
14	Course Integration	20-12-2022	20-12-2022	L39
15	Discussion of End Term Exam Question Pattern	22-12-2022	22-12-2022	L40
16	End Term Exam	05-01-2023	25-01-2023	-
17	Discussion of End Term Exam Questions and Answers			-

Schedule of Instruction:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No. / Date	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
1	L01 / 12-09-2022	Overview of the Program and Course	Overview of the Program and Course	-	PowerPoint Presentation	N/A
Module I						
2	L02 / 13-09-2022	Well Performance	Wellhead; Christmas tree; Casing and tubing.	CO1	Lecture and PowerPoint Presentation	T1 CH3 / CN
3	L03 / 15-09-2022		Definition; Purpose; Determination.	CO1	PowerPoint Presentation / Videos	T1 CH3 / CN

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4	L04 / 19-09-2022		Definition & Purpose; AOF; Vogel method.	CO1	PowerPoint Presentation / Videos	T1 CH3 / CN
5	L05 / 20-09-2022		Fetkovich method; Future IPR determination Method.	CO1	PowerPoint Presentation / Videos	T1 CH3 / CN
6	L06 / 22-09-2022		Definition; Purpose and determination methods	CO1	PowerPoint Presentation / Videos	T1 CH3 / CN
7	L07/26-09-2022		Definition of node; Purpose of nodal analysis; nodal analysis procedure	CO1	Lecture & presentation	T1 CH4 / CN
8	L08/27-09-2022		PI & Vogels method	CO1	Lecture & Presentation	T1 CH4 / CN
9	L09/29-09-2022		Vogels method & Fetkovich method	CO1	Lecture & Presentation	T1 CH4 / CN
10	L10/06-10-2022		Future IPR determination	CO1	Lecture & Presentation	T1 CH4 / CN
	-		Continuous Internal Assessment 1- Quiz	-	-	-
Module II						
11	L11 /10-10-2022	Artificial Lift Introduction and SRP	Definition; Purpose of artificial lift; Type of artificial lifts: SRP, Gas lift, ESP, Hydraulic pumps.	CO2	PowerPoint Presentation / Videos	T1 CH16 / CN
12	L12 / 11-10-2022		Introduction; Type of units; API classification.	CO2		T1 CH16 / CN
13	L13 / 13-10-2022		Power unit; Transition unit; Well head unit.	CO2		T1 CH16 / CN
14	L14 / 17-10-2022		Type of down hole pump; Working mechanism of pumps.	CO2	Lecture, Presentation & Video	T1 CH16 / CN
15	L15/ 18-10-2022		Volumetric calculation; Power calculation; Dynamometer.	CO2	Lecture & Presentation	T1 CH16 / CN
16	L16/ 20-10-2022		Volumetric calculation for SRP	CO2	Lecture & Presentation	T1 CH16 / CN
17	L17/27-10-2022		SRP rods; Protection equipment.	CO2	Lecture & Presentation	T1 CH16 / CN
18	L18/31-10-2022		Gas anchors; Tubing anchor.	CO2	Lecture & Presentation	T1 CH16 / CN
-	-		Continuous Internal Assessment 2a- Quiz	CO2	-	-
-	-		Continuous Internal Assessment 2b - Course based problems	CO2	-	-
19	L19 / 01-11-2022		Discussion of Mid Term Exam Question Pattern	CO1 and CO2	PowerPoint Presentation	N/A
			Mid Term Exam	CO1 and CO2	N/A	N/A
20	L20 / 08-11-2022		Discussion of Mid Term Exam Questions and Answers	CO1 and CO2	PowerPoint Presentation	N/A
21	L21/10-11-2022	Design calculation	Power calculation for SRP	CO2	Lecture & Presentation	CN
Module III						
22	L22 / 14-11-2022	Gas lift	Introduction; Working mechanism.	CO3	Lecture & Presentation	T1 CH17 / CN

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23	L23 / 15-11-2022		Continuous lift; Intermittent lift.	CO3	Lecture & Presentation	T1 CH17 / CN
24	L24 / 17-11-2022		Valve mechanism; Type of valves.	CO3	Lecture & Presentation	T1 CH17 / CN
25	L25 / 21-11-2022		Valve selection; Valve pressure calculation.	CO3	Lecture & Presentation	T1 CH17 / CN
26	L26 / 22-11-2022		Gas lift mandrel; Type of installations; Surface components.	CO3	Lecture & Presentation	T1 CH17 / CN
27	L27/24-11-2022		Compressor power calculation; Volumetric calculation; Pressure calculation;	CO3	Lecture & Presentation	CN
28	L28/28-11-2022		Valve location determination.	CO3	Lecture & Presentation	CN
29	L29/29-11-2022		Plunger lift & chamber lift.	CO3	Lecture & Presentation &Video	CN
30	L30/01-12-2022		Valve pressure determination	CO3	Lecture & Presentation	CN
-	-		Continuous Internal Assessment 3-Quiz	-	-	-
			Module IV			
31	L31 / 05-12-2022	ESP and Other Pump	ESP Introduction; Working principle.	CO4	PowerPoint Presentation	T1 CH18 / CN
32	L32 / 06-12-2022		Subsurface components.	CO4	PowerPoint Presentation	T1 CH18 / CN
33	L33 / 08-12-2022		Wellhead equipment; surface components.	CO4	PowerPoint Presentation / Videos	T1 CH18 / CN
34	L34 / 12-12-2022		Head and unit calculation.	CO4	PowerPoint Presentation	CN
35	L35 / 13-12-2022		PCP Components and working principle.	CO4	PowerPoint Presentation	CN
36	L36 / 15-12-2022		Components and working principle.	CO4	Lecture & Presentation	T1 CH18 / CN
37	L37 / 19-12-2022		Hydraulic pump and PCP design principle.	CO4	Lecture & Presentation	CN
38	L38 / 20-12-2022		ESP power calculation	CO4	Lecture & Presentation &Video	CN
	-		Continuous Internal Assessment 4: Article Review	-	-	-
23	L39 / 22-12-2022	Course Integration	Course Integration	CO1 through CO4	PowerPoint Presentation	N/A
24	L40 / 26-12-2022		Discussion of End Term Exam Questions and Answers	CO3 and CO4	PowerPoint Presentation	N/A
			End Term Exam	CO1 through CO4	N/A	N/A

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Topics relevant to "**SKILL DEVELOPMENT**": Gas lift valves: Valve mechanism, Type of valves, Valve selection, Valve pressure calculation for **Skill Development** through **Problem Solving methodologies**. This is attained through the Assignment as mentioned in the assessment Schedule.

Assessment Schedule:

Module-wise Micro Level planning for course assessment schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time (Date may Change)
01	Continuous Internal Assessment 1:Quiz	L02 – L10	CO1, CO2	-	10	5%	-
02	Continuous Internal Assessment 2: Quiz	L11 – L21	CO1, CO2	-	5	2.5%	-
03	Continuous Internal Assessment-Course based problems	L11 - L21	CO2	-	5	2.5%	-
04	Mid Term Examination	L02 – L21	CO1, CO2	2	60	30%	03-11-2022 to 07-11-2022
05	Continuous Internal Assessment 3: Quiz	L22 – L30	CO3	-	10	5%	-
06	Assignment: Article writing – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://presiuniv.knimbus.com/user#/home). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)	L31 - L38	CO4	-	10	5%	-
07	End Term Examinations	L03 - L38	CO1, CO2, CO3, CO4	3	100	50%	05-01-2023 to 25-01-2023

Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, Head of the Department, and Dean (School of Engineering) for further assistance.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level

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1	The well completion is the lowermost portion of the well, comprised of tubulars and downhole equipment, that enables the safe and effective production from an oil or gas well.Completion design of well depends on properties of reservoir, fluid and production strategy of the company. Among all the completion designs, explain the completion design that causes least formation damage.	6	CO1	Comprehension
2	SRP is a type of positive displacement pump used as artificial lift technique. It involves surface and sub surface components that work together to provide pumping action. Based on general understanding of SRP, justify the following: a) SRP is positive displacement pump. b) Tubing pump can be used for deviated wells more effectively as compared to rod pumps. c) Presence of free gas reduces pumping efficiency of SRP.	6	CO2	Comprehension
3	Gas lift technique involves injection of gas in the tubing on continues or intermittent bases. The completion design for gas lift depends on selected process for gas injection. Provide appropriate reason for the following design aspects: a) A closed installation is used for intermittent gas lift having low reservoir pressure. b) Intermittent gas lift require large port size valves as compared to continues gas lift. c) Excessively high GOR in gas lift well can cause production to decrease.	6	CO3	Comprehension
4	A PCP is a positive displacement pump, made up of a single external helical shaped rotor turning eccentrically inside a double internal helical shaped stator of the same minor diameter and twice the pitch length of the rotor. ESP involves use of the impellers placed in pump housing. These impellers are run using motor present down hole. The motor is electricity driven using a power cable from surface. Compare ESP with PCP on the basis of their working characteristics and applications in Oil and Gas wells.	6	CO4	Comprehension

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Apply the knowledge of IPR, TPR and nodal analysis for determining various well performance parameters	40
2	CO2	Illustrate different pumps for artificial lift technique	40
3	CO3	Compute various operating parameters of gas lift technique	40
4	CO4	Discuss ESP and other pumps along with their components and working principle	40

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

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This course has been duly verified and approved by the D.A.C.

Signature of the Chairperson D.A.C.:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1	Continuous Internal Assessment 1:Quiz	-	-	
2	Continuous Internal Assessment 2: Quiz	-	-	
3	Continuous Internal Assessment-Course based problems	-	-	
4	Mid Term Examination	03-11-2022 to 07-11-2022	03-11-2022 to 07-11-2022	
5	Continuous Internal Assessment 3: Quiz	-	-	
6	Assignment: Article writing – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://presiuniv.knimbus.com/user#/home). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)	-	-	
7	End Term Examinations	05-01-2023 to 25-01-2023	05-01-2023 to 25-01-2023	
8				
9				
10				

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

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Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Apply the knowledge of IPR, TPR and nodal analysis for determining various well performance parameters	40		
2	CO2	Illustrate different pumps for artificial lift techniques	40		
3	C03	Compute various operating parameters of gas lift technique	40		
4	CO4	Discuss ESP and other pumps along with their components and working principle	40		

Name and Signature of the Course Instructor:

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D.A.C. Observation and Approval:

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Course Code: **PET2008**	**Course Title:** **Heat and Mass Transfer for Petroleum Engineering** **Type of Course:** **1] Program Core** **2] Laboratory integrated**	**L- P- C**	2	2	3
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	The course is designed to discuss the fundamental laws relating to the heat and mass transfer processes. It enables the need for analyze the heat and mass transfer applications in oil and gas industries. The course is both conceptual and analytical in nature. It needs fair knowledge of Physics and Mathematics. The course develops the critical thinking and analytical skills. The associated laboratory experiments provide an opportunity to validate the concepts taught and enhances the ability to visualize the real system performance. Knowledge gained from this course can be applied for analyzing the heat and mass transfer applications in oil and gas industries.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Heat and Mass Transfer for Petroleum and attain **Skill Development** through **Experiential Learning** techniques.				
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: Solve the heat transfer problems of Conduction and Convection, CO2: Illustrate the concept of radiation and the working of heat exchanger, CO3: Apply diffusive and convective mass transfer equations to solve problems for different applications.				
Course Content:					
Module 1:	Heat Transfer by Conduction and Convection	Assignment / Quiz	Data Collection and Report Submission	09 Periods	
Topics: Introduction, Basic modes of heat transfer – conduction, Convection and Radiation, General heat conduction equation in Cartesian, cylindrical and spherical coordinates – extended surface heat transfer – fin performance – Newton's law – concept of boundary layer – boundary layer equations– film and drop wise condensation – film boiling and pool boiling – boiling curve. **Related Experiment No:** 1, 2 ,3, 4, 5 and 6					
Module 2:	Radiation Heat Transfer and Heat -Exchange Equipment	Assignment / Quiz	Poster Designing and Presentation	08 Periods	
Topics: Fundamentals of radiation – radiation spectrum – thermal radiation – concept of black body and grey body – monochromatic and total emissive power – absorptivity, reflectivity and transmissivity - laws of radiation – radiation between two surfaces –Classification – log mean temperature difference – overall heat transfer coefficient – fouling and scaling of heat exchangers. **Related Experiment No:** 7, and 8					
Module 3:	Mass Transfer	Assignment / Quiz	Data Collection and Report Submission	07 Periods	
Topics: Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations **Related Experiment No:** 1, 6, and 7					

List of Laboratory Tasks:

Experiment No. 1: Thermal Conductivity of Metal Rod
Level 1: To find the thermal conductivity of the metal rod
Level 2: To plot the variation of temperature along the length of the metal rod. (Graph Paper / Grapher / MS Excel)

Experiment No. 2: Thermal Conductivity of Insulating Powder
Level 1: To find the thermal conductivity of insulating powder.
Level 2: To plot the variation of temperature along the length of the metal rod.

Experiment No. 3: Computer Controlled Heat Transfer Through Composite Wall
Level 1: To calculate total thermal resistance of the composite wall
Level 2: To calculate total thermal conductivity of the composite wall

Experiment No. 4: Computer Controlled Heat Transfer Through Lagged Pipe
Level 1: To find the actual rate of heat transfer through the composite cylinders from the measured interface temperature of the two insulating materials with known thermal conductivities
Level 2: To find the effective thermal conductivity of the composite cylinders

Experiment No. 5: Unsteady State Heat Transfer
Level 1: To find the Fourier number, the Biot number.
Level 2: To find the heat transfer coefficient, and the heat transfer rate.

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Experiment No. 6: Heat Transfer from A Pin – Fin By Free & Forced Convection
Level 1: To calculate the heat transfer coefficient experimentally and theoretically for forced convection.
Level 2: To plot a graph between theoretical temperature distribution with experimentally obtained distribution.

Experiment No. 7: To study the heat transfer phenomena in parallel and counter flow heat exchanger

Level 1: To find out the heat transfer rate for given fluids in parallel and counter flow condition.
Level 2: To calculate the overall heat transfer coefficient for both parallel and counter flow arrangements.

Experiment No. 8: Emissivity Measurement Apparatus
Level 1: To find the emissivity of the test plate
Level 2: To find the emissivity of different test plate.

Targeted Application and Tools that can be used:
Application: Process Engineer in Chemicals Industries, Pipeline Engineer in Upstream / Midstream Oil and Gas Industry
Tools: MS Excel, Grapher, Unisim Design Software

Text Book:
T1: R,K Rajput, "A Textbook Of Heat And Mass Transfer Si Units", S Chand, 1st ed,2018
T2: P.K Nag, "Heat and Mass transfer", McGraw Hill, 3rd ed,2011

References:
R1. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, John W. Mitchell, "Fluid Mechanics: SI Version", Wiley India.
R2. J.P. Holman, "Heat Transfer", 10th Edition, McGraw Hill, 2002.
R3. Treybal "Mass Transfer Operations", 3rd Edition, Mc.Graw Hill Book Co., New York.

e- References:
1. https://puniversity.informaticsglobal.com/login
2. https://nptel.ac.in/courses/112/108/112108149/
3. https://nptel.ac.in/courses/112/101/112101097/
4. https://www.newtondesk.com/heat-and-mass-transfer-study-notes-hand-written/

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. The course attainment will be assessed through assessment component mentioned in course handout.

Catalogue prepared by:	Dr. Suman Paul, Dr. Deepjyoti Mech, Dr. Kalpajit Hazarika, Mr. Ankur Neog
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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Course Handout (AY: 2022-2023)

Date of Issue: 07-09-2022

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2020-24
Semester / Year	:	V / 3rd
Course Code / Title	:	PET2008/ Heat and Mass for Petroleum Engineering
Course Credit Structure	:	2L-2P-3C
Contact Hours	:	38 (27L+ 11P)
Course Instructor In-charge	:	Mr. Ankur Neog
Course Instructor	:	Dr. Abhinav Kumar
Course URL	:	
Program Outcomes (POs)	:	

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO08: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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PO09: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:

Nil

Course Description:

The course is designed to discuss the fundamental laws relating to the heat and mass transfer processes. It enables the need for analyze the heat and mass transfer applications in oil and gas industries. The course is both conceptual and analytical in nature. It needs fair knowledge of Physics and Mathematics. The course develops the critical thinking and analytical skills. The associated laboratory experiments provide an opportunity to validate the concepts taught and enhances the ability to visualize the real system performance. Knowledge gained from this course can be applied for analyzing the heat and mass transfer applications in oil and gas industries.

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Heat and Mass Transfer for Petroleum and attain **Skill Development** through **Experiential Learning** techniques.

Course Outcomes (COs):

On successful completion of the course, the student shall be able to:

CO1: Solve the heat transfer problems of Conduction and Convection,
CO2: Illustrate the concept of radiation and the working of heat exchanger,
CO3: Apply diffusive and convective mass transfer equations to solve problems for different applications

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	M	H	M	L	M	M	M	H		H	L	L
CO2	H	M	M	H	M	M	H	L		M	M	L
C03	H	L	H	M	L	H	L	M		M	L	L
H = High, M = Moderate, L = Low												

Course Content (Syllabus):

Module I: Heat Transfer by Conduction and Convection [8 Classes] [Application]

Introduction, Basic modes of heat transfer – conduction, Convection and Radiation, General heat conduction equation in Cartesian, cylindrical and spherical coordinates – extended surface heat transfer – fin performance – Newton's law – concept of boundary layer – boundary layer equations– film and drop wise condensation – film boiling and pool boiling – boiling curve.

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Related Experiment No: 1, 2 ,3, 4, 5 and 6

Module II: Radiation Heat Transfer and Heat Exchange Equipment [7 Classes] [Application]
Fundamentals of radiation – radiation spectrum – thermal radiation – concept of black body and grey body – monochromatic and total emissive power – absorptivity, reflectivity and transmissivity - laws of radiation – radiation between two surfaces –Classification – log mean temperature difference – overall heat transfer coefficient – fouling and scaling of heat exchangers.

Related Experiment No: 7, and 8

Module III: Mass Transfer [7 Classes] [Application]
Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

Related Experiment No: 1, 6, and 7

Skill Sets To Be Developed:

1. **An attitude of enquiry.**
2. **Confidence and ability to tackle new problems.**
3. **Ability to interpret events and results.**
4. **Ability to work as a leader and as a member of a team.**
5. **Assess errors in systems/processes/programs/computations and eliminate them.**
6. Observe and measure physical phenomena.
7. **Write reports.**
8. **Select suitable equipment, instrument, materials & software**
9. Locate faults in system/Processes/software.
10. **Manipulative skills for setting and handling systems/Process/ Issues**
11. **The ability to follow standard /Legal procedures.**
12. **An awareness of the Professional Ethics.**
13. **Need to observe safety/General precautions**.
14. To judge magnitudes/Results/issues without actual measurement/actual contacts

Course Content &Task Schedule For Laboratory Component:

Sl. No	Session Number and Date	Task No	Task	Level 1	Level 2	Number of Lab Sessions required	Skills to be developed	Course Outcome to be developed
1	13/09/22	P1	Familiarization with Heat and Mass Transfer Lab					
2	13/09/22	P1	Familiarization with Heat and Mass Transfer Lab Equiptments					
3	20/09/22	P2	Thermal Conductivity of Metal Rod	To find the thermal conductivity of the metal rod	To plot the variation of temperature along the length of the metal rod.	1	2, 7, 8, 10, 11, 12, 13	CO1,CO3

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4	27/09/22	P3	Thermal Conductivity Of Insulating Powder	To find the thermal conductivity of insulating powder.	To plot the variation of temperature along the length of the metal rod.	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1
5	11/10/22	P4	Computer Controlled Heat Transfer Through Composite Wall	To calculate total thermal resistance of the composite wall	To calculate total thermal conductivity of the composite wall.	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1
6	18/10/22	P5	Computer Controlled Heat Transfer Through Lagged Pipe	To find the actual rate of heat transfer through the composite cylinders from the measured interface temperature of the two insulating materials with known thermal conductivities	To find the effective thermal conductivity of the composite cylinders.	1	1, 2, 3, 4, 5, 8, 10, 11, 12, 13	CO1
7	08/11/22	P6	Unsteady State Heat Transfer	To find the Fourier number, the Biot number.	To find the heat transfer coefficient, and the heat transfer rate.	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1
8	15/11/22	P7	Heat Transfer From A Pin Fin By Free & Forced Convection	To calculate the heat transfer coefficient experimentally and theoretically for forced convection.	To plot a graph between theoretical temperature distribution with experimentally obtained distribution.	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO1,CO3
9	22/11/22	P8	To study the heat transfer phenomena in parallel and counter flow heat exchanger	To find out the heat transfer rate for given fluids in parallel and counter flow condition.	To calculate the overall heat transfer coefficient for both parallel and counter flow arrangements.	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO2,CO3
10	29/11/22	P9	Emissivity Measurement Apparatus	To find the emissivity of the test plate	To find the emissivity of different test plate.	1	1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13	CO2

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11	06/12/22	P10	Revision
12	13/12/22	P11	Revision

Delivery Procedure (Pedagogy):
This is an integrated lab based theory course. Most of the lectures will be taken with the help of Power Point Presentation and White board. Videos will be shown for the better understanding of selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. During the lab session a problem statement will be given to the students and based on their understanding they have to prepare the solution. Continuous lab assessment will carry 20% weightage under Continuous Internal Assessment (CIA). If required, classes may take through virtual mode.
Following procedures will be adopted in the course for delivering the content:

Experiential learning (Module I) (Foundation Skill)
Article writing on the following topic:

- Types of Fins and its application in Industry.

- **Literature review (Module III) (Employability/Skill development/ Environment and sustainability):**

Literature Review of Digital/e-resources from Presidency University link shared below. It is mandatory to submit a screenshot accessing digital resources, otherwise, it will not be evaluated.

Link for Knimbus remote login: https://presiuniv.knimbus.com

Students are required to submit the Literature review before the due date.

Participative learning (Module I, Module II, Module III) (Skill Development/ Human Values and Professional Ethics):
Poster Presentation on the topic:
- Implementation of Heat Transfer in Industry.

Students are required to submit the poster before the due date.

Problem solving (Module I, Module II) (Employability):

- Numerical on Conduction
- Numerical on Heat Exchanger

Students are required to submit the poster before the due date.

Reference Materials:

(a) Text Book:

T1: R,K Rajput, "A Textbook Of Heat And Mass Transfer Si Units", S Chand, 1st ed,2018
T2: P.K Nag, "Heat and Mass transfer", McGraw Hill, 3rd ed,2011
T3: Yunus A. Cengel, Afshin J. Ghajar "Heat and Mass Transfer: Fundamentals and Applications", McGraw Hill, fifth Edition, 2017

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(b) Reference Book(s):

R1: Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, John W. Mitchell, "Fluid Mechanics: SI Version", Wiley India.

R2: J.P. Holman, "Heat Transfer", 10th Edition, McGraw Hill, 2002.

R3: Treybal "Mass Transfer Operations", 3rd Edition, Mc.Graw Hill Book Co., New York.

(c) Case study:

1. Efficient Wastewater Plant Applying E-Plate Heat Exchanger: https://www.das-ee.com/en-us/wastewater-treatment/case-studies/case-study-paper-industry/

(d) e- References:

1. Link for Knimbus remote login: https://presiuniv.knimbus.com
2. NPTEL resource on Heat Transfer: https://nptel.ac.in/courses/112/108/112108149/
3. NPTEL resource on Modes of Heat Transfer: https://nptel.ac.in/courses/112/101/112101097/
4. Notes on Heat and Mass Transfer: https://www.newtondesk.com/heat-and-mass-transfer-study-notes-hand-written/
5. E-Book: https://ahtt.mit.edu/wp-content/uploads/2019/08/AHTTv500.pdf

Guideline to Students:

(a) About the Course:

This theory as well as practical based course which will provide fundamentals of heat and mass transfer concepts required in various oil and gas industries. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students.

(b) Notification / Announcement related to the course:

All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0.

COURSE SCHEDULE FOR THEORY COMPONENT

Module-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course	15-09-22	15-09-22	1
2	Module I:	16-09-22	30-09-22	8
3	CIA I from Module I: Literature review	-	-	-
4	Module II:	06-10-22	20-10-22	7
6	CIA II from Module II: Poster Presentation	-	-	-
7	Mid Term Syllabus and question pattern discussion	28-10-22	28-10-22	1
8	Mid term	03-11-22	07-11-22	-

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9	Mid Term Question Paper discussion	10-11-22	10-11-22	1
10	Module III:	21-10-22	25-11-22	7
10	CIA III from Module III: Quiz	-	-	-
11	Course Integration	29-12-22	29-12-22	1
12	End Term Syllabus and Question Paper Pattern Discussion	30-12-22	30-12-22	1
13	End Term Final Examination	05-01-23	25-01-23	-

*****Dates as per the academic calendar***

COURSE SCHEDULE FOR LABORATORY COMPONENT

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course	13-09-2022	12-09-2022	1
2	Laboratory Familiarization	13-09-2022	12-09-2022	1
2	Demonstration of first set of Experiments/Skills	20-09-2022	20-09-2022	1
4	Conduct of first set of experiments	20-09-2022	20-09-2022	9
5	Project work	-	-	-
6	Conduct of second set of experiments	25-10-2022	25-10-2022	9
7	Summary of the Laboratory tasks	-	-	-
8	End Term Evaluation	-	-	-

Schedule of Instruction:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No.	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
1	L1 / 12/09/22	**Programme Integration**	Overview of the course		PPT/White board	
Module I						
2	L2 / 15/09/22	Heat Transfer by Conduction and Convection	conduction, Convection and Radiation	CO1	PPT/White board	T1 Ch01
3	L3 / 19/09/22		Cartesian, cylindrical and	CO1	PPT/White board	T1 Ch01

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			spherical coordinates			
4	L4 / 22/09/22		extended surface heat transfer, fin performance	CO1	PPT/White board	T1 Ch02
5	L5 / 26/09/22		extended surface heat transfer, fin performance	CO1	PPT/White board	T1 Ch02
6	L6 / 29/09/22	Heat Transfer by Conduction and Convection	concept of boundary layer – boundary layer equations laminar and turbulent flow – Reynolds analogy	CO1	PPT/White board	T1 Ch02
7	L7 / 06/10/22		concept of boundary layer – boundary layer equations laminar and turbulent flow – Reynolds analogy	CO1	PPT/White board	T1 Ch02
8	L8 / 10/10/22		film and drop wise condensation	CO1	PPT/White board	T1 Ch07
9	L9 / 13/10/22		film boiling and pool boiling – boiling curve	CO1	PPT/White board	T1 Ch07
CIA I from Module I: Literature Survey						
Module II						
10	L10 / 17/10/22	Radiation Heat Transfer and Heat Exchange Equipment	radiation spectrum – thermal radiation	CO2	PPT/White board	T1 Ch09
11	L11 / 20/10/22		concept of black body and grey body	CO2	PPT/White board	T1 Ch09
12	L12 / 27/10/22	Mid Term Syllabus and question pattern discussion		C01, CO2		
13	L13 / 10/11/22	Mid Term question paper discussion		C01, CO2		
14	L14 / 14/11/22		monochromatic and total emissive power	CO2	PPT/White board	T1 Ch09
15	L15 / 17/11/22		absorptivity, reflectivity and transmissivity, laws of radiation	CO2	PPT/White board	T1 Ch09
16	L16 / 21/11/22	Radiation Heat Transfer and	Classification – log mean	CO2	PPT/White board	T1,CN

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		Heat Exchange Equipment	temperature difference			
17	L17 / 24/11/22		Classification – log mean temperature difference	CO2	PPT/White board	T1,CN
18	L18 / 28/11/22		overall heat transfer coefficient – fouling and scaling of heat exchangers	CO2	PPT/White board	T1,CN
CIA II from Module II : Poster Presentation						
Module III						
19	L19 / 05/12/22	Mass Transfer	Basic Concepts – Diffusion Mass Transfer	CO3	PPT/White board	T1,CN
20	L20 / 08/12/22		Fick's Law of Diffusion – Correlations	CO3	PPT/White board	T1,CN
21	L21 / 12/12/22		Steady state Molecular Diffusion	CO3	PPT/White board	T1,CN
22	L22 / 15/12/22		Convective Mass Transfer	CO3	PPT/White board	T1,CN
23	L23 / 19/12/22		Momentum, Heat and Mass Transfer Analogy	CO3	PPT/White board	T1,CN
24	L24 / 22/12/22		Convective Mass Transfer	CO3	PPT/White board	T1,CN
25	L25 / 26/12/22		Convective Mass Transfer	CO3	PPT/White board	T1,CN
26	L26 / 29/12/22	Course Integration	Course Summary and Relation with other Courses of the Program	-	PPT/White boar	-
CIA III from Module III : Quiz						
27	L27 / 29/12/22	End Term Question paper discussion		CO1-CO4		

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Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. This is attained through the Lab Experiments as mentioned in the assessment Schedule.

ASSESSMENT SCHEDULE FOR THEORY COMPONENT:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weight age	Venue, Date, and Time
1	CIA I from Module I: Report – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://puniversity.informaticsglobal.com/login). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)	L02-L09	CO1	-	-	2%	
2	CIA II from Module II: Poster presentation	L10-L18	CO2	-	-	-	
3	Mid term	L02-L11	CO1, CO2	1.5	60	30	
4	CIA III from Module III: Quiz	L20-L28	CO3	-	-	-	
5	End term final examination	L02-L27	CO1 - CO4	3	60	30	
6	End term Lab examination		CO1 - CO4		40	20	

ASSESSMENT DETAILS FOR LABORATORY COMPONENT:

Sl. No	Assessment type	List of Tasks	Course outcome number	Duration (In hours)	Marks	Weightage	Venue, DATE &TIME
1	Sample composition calculation and preparation	After conduction of experiment student has	CO5	2	4	2	Day wise evaluation

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		to write the entire experiment on lab record					
2	Experiment conduction	Students need to follow the API standards and perform the experiment	CO5	2	8	4	
3	Results and Discussion	Calculation of values and discussion on the results	CO5	2	10	5	
4	Recent Development	Students need to write any recent developme nt regarding the apparatus	CO5	2	4	2	
5	VIVA	-	CO5	2	10	5	

Course Clearance Criteria :

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, Head of the Department, and Dean (School of Engineering) for further assistance

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1	Suppose we heat water to take bath by a Bajaj immersion rod water heater. Identify the mode of heat transfer taking place and the law governing it.	10	CO1	Comprehension

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	Also identify among the types of this mode of heat transfer which type does this particular example belong to and explain it?			
2	Let's suppose you have been given parallel flow heat exchanger and counter flow heat exchanger. Being an engineer for maximum heat transfer what will you suggest to install in the petroleum industry and why?	10	C02	Comprehension
3	There is a spherical pill which only dissolves by diffusion. Throw some light regarding concentration distribution around the sphere.	10	C03	Comprehension

Sample Thought Provoking Questions to be asked to assess the Students' Preparedness to carry out the Task [For Laboratory Component]:

Sl No.	Question	Task No.	Course Outcome No.
1	Metal A and metal B have the same length and the same cross-sectional area. If the thermal conductivity of metal A = ¼ times the thermal conductivity of metal B. Both metals heated at its end and the change in temperature of both metals are the same. The ratio of the rate of the heat conduction of metal A to metal B.	1	CO1
2	Suppose we need to cool 1000 liter of chemical liquid in an industry. The chemical is cooled by huge tank in which there is a rotating impeller or fan in the tank. Identify the mode of heat transfer taking place and the law governing it. Also, identify among the two types of this mode of heat transfer which type does this particular example belong to and explain it ?	8	CO2

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Solve the heat transfer problems of Conduction and Convection,	55
2	CO2	Illustrate the concept of radiation and the working of heat exchanger,	60
3	C03	Apply diffusive and convective mass transfer equations to solve problems for different applications	50

Signature of the Course Instructor In-charge: Mr. Ankur Neog

Signature of the Course Instructor: Dr. Abhinav Kumar

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Signature of the Chairperson DAC:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1	CIA I from Module I: Report – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://puniversity.informaticsglobal.com/login). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)			
2	CIA II from Module II: Poster presentation			
3	Mid term			
4	CIA III from Module III: Quiz			
5	End term final examination			
6	End term Lab examination			

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

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Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Solve the heat transfer problems of Conduction and Convection,	55		
2	CO2	Illustrate the concept of radiation and the working of heat exchanger,	60		
3	C03	Apply diffusive and convective mass transfer equations to solve problems for different applications	50		

Name and Signature of the Course Instructor:s

DAC Observation and Approval:

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Course Code: PET2009	**Course Title: Thermodynamics of Reservoir Fluids** **Type of Course: 1] Program Core** **2] Laboratory Integrated**	**L- P- C**	2	2	3
Version No.:	2.0				
Course Pre-requisites:	Nil				
Anti-requisites:	Nil				
Course Description:	The main aim of this course is to get an overview of the thermodynamics of fluids present in the reservoir and how they are identified and controlled on time in the oil and gas industry. The course intends to develop understanding of laws of thermodynamics and how they may influence the behavior of reservoir fluids. The course will highlight important aspects of the fluid flow equations and other flow process related to compressors and throttling devices. This course will also discuss properties of reservoirs fluids including formation volume factors and will discuss their behaviour in reservoir and surface. The course will also include team exercises and numerical solving activities, which will help to improve the employability skills. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematical and computing. The course develops the critical thinking and analytical skills. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to correlate with the real time field experiment.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Thermodynamics of Reservoir Fluids and attain **Skill Development** through **Experiential Learning** techniques.				
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: Understand first law and second law of thermodynamics, CO2: Apply the thermodynamics understanding to fluid flow processes such as turbine and compressor, CO3: Classify different types of oil and gas reservoirs based on the fundamentals of reservoir fluid behavior and properties CO4: Interpret the theoretical knowledge of thermodynamics with lab experiments.				
Course Content:					
Module 1:	First and Second Law of Thermodynamics	Assignment	Data Collection	10 Periods	
Topics: The scope of thermodynamics, Dimensions and Units. **First law and other basic concepts**: Joule's Experiments, Internal Energy, First law of thermodynamics, Energy balance for closed systems, Equilibrium, Reversible process, Constant-V & P process, Enthalpy, Heat Capacity, Mass and Energy balances for Open systems; Statements of Second law, Heat engines, Mathematical statement of the second law, Entropy balance for open systems. **Thermodynamic properties of fluids**: Property relations for homogenous phases, Two-Phase systems, Generalized property correlations for gases.					
Module 2:	Applications of Thermodynamics to Flow Processes	Case Study	Programming / Simulation	06 Periods	
Topics: Throttling device, Duct Flow Of Compressible Fluids, Turbines (Expanders), Compression Processes, pumps, Phase Behavior of pure component and hydrocarbon mixture, Gibbs Phase Rule, PVT Experiments, PVT/ Phase Behavior Simulation.					
Module 3:	Fundamentals of Reservoir Fluid Behavior	Case Study	Data Collection	07 Periods	
Topics: Classification of reservoirs and reservoir fluids, PT diagram, Vapor liquid equilibrium (VLE), Phase rule, Raoult's Law, Dew point and Bubble point Calculations with Raoult's Law, Oil reservoirs, Gas reservoirs, behavior of ideal and real gases, Compressibility factor, viscosity of fluid **Related Experiment No.:** 1 to 9					
List of Laboratory Tasks: **Exp. No 1:** Determination of specific gravity using hydrometer Level 1: Determine specific gravity of given sample. Level 2: To determine variation of density with viscosity. **Exp. No 2:** Determination of kinematic and dynamic viscosity using Engler viscometer Level 1: Determine viscosity of given sample at different temperature Level 2: Compare the viscosity of sample as obtained from other viscometer viscometer, at different temp rapture **Exp. No 3:** Determination of kinetic and dynamic viscosity using Redwood I viscometer Level 1: Determine viscosity of given sample at different temperature Level 2: Compare the viscosity of sample as obtained from other viscometer viscometer, at different temp rapture					

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Exp. No 4: Determination of kinetic and dynamic viscosity using Redwood II viscometer
Level 1: Determine viscosity of given sample at different temperature
Level 2: Compare the viscosity of sample as obtained from other viscometer ,at different temp rapture

Exp. No 5: Determination of kinetic and dynamic viscosity using Saybolt viscometer
Level 1: Determine viscosity of given sample at different temperature
Level 2: Compare the viscosity of sample as obtained from other viscometer, at different temperature

Exp. No 6: Determination of flash and fire point using Pensky Martin apparatus
Level 1: Determine flash and fire point of given sample
Level 2: Determine flash and fire point of different blends & compare it with results obtained from Abel Pensky apparatus.

Exp. No 7: Determination of flash and fire point using Abel Pensky apparatus
Level 1: Determine flash and fire point of given sample
Level 2: Determine flash and fire point of different blends & compare it with results obtained Pensky Martin apparatus

Exp. No 8: Determination depth of penetration using Penetrometer
Level 1: Determination depth of penetration of given sample
Level 2: Determine the penetration rate of different grease and at different temperature**.**

Exp. No 9: Determination of refractive index using Abbe's refractometer
Level 1: Determination refractive index of given sample
Level 2: Determine change in purity using refractive index.

Targeted Application and Tools that can be used:
Application Area are oil and gas companies
Professionally Used Software: PVTSIM, CMG-WINPROP

Text Book:
T1: Smith J.M., H.C. Van Ness, M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 7th Edition, Tata Mc. Graw – Hill Publishing Company Limited, New Delhi, 2009.
T2: Nag, P.K.. Engineering thermodynamics, 5th Edition, Tata Mc. Graw – Hill Publishing Company Limited New Delhi, 2008

References:
Reference Book(s)
R1: Jean Vidal, Thermodynamics Application in Chemical Engineering and the Petroleum Industry, Institute Francal Sbupetrole Publications, France.
R2: John J.Mcketta Jr., Advances in Petroleum Chemistry and Refining-volume 9, Inter Science Publications, New York.
R3: Danesh, A., 1998. PVT and phase behaviour of petroleum reservoir fluids. Elsevier.
R4: Ahmed, T., 2013. Equations of state and PVT analysis. Elsevier.
E-resources
1. Link for Knimbus remote login: https://presiuniv.knimbus.com
2. Pressure –Temperature Diagram of Reservoir Fluids: https://petrowiki.spe.org/Phase_diagrams_for_reservoir_fluid_systems
3. Reservoir Types: https://www.informit.com/articles/article.aspx?p=2241145&seqNum=4
4. Oil and Gas Formation Volume Factor : https://www.sciencedirect.com/topics/engineering/oil-formation-volume-factor
5. Laws of Thermodynamics: https://en.wikipedia.org/wiki/Laws_of_thermodynamics
6. NPTEL Videos: https://archive.nptel.ac.in/courses/112/105/112105123/.
7. Engineering Thermodynamics – A Graphical Approach: https://www.ohio.edu/mechanical/thermo/
8. Thermodynamics Notes (MIT OPENCOURSEWARE) https://ocw.mit.edu/courses/5-60-thermodynamics-kinetics-spring-2008/pages/lecture-notes/

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory-integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning** techniques. The course attainment will be assessed through the assessment component(s) mentioned in the course handout.

Catalogue prepared by:	Dr. Suman Paul, Dr. Kalpajit Hazarika, Dr. Deepjyoti Mech, Mr. Bhairab Jyoti Gogoi, Mr. Anmol Bhargava, Mr. Sugat Srivastava, Mr. Gaurav Kundu
Recommended by the Board of Studies on:	16th Meeting of the Board of Studies held on 8th July 2023
Date of Approval by the Academic Council:	16th Meeting of the Academic Council held on 23rd October 2021

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(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Handout : AY: 2022-2023

Date of Issue: 07-09-2022
Revised On: N/A

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2021-25
Semester / Year	:	III / 2nd
Course Code / Title	:	PET2009 / Thermodynamics of Reservoir Fluids
Course Credit Structure	:	2L-2P-3C
Contact Hours	:	40 (28L+ 12P)
Course Instructor In-charge	:	Dr. Kalpajit Hazarika
Course Instructor	:	Dr. Sidharth Gautam

Program Outcomes (POs) :

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering commmoduley and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:

NIL

Course Description:

The main aim of this course is to get an overview of the thermodynamics of fluids present in the reservoir and how they are identified and controlled on time in the oil and gas industry. The course intends to develop understanding of laws of thermodynamics and how they may influence the behavior of reservoir fluids. The course will highlight important aspects of the fluid flow equations and other flow process related to compressors and throttling devices. This course will also discuss properties of reservoirs fluids including formation volume factors and will discuss their behaviour in reservoir and surface. The course will also include team exercises and numerical solving activities, which will help to improve the employability skills of the students. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematical and computing. The course develops the critical thinking and analytical skills. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to correlate with the real time field experiment.

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Thermodynamics of Reservoir Fluids and attain **Skill Development** through **Experiential Learning** techniques.

Course Outcomes (COs):

On successful completion of the course the students shall be able to:

CO1: Understand first law and second law of thermodynamics,

CO2: Apply the thermodynamics understanding to fluid flow processes such as turbine and compressor,

CO3: Classify different types of oil and gas reservoirs based on the fundamentals of reservoir fluid behavior and properties,

CO4: Interpret the theoretical knowledge of thermodynamics with lab experiments.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	H	H	M	L	L	M	L	M			L	L

CO2	H	H	M	M	L	M	L	M		L	L	L
C03	H	H	H	M	L	H	M	M		M	L	L
CO4	H	H	H	M	M	H	M	M		M	M	H
H = High, M = Moderate, L = Low												

Course Content (Syllabus):

Module I: First and Second Law of Thermodynamics [10 Classes] – Understanding Level

The scope of thermodynamics, Dimensions and Units.

First law and other basic concepts: Joule's Experiments, Internal Energy, First law of thermodynamics, Energy balance for closed systems, Equilibrium, Reversible process, Constant-V & P process, Enthalpy, Heat Capacity, Mass and Energy balances for Open systems; Statements of Second law, Heat engines, Mathematical statement of the second law, Entropy balance for open systems.

Thermodynamic properties of fluids: Property relations for homogenous phases, Two-Phase systems, Generalized property correlations for gases.

Module II: Applications of Thermodynamics to Flow Processes [6 Classes] – Application Level

Throttling device, Duct Flow Of Compressible Fluids, Turbines (Expanders), Compression Processes, pumps.

Module III: Fundamentals of reservoir fluid behavior [7 Classes] – Understanding Level

Classification of reservoirs and reservoir fluids, PT diagram, Vapor liquid equilibrium (VLE), Phase rule, Raoult's Law, Dew point and Bubble point Calculations with Raoult's Law, Oil reservoirs, Gas reservoirs, behavior of ideal and real gases, Compressibility factor, viscosity of fluid

Skill Sets To Be Devloped:

1. **An attitude of enquiry**
2. **Confidence and ability to tackle new problems**
3. **Ability to interpret events and results**
4. **Ability to work as a leader and as a member of a team**
5. **Assess errors in systems/processes/programs/computations and eliminate them**
6. Observe and measure physical phenomena
7. **Write reports**
8. **Select suitable equipment, instrument, materials & software**
9. Locate faults in system/Processes/software
10. **Manipulative skills for setting and handling systems/Process/ Issues**
11. **The ability to follow standard /Legal procedures**
12. **An awareness of the Professional Ethics**
13. **Need to observe safety/General precautions**
14. To judge magnitudes/Results/issues without actual measurement/actual contacts

COURSE CONTENT & TASK SCHEDULE FOR LABORATORY COMPONENT:

Sl. No	Session Number and Date	Task No	Task	Level 1	Level 2	Number of Lab Sessions required	Skills to be developed	Course Outcome to be developed
1	S1-15/09/22	-	Familiarization with LAB and Equipments			1		

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2	S2-22/09/22	E1	Determination of specific gravity using hydrometer	Determine specific gravity of given sample	To determine variation of density with viscosity	1	2, 7, 8, 10, 11, 12, 13	CO4
3	S3-29/09/22	E2	Determination of kinematic and dynamic viscosity using Engler viscometer	Determine viscosity of given sample at different temperature	Compare the viscosity of sample as obtained from other viscometer viscometer ,at different temp rapture	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO4
4	S4-06/10/22	E3	Determination of kinetic and dynamic viscosity using Redwood I viscometer	Determine viscosity of given sample at different temperature	Compare the viscosity of sample as obtained from other viscometer viscometer, at different temp rapture	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO4
5	S5-13/10/22	E4	Determination of kinetic and dynamic viscosity using Redwood II viscometer	Determine viscosity of given sample at different temperature	Compare the viscosity of sample as obtained from other viscometer ,at different temp rapture	1	1, 2, 3, 4, 5, 8, 10, 11, 12, 13	CO4
6	S6-20/10/22	E5	Determination of kinetic and dynamic viscosity using Saybolt viscometer	Determine viscosity of given sample at different temperature	Compare the viscosity of sample as obtained from other viscometer, at different temperature	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO4
7	S7-27/10/22	-	Revision					
8	S8-10/11/22	E6	Determination of flash and fire point using Pensky Martin apparatus	Determine flash and fire point of given sample	Determine flash and fire point of different blends & compare it with results obtained from Abel Pensky apparatus	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO4
9	S9-17/11/22	E7	Determination of flash and fire point using Abel Pensky apparatus	Determine flash and fire point of given sample	Determine flash and fire point of different blends & compare it with results obtained Pensky Martin apparatus	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO4

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10	S10-24/11/22	E8	Determination depth of penetration using Penetrometer	Determination depth of penetration of given sample	Determine the penetration rate of different grease and at different temperature	1	1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13	CO4
11	S11-1/12/22	E9	Determination of refractive index using Abbe's refractometer	Determination refractive index of given sample	Determine change in purity using refractive index	1	1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13	CO4
12	S12-08/12/22	E10	Revision					

Delivery Procedure (Pedagogy):

This is a laboratory intregrated course. Most of the lectures will be taken with the help of Power Point Presentations and White Board. Videos will be shown for the better understanding of selective topics. Flip Class Room sessions will be conducted on selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. Report Submission. Review classes will be conducted to clear doubts and to evaluate the level of understanding of the each student individually. Continuous Internal Assessment (CIA) will carry 5% weightage and Continuous Lab Performance Evaluation will carry 20% weightage.

Following procedures will be adopted in the course for delivering the content:

I. Experiential Learning Topics (ELT):

Literature Survey on a topic from Module-I. Literature Review of Digital/e-resources from Presidency University link shared below. It is mandatory to submit a screenshot accessing digital resources, otherwise, it will not be evaluated. Link to Presidency University e-resources: https://presiuniv.knimbus.com *This activity will help in developing the Foundation Skills of the students.*

II. Participative Learning Topics (PLT):

One minute Presentation on a topic from Module III. *This activity will help in building employability skills of the students.*

III. Problem Based Learning Topics (PBLT):

Subject Related Exercise

Carry out numerical calculations for first and second law of thermodynamicscompressibility factor, PVT analysis, enthalpy and entropy (Module-I, II, III). *This activity will help in developing employability skills of the students.*

Reference Materials:

Textbook(s)

T1: Smith J.M., H.C. Van Ness, M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 7th Edition, Tata Mc. Graw – Hill Publishing Company Limited, New Delhi, 2009.

T2: Nag, P.K.. Engineering thermodynamics, 5th Edition, Tata Mc. Graw – Hill Publishing Company Limited New Delhi, 2008

Reference Book(s)

R1: Jean Vidal, Thermodynamics Application in Chemical Engineering and the Petroleum Industry, Institute Francal Sbupetrole Publications, France.

R2: John J.Mcketta Jr., Advances in Petroleum Chemistry and Refining-volume 9, Inter Science Publications, New York.

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E-resources :

1. Link for Knimbus remote login: https://presiuniv.knimbus.com
2. Pressure –Temperature Diagram of Reservoir Fluids: https://petrowiki.spe.org/Phase_diagrams_for_reservoir_fluid_systems
3. Reservoir Types: https://www.informit.com/articles/article.aspx?p=2241145&seqNum=4
4. Oil and Gas Formation Volume Factor: https://www.sciencedirect.com/topics/engineering/oil-formation-volume-factor
5. Laws of Thermodynamics: https://en.wikipedia.org/wiki/Laws_of_thermodynamics
6. NPTEL Videos -Basic Thermodynamics: https://archive.nptel.ac.in/courses/112/105/112105123/.
7. Engineering Thermodynamics – A Graphical Approach: https://www.ohio.edu/mechanical/thermo/
8. Thermodynamics Notes (MIT OPENCOURSEWARE) https://ocw.mit.edu/courses/5-60-thermodynamics-kinetics-spring-2008/pages/lecture-notes/
9. NPTEL Lecture – Chemical Engineering Thermodynamics: https://archive.nptel.ac.in/courses/103/104/103104151/

Guideline to Students:

(a) About the Course:

This course will provide an overview of the thermodynamics of fluids present in the reservoir and how they are identified and controlled on time in the oil and gas industry. The course intends to understand the laws of thermodynamics and how they may influence the behavior of reservoir fluids. The course will highlight important aspects of the fluid flow equations. This course will also discuss properties of reservoirs fluids including formation volume factors and will discuss their behaviour in reservoir and surface. The course will also include team excersies and numerical solving activities, which will help to improve the employability skills of the students. Students are requested to collect the books related to this course from the library and start reading the chapters mention in the handout. It is a request to all the students not to rely entirely on class notes and presentation. To clear concepts they need to go through the books which is recommended here. Students are requested to be serious about their Assignments, Quiz, Poster presentation. These all are part of continuous internal evaluation and no make up for any of these components will be offered. All assignments should be submitted on or before the given day. No assignments will be accepted once the submission date has passed.

(b) Notification / Announcement related to the Course:

All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2021', Regulation No. PU/AC-15/10/06_2021, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2022/09/Academic-Regulations-2021.pdf) and go through the Section Nos. 1.0 through 25.0.

Course Schedule:

Module-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
01	Overview of the Course	14-09-22	14-09-22	1
02	Module I	16-09-22	21-10-22	10

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	Continuous Internal Assessment 1: Literature Survey from Module I.	21-10-22	21-10-22	
03	Module II	28-10-22	23-11-22	6
	Continuous Internal Assessment: Component 2 – Quiz Competition on a topic from Module I and II	28-10-22	28-10-22	
04	Discussion of Mid Term Question Pattern	02-11-22	02-11-22	1
05	Mid Term	03-11-22	07-11-22	-
06	Discussion of Mid Term Question and Answers	09-11-22	09-11-22	1
07	Module III	25-11-22	23-12-22	7
08	Continuous Internal Assessment: Component 3 – Poster Presentation on topic from Module III	30-11-22	30-11-22	-
09	Course Integration	21-12-22	21-12-22	1
10	Discussion of END TERM Question Pattern	23-12-22	23-12-22	1
11	End Term Examination	05-01-23	23-01-23	-

Course Schedule for Laboratory Component

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course	15-09-22	15-09-22	1
2	Laboratory Familiarization	15-09-22	15-09-22	1
2	Demonstration of first set of Experiments/Skills	22-09-22	27-10-22	2
4	Conduct of first set of experiments	29-09-22	20-10-22	10
5	Conduct of second set of experiments	10-11-22	08-12-22	10

Schedule of Instruction:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No./Date	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
01	L01/ 14-09-2022	Program Integration	Overview of the Course	-	White Board/Video Lecture	-
Module I: First and Second Law of Thermodynamics						
02	L02/ 16-09-2022	First and Second Law of	The scope of thermodynamics	CO1	White Board/Video Lecture	CN

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03	L03/ 21-09-2022	Thermodynamics	Dimensions and Modules, – First law and other basic concepts: Joule's Experiments, Internal Energy,	CO1	White Board/ PPT/Video Lecture	T1, CN
04	L04/ 23-09-2022		First law of thermodynamics, Energy balance for closed systems, Equilibrium,	CO1	White Board/ PPT/Video Lecture	T1, CN
05	L05/ 28-09-2022		Phase rule, Reversible process, Constant-V & P process, Enthalpy	CO1	White Board/ PPT/Video Lecture	T1, CN
06	L06/ 30-09-2022		Heat Capacity, Mass and Energy balances for Open systems	CO1	White Board/ PPT/Video Lecture	T1, CN
07	L07/ 07-10-2022		Statements of Second law, Heat engines, Mathematical statement of the second law,	CO1	White Board/ PPT/Video Lecture	T1, CN
08	L08/12-10-2022		Entropy balance for open systems	CO1	White Board/ PPT/Video Lecture	T1, CN
09	L09/ 14-10-2022		Thermodynamic properties of fluids:	CO1	White Board/ PPT/Video Lecture	T1, CN
10	L10/ 19-10-2022		Property relations for homogenous phases, Two-Phase systems,	CO1	White Board/ PPT/Video Lecture	T1, CN
11	L11/ 21-10-2022		Generalized property correlations for gases.	C01	White Board/ PPT/Video Lecture	T1, CN
	Literature Survey on a topic from Module-I			CO1		
	Module II: Applications of Thermodynamics to Flow Processes					
12	L12/ 28-10-2022	Applications of Thermodynamics to Flow Processes	Throttling device,			
13	L13/ 02-11-2022		Mid Term paper discussion	CO1, CO2	White Board/ PPT/Video Lecture	T1, CN
14	L14/ 09-11-2022		Mid Term answer discussion	CO1, CO2	White Board/ PPT/Video Lecture	T1, CN
15	L15/ 11-11-2022		Duct Flow Of Compressible Fluids,	CO2	White Board/ PPT/Video Lecture	T1, CN
16	L16/ 16-11-2022		Turbines (Expanders),	CO2	White Board/ PPT/Video Lecture	T1, CN
17	L17/ 18-11-2022		Turbines (Expanders),	CO2	White Board/ PPT/Video Lecture	T1, CN
18	L18/ 23-11-2022		Compression Processes, pumps	CO2	White Board/ PPT/Video Lecture	T1, CN
	Quiz on the topic from Module II					
	Module-III: Fundamentals of reservoir fluid behavior and properties					

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19	L19/ 25-11-2022	Fundamentals of reservoir fluid behavior and properties	Classification of reservoirs and reservoir fluids,	CO3	White Board/ PPT/Video Lecture	T1, CN
20	L20/ 30-11-2022		PT diagram, Vapor liquid equilibrium (VLE),	CO3	White Board/ PPT/Video Lecture	T1, CN
21	L21/ 02-12-2022		Phase rule,	CO3	White Board/ PPT/Video Lecture	
22	L22/ 07-12-2022		Raoult's Law, Dew point and Bubble point Calculations with Raoult's Law,	CO3	White Board/ PPT/Video Lecture	T1, CN
23	L23/ 09-12-2022		Oil reservoirs, Gas reservoirs,	CO3	White Board/ PPT/Video Lecture	T1, CN
24	L24/ 14-12-2022		behavior of ideal and real gases,	CO3	White Board/ PPT/Video Lecture	T1, CN
25	L25/ 16-12-2022		Compressibility factor, viscosity of fluid	CO3	White Board/ PPT/Video Lecture	T1, CN
26	L26/ 21-12-2022		Course Integration		White Board/Video Lecture	
	Poster Presentation on a topic from Module III					
27	L27/ 23-12-2022		End Term Paper Discussion		White Board/ PPT/Video Lecture	T1, CN

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. This is attained through the Lab Experiments as mentioned in the assessment Schedule.

Assessment Schedule:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Mode
01	**Continuous Internal Assessment: 1** – Literature Survey Literature Review of Digital/e-resources from Presidency University link shared below. It is mandatory to submit a screenshot accessing digital resources, otherwise, it will not be evaluated. Link to Presidency University e-resources: https://presiuniv.knimbus.com	Module I	CO1	1 hour	2	1%	Online mode

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02	**Continuous Internal Assessment** 2: Quiz	Module II	CO2	1 hour	4	2%	Online mode/classroom
03	Mid Term Examination	Module I and Module II	CO1 and CO2	1:30 hours	50	25%	-
04	**Continuous Internal Assessment 3**: Poster presentation	Module III	CO3	1 hour	4	2%	Online mode/classroom
05	**Continous Lab Performance Assessment**	-	CO4	-	40	20%	-
06	End term Final Examination	Full Syllabus	CO1, CO2, CO3	3 hours	100	50%	-

ASSESSMENT DETAILS FOR LABORATORY COMPONENT:

Sl. No	Assessment type	List of Tasks	Course outcome number	Duration (In hours)	Marks	Weightage	Venue, DATE &TIME
1	Sample composition calculation and preparation	After conduction of experiment student has to write the entire experiment on lab record	CO4	2	4	2	Day wise evaluation
2	Experiment conduction	Students need to follow the API standards and perform the experiment	CO4	2	4	2	
3	Results and Discussion	Calculation of values and discussion on the results	CO4	2	8	4	
4	Recent Development	Students need to write any recent development regarding the apparatus	CO4	2	8	4	
5	VIVA	-	CO4	2	16	8	

Assessment Matrix for Daily Task Evaluation for Laboratory component:

Sl. No.	Task No.	Marks for activity 01 [Mention the activity]	Marks for activity 02 [Mention the activity]	Marks for activity 03 [Mention the activity]	Total Marks		
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

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-	-	-	-	-	-	-	-

Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2021', Regulation No. PU/AC-15/10/06_2021, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2022/09/Academic-Regulations-2021.pdf) and go through the Section Nos. 1.0 through 25.0. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, Head of the Department, and Dean (School of Engineering) for further assistance.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1	Shikhar explained to his friend that heat cannot be transferred from a colder to a warmer body. His friend Raman was taken aback because the first law of thermodynamics contained no such explanations for the direction in which change can occur. Can you address the limitations of first law of thermodynamics and how does the second law of thermodynamics address them ?	10	CO1	Comprehension
2	Throttling a real gas from conditions of moderate temperature and pressure usually results in a temperature decrease. Under what conditions would an increase in temperature be expected?	10	CO2	Comprehension
3	A team of reservoir engineers has analysed a crude oil sample with API gravity of crude oil is 45° and GOR of 2000 scf/STB. Identify the crude oil and draw the phase envelope diagram.	10	CO3	Comprehnsion

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Understand first law and second law of thermodynamics	50
2	CO2	Apply the thermodynamics understanding to fluid flow processes such as turbine and compressor	45
3	C03	Classify different types of oil and gas reservoirs based on the fundamentals of reservoir fluid behavior and properties	50
4	CO4	Interpret the theoretical knowledge of thermodynamics with lab experiments	50

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Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

This course has been duly verified and approved by the D.A.C.

Signature of the Chairperson D.A.C.:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1	**Continuous Internal Assessment: 1** – Literature Survey Literature Review of Digital/e-resources from Presidency University link shared below. It is mandatory to submit a screenshot accessing digital resources, otherwise, it will not be evaluated. Link to Presidency University e-resources: https://presiuniv.knimbus.com			
2	**Continuous Internal Assessment** 2: Quiz			
3	Mid Term Examination			
4	**Continuous Internal Assessment 3**: Poster presentation			
5	**Continous Lab Performance Assessment**			
6	End term Final Examination			

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

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Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Understand first law and second law of thermodynamics	50		
2	CO2	Apply the thermodynamics understanding to fluid flow processes such as turbine and compressor	55		
3	C03	Classify different types of oil and gas reservoirs based on the fundamentals of reservoir fluid behavior and properties	50		
4	CO4	Interpret the theoretical knowledge of thermodynamics with lab experiments	50		

Name and Signature of the Course Instructor:

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D.A.C. Observation and Approval:

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Course Code: **PET2010**	**Course Title: Introduction to Oil and Gas Reservoir Simulation** **Type of Course: 1] Program Core** **2] Theory Embedded**	**L-P-C**	1	2	2
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	The main aim of this lab is to understand reservoir engineering simulation using software's. Solution of production and reservoir engineering problems using state-of-the-art commercial reservoir simulation software, using data commonly available in industry; emphasis on reservoir description, reservoir model design and calibration, production forecasting and optimization, economic analysis and decision making under uncertainty				
Course Objectives:	The objective of the course is to familiarize the learners with the concepts of Introduction to Oil and Gas Reservoir Simulation and attain **Skill Development** through **Experiential Learning** techniques.				
Course Outcomes:	On successful completion of the course, the student shall be able to: CO1: explain reservoir simulation fundamentals- the underlying equations, the numerical techniques used to solve them and History matching, CO2: design a reservoir simulation model, construct the data set, execute the simulator, and view simulation results visually using software, CO3: predict and optimize future performance of petroleum reservoirs using reservoir simulation and economic models.				
Course Content					
Module 1:	Introduction to Reservoir Modelling and Simulation	Quiz	Programme	12 Periods	
Introduction to reservoir simulation, Modelling Types and Applications, Description in Modelling-Reservoir geometry and Continuity, Uncertainty in reservoir model description; Numerical Discretization, Grids, Numerical Techniques and approaches, Equations of Multiphase Flow, History Matching, Implicit and Explicit Formulation, Comparative study of Black Oil and Compositional Model, Fundamentals - IMPES					
Module 2:	Introduction to CMG	Case study	Model Simulation	20 Sessions	
Introduction, Simulators in CMG, Simulator Applications, Other Commercial Software Experiment 1: Level 1: CMG introduction: Basic understanding of available reservoir simulator Level 2: Working Environment of simulator Experiment 2: To enable learners to learn the basic steps of building black oil simulation model using IMEX – CMG simulator. Level 1: Geometric modelling: Input and modify model dimensions and geometry as per given conditions Level 2: Creating and importing grid and grid properties, Experiment 3: Level 1: Fluid properties modelling: Understand fluid properties that can be quantified in a given simulator Level 2: Fluid properties modelling: Apply fluid properties that can be quantified in a given simulator Experiment 4 Level 1: Fluid properties modelling: Add the fluids PVT data for simple model Level 2: Importing or creating fluid models, locating wells, importing well production data, rock fluid properties Experiment 5: Level 1: Rock properties modelling: Input and understand porosity and permeability distributions Level 2: Rock properties modelling: Analyze porosity and permeability distributions Experiment 5: Phase Behavior Prediction of Reservoir Fluid using Winprop Simulator Level 1: Introduction to Winprop Simulator Level 2: Develop a compositional model with the given data. Experiment 6: Level 1: Rock properties modelling: Know the effects of changes in rock properties Level 2: Apply the effects of changes in rock properties Experiment 6: Level 1: Calculate saturation pressure at temperatures above and below critical temperature. Level 2: Generate phase envelope diagram and note down Cricondenbar, Cricondentherm, critical temperature and critical pressure Experiment 7: Level 1: Rock-fluid interaction modelling: Know the effects of modifications to pore volumes and transmissibilities Level 2: Analyze effects of modifications to pore volumes and transmissibilities					

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Experiment 7: To enable students learn the basic steps of building a Coalbed Methane Reservoir Model
Level 1: Introduction to CMG-GEM simulator
Level 2: Creating dual porosity reservoir model using
Experiment 8:
Level 1: Reservoir Modelling: Evaluate OOIP
Level 2: Original Oil in Place estimation using IMEX
Experiment 8:
Level 1: Using cmg gem to model cbm reservoir model
Level 2: Performance prediction of cbm reservoir using cmg gem model
Experiment 9:
Level 1: History matching: Introduction to History matching in Simulator
Level 2: History matching: Perform History matching
Experiment 9: To enable learners, understand basic concepts of Plus fraction splitting and Lumping matching experimental data by regression.
Level 1: To create a reservoir fluid model by Plus fraction splitting
Level 2: Lumping matching experimental data by regression.
Experiment 10:
Level 1: Performance prediction: Predict and compare reservoir performance by applying secondary oil recovery techniques
Level 2: Case study on CMG-STARS
Experiment 10: To enable learners to learn the basic steps of Compositional oil simulation model using IMEX – GEM simulator.
Level 1: To create a fluid model using Winprop simulator
Level 2: Performance prediction: Predict and compare reservoir performance by importing fluid model in CMG -GEM simulator

Targeted Application and Tools that can be used:
Applications: Production and design engineer
Tool: CMG, Eclipse

Text Book:
T1: Abou Kassem J.H. "Petroleum Reservoir Simulation", Elsevier; 1st Edition; 2013; Gulf Publishing
T2: Tarek Ahmed "Advanced Reservoir Engineering", Elsevier; 1st Edition; 2004; Gulf Publishing

References:
R1: John R. Fanchi "Principles of Applied Reservoir Simulation", Elsevier; 3rd Edition; 2005; Gulf Publishing
R2: Abdullah Alajmi "Handbook of Applied Petroleum Reservoir Simulation", 1st Edition; 2016; Auris
R3: CMG. 2022a. CMG GEM User's Guide. Calgary, Alberta, Canada: Computer Modelling Group Ltd.
e-resources:
1. Presidency University official ID: https://presiuniv.knimbus.com/user#/home
2. Youtube Videos Lecture Series- PGE 323M Reservoir Engineering III (Simulation): https://www.youtube.com/channel/UCkCwNnLZnRoaHYFyKTdySDw
3. Case Study- A collection of Case Studies for verification of Reservoir Simulators: https://repositories.lib.utexas.edu/handle/2152/23014

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory-integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning** techniques. The course attainment will be assessed through the assessment component(s) mentioned in the course handout.

Catalogue prepared by:	Dr. Deepjyoti Mech, Mr. Bhairab Jyoti Gogoi, Mr. Sugat Srivastava, Mr. Gaurav Kundu
Recommended by the Board of Studies on:	16th Meeting of the Board of Studies held on 8th July 2023
Date of Approval by the Academic Council:	16th Meeting of the Academic Council held on 23rd October 2021

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PRESIDENCY UNIVERSITY

(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Handout (AY 2022-2023)

Date of Issue: 23-01-23
Revised on: NA

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2020-24
Semester / Year	:	VI / 3rd
Course Code / Title	:	PET 2010 / Introduction to Oil and Gas Reservoir Simulation
Course Credit Structure	:	1L – 0T- 2P – 1C
Contact Hours	:	14L + 0T+ 24P = 38
Course Instructor In-charge	:	Dr. Deepjyoti Mech/ Dr. Barasha Deka
Course Instructor	:	Dr. Deepjyoti Mech/ Dr. Barasha Deka

Program Outcomes (POs):

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design

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documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:
NIL

Course Description:

The main aim of this lab is to understand reservoir engineering simulation using software's. Solution of production and reservoir engineering problems using state-of-the-art commercial reservoir simulation software, using data commonly available in industry; emphasis on reservoir description, reservoir model design and calibration, production forecasting and optimization, economic analysis and decision making under uncertainty

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Introduction to Oil and Gas Reservoir Simulation and attain **Skill Development** through **Experiential Learning** techniques.

Course Outcomes (COs):

On successful completion of the course, the student shall be able to:

CO1: Explain reservoir simulation fundamentals- the underlying equations, the numerical techniques usedto solve them and History matching,

CO2: Design a reservoir simulation model, construct the data set, execute the simulator, and view simulation results visually using software,

CO3: Predict and optimize future performance of petroleum reservoirs using reservoir simulation and economic models.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	H	M	M	L	L				L	H	L	L
CO2	H	H	M	L	L				L	H	L	L
C03	H	H	L	M	M				M	H	M	M
CO4	H	H	L	M	M				M	H	H	L
	H = High, M = Moderate, L = Low											

Course Content (Syllabus):

Unit I: Introduction to Reservoir Modelling and Simulation [12 Classes – Comprehension]

Modelling techniques through field life, Introduction to reservoir simulation, Modelling Types and Applications, Description in Modelling-Reservoir geometry and Continuity, Uncertainty in reservoir model description;

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Numerical Discretization, Grids, Reservoir Simulation Elements, Numerical Techniques and approaches, Equations Of Multiphase Flow, Fundamentals—Black Oil and Compositional Model, History Matching.

Unit II: Introduction to CMG [20 Classes – Application]

Introduction, Simulators in CMG, Simulator Applications, Other Commercial Software

Skill sets to be developed:

1. **An attitude of enquiry.**
2. **Confidence and ability to tackle new problems.**
3. **Ability to interpret events and results.**
4. **Ability to work as a leader and as a member of a team.**
5. **Assess errors in systems/processes/programs/computations and eliminate them.**
6. Observe and measure physical phenomena.
7. **Write reports.**
8. **Select suitable equipment, instrument, materials, Alogorithms & software**
9. **Locate faults in system/Processes/software.**
10. Adaptive skills for setting and handling systems/Process/Issues
11. The ability to follow standard /Legal procedures.
12. An awareness of the Professional Ethics.
13. **Need to observe safety/General precautions.**
14. **To judge magnitudes/Results/issues without actual measurement/actual contacts.**

Course Schedule:

Schedule of Instruction:

Experiment-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session Number and Date	Task No	Task	Level 01	Level 02	Number of Lab Sessions required to complete the task	Skills to be developed	Course Outcome to be developed
1	P1/	01	Basic understanding of available reservoir simulator	CMG introduction: Basic understanding of available reservoir simulator	Working Environment of simulator	1	**1,2,3,4,5,8**	CO1
2	P2/	02	Input and modify model dimensions and geometry as per given	Geometric modelling: Input and modify model dimensions and geometry as per	Importing the rescue file	1	**1,2,3,4,5,7,8,13**	CO1

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			conditions	given conditions				
3	P3/	03	Understand fluid properties that can be quantified in a given simulator	Fluid properties modelling: Understand fluid properties that can be quantified in a given simulator	Fluid properties modelling: Apply fluid properties that can be quantified in a given simulator	1	**1,2,3,4,5,7,8,9, 10, 13, 14**	CO2
4	P4/	04	Change the fluids PVTdata for simple model	Fluid properties modelling: Change the fluids PVT data for simple model	Fluid properties modelling: Add the fluids PVT data for simple model	1	**1,2,3,4,5,7,9, 10, 13, 14**	CO2
5	P5/	05	Input and understandporosity and permeability distributions	Rock properties modelling: Input and understand porosity and permeability distributions	Rock properties modelling: Analyze porosity and permeability distributions	1	**1,2,3,4,5,7,9,10, 13, 14**	CO2
6	P6/	06	Revision Class					
7	P7/	07	Mid Term Examination					
8	P8/	08	Rock properties modelling: Know the effects of changes in rock properties	Rock properties modelling: Know the effects of changes in rock properties	Apply the effects of changes in rock properties	1	**1,2,3,4,5,7,9,10, 13, 14**	CO3
9	P9/	09	Rock-fluid interaction modelling :Know the effects of modifications to pore volumes and transmissibilities	Rock-fluid interaction modelling :Know the effects of modifications to pore volumes and transmissibilities	Original Oil in Place estimation using IMEX	1	**1,2,3,4,5,7,9,10, 13, 14**	CO3

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10	P10/	10	Evaluate OOIP	Reservoir Modelling: Evaluate OOIP	History matching: Perform History matching	1	**1,2,3,4,5,7,9, 10, 13, 14**	CO4
11	P11/	11	History matching: Perform History matching	History matching: Perform History matching	Case study on CMG-STARS	1	**1,2,3,4,5,7,8,9, 10, 13, 14**	CO4
12	P12/	12	Performance prediction	Performance prediction: Predict and compare reservoir performance by applying secondary oil recovery technique	Case study on CMG-STARS	1	**1,2,3,4,5,7,8, 9, 10, 13, 14**	CO1 through CO4
13	-	-	End Term Examination					

Delivery Procedure (Pedagogy):
This is a laboratory course. Most of the lectures will be taken with the help of Power Point Presentations. Videos will be shown for the better understanding of selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. Report Submission. Review classes will be conducted to clear doubts and to evaluate the level of understanding of the each student individually. Continuous Internal Assessment (CIA) will carry 5% weightage and Continuous Lab Performance Evaluation will carry 20% weightage.
Following procedures will be adopted in the course for delivering the content:

I. Experiential Learning Topics (ELT):
Literature Survey on a topic will be given from Reservoir Simulation and Modeling Lab. Literature Review of Digital/e-resources from Presidency University link shared below. It is mandatory to submit a screenshot accessing digital resources, otherwise, it will not be evaluated. Link to Presidency University e-resources: https://presiuniv.knimbus.com This activity will help in developing the Foundation Skills of the students. It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)

Reference Materials:

Text Book:
T1: Abou Kassem J.H. "Petroleum Reservoir Simulation", Elsevier; 1st Edition; 2013; Gulf Publishing
T2: Tarek Ahmed "Advanced Reservoir Engineering", Elsevier; 1st Edition; 2004; Gulf Publishing

References:
R1: Hussein K, " Petroleum and Gas Field Processing", Apple Academic Press Inc., 2nd Edition,2016.
R2: Abdullah Alajmi "Handbook of Applied Petroleum Reservoir Simulation", 1st Edition; 2016; Auris

E-resources:
1.Presidency University e-access portal:https://presiuniv.knimbus.com/user#/home
2. Youtube Channel Reservoir Simulation Course : https://www.youtube.com/channel/UCkCwNnLZnRoaHYFyKTdySDw

Guideline to Students:

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(a) About the Course:
This lab course intends to develop the skills to work on the Reservoir Simulation software and apply the theoretical knowledge they obtained through the lectures. Knowledge of Reservoir Engineering lab plays major role during the various stages of Reservoir fluid and rock in Oil and Gas industry. Basic awareness about this course may help understanding other course such as, Drilling Engineering, Petroleum Production Engineering and Surface Production Operations.

(b) Notification / Announcement related to the Course:
All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulation
The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0.

Course schedule:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
01	Over View of the course			01
02	Familiarization to Software			01
03	Demonstration of first set of Experiments/Skills			04
04	Revision			01
05	Mid Term Examination			01
06	Conduct of second set of experiments			05
07	Summary of the Software tasks			01
08	End Term Evaluation	____	_____	

Schedule of Instruction:
Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No.	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
01	L01	Program Integration				
Unit I: Introduction to Reservoir Modelling and Simulation						
02	L02	Reservoir modelling	Introduction to Reservoir Modelling and Simulation	CO1	Lecture/Presentation	CN
03	L03	Reservoir modelling	Modelling techniques through field life, Introduction to reservoir simulation	CO1	Lecture / Presentation	CN

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04	L04	Reservoir modelling	Modelling Types and Applications	CO1	Lecture / Presentation	CN
05	L05	Reservoir Simulation	Numerical Discretization, Grids	CO1	Lecture / Presentation	CN
06	L06	Reservoir Simulation	Reservoir Simulation Elements	CO1	Lecture / Presentation	CN
07	L07	Reservoir Simulation	Reservoir Simulation Elements…cont.	CO1	Lecture / Presentation	CN
08	L08	Reservoir Simulation	Numerical Techniques and approaches	CO1	Lecture / Presentation	CN
09	L09	Reservoir Simulation	Numerical Techniques and approaches...cont.	CO1	Lecture / Presentation	CN
10	L10	Simulation models	Fundamentals—Black Oil and Compositional Model	CO1	Lecture / Presentation	CN
11	L11	History Matching	History Matching	CO1	Lecture / Presentation	CN
12	L12	Simulation software	CMG Software, Simulators in CMG	CO1	Lecture / Presentation	CN
13	L13	Simulation software	Other Commercial Softwares	CO1	Lecture / Presentation	CN

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. This is attained through the Lab Experiments as mentioned in the assessment Schedule.

Assessment Schedule:

Experiment-wise Micro Level planning for course assessment schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time (Date may Change)
01	Continuous Internal Assessment: Lab Exercises (Conduction of experiment, analysis of result, Lab record and attendance)	Module 1 and Module 2	CO1 and CO2	-	40	20%	-
02	Mid Term Exam	Module 1 and Module 2	CO1 and CO2		40	20%	
03	Continuous Internal Assessment: Assignment 1: Literature Review	Module 3 and Module 4	CO3 and CO4	-	20	10%	-

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04	End Term Exam	Module 1 through Module 4	CO1 through CO4		100	50%	-

ASSESSMENT DETAILS FOR LABORATORY COMPONENT:

Sl. No	Assessment type	List of Tasks	Course outcome number	Duration (In hours)	Marks	Weightage	Venue, DATE &TIME
1	Performing Experiment in CMG	After conduction of experiment student has to write the entire practical performed in CMG on lab record	CO1-CO4	2	8	4	Day wise evaluation
2	Results and Discussion	Calculation of values and discussion on the results	CO1-CO4	2	8	4	
3	Recent Development	Students need to write any recent development regarding the equipments used in simulation	CO1-CO4	2	8	4	
4	VIVA	-	CO1-CO4	2	16	8	

Assessment Matrix for Daily Task Evaluation for Laboratory component:

Sl. No.	Task No.	Marks for activity 01 [Mention the activity]	Marks for activity 02 [Mention the activity]	Marks for activity 03 [Mention the activity]	Total Marks		
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, Head of the Department, and Dean (School of Engineering) for further assistance.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample thought provoking questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1	How is Reservoir Simulation different from Reservoir Modeling? Explain Compositional Oil Model with reference to Black Oil	5 marks	CO1	Comprehension

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	Model? Why Black Oil Model it not used in real reservoir modeling?			
2	Why is it easy to solve diffusivity equation using Finite volume method and not using Finite Difference Method? Explain the uncertainties which result from Modeling Reservoirs using CMG?	5 marks	CO2	Comprehension
3	Apply Diffusivity equation using CMG and evaluate reservoir pressure using implicit method. Apply Diffusivity equation using CMG and evaluate reservoir pressure using implicit method.	5 marks	CO3	Application

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Explain reservoir simulation fundamentals- the underlying equations,the numerical techniques used to solve them and History matching	50
2	CO2	Design a reservoir simulation model, construct the data set, executethe simulator, and view simulation results visually using software	50
3	CO3	Predict and optimize future performance of petroleum reservoirs usingreservoir simulation and economic models	50

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

This course has been duly verified and approved by the D.A.C.

Signature of the Chairperson D.A.C.:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1	Overview of the Programme and Course	-	-	
2	Unit I			
3	Mid Term Lab Paper Revision	-	-	
4	Mid Term Lab Test	-	-	

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5	Unit II			
6	Course Integration			
7	END Term Exam Paper and Lab Exam Revision			
8				
9				
10				

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment

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1	CO1	Explain reservoir simulation fundamentals- the underlying equations,the numerical techniques used to solve them and History matching	50		
2	CO2	Design a reservoir simulation model, construct the data set, executethe simulator, and view simulation results visually using software	50		
3	CO3	Predict and optimize future performance of petroleum reservoirs usingreservoir simulation and economic models	50		

Name and Signature of the Course Instructor:

D.A.C. Observation and Approval:

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Course Code: **PET2012**	**Course Title:** **Reservoir Fluid Mechanics** **Type of Course:** **1] Program Core** **2] Laboratory Integrated**	**L-P-C**	2	2	3
Version No.	1.0				
Course Pre-requisites	NIL				
Anti-requisites	NIL				
Course Description	The course is designed to discuss the fundamental laws relating to the static and dynamic behavior of fluids. It enables the need for analyze the fluid flow behavior and its applications in porous media. The course is both conceptual and analytical in nature. It needs fair knowledge of Physics and Mathematics. The course develops the critical thinking and analytical skills. The associated laboratory experiments provide an opportunity to validate the concepts taught and enhances the ability to visualize the real system performance. Knowledge gained from this course can be applied for analyzing fluid flow through hydrocarbon reservoir.				
Course objective	The objective of the course is to familiarize the learners with the concepts of Reservoir Fluid Mechanics and attain **Skill Development** through **Experiential Learning** techniques.				
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Summarize the basic properties of fluids, CO2: Employ the concept of hydrostatics to pressure measuring devices, CO3: Apply the principle of energy conservation to flow measuring devices, CO4: Calculate different parameters for compressible fluid flow, CO5: Interpret the fluid dynamics theoretical knowledge with lab experiments.				
Course Content:					
Module 1	Fluid Statics	Assignment	Data Collection	05 Periods	
Topics: Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmosphere and vacuum pressure. Manometers, simple and differential manometers, total pressure and location of center of pressure on horizontal / vertical / inclined plane surfaces and curved surfaces submerged in a liquid. **Related Experiment No:** 1					
Module 2	Fluid Kinematics	Assignment	Data Collection	05 Periods	
Topics: Types of fluid flow-introduction, continuity equation in three dimensions (Cartesian co-ordinate system only), velocity and acceleration, velocity potential function and stream function and flow nets.					
Module 3	Fluid Dynamics	Assignment	Literature Survey and Presentation	08 Periods	
Topics: Fluid Dynamics: Introduction, equations of motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, limitation of Bernoulli's equation, fluid flow measurements: Venturimeter, vertical orifice & orifice meter, Pitot tube, v-notch and rectangular notch, rotameter. Laminar flow and viscous effects: Reynolds number, laminar and turbulent flows, critical Reynolds number, laminar flow between parallel plates, steady state flow, unsteady state flow. **Related Experiment No:** 2, 3, 4, 5, and 8					
Module 4	Compressible Flow	Assignment	Coding	07 Periods	
Topics: Compressible Flow- Introduction: Review of Thermodynamics, The Speed of Sound, Adiabatic and Isentropic Steady Flow, Isentropic Flow with Area Changes, The Normal Shock Wave, Operation of Converging and Diverging Nozzles, Compressible Duct Flow with Friction. Flow through pipes: Frictional loss in pipe flow, Darcy's-equation and Chezy's equation for loss of head due to friction in pipes, hydraulic gradient line and total energy line, hydrate formation pipeline, Darcy's equation of fluid flow through porous media. Related Experiment No: 6, and 7					
List of Laboratory Tasks: **Experiment No. 1: To measure the viscosity of fluids** Level 1: To determine the viscosity at room temperature Level 2: To find the viscosity variation with respect to temperature (Students will learn to plot the graphs on normal graph paper manually and also using free available software/tool) **Experiment No. 2: Verification of Bernoulli's Theorem** Level 1: To calculate the total energy at different cross section of pipe Level 2: To plot the graph between total energy versus distance and prove the Theorem (Students will learn to plot the graphs on normal graph paper manually and also using free available software/tool) **Experiment No. 3: To determine flow regime from Reynolds number**					

Level 1: To determine the type of flow
Level 2: To study transition zone

Experiment No. 4: To study the variation of coefficient of discharge
Level 1: To demonstrate the use of Venturimeter for fluid flow measurement
Level 1: To demonstrate the use of Orifice for fluid flow measurement
Level 2: To determine the coefficient of discharge for a given input

Experiment No. 5: To calculate the rate of flow
Level 1: To calculate the rate of flow using Rotameter
Level 2: To calibrate the rotameter

Experiment No. 6: To determine loss of head due to bend, enlargement and contraction in pipes
Level 1: To determine loss of head due to bend, enlargement and contraction in pipes using minor loss
Level 2: To compare the head losses in the presence of different sections of pipes

Experiment No. 7: To evaluate the friction losses in pipes
Level 1: To determine the friction factor for Darcy - Weisbach equation using major loss
Level 2: To determine the reason for friction loss

Experiment No. 8: To measure the force developed by impact of jet of water on plates of different configurations and compare with the theoretical value
Level 1: To determine the impact forces of jet on flat vane
Level 2: To plot the performance characteristics
Level 2: To compare the force exerted on different plates (Students will learn to plot the graphs on normal graph paper manually and also using free available software/tool)

Targeted Application & Tools that can be used:
Application: Process Engineer, Pipeline Engineer, Reservoir Engineer in Oil and Gas Industry
Tools: MS Excel, Grapher

Text Book:
T1: White, Frank M., "Fluid Mechanics," 7th Edition, 2011, McGraw Hill Education (India)
T2: Modi P.N., Seth S.M., Hydraulics and Fluid Mechanics Including Hydraulics Machines, 21st Edition, 2017, Raispns Publications Pvt. Ltd.

References:
R1: Çengel, Yunus A., and John M. Cimbala. Fluid mechanics: Fundamentals and applications, 15th Edition. 2006, Boston: McGraw-HillHigher Education
R2: Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, John W. Mitchell, "Fluid Mechanics: SI Version," Wiley India.
R3: Tarek Ahmed, Elsevier, "Reservoir Engineering Handbook".

e- References:
1. Link for Knimbus remote login: https://presiuniv.knimbus.com
2. https://byjus.com/physics/fluid-dynamics/
3. https://www.youtube.com/watch?v=djx9jlkYAt4
4. https://www.youtube.com/watch?v=Cdpoo2XM6Hg

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. The course attainment will be assessed through assessment component mentioned in course handout.

Catalogue prepared by:	Dr. Suman Paul, Dr. Deepjyoti Mech, Dr. Kalpajit Hazarika, Mr. Indraneel Agasty, Mr. Anmol Bhargava, Mr. Sugat Srivastava
Recommended by the Board of Studies on:	12th Meeting of the Board of Studies held on 9th August 2021
Date of Approval by the Academic Council:	16th Meeting of the Academic Council held on 23rd October 2021

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Course Handout AY 2022-2023

Date of Issue: 07-09-2022

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2020-24
Semester / Year	:	V / 3rd
Course Code / Title	:	PET2012/ Reservoir Fluid Mechanics
Course Credit Structure	:	2L-2P-3C
Contact Hours	:	41 (29L+12P)
Course Instructor In-charge	:	Dr. Kalpajit Hazarika/ Dr. Abhinav Kumar
Course Instructor	:	Dr. Kalpajit Hazarika/ Dr. Abhinav Kumar
Course URL	:	
Program Outcomes (POs)	:	

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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PO08: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO09: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:
NIL

Course Description:

The course is designed to discuss the fundamental laws relating to the static and dynamic behavior of fluids. It enables the need for analyze the fluid flow behavior and its applications in porous media. The course is both conceptual and analytical in nature. It needs fair knowledge of Physics and Mathematics. The course develops the critical thinking and analytical skills. The associated laboratory experiments provide an opportunity to validate the concepts taught and enhances the ability to visualize the real system performance. Knowledge gained from this course can be applied for analyzing fluid flow through hydrocarbon reservoir.

Course Objective:
The objective of the course is to familiarize the learners with the concepts of Reservoir Fluid Mechanics and attain **Skill Development** through **Experiential Learning techniques**.

Course Outcomes (COs):

On successful completion of this course the students shall be able to:

CO1: Summarize the basic properties of fluids,
CO2: Employ the concept of hydrostatics to pressure measuring devices,
CO3: Apply the principle of energy conservation to flow measuring devices,
CO4: Calculate different parameters for compressible fluid flow,
CO5: Interpret the fluid dynamics theoretical knowledge with lab experiments.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	L	L	L	L	M	M	M	L	L	M	L	L
CO2	H	H	H	M	L	L	L	H	L	M	L	L
C03	L	L	L	L	M	M	M	L	M	M	L	L
CO4	H	H	H	M	L	L	L	H	H	M	H	L
CO5	H	M	M	M	M	L	M	M	M	L	L	L

H = High, M = Moderate, L = Low

Course Content (Syllabus):

Module I: Fluid Statics [5 hours]-Application Level

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Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmosphere and vacuum pressure. Manometers, simple and differential manometers, total pressure and location of center of pressure on horizontal / vertical / inclined plane surfaces and curved surfaces submerged in a liquid.
Related Experiment No: 1

Module II: Fluid Kinematics [5 hours]- Application Level
Types of fluid flow-introduction, continuity equation in three dimensions (Cartesian co-ordinate system only), velocity and acceleration, velocity potential function and stream function and flow nets.

Module III: Fluid Dynamics [7 hours]-Application Level
Fluid Dynamics: Introduction, equations of motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, limitation of Bernoulli's equation, fluid flow measurements: Venturimeter, vertical orifice & orifice meter, Pitot tube, v-notch and rectangular notch, rotameter. Laminar flow and viscous effects: Reynolds number, laminar and turbulent flows, critical Reynolds number, laminar flow between parallel plates, steady state flow, unsteady state flow.
Related Experiment No: 2, 3, 4, 5, and 8

Module IV: Compressible flow [8 hours]- Application Level
Compressible Flow- Introduction: Review of Thermodynamics, The Speed of Sound, Adiabatic and Isentropic Steady Flow, Isentropic Flow with Area Changes, The Normal Shock Wave, Operation of Converging and Diverging Nozzles, Compressible Duct Flow with Friction.
Flow through pipes: Frictional loss in pipe flow, Darcy's-equation and Chezy's equation for loss of head due to friction in pipes, hydraulic gradient line and total energy line, hydrate formation pipeline, Darcy's equation of fluid flow through porous media.
Related Experiment No: 6, and 7

SKILL SETS TO BE DEVLOPED:

1. **An attitude of enquiry.**
2. **Confidence and ability to tackle new problems.**
3. **Ability to interpret events and results.**
4. **Ability to work as a leader and as a member of a team.**
5. **Assess errors in systems/processes/programs/computations and eliminate them.**
6. Observe and measure physical phenomena.
7. **Write reports.**
8. **Select suitable equipment, instrument, materials & software**
9. Locate faults in system/Processes/software.
10. **Manipulative skills for setting and handling systems/Process/ Issues**
11. **The ability to follow standard /Legal procedures.**
12. **An awareness of the Professional Ethics.**
13. **Need to observe safety/General precautions**.
14. To judge magnitudes/Results/issues without actual measurement/actual contacts

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COURSE CONTENT &TASK SCHEDULE FOR LABORATORY COMPONENT:

Sl. No	Session Number and Date	Task No	Task	Level 1	Level 2	Number of Lab Sessions required to complete the task	Skills to be developed	Course Outcome to be developed
1	12/09/22	P1	Familiarization with RFM LAB			1		
2	12/09/22	P1	Familiarization with RFM LAB equipment					
3	19/09/22	P2	To measure the viscosity of fluids	To determine the viscosity at room temperature	To find the viscosity variation with respect to temperature (Students will learn to plot the graphs on normal graph paper manually and also using free available software/tool)	1	2, 7, 8, 10, 11, 12, 13	CO5
4	26/09/22	P3	Verification of Bernoulli's Theorem	To calculate the total energy at different cross section of pipe	To plot the graph between total energy versus distance and prove the Theorem (Students will learn to plot the graphs on normal graph paper manually and also using free available software/tool)	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO5
5	10/10/22	P4	To determine flow regime from Reynolds number	To determine the type of flow	To study transition zone	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO5
6	17/10/22	P5	To study the variation of coefficient of discharge	To demonstrate the use of Venturimeter for fluid flow measurement To demonstrate the use of Orifice for fluid flow measurement	To determine the coefficient of discharge for a given input	1	1, 2, 3, 4, 5, 8, 10, 11, 12, 13	CO5
7	14/11/22	P6	To calculate the rate of flow	To calculate the rate of flow using Rotameter	To calibrate the rotameter	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO5
8	21/11/22	P7	To determine loss of head due to bend, enlargement and contraction in pipes	To determine loss of head due to bend, enlargement and contraction in pipes using minor loss	To compare the head losses in the presence of different sections of pipes	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO5

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9	28/11/22	P8	To evaluate the friction losses in pipes	To determine the friction factor for Darcy - Weisbach equation using major loss	To determine the reason for friction loss	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO5
10	5/12/22	P9	To measure the force developed by impact of jet of water on plates of different configurations and compare with the theoretical value	To determine the impact forces of jet on flat vane	To plot the performance characteristics To compare the force exerted on different plates (Students will learn to plot the graphs on normal graph paper manually and also using free available software/tool)	1	1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13	CO5
11	12/12/22	P10	Revision					

Delivery Procedure (Pedagogy):

This is an integrated lab based theory course. Most of the lectures will be taken with the help of Power Point Presentation and White board. Videos will be shown for the better understanding of selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. During the lab session a problem statement will be given to the students and based on their understanding they have to prepare the solution. Continuous lab assessment will carry 20% weightage under Continuous Internal Assessment (CIA). If required, classes may take through virtual mode.
Following procedures will be adopted in the course for delivering the content:

Experiential learning:

- **Poster Presentation (Module I) (Skill development):**

List out the different pressure measuring devices for different application

- **Literature review (Module III) (Employability/Skill development/ Environment and sustainability):**

Literature Review of Digital/e-resources from Presidency University link shared below. It is mandatory to submit a screenshot accessing digital resources, otherwise, it will not be evaluated. Link for Knimbus remote login: https://presiuniv.knimbus.com

Participative learning:

- **Quiz (Module II) (Employability):**
- Quiz on fluid statics and dynamics
- **Quiz (Module IV) (Employability):**
- Quiz on flow measuring devices
- **Peer learning**

Problem solving:

- **Subject related exercise (Module I, II, III, IV)**

Reference Materials:

a. Text Book(s):

T1: White, Frank M., "Fluid Mechanics," 7th Edition, 2011, McGraw Hill Education (India)

T2: Modi P.N., Seth S.M., Hydraulics and Fluid Mechanics Including Hydraulics Machines, 21st Edition, 2017, Raispns Publications Pvt. Ltd.

(b) Reference Book(s):

R1: Çengel, Yunus A., and John M. Cimbala. Fluid mechanics: Fundamentals and applications, 15th Edition. 2006, Boston: McGraw-HillHigher Education

R2: Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, John W. Mitchell, "Fluid Mechanics: SI Version," Wiley India.

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R3: Tarek Ahmed, Elsevier, "Reservoir Engineering Handbook".

(c) *e-resources:*

1. Link for Knimbus remote login: https://presiuniv.knimbus.com
2. https://byjus.com/physics/fluid-dynamics/
3. https://www.youtube.com/watch?v=djx9jlkYAt4
4. https://www.youtube.com/watch?v=Cdpoo2XM6Hg

Guideline to Students:

(a) About the Course:

This is a theory based course which will provide fundamental concepts of fluid mechanics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students.

(b) Notification / Announcement related to the Course:

All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulations

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0.

COURSE SCHEDULE FOR THEORY COMPONENT

Unit-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course	15-09-22	15-09-22	1
2	Module I:	16-09-22	30-09-22	5
3	Poster Presentation on Module I	-	-	-
4	Module II:	06-10-22	20-10-22	5
5	Quiz on Module II	-	-	-
6	Mid Term Syllabus and question pattern discussion	28-10-22	28-10-22	1
7	Mid term	03-11-22	07-11-22	-
8	Mid Term Question Paper discussion	10-11-22	10-11-22	1
9	Module III:	21-10-22	25-11-22	7
10	Literature review on Module III	-	-	-
11	Module IV:	01-12-22	23-12-22	8
12	Quiz on Module IV	-	-	-
13	Course Integration	29-12-22	29-12-22	1
14	End Term Syllabus and Question Paper Pattern Discussion	30-12-22	30-12-22	1
15	End Term Final Examination	05-01-23	25-01-23	-

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*****Dates as per the academic calendar***

COURSE SCHEDULE FOR LABORATORY COMPONENT

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course			1
2	Laboratory Familiarization			1
2	Demonstration of first set of Experiments/Skills			2
4	Conduct of first set of experiments			10
5	Conduct of second set of experiments			10

Schedule of Instruction:

Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No. / Date	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
1	L1 / 15/09/22	Programe Integration	Overview of the course		Offline/PPT/ White board	
Module I: Fluid Statics						
2	L2 / 16/09/22	Introduction to fluid statics	Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmosphere and vacuum pressure.	CO1	Offline/PPT/ White board	T1 Ch01
3	L3 / 22/09/22	Manometer	Manometers, simple and differential manometers,	CO1	Offline/PPT/ White board	T1 Ch01
4	L4 / 23/09/22	Pressure calculation	total pressure and location of center of pressure on horizontal /	CO1	Offline/PPT/ White board	T1 Ch01
5	L5 / 29/09/22		total pressure and location of center of pressure on vertical /	CO1	Offline/PPT/ White board	T1 Ch02
6	L6 / 30/09/22		total pressure and location of center of pressure on inclined plane surfaces and curved surfaces submerged in a liquid	CO1	Offline/PPT/ White board	T1 Ch02
7	Poster Presentation on Module I			CO1	-	-
Module II: Fluid Kinematics						
8	L7 / 06/10/22	Types of flow	Types of fluid flow-introduction,	CO2	Offline/PPT/ White board	T1 Ch03
9	L8 / 7/10/22	Continuity equation	continuity equation in three dimensions (Cartesian co-ordinate system only),		Offline/PPT/ White board	T1 Ch03

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10	L9 / 13/10/22	Velocity and stream function	velocity and acceleration,	CO2	Offline/PPT/ White board	T1 Ch03
11	L10 / 14/10/22		velocity potential function and	CO2	Offline/PPT/ White board	T1 Ch03
12	L11 / 20/10/22		stream function and flow nets.	CO2	Offline/PPT/ White board	T1 Ch03
13	Quiz on Module II			CO2	-	-
Module III: Fluid Dynamics						
14	L12 / 21/10/22	Fluid Dynamics: Introduction	Fluid Dynamics: Introduction, equations of motion, Euler's equation of motion,	CO3	Offline/PPT/ White board	T1 Ch04
15	L13 / 27/10/22	Bernoulli's equation	Bernoulli's equation from Euler's equation, limitation of Bernoulli's equation, fluid flow measurements:	CO3	Offline/PPT/ White board	T1 Ch04
16	L14 / 28/10/22	Mid Term Syllabus and question pattern discussion		C01, CO2	-	-
17	L15 / 10/11/22	Mid Term question paper discussion		CO1, CO2	-	-
18	L16 / 11/11/22	Flow measuring devices	Venturimeter, vertical orifice & orifice meter, Pitot tube, v-notch and rectangular notch, rotameter. Mid term paper discussion	CO3	Offline/PPT/ White board	T1 Ch04
19	L17 / 17/11/22	Type of flow	Laminar flow and viscous effects:	CO3	Offline/PPT/ White board	T1 Ch04
20	L18 / 18/11/22		Reynolds number, laminar and turbulent flows, critical Reynolds number,	CO3	Offline/PPT/ White board	T1 Ch04
21	L19 / 24/11/22		laminar flow between parallel plates,	CO3	Offline/PPT/ White board	T1 Ch04
22	L20 / 25/11/22		steady state flow, unsteady state flow.	CO3	Offline/PPT/ White board	T1 Ch04
23	Literature review on Module III			CO3	-	-
Module IV: Compressible flow						
24	L21 / 01/12/22	Compressible Flow-Introduction	Compressible Flow-Introduction: Review of Thermodynamics, The Speed of Sound, Adiabatic and Isentropic	CO4	Offline/PPT/ White board	T1 Ch05
25	L22 / 02/12/22		Steady Flow, Isentropic Flow with Area Changes,	CO4	Offline/PPT/ White board	T1 Ch05
26	L23 / 08/12/22		The Normal Shock Wave, Operation of Converging and Diverging Nozzles,	CO4	Offline/PPT/ White board	T1 Ch05
27	L24 / 09/12/22	Flow through pipes	Compressible Duct Flow with Friction.	CO4	Offline/PPT/ White board	T1 Ch05

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28	L25 / 15/12/22		Flow through pipes: Frictional loss in pipe flow,	CO4	Offline/PPT/ White board	T1 Ch05
29	L26 / 16/12/22		Darcy's-equation and Chezy's equation for loss of head due to friction in pipes,	CO4	Offline/PPT/ White board	T1 Ch05
30	L27 / 22/12/22		hydraulic gradient line and total energy line, hydrate formation pipeline,	CO4	Offline/PPT/ White board	T1 Ch05
31	L28 / 23/12/22		Darcy's equation of fluid flow through porous media.	CO4	Offline/PPT/ White board	T1 Ch05
32	L29 / 29/12/22	Course Integration		CO1 - CO4	-	-
33	Quiz on Module IV			CO4	-	-
34	L30 / 30/12/22	End Term Question paper discussion		CO1- CO4	-	-

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. This is attained through the Lab Experiments as mentioned in the assessment Schedule.

ASSESSMENT SCHEDULE FOR THEORY COMPONENT:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time
1	**Continuous Internal Assessment:** Poster Presentation on Module I	L02-L06	CO1	-	-	-	
2	**Continuous Internal Assessment:** Quiz on Module II	L07-L11	CO2	-	-	-	
3	Mid term	L02-L11	CO1, CO2	2	60	30	
4	**Continuous Internal Assessment:** Literature Survey Literature Review of Digital/e-resources from Presidency University link shared below. It is mandatory to submit a screenshot accessing digital resources, otherwise, it will not be evaluated. Link to Presidency University e-resources:	L12-L20	CO3	-	4	2	

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	https://presiuniv.knimbus.com						
5	**Continuous Internal Assessment:** Quiz on Module IV	P21-P28	CO4	-	-	-	
6	CIA on lab assessment	P1-P12	CO5	-	36	18	
7	End term final examination	L02-L28	CO1 - CO4	3	60	30	
8	End term lab final examination		CO5	2	40	20	

ASSESSMENT DETAILS FOR LABORATORY COMPONENT:

Sl. No	Assessment type	List of Tasks	Course outcome number	Duration (In hours)	Marks	Weightage	Venue, DATE &TIME
1	Sample composition calculation and preparation	After conduction of experiment student has to write the entire experiment on lab record	CO5	2	2	1	Day wise evaluation
2	Experiment conduction	Students need to follow the API standards and perform the experiment	CO5	2	10	5	
3	Results and Discussion	Calculation of values and discussion on the results	CO5	2	6	3	
4	Recent Development	Students need to write any recent development regarding the apparatus	CO5	2	2	5	
5	VIVA	-	CO5	2	10	6	

Assessment Matrix for Daily Task Evaluation for Laboratory component:

Sl. No.	Task No.	Marks for activity 01 [Mention the activity]	Marks for activity 02 [Mention the activity]	Marks for activity 03 [Mention the activity]	Total Marks		
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

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Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, Head of the Department, and Dean (School of Engineering) for further assistance.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl No.	Question	Marks	Course Outcome No.
1	A 3.6 m by 1.5 m wide rectangular gate MN is vertical and is hinged at point 0.15 m below the center of gravity of the gate. The depth of water is 6m. Select the point on which least horizontal force must be applied to close the gate. Also find the least force to close the gate.	10	CO1

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	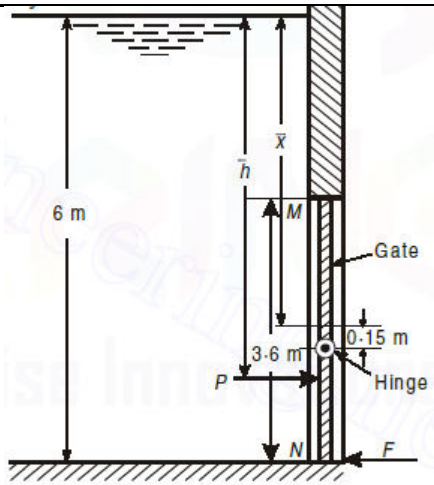		
2	A venturi meter measures the flow of water in a 75 mm diameter pipe. The difference of head between the entrance and the throat of the venturi meter is measured by *U*-tube containing mercury, the space above the mercury on each side being filled with water. What should be the diameter of the throat of the meter in order that the difference of the levels of the mercury shall be 0.25 m when the quantity of water flowing in the pipe is 630 litres per minute? Assume the discharge coefficient as 0.97. Can you change the manometer fluid by oil with specific gravity 0.85, justify your answer.	10	CO3
3	If two pipes of diameter *D* and *d* and equal length *L* are arranged in parallel the loss of head for a flow of *Q* is *h*. If the same pipes are arranged in series the loss of head for the same flow *Q* is *H*. If $d = 0.5\ D$, find the percentage of total flow through each pipe when placed in parallel and the ratio (H/h). Neglect minor losses and assume *f* to be constant.	10	CO4
4	Oil of specific gravity 0.90 flows in a pipe 300 mm diameter at the rate of 120 litres per second and the pressure at a point *A* is 24.525 kPa [0.25 kg(f)/cm2] (gage). If the point *A* is 5.2 m above the datum line, select the principle based on which you can calculate the total energy at point *A* in terms of metres of oil.	10	CO2

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Summarize the basic properties of fluids,	40
2	CO2	Employ the concept of hydrostatics to pressure measuring devices,	50
3	C03	Apply the principle of energy conservation to flow measuring devices,	45
4	CO4	Calculate different parameters for compressible fluid flow,	40

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5	CO5	Interpret the fluid dynamics theoretical knowledge with lab experiments.	45

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

Signature of the Chairperson DAC:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1	**Continuous Internal Assessment:** Poster Presentation on Module I			
2	**Continuous Internal Assessment:** Quiz on Module II			
3	Mid term			
4	**Continuous Internal Assessment:** Literature Survey Literature Review of Digital/e-resources from Presidency University link shared below. It is mandatory to submit a screenshot accessing digital resources, otherwise, it will not be evaluated. Link to Presidency University e-resources: https://presiuniv.knimbus.com			
5	**Continuous Internal Assessment:** Quiz on Module IV			
6	CIA			
7	End term final examination			
8	End term lab final examination			

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

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Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Summarize the basic properties of fluids,	40		
2	CO2	Employ the concept of hydrostatics to pressure measuring devices,	50		
3	C03	Apply the principle of energy conservation to flow measuring devices,	45		
4	CO4	Calculate different parameters for compressible fluid flow,	40		
5	CO5	Interpret the fluid dynamics theoretical knowledge with lab experiments.	45		

Name and Signature of the Course Instructor:

DAC Observation and Approval:

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Course Code: **PET2019**	**Course Title:** **Oil and Gas Well Test Analysis** **Type of Course:** **1] Core Course** **2] Theory Only**	**L-T-P-C**	3	0	3
Version No.:	1.0				
Course Pre-requisites:	PET 2004 – Fundamentals of Reservoir Engineering				
Anti-requisites:	NIL				
Course Description:	This course is aims to improve the knowledge of the students about fluid flow through porous media, solutions of diffusivity equations, pressure transient analysis, and gas well testing. To excel in this course, students should be well versed in the numerical solving and reservoir engineering. The course is mathematically rich with modelling and derivations of complex flow through porous media phenomena, pressure and flow rate relationship for different conditions, and the flow in non-circular reservoirs. This course will enhance programming knowledge of the students through assignments.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Oil and Gas Well Test Analysis and attain **Skill Development** through **Problem Solving** techniques.				
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: explain diffusivity equation, its derivation and solution, Principle of superposition, CO2: apply the knowledge to determine the reservoir Pressure, Permeability and Skin factor using pressure build-up test analysis, CO3: apply the knowledge of flow tests in order to calculate the pore volume of the reservoir, CO4: explain the different types of gas well tests and their uses.				
Course Content:					
Module 1:	Introduction to Well Test Analysis	Assignment	Programming	09 Periods	
Topics: Ideal reservoir model, mathematical preparation for well test analysis, derivation for diffusivity equation, radius of investigation, Principle of superposition, Horner's approximation**.**					
Module 2:	Pressure Build-up tests	Assignment	Programming	09 Periods	
Topics: Ideal buildup test, Actual buildup test, derivation from assumptions in ideal test theory, Qualitative behaviours of field test, Effect and duration of after flow, Permeability determination, skin factor, Well damage and stimulation, Reservoir limit tests.					
Module 3:	Flow Test	Assignment	Programming	09 Periods	
Topics: Introduction, Pressure draw down test, Multirate tests, Application of Flow tests.					
Module 4:	Gas Well Testing	Assignment	Programming	09 Periods	
Topics: Basic theory of Gas flow in reservoirs, Flow after flow tests, Isochronal test, Modified Isochronal tests.					
Targeted Application and Tools that can be used: Application – Well Testing Engineer, Reservoir Engineer in companies like Schlumberger, ONGC, Baker Hughes, etc. Software – Schlumberger – KAPPA					
Text Book: T1: Lee, J., 1982. Well testing. T2: Lee, J., Rollins, J.B. and Spivey, J.P., 2003. Pressure transient testing (eBook). SPE textbook series, 9.					
References: R1: Bourdet, Dominique. Well Test Analysis: The Use of Advanced Interpretation Models. Netherlands, Elsevier Science, 2002. R2: McAleese, S. Operational Aspects of Oil and Gas Well Testing. Netherlands, Elsevier Science, 2000. **e-resources:** 1. Presidency University e-access portal :https://presiuniv.knimbus.com/user#/home 2. YouTube Well Test Analysis: https://www.youtube.com/watch?v=kQvQtU0n1YQ 3. SPE Well Test Series: https://www.youtube.com/watch?v=3R3JV-zzHJU					
Topics relevant to "**SKILL DEVELOPMENT**": Pressure draw down test and Multirate tests for **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.					
Catalogue prepared by:	Dr. Kalpajit Hazarika, Mr. Bhairab Jyoti Gogoi, Mr. Anmol Bhargava, Mr. Sugat Srivastava				
Recommended by the Board of Studies on:	11th Meeting of the Board of Studies held on 5th September 2020				

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Date of Approval by the Academic Council:	13th Meeting of the Academic Council held on 6th November 2020

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PRESIDENCY UNIVERSITY

(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Handout AY: 2022-2023

Date of Issue:23-01-23

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech.
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2020-24
Semester / Year	:	VI Sem / 3rd Year
Course Code / Title	:	PET2019 / Oil and Gas Well Test Analysis
Course Credit Structure	:	3L – 0P – 3C
Contact Hours	:	40 (L)
Course Instructor In-charge	:	Dr. Abhinav Kumar
Course Instructor	:	Dr. Abhinav Kumar
Course URL of Edhitch	:	

Program Outcomes (POs):

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**

PO2: **Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**

PO3: **Design / Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.**

PO4: **Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.**

PO5: **Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.**

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.**

PO8: **Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.**

PO9: **Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.**

PO10: **Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.**

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:

1] PET 2004 – Fundamentals of Reservoir Engineering

Course Description:

This course is aims to improve the knowledge of the students about fluid flow through porous media, solutions of diffusivity equations, pressure transient analysis, and gas well testing. To excel in this course, students should be well versed in the numerical solving and reservoir engineering. The course is mathematically rich with modelling and derivations of complex flow through porous media phenomena, pressure and flow rate relationship for different conditions, and the flow in non-circular reservoirs. This course will enhance programming knowledge of the students through assignments.

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Oil and Gas Well Test Analysis and attain **Skill Development** through **Problem Solving** techniques.

Course Outcomes (COs):

On successful completion of the course the students shall be able to:
1] Explain diffusivity equation, its derivation and solution, Principle of superposition,
2] Apply the knowledge to determine the reservoir Pressure, Permeability and Skin factor using pressure build-up test analysis.
3] Apply the knowledge of flow tests in order to calculate the pore volume of the reservoir.
4] Explain the different types of gas well tests and their uses.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	H	M	M	L	L		L	L	L	H	L	L
CO2	H	H	M	L	L		L	L	L	H	L	L
CO3	H	H	L	M	M		M	M	M	H	M	M
CO4	H	H	L	M	M		H	M	M	H	M	L
H = High, M = Moderate, L = Low												

Course Content (Syllabus):

Module 1: Introduction to Well Test Analysis [9 Classes] – Comprehension Level
Ideal reservoir model, mathematical preparation for well test analysis, derivation for diffusivity equation, radius of investigation, Principle of superposition, Horner's approximation.

Module 2: Pressure Build-up Test [9 Classes] – Comprehension Level
Ideal buildup test, Actual buildup test, derivation from assumptions in ideal test theory, Qualitative behaviours of field test, Effect and duration of after flow, Permeability determination, skin factor, Well damage and stimulation, Reservoir limit tests.

Module 3: Flow Test [9 Classes] – Application Level
Introduction, Pressure draw down test, Multirate tests, Application of Flow tests.

Module 4: Gas Well Testing [9 Classes] – Comprehension Level
Basic theory of Gas flow in reservoirs, Flow after flow tests, Isochronal test, Modified Isochronal tests

Delivery Procedure (Pedagogy):

This is a theory based course. All the lectures will be taken with the help of Power Point Presentations and Lecture. Videos will be shown for the better understanding of selective topics. Assignments will be given to each student. Some topics related the course will be given to the students and students has to go through the existing work related to the topic and prepare a

presentation on it. This presentation has to be presented and discussed in groups. Self-learning topics will be given to students. Students need to go through these topics before the respective topics are taught in class for better understanding. Report Submission, Quiz Competition, Poster Presentation, and Group Discussion will carry 20% weightage under Continuous Internal Assessment (CA). Review classes will be conducted to clear doubts and to evaluate the level of understanding of each student individually.

Following procedures will be adopted in the course for delivering the content:

(a) Self Learning Topics (SLT):

- Radius of Investigation (Module -I)
- Skin Factor (Module -II)

(b) Experiential Learning Topics (ELT): Any one of the following activities will be conducted:

-Article Review [Foundation/Skill Development]

(1) Permeability determination technique (Team Activity)
(2) Application of Flow test (Team Activity)

(c) Participative Learning Topics (PLT): Any one of the following activities will be conducted:

- Quiz[Skill Development]

(d) Problem Based Learning Topics (PBLT):

- Presentation on Well damage and stimulation

Reference Materials:

Text Book:

T1. Lee, J., 1982. Well testing.
T2. Lee, J., Rollins, J.B. and Spivey, J.P., 2003. Pressure transient testing (eBook). SPE textbook series, 9.

References:

R1. Bourdet, Dominique. Well Test Analysis: The Use of Advanced Interpretation Models. Netherlands, Elsevier Science, 2002.
R2. McAleese, S.. Operational Aspects of Oil and Gas Well Testing. Netherlands, Elsevier Science, 2000.

e-resources:

1. Presidency University e-access portal :https://presiuniv.knimbus.com/user#/home
2. YouTube Well Test Analysis: https://www.youtube.com/watch?v=kQvQtU0n1YQ
3. SPE Well Test Series: https://www.youtube.com/watch?v=3R3JV-zzHJU

Guideline to Students:

(a) About the Course:

This course deals with methods used for testing oil and gas well. The course will introduce mathematical models to analyze skin effect, damage and stimulation. The course is both theoretical and problem solving. It develops the critical thinking and analytical skills in students. The course also enables the students to develop basic analytical skills through assignments.

(b) Notification / Announcement related to the Course:

All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2021', Regulation No. PU/AC-15/10/06_2021, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2022/09/Academic-Regulations-2021.pdf) and go through the Section Nos. 1.0 through 25.0.

Course Schedule:

Module-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
01	Overview of the Program and Course			1
02	Module I			9
03	Module II			9

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04	Continuous Assessment: Assignment 1 on Module 1 and Module 2			-
05	Discussion of Mid Term Exam Question Pattern			1
06	Mid Term Exam			-
07	Discussion of Mid Term Exam Questions and Answers			1
08	Module III			9
09	Module IV			9
10	Continuous Assessment: Assignment 2 on Module 3 and Module 4			-
11	Course Integration			1
12	Discussion of End Term Exam Question Pattern			1
13	End Term Exam			-
14	Discussion of End Term Exam Questions and Answers			-

Schedule of Instruction:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No. / Date	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
1	L01	Overview of the Program and Course	Overview of the Program and Course	-	PowerPoint Presentation	N/A
Module I						
2	L02	Introduction to Well Test Analysis	Ideal reservoir model	CO1	Lecture and PowerPoint Presentation	Class Notes
3	L03		mathematical preparation for well test analysis	CO1	PowerPoint Presentation / Videos	CN
4	L04			CO1	PowerPoint Presentation / Videos	T1 / CN
5	L05		derivation for diffusivity equation	CO1	PowerPoint Presentation / Videos	T1 / CN
6	L06			CO1	PowerPoint Presentation / Videos	T1 / CN
7	L07		radius of investigation,	CO1	Lecture & presentation	T1 / CN
8	L08		Principle of superposition,	CO1	Lecture & Presentation	CN
9	L09			CO1	Lecture & Presentation	CN
10	L10		Horner's approximation.	CO1	Lecture & Presentation	CN
	CA01		Continuous Internal Assessment-1			
Module II						
11	L11	Pressure Build-up tests	Ideal buildup test	CO2	PowerPoint Presentation / Videos	CN
12	L12			CO2		T1 / CN

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13	L13		Actual buildup test	CO2		T1 / CN
14	L14			CO2	Lecture & Presentation	CN
15	L15		derivation from assumptions in ideal test theory	CO2	Lecture & Presentation	CN
16	L16		Qualitative behaviours of field test	CO2	Lecture & Presentation	T1 / CN
17	L17		Effect and duration of after flow	CO2	Lecture & Presentation	T1 / CN
18	L18		Permeability determination	CO2	Lecture & Presentation	CN
19	L19		skin factor	CO2	Lecture & Presentation	T1 / CN
20	L20		Well damage and stimulation	CO2	PowerPoint Presentation	N/A
21	L21		Reservoir limit tests.	CO2	PowerPoint Presentation	N/A
	CA02		Continuous Internal Assessment-2			
Module III						
22	L22	Flow Test	Introduction	CO3	Lecture & Presentation	T1 / CN
23	L23			CO3	Lecture & Presentation	T1 / CN
24	L24		Pressure draw down test	CO3	Lecture & Presentation	T1 / CN
25	L25			CO3	Lecture & Presentation	T1 / CN
26	L26			CO3	Lecture & Presentation	T1/ CN
27	L27		Multirate tests,	CO3	Lecture & Presentation	CN
28	L28			CO3	Lecture & Presentation	CN
29	L29		Application of Flow tests.	CO3	Lecture & Presentation &Video	CN
30	L30			CO3	Lecture & Presentation	CN
Module IV						
31	L31	Gas Well Testing	Basic theory of Gas flow in reservoirs	CO4	PowerPoint Presentation	T1/ CN
32	L32		Flow after flow test	CO4	PowerPoint Presentation	T1/ CN
33	L33			CO4	PowerPoint Presentation / Videos	T1 / CN
34	L34		Isochronal test,	CO4	PowerPoint Presentation	CN
35	L35			CO4	PowerPoint Presentation	CN
36	L36			CO4	Lecture & Presentation	T1 / CN
37	L37		Modified Isochronal tests.	CO4	Lecture & Presentation	CN
38	L38			CO4	Lecture & Presentation &video	CN

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39	L39			CO4	Lecture & Presentation &Video	CN
	CA03		Continuous Assessment: Assignment 2 on Module 3 & Module 4	CO4	N/A	N/A
40	L40	Course Integration	Course Integration	CO1 through CO4	PowerPoint Presentation	N/A
41	L41	-	Discussion of End Term Exam Questions and Answers	CO3 and CO4	PowerPoint Presentation	N/A
			End Term Exam	CO1 through CO4	N/A	N/A

Topics relevant to "**SKILL DEVELOPMENT**": ": Pressure draw down test and Multirate tests for **Skill Development** through **Problem Solving methodologies**. This is attained through the Assignment as mentioned in the assessment Schedule.

Assessment Schedule:

Module-wise Micro Level planning for course assessment schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time (Date may Change)
01	CA: Assignment 1: Literature Review – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://puniversity.informaticsglobal.com/login). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.) Numerical solving from Module-1	Module 1 & Module 2	CO1 and CO2	-	10	5%	
02	Mid Term Exam	Module 1 and Module 2	CO1 and CO2		60	30%	
03	CA: Assignment 2: Quiz	Module 3 and Module 4	CO3 and CO4	-	20	10%	
04	CA: Assignment 3: Poster Presentation	Module 3 and Module 4	CO3 and CO4	-	10	5%	
05	End Term Exam	Module 1 through Module 4	CO1 through CO4		100	50%	-

Course Clearance Criteria:

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The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website and go through the Section Nos. 1.0 through 24.0. Website: https://presidencyuniversity.in/university-document/. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, and Head of the Department, for further assistance.

Minimum requirements for clearing any Course are mentioned below:

- **Minimum Attendance Requirement:**
  The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website and refer to Section No. 7.0.
- **Academic Performance Evaluation and Grading System:**
  The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website and refer to Section No. 8.0.
- **Make-up Exam Policy:**
  If any student misses an evaluation component, he/she may be granted a make-up. In case of an absence that is foreseen, the make-up request should be personally made to the Instructor In-Charge, well ahead of the scheduled evaluation component. Reasons for unanticipated absences that qualify a student to apply for make-up include medical emergencies or personal exigencies. In such an event, the student should contact the Instructor In-Charge as soon as practically possible.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1.	Derive the expression for Reservoir Limit Test. What assumption Is made in arriving at the formula. In presence of a Fault how the does the Slope change? Write one Disadvantage of this method From the flow after flow data given below, Calculate AOFP. Given Average stable flowing pressure β=408.2 psia Test Pwf (Psia) Q (MMScf/D) 1 403.1 4.288 2 394.0 9.265 3 378.5 15.552 4 362.6 20.177 Well flows until the pressure stabilizes again at the new rate. The process is repeated for a total of 3-4 rate.	10	CO1	Comprehension
2.	A well and a reservoir have the following characteristics: The well is producing only oil; it is producing at a constant rate of 20 STB/D. Data for the well and formation are μ= 0.72cp K = 0.1md Ct = 1.5 x 10^{-5} psi^{-1} Pi = 3000 psi re =3000 ft rw = 0.5 ft Bo = 1.475 RB/STB h = 150 ft Φ = 0.23 and S = 0 Calculate the reservoir pressure at a radius of 1 ft after 3 hours of production, then, calculate the pressure at radii of 10 and 100 ft after 3	10	CO4	Comprehension

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	hours of production. Ei(-0.7849) = -0.318. Find AOFP for data given above.			

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Explain diffusivity equation, its derivation and solution, Principle of superposition,	35
2	CO2	Apply the knowledge to determine the reservoir Pressure, Permeability and Skin factor using pressure build-up test analysis.	35
3	CO3	Apply the knowledge of flow tests in order to calculate the pore volume of the reservoir.	35
4	CO4	Explain the different types of gas well tests and their uses.	35

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

This course has been duly verified and approved by the D.A.C.

Signature of the Chairperson D.A.C.:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1	CA: Assignment 1: Literature Review – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://puniversity.informaticsglobal.com/login). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)			
2	Mid Term Exam			
3	CA: Assignment 2: Quiz			
4	CA: Assignment 3: Poster Presentation			
5	End Term Exam			

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Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Explain diffusivity equation, its derivation and solution, Principle of superposition,	35		
2	CO2	Apply the knowledge to determine the reservoir Pressure, Permeability and Skin factor using pressure build-up test analysis.	35		
3	CO3	Apply the knowledge of flow tests in order to calculate the pore volume of the reservoir.	35		
4	CO4	Explain the different types of gas well tests and their uses.	35		

Name and Signature of the Course Instructor: Mr. Utkarsh Lall

D.A.C. Observation and Approval:

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Course Code: **PET2001**	**Course Title:** **Drilling Fluids and Cements** **Type of Course:** **1] Program Core** **2] Laboratory Integrated**	**L- P- C**	3	2	4
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	This course enables students to select, develop and formulate drilling fluid as per the subsurface requirement. This course is both conceptual and analytical in nature and require the knowledge on basic sciences. Along with practical sessions the standards operating procedure of the equipment used in Oil field operations will be taught. This course also enables to compute a cementing plan for oil field jobs.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Drilling Fluids and Cements and attain **Skill Development** through **Participative Learning** techniques.				
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: recognize different type of drilling fluid, CO2: discuss the clay industry, CO3: manipulate the rheological properties of drilling fluid as per requirement, CO4: identify different component of mud conditioning system, CO5: review a cementing job.				
Course Content:					
Module 1:	Introduction to Drilling Fluid	Seminar	Literature Survey	07 Periods	
Topics: Drilling fluid, its classification, components and Clay chemistry					
Module 2:	Clay Chemistry	Seminar	Literature Survey	07 Periods	
Topics: Clay, Type of clay, Particle association, Electrostatic double layer, Nernst Potential, Zeta potential					
Module 3:	Properties of Drilling Fluid	Assignment, Quiz	Programming	09 Periods	
Topics: Study of different flow models for Drilling fluid, Rheological properties of Drilling fluid, Mud calculation **Related Experiment No:** 1, 2, 3, 4, 5, 6, 7 and 8					
Module 4:	Mud Conditioning System	Case Study	Project Work	11 Periods	
Topics: Basics of Shale shaker, Desander and Desilter, Mud cleaner, Hydro cyclone, Centrifuge					
Module 5:	Oil well Cement	Quiz	Online Quiz	04 Periods	
Topics: Cements, its functions, classification, cementing accessories, Cementing method					

List of Laboratory Tasks:

Experiment No. 1:
Level 1: To prepare drilling with the given composition using Hamilton Beach mixer
Level 2: To prepare drilling with the given composition using RAMI stirrer
Experiment No. 2:
Level 1: To determine the mud weight of the given fluid sample using Mud balance and Hydrometer
Level 2: Analyze the change in Hydrostatic head with the addition of weighting material and water
Experiment No. 3:
Level 1: To determine the P^H and Gel strength of the given fluid sample using P^H meter and Shearometer
Level 2: Analyze the variance in Gel strength with the change in P^H of the Drilling fluid sample
Experiment No. 4:
Level 1: To determine the Plastic viscosity, Apparent viscosity, Yield Point and Gel strength of the given fluid sample Hand crank viscometer and 6-Speed viscometer
Level 2: Development of Drilling fluid with the help of various additives to meet YP/PV ratio
Experiment No. 5:
Level 1: To determine the sand content and Marsh Funnel viscosity of the given fluid sample using Sand content kit and Marsh Funnel apparatus
Level 2: Study the effect of Sand content on the Funnel viscosity of the Drilling fluid
Experiment No. 6:
Level 1: To determine the filtrate loss and filter cake thickness on the given fluid sample using LPLT Filter Press
Level 2: To determine the filtrate loss and filter cake thickness on the given fluid sample using HPHT Filter Press
Experiment No. 7:

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Level 1: To determine the lubricity coefficient of the given fluid sample using EP Lubricity Tester
Level 2: Compression of Lubricity coefficient of different Lube oils to smooth conduction of Drilling operation
Experiment No. 8:
Level 1: To determine the reactive clay content of the Drilling fluid using Methylene Blue apparatus
Level 2: To study the effect of particle size distribution on the reactivity of the clay

Targeted Application and Tools that can be used:
Application: Mud Engineer / Cement Engineer at Oil & Gas industry.
Tools: MUDWERE, Equipment used in Drilling fluid testing as per API standards, Microsoft excel

Text Book:
T1. H.C. H. Darly and George R. Gray, "Composition and Properties of Drilling fluid Completion Fluid", 2011 6th Edition, Gulf Publication.
T2. Samuel Bridges, Leon Robinson, A Practical Handbook for Drilling Fluids Processing (Gulf Drilling Guides) Hardcover – 18 February 2020

References:
R1. Hayden H. murray, "Applied clay Mineralogy"; 2006, Volume-1, First edition, Elsevier
R2. R. Monicard, Drilling Mud and Cement Slurry Rheology Manual, 1982, Springer
R3. H. Rabia, Graham and Trotman, "Oil Well Drilling Engineering: Principle and Practice", 1985, Gaithersburg, MD, USA: Graham & Trotman, 1985.

Case Study:
1. Verified 99.9% Drilling Fluids Recovery
https://www.katchkan.com/2019/09/03/case-study-verified-drilling-fluids-recovery/
2. Hollow-Glass Sphere Application in Drilling Fluids
https://doi.org/10.2118/174010-MS

e-book:
1. Fundamentals and Applications of Bionic Drilling Fluids Book by Guancheng Jiang
https://www.google.co.in/books/edition/Fundamentals_and_Applications_of_Bionic/CgUhEAAAQBAJ?hl=en&gbpv=0
2. Shale Shakers and Drilling Fluid Systems: Techniques and Technology for Improving Solids Control Management
https://www.google.co.in/books/edition/Shale_Shakers_and_Drilling_Fluid_Systems/M8LbOAw9sykC?hl=en&gbpv=1&printsec=frontcover

e-resources:
1. Presidency University e-Resource:
https://puniversity.informaticsglobal.com/login
2. Drilling Fluid Software: MUDWARE
https://www.slb.com/drilling/drilling-fluids-and-well-cementing/drilling-fluids/drilling-fluids-simulation-software/mudware
3. Online 5 day course on Drilling Fluid:
https://www.nexttraining.net/course/drilling-fluids/1420
4. Newpark, Drilling Fluid service provider's website:
https://www.newpark.com/drilling-fluids/

Online videos:
1. Oil Well drilling process-A shell film https://youtu.be/guFiQ87tg_s
2. Drilling animation- https://youtu.be/eBOtXD_UQSo
3. Oil well drilling animation- https://youtu.be/SdgeSFbxQps
4. Functions of Drilling fluid- https://youtu.be/grdEOy7AKv4
5. Introduction to drilling fluid- https://youtu.be/9rnYK7cQ6wA

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. The course attainment will be assessed through assessment component mentioned in course handout.

Catalogue prepared by:	Dr. Suman Paul, Dr. Deepjyoti Mech, Dr. Kalpajit Hazarika, Mr. Bhairab Jyoti Gogoi
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Handout: AY 2021-2022

Date of Issue: 11-03-2022

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2022-26
Semester / Year	:	II / 1nd
Course Code / Title	:	PET 2001/ Drilling Fluid Technology
Course Credit Structure	:	3L 0T 2P 4C
Contact Hours	:	31 Lecture+ 12 Practical session
Course Instructor In-charge	:	Mr. Bhairab Jyoti Gogoi
Course Instructor	:	Mr. Bhairab Jyoti Gogoi, Mr. Ankur Neog
Course URL	:	
Program Outcomes (POs)	:	

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO08: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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PO09: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:

NIL

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Drilling Fluids and Cements and attain **Skill Development** through **Experiential Learning** techniques.

Course Description:

This course enables students to select, develop and formulate drilling fluid as per the subsurface requirement. This course is both conceptual and analytical in nature and require the knowledge on basic sciences. Along with practical sessions the standards operating procedure of the equipment used in Oil field operations will be taught. This course also enables to compute a cementing plan for oil field jobs.

Course Outcomes (COs):

On successful completion of the course, the student shall be able to:

CO1: Recognize different type of drilling fluids,
CO2: Discuss about the clay chemistry,
CO3: Compare different properties of various type of drilling fluid,
CO4:Identify different component of mud conditioning system,
CO5: Prepare a schedule for cementing job.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	L	L	L	L	M	M	M	L	L	M		L
CO2	H	H	H	M	L	L	L	H	L	M		L
C03	L	L	L	L	M	M	M	L	M	M		L
CO4	H	H	H	M	L	L	L	H	H	M		L
CO5	H	M	M	M	M	L	M	M	M	L		L
H = High, M = Moderate, L = Low												

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Course Content (Syllabus):

Module I: Introduction to drilling fluid [7 Hrs.] [Knowledge]
Introduction to Drilling fluid, its classification, components

Module II: Clay chemistry [7 Hrs.] [Comprehension]
Clay, Type of clay, Particle association, Electrostatic double layer, Nernst Potential, Zeta potential

Module III: Properties of Drilling fluid [9 Hrs.] [Application]
Study of different flow models for Drilling fluid, Rheological properties of Drilling fluid, Mud calculation

Module IV: Mud conditioning system [4 Hrs.] [Application]
Study of different flow models for Drilling fluid, Rheological properties of Drilling fluid, Mud calculation

Module V: Oil well Cementing [11 Hrs.] [Comprehension]
Cements, its functions, classification, cementing accessories, Cementing method

SKILL SETS TO BE DEVLOPED:

1. **An attitude of enquiry.**
2. **Confidence and ability to tackle new problems.**
3. **Ability to interpret events and results.**
4. **Ability to work as a leader and as a member of a team.**
5. **Assess errors in systems/processes/programs/computations and eliminate them.**
6. Observe and measure physical phenomena.
7. **Write reports.**
8. **Select suitable equipment, instrument, materials & software**
9. Locate faults in system/Processes/software.
10. **Manipulative skills for setting and handling systems/Process/ Issues**
11. **The ability to follow standard /Legal procedures.**
12. **An awareness of the Professional Ethics.**
13. **Need to observe safety/General precautions**.
14. To judge magnitudes/Results/issues without actual measurement/actual contacts

COURSE CONTENT &TASK SCHEDULE FOR LABORATORY COMPONENT:

Sl. No	Session Number and Date	Task No	Task	Level 1	Level 2	Number of Lab Sessions required	Skills to be developed	Course Outcome to be developed
1	24-03-2022	P1	Familiarization with DFC LAB			1		
2	31-03-2022	P2	Familiarization with DFC LAB equipments			1		

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3	07-04-22	P3	To prepare drilling with the given composition	To prepare drilling with the given composition using Hamilton Beach mixer	To prepare drilling with the given composition using RAMI stirrer	1	2, 7, 8, 10, 11, 12, 13	CO3
4	14-04-22	P4	To determine funnel viscosity and send content in Drilling fluid	Measurement of funnel viscosity using Marsh funnel and sand content using Sand content kit	Study the effect of Sand content on the Funnel viscosity of the Drilling fluid	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO3
5	21-04-22	P5	To determine the mud weight of the given fluid sample	To determine the mud weight of the given fluid sample using Mud balance and Hydrometer	Analyze the change in Hydrostatic head with the addition of weighting material and water	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO3
6	28-04-22	P6	To determine the Plastic viscosity, Apparent viscosity, Yield Point and Gel strength of the given fluid sample	Determine the PV, YP, AV and Gel strength of given fluid sample using Hand crank viscometer and 6 speed viscometer	Development of Drilling fluid with the help of various additives to meet YP/PV ratio	1	1, 2, 3, 4, 5, 8, 10, 11, 12, 13	CO3
7	5-5-22	P7	To determine the pH and Gel strength of the given fluid sample	Determination of pH and Gel strength of the given fluid sample using pH meter and Shearometer	Experimental investigation on the effect of pH on the gel strength of Drilling fluid	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO3
8	19-5-22	P8	Revision					
9	26-5-22	P9	To determine the lubricity coefficient of the given fluid sample	Determine the lubricity coefficient of the given fluid sample using EP Lubricity Tester	Compression of Lubricity coefficient of different Lube oils to smooth conduction of Drilling operation	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO3
10	2-6-22	P10	To determine the filtrate loss and filter cake thickness on the given fluid sample	Determine the filtrate loss and filter cake thickness on the given fluid sample using LPLT Filter Press	To determine the filtrate loss and filter cake thickness on the given fluid sample using HPHT Filter Press	1	1, 2, 3, 4, 7, 8, 10, 11, 12, 13	CO3

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11	9-6-2022	P11	To determine the amount of reactive clay content ion Drilling fluid	Determine the amount of reactive clay content ion Drilling fluid using Methylene Blue Test Kit	To study the effect of particle size distribution on the reactivity of the clay	1	1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13	CO3
12	16-6-2022	P12	Revision					

Delivery Procedure (Pedagogy):

This is an integrated lab based theory course. Most of the lectures will be taken with the help of Power Point Presentation and White board. Videos will be shown for the better understanding of selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. During the lab session a problem statement will be given to the students and based on their understanding they have to prepare the solution.
Following procedures will be adopted in the course for delivering the content:

Experiential learning:

- **Seminar (Module 1) (Skill development):**

List out the challenges associated with Drilling fluid in a geothermal well from different research papers publish in well-established journals

- **Project (Module 3) (Employability/Skill development/ Environment and sustainability):**

Students will be given a problem statement and they have to come up with a solution which again need to validate with experimental investigation

Participative learning:

- **Quiz (Module 2) (Employability):**
- Identification of different environmentally friendly additives currently used in oil industry to improve the rheological properties of Drilling fluid
- **Quiz (Module 4) (Employability):**
- Quiz on mud conditioning system
- **Quiz (Module 5) (Foundation skill):** List out the problems associated with oil well cements in HPHT well and their mitigation techniques
- **Peer learning**

Problem solving:

- **Case study (Module 2, 3 & 5) (Employability):**

Case study on Deep water horizon and Baghjan's blow out

- **Subject related exercise (Module 1, 2, 4, 5)**

Reference Materials:

a. Text Book(s):

1. H.C. H. Darly and George R. Gray, "Composition and Properties of Drilling fluid Completion Fluid", 2011 6th Edition, Gulf Publication.
2. Leon Robinson and Samuel Bridges, "A Practical Handbook for Drilling Fluids Processing" , 2020, Gulf Professional Publishing, DOI: https://doi.org/10.1016/C2019-0-00458-X

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3. ASME, "Drilling Fluids Processing Handbook", 2005, Gulf Professional Publishing, DOI https://doi.org/10.1016/B978-0-7506-7775-2.X5000-8

(b) Reference Book(s):

1. Hayden H. murray, "Applied clay Mineralogy"; 2006, Volume-1, First edition, Elsevier
2. R. Monicard, Drilling Mud and Cement Slurry Rheology Manual, 1982, Springer
3. H. Rabia, Graham and Trotman, "Oil Well Drilling Engineering: Principle and Practice", 1985, Gaithersburg, MD, USA: Graham & Trotman, 1985.

(c) *Case study:*

1. Verified 99.9% Drilling Fluids Recovery (https://www.katchkan.com/2019/09/03/case-study-verified-drilling-fluids-recovery/)
2. Hollow-Glass Sphere Application in Drilling Fluids (https://doi.org/10.2118/174010-MS)

(d) *Ebook:*

1. Fundamentals and Applications of Bionic Drilling Fluids Book by Guancheng Jiang [https://www.google.co.in/books/edition/Fundamentals_and_Applications_of_Bionic/CgUhEAAAQBAJ?hl=en&gbpv=0]
2. Shale Shakers and Drilling Fluid Systems: Techniques and Technology for Improving Solids Control Management [https://www.google.co.in/books/edition/Shale_Shakers_and_Drilling_Fluid_Systems/M8LbOAw9sykC?hl=en&gbpv=1&printsec=frontcover]

(e) *e-resources:*

1. Presidency University e-Resource: https://puniversity.informaticsglobal.com/login
2.Drilling Fluid Software: MUDWARE https://www.slb.com/drilling/drilling-fluids-and-well-cementing/drilling-fluids/drilling-fluids-simulation-software/mudware
3.Online 5 day course on Drilling Fluid: https://www.nexttraining.net/course/drilling-fluids/1420
4.Newpark, Drilling Fluid service providers website: https://www.newpark.com/drilling-fluids/

(f) *Online videos:*

1. Oil Well drilling process-A shell film https://youtu.be/guFiQ87tg_s
2. Drilling animation- https://youtu.be/eBOtXD_UQSo
3. Oil well drilling animation- https://youtu.be/SdgeSFbxQps
4. Functions of Drilling fluid- https://youtu.be/grdEOy7AKv4
5. Introduction to drilling fluid- https://youtu.be/9rnYK7cQ6wA

Guideline to Students:

(a) About the Course:

Drilling fluid is called the heart of any drilling operation. Basic awareness about this course may help understanding few other courses like Drilling Engineering, Well Logging and Formation Evaluation etc

(b) Notification / Announcement related to the Course:

All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulations

The students are advised to download the 'Academic Regulations, 2021', Regulation No. PU/AC-15/10/06_2021, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2022/09/Academic-Regulations-2021.pdf) and go through the Section Nos. 1.0 through 25.0.

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COURSE SCHEDULE FOR THEORY COMPONENT

Unit-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course	03/23/2022	03/23/2022	1
2	Module 01:	03/25/2022	4/8/2022	7
3	Module 02:	4/12/2022	5/4/2022	7
4	Module 04:	5/6/2022	5/25/2022	11
5	Module 05:	5/27/2022	6/14/2022	4
6	Mid term	5/16/2022*	5/19/2022*	-
7	Assignment	03/23/2022	6/14/2022	-
8	Quiz	03/23/2022	6/14/2022	-
9	End Term Final Examination	6/27/2022	7/9/2022	-

*****Dates as per the academic calendar***

COURSE SCHEDULE FOR LABORATORY COMPONENT

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
1	Over View of the course	3/24/2022	3/24/2022	1
2	Laboratory Familiarization	3/24/2022	3/24/2022	1
2	Demonstration of first set of Experiments/Skills	3/31/2022	3/31/2022	2
4	Conduct of first set of experiments	4/7/2022	3/5/2022	10
5	Conduct of second set of experiments	5/26/2022	5/9/2022	10

Schedule of Instruction:

Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No.	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
1	L1	**Programme Integration**			Offline/PPT/White board	
2	L2	Introduction to Module I	**What is Drilling fluid?**	CO1	Offline/PPT/White board	
3	L3	Classification of drilling fluid	History and evolution of drilling fluid	CO1	Offline/PPT/White board	T1 Ch01
4	L4	Application of Drilling fluid	Counter balance of formation pressure, Cutting carrying	CO1	Offline/PPT/White board	T1 Ch01

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5	L5	Application of Drilling fluid	Mud cake generation, cooling and lubricating bit	CO1	Offline/PPT/White board	T1 Ch02
6	L6	Components of Drilling fluid	Water based, oil based, pneumatic Drilling fluid	CO1	Offline/PPT/White board	T1 Ch02
7	L7	Components of Drilling fluid	Reactive phase, Continuous phase, Additive, inert phase	CO1	Offline/PPT/White board	T1 Ch01
8	L8	Classification of Drilling fluid	Oil, Water and Synthetic Drilling fluid	CO1	Offline/PPT/White board	T1 Ch04
Module I Completed						
9	L9	Introduction to Module II	What is clay?	CO2	Offline/PPT/White board	T1 Ch04
10	L10	Clay chemistry	Type of clay and their characteristics	CO2	Offline/PPT/White board	T1 Ch03
11	L11	Clay chemistry	Characteristic of clay	CO2	Offline/PPT/White board	T1 Ch03
12	L12	Clay chemistry	Clay occurrence	CO2	Offline/PPT/White board	T1 Ch03
13	L13	Clay chemistry	Ion exchange property of clay	CO2	Offline/PPT/White board	T1 Ch03
14	L14	Clay chemistry	Inter-particular association	CO2	Offline/PPT/White board	T1 Ch03
15	L15	Clay chemistry	Electrostatic double layer	CO2	Offline/PPT/White board	T1 Ch03
16	L16	Clay chemistry	Particle association of clay	CO2	Offline/PPT/White board	T1 Ch03
17	L17	Clay chemistry	Relation of different potential of clay with mud properties	CO2	Offline/PPT/White board	T1 Ch05
Module II Completed						
18	L18	Introduction to Module IV	Equipment description: Shale shaker and Hydrocyclone	CO2	Offline/PPT/White board	T1 Ch05
19	L19	Mud conditioning system	Equipment description: Mud cleaner, Centrifuge	CO4	Offline/PPT/White board	CN

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20	L20	Mud conditioning system	Equipment description: Mud pump	CO4	Offline/PPT/White board	CN/RB3 Ch 6
21	L21	Mud conditioning system	Layout of the mud conditioning system	CO4	Offline/PPT/White board	CN/RB3 Ch 6
Module IV Completed						
22	L22	Discussion on Midterm paper pattern	Discussion on Midterm paper			
23	L23	Discussion on Midterm question paper	Discussion on Midterm question paper			
24	L24	Introduction to Module V	Cement and its function	CO5	Offline/PPT/White board	CN/RB3 Ch 6
25	L25	Properties of cement	Cements types, Hydration of cements, Sulfate resistance, Strength retrogression, Thickening time, Slurry density	CO5	Offline/PPT/White board	R3 Ch11
26	L26	Type of cements	Class A, B,C, D, E, G, H, I	CO5	Offline/PPT/White board	R3 Ch11
27	L27	Cementing accessories	Guide shoe, float collar, stage cementer, stabilizer, scratcher, DV tool	CO5	Offline/PPT/White board	R3 Ch11
28	L28	Primary cementing	Single stage cementing,	CO5	Offline/PPT/White board	R3 Ch11
29	L29	Primary cementing	Multi stage cementing	CO5	Offline/PPT/White board	R3 Ch11
30	L30	Secondary Cementing	Squeeze cementing method	CO5	Offline/PPT/White board	R3 Ch11
31	L31	Cementing accessories	Cement plugging	CO5	Offline/PPT/White board	R3 Ch11
32	L32	Secondary Cementing	Numerical on cement plugging	CO5	Offline/PPT/White board	R3 Ch11
33	L33	Secondary Cementing	Numerical on cement plugging	CO5	Offline/PPT/White board	R3 Ch11
34	L34	Discussion on End Term Question paper	Discussion on End Term Question paper			

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35	L35	Course Integration	Course Integration			
Module V Completed						

Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. This is attained through the Lab Experiments as mentioned in the assessment schedule.

ASSESSMENT SCHEDULE FOR THEORY COMPONENT:

Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time
1	Mid term	L02-L17	CO1 & CO2	2	50	25%	4/16/2022 to /19/2022
2	Seminar	L01-L31	CO1, CO2, CO4, CO5	3	4	2%	3/23/2022 to 6/17/2022
3	Submission of project report in reference to the e-Resource linked shared in the reference material	P01-P12	C03	1	10	5%	3/23/2022 to 6/17/2022
4	Quiz	L01-L31	CO1, CO2, CO4, CO5	1/2	6	3%	3/23/2022 to 6/17/2022
5	End term final examination	L01-L31	CO1, CO2, CO4, CO5	3	100	50%	6/27/2022 to 7/9/2022

ASSESSMENT DETAILS FOR LABORATORY COMPONENT:

Sl. No	Assessment type	List of Tasks	Course outcome number	Duration (In hours)	Marks	Weightage	Venue, DATE &TIME
1	Sample composition calculation and preparation	After conduction of experiment student has to write the entire experiment on lab record	CO3	2	3	1.5	Day wise evaluation
2	Experiment conduction	Students need to follow the API standards and	CO3	2	10	5	

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		perform the experiment					
3	Results and Discussion	Calculation of values and discussion on the results	CO3	2	5	2.5	
4	Recent Development	Students need to write any recent developme nt regarding the apparatus	CO3	2	2	1	
5	VIVA	-	CO3	2	10	5	

Assessment Matrix for Daily Task Evaluation for Laboratory component:

Sl. No.	Task No.	Marks for activity 01 [Mention the activity]	Marks for activity 02 [Mention the activity]	Marks for activity 03 [Mention the activity]	Total Marks		
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2021', Regulation No. PU/AC-15/10/06_2021, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2022/09/Academic-Regulations-2021.pdf) and go through the Section Nos. 1.0 through 25.0. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, Head of the Department, and Dean (School of Engineering) for further assistance.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level

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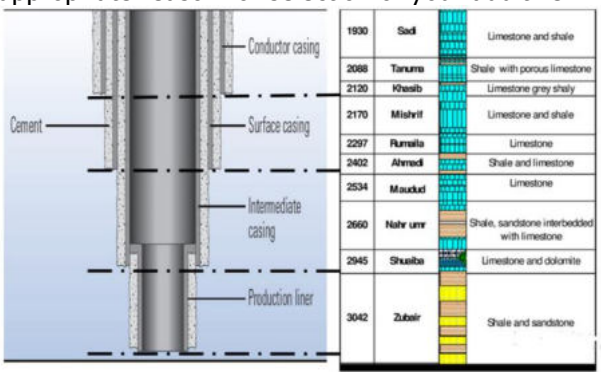
1	One of the important functions of drilling mud is the control of formation fluid pressure to prevent blowouts. The density of the mud must be raised at times to stabilize fragile formations. Barite contains 58.8 % barium and has a specific gravity of (4.2–4.5). During the conditioning of mud return this Barite along with other solid has been removed and disposed. That means we are losing some valuable assets and wasting money. So as Mud Engineering it is our responsibility to retain Barite and reuse it. Make a layout of the entire mud conditioning system which can help us to retain Barite and all other important solids and also write the function of each and every component of your mud conditioning system.	15	C01	Application
2	A typical formation layout and the casing policy of an XYZ basin is given in the Fig.1. Formation characteristics for each zone is tabulated (Table 1) below. Based on the information available select proper Water Based Drilling Fluid additive for each zone for smooth Drilling of respective zone. Write your answer in a tabulated form and do mention the appropriate reason for selection of your additive.  1930 ft. to 2120 ft. / 2170 ft. to 2402 ft. / 2534 ft. to 2945 ft. / 3945 ft. to 3042 ft. Temperature less than 79°C, P^H value changes from 5 to 12; Shallow depth / Required less viscous med; formation temperature 149°C; Require moderate sulfate resistance cement / Formation temperature <177°C; thicker mud cake;1 H_2S bearing formation / High gel strength is required, Clay sensitive formation: High early strength/sulphate resistance required, Anhydrite/ Gypsum bearing formation;	15	C02	Comprehension

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					Tier-3 HPHT well			
3	Explain in short the following statements: i. "Yield of Clay is 16"-Explain the statement. ii. "After MBT test of two different mud samples it was observe that CEC value for Sample 1 is 10 mili-equivalent and Sample two is 7 mili-equivalent					15	C03	Comprehension
4	An oil reserve is discovered the upper Assam shelf, a southeast dipping shelf is the foreland part of Assam-Arakan Basin. Based on the given characteristics of the formation, Design a best suitable mud plan. In the given diagram the characteristics of different formation are as follows a. Shale A: Contain aquifer b. Sandstone B: Thief Zone c. Shale C: Anhydrite/Gypsum bearing formation d. Sandstone D: Clay sensitive zone e. Shale E: Abnormal formation f. Sandstone F, Shale G and Sandstone H has HPHT environment					15	C03	Application
5	Answer the following: i. What is the minimum mud weight we can obtain after addition of Lignosulphonate as an additive to Bentonite based drilling fluid? ii. Why we can't use Iron ore as an additive to Bentonite? iii. What kind of polymer use along with KCl based mud? iv. What metal ion is present in octahedral structure of clay? v. What is the CEC value for Bentonite?					15	C03	Application
6	In the below mention figure Fig.2 the entire casing policy of a developmental well is provide. Here 24" Conductor pipe is used and perforation is done in the 7" liner. A liner is a casing string that does not extend to the top of the wellbore, but instead is anchored or suspended from inside the bottom of the previous casing string. The main purpose of replacing casing with liner is to reduce cost. This formation was very hostile and the cementing team faced many challenges during the cementing process. The list of problems face by the cementing are listed below					20	C04	Application

Casing String	Problem faced/possibly threat
24"	The topmost part of the formation is very weak. The cellar is constantly filling up by sand from the surrounding
$18^5/_8$"	A shallow high pressure gas bearing zone followed by an abnormal pressure zone. All safety measures need to be in operational mode ASAP.

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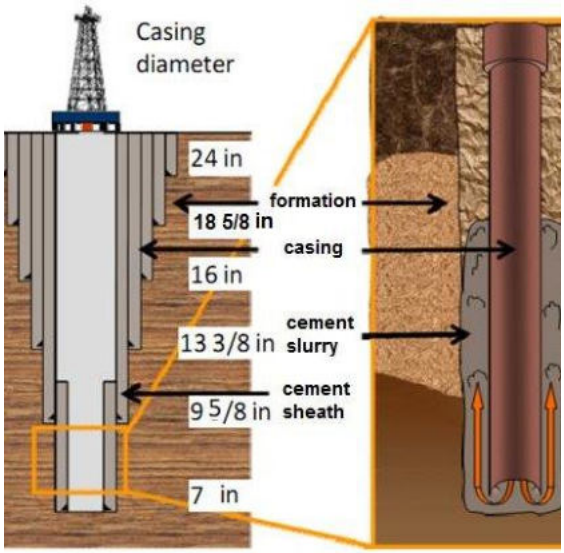
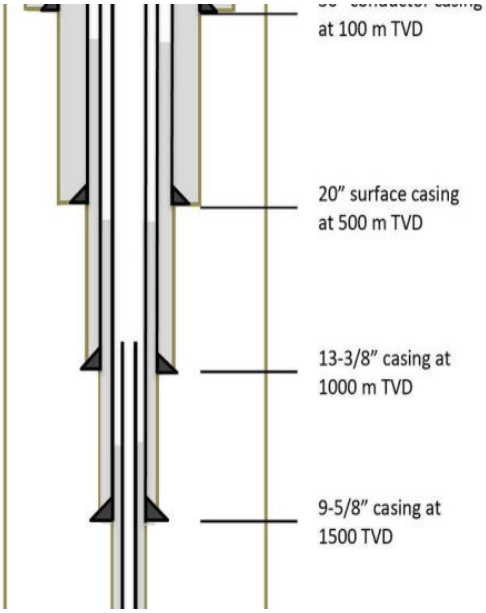
	16"	Formation temperature is not letting the cement to set. It is taking more time to start drilling the next hole section		
	$18^3/_8$ "	This formation is thief zone can lead to high filtrate loss		
	$9^5/_8$"	Longest casing string. Pump capacity is limited so it will require more time displace and completely fill the annulus		
	7"	After cementing the liner when Cement Integrity Test was performed it was found that cement is not displaced evenly in the annulus.		

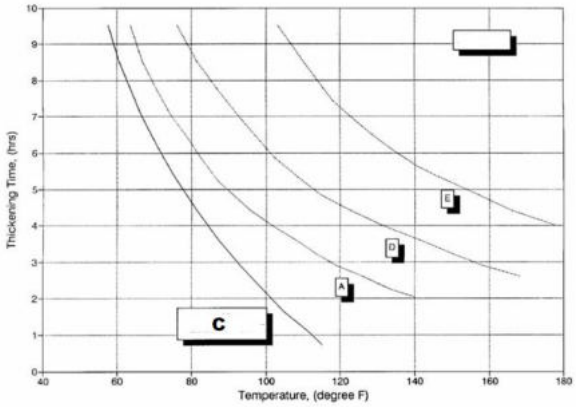


Think yourself as a Cementing Engineer and give solution to the above mention problems and complete the well on time. Add sufficient justification for each solution. Also mention steps to be followed to cement 16" casing in considering no DV tool available at the site.

7	"The overwhelming majority of the barite that is mined is used by the petroleum industry as a weighting material in the formulation of drilling mud. Barite increases the hydrostatic pressure of the drilling mud allowing it to compensate for high-pressure zones experienced during drilling."-It is clearly evident from the above statement that Barite is a very important component of Drilling fluid. So during the recycling of Drilling fluid we must retail Barite. As a mud engineer what modification you will made in the mud circulatory system which will help you to retain Barite. Draw the flow chat as well.	8	C04	Application
8	A developmental well is drilled at some XYZ location. The casing polity of well is given in the Fig 1. The available cements at the rig site is Class C, A, D and E. The relationship between the thickening time and Temperature is also given in Fig: 2. The casing running operation was going as per plan and the crew was expecting to complete the well on or before the	8	C05	Application

deadline. But after cementing the 20" surface casing when the crew was about to drill the next hole section, the Drill pipe suddenly fell into the well bore and the entire operation is kept on halt. The fishing team was called upon which took 2 extra days to reach the site and finally after almost 4 days the operation resumed. As the crew is lagging behind the schedule so the company man instructed the Driller and the Cementing Engineer to quicken the entire process to meet the deadline. Let's suppose you are leading the cementing team, how will you execute the entire cementing plan to meet the dead line? Start from the first casing string. Your answer must contain the selection of the cement for each casing string, reason for selection, any uses of additives, reasons for their use, also your strategy to tackle the challenges during the cementing operation.





Sample Thought Provoking Questions to be asked to assess the Students' Preparedness to carry out the Task [For Laboratory Component]:

Sl No.	Question	Task No.	Course Outcome No.
1	In a research work is carried out on "Utilizing a new eco-friendly drilling mud additive generated from wastes to minimize the use of the conventional chemical additives", The cost of the drilling operation is very high. Drilling fluid presents 15 to 30% of the entire expense of the drilling process. Ordinarily, the major drilling fluids additives are viscosity modifiers, filtration control agents, and partial loss treatments. In this experimental work, full-set measurements under fresh and aged conditions, as well as high-temperature and high-pressure (HTHP) API filtration, were conducted to study the impacts of adding 0.5%, 1.5%, 2.5%, and 3.5% of black sunflower seeds' shell powder (BSSSP) to spud mud. BSSSP of various grain sizes showed their ability to be invested for viscosity modifying, seepage loss controlling, and partial loss remediation. In addition to BSSSP eminent efficiency to be used as a multifunctional additive, the BSSSP is cheap, locally obtainable in commercial quantities, environmentally friendly additive and easy to grind into various desired grain sizes. To sum it up, experimental findings revealed that BSSSP can be used for multiple applications as a novel fibrous and particulate additive. The results elucidated BSSSP suitability in substituting or at least minimizing some of the traditional chemical materials utilized in the petroleum industry such as salt clay, polymers, and lost circulation materials (LCM). The results obtained in this research is given below with the graph. Based on the data provided make a brief summery and do mention what are the instrument you will be using in this research work. You solution must cover all the data provided with the problem. Important information: "Drilling fluid aging is the process in which a drilling fluid sample, previously subjected to a period of shear, is allowed to more fully develop its rheological and filtration properties. The time period needed to more fully develop properties varies from as little as several hours (usually 16 h and moderate temperature aging up to 122 °F (50 °C)) to as much as several days. The aging can be done at either ambient or elevated temperatures. Aging is done under conditions which vary from static to dynamic and from ambient to highly elevated temperatures"(Fann Instrument Company) **Table 1** The findings of the reference fluid and four concentrations of BSSSP (fresh conditions) Property / RF / 0.5% BSSSP / 1.5% BSSSP / 2.5% BSSSP / 3.5% BSSSP Mud density (ppg) / 8.6 / 8.6 / 8.6 / 8.6 / x Marsh funnel viscosity (s) / 33 / 56 / 102 / 96 / x PV (cp) / 7 / 7 / 8 / 8 / x YP (lb/100ft^2) / 7 / 22 / 35 / 32 / x Initial gel strength (lb/100ft^2) / 9 / 23 / 31 / 30 / x Final gel strength (lb/100ft^2) / 15 / 27 / 35 / 35 / x pH / 10.4 / 9.9 / 9.6 / 8.3 / x 7.5 min filtrate (cc) (LTLP) / 6 / 4.25 / 4 / 3.5 / x 30 min filtrate (cc) (LTLP) / 12.5 / 9.75 / 9.5 / 8.5 / x Filter cake thickness (mm) (LTLP) / 3 / 2.3 / 2.5 / 2 / x 7.5 min filtrate (cc) (HTHP) / 18 / 13.25 / 13 / 12 / x 30 min filtrate (cc) (HTHP) / 34 / 25.5 / 25 / 24 / x Filter cake thickness (mm) (HTHP) / 4.7 / 4 / 4.1 / 4 / x x indicates that no readings were observed due to the high concentration of BSSSP	4	CO3

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Table 2 The findings of introducing of BSSSP additives the reference fluid (aged conditions) 50 °C (122 °F) for 30 h

Property	0.5% BSSSP	1.5% BSSSP	2.5% BSSSP	3.5% BSSSP
Mud density (ppg)	8.6	8.6	8.6	x
Marsh funnel viscosity (s)	62	107	102	x
PV (cp)	7	13	13	x
YP (lb/100ft^2)	26	47	45	x
Initial gel strength (lb/100ft^2)	28	41	38	x
Final gel strength (lb/100ft^2)	33	46	42	x
pH	9.5	9.1	8	x
7.5 min filtrate (cc) (LTLP)	4	3.5	3	x
30 min filtrate (cc) (LTLP)	8.5	8	7.5	x
Filter cake thickness (mm) (LTLP)	2.2	2.2	2	x
7.5 min filtrate (cc) (HTHP)	12.75	12	10.5	x
30 min filtrate (cc) (HTHP)	23	22	20.5	x
Filter cake thickness (mm) (HTHP)	3.95	3.9	3.7	x

x indicates that no readings were observed due to the high concentration of BSSSP

Fig. 1 The effects of BSSSP on the rheological properties (fresh conditions)

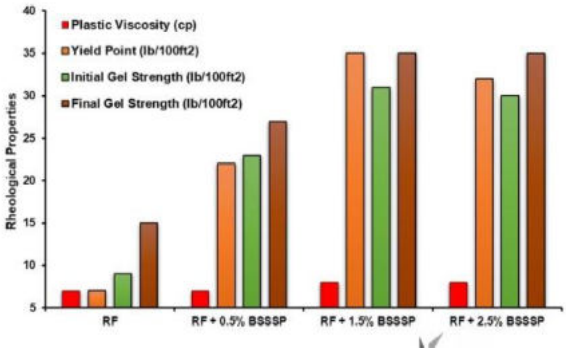


Fig.3 Comparison between the effects of BSSSP on the mud weight under the fresh and aged conditions

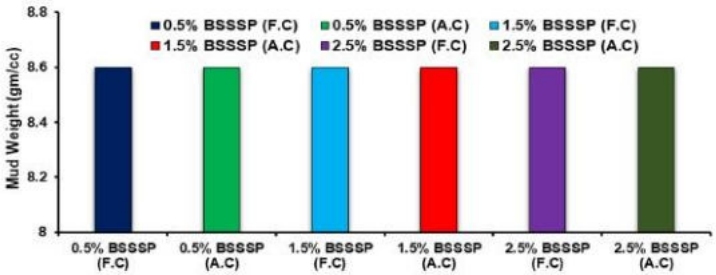
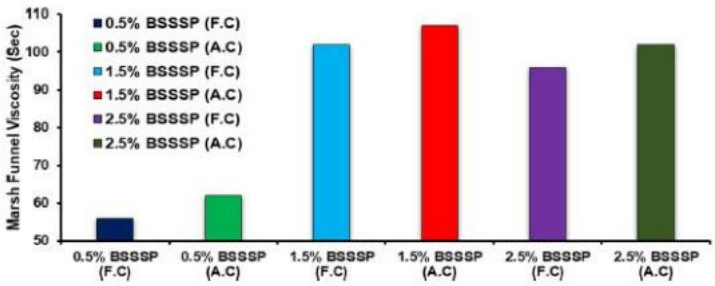


Fig. 4 Comparison between the effects of BSSSP on the marsh funnel viscosity under the fresh and aged conditions



2	Add the necessary additives to reach the targeted rheological properties and validate your results	4	CO3

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage

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1	CO1	Recognized different type of Drilling fluid,	18
2	CO2	Discuss the rheological properties of Drilling fluid	20
3	C03	Manipulate the rheological properties of Drilling fluid as per requirement	35
4	CO4	Identify different component of mud conditioning system	58
5	CO5	Review a cementing job	40

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

Signature of the Chairperson DAC:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1	Mid term			
2	Seminar			
3	Project			
4	Quiz			
5	End term final examination			

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

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Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Recognized different type of Drilling fluid,			
2	CO2	Discuss the rheological properties of Drilling fluid			
3	C03	Manipulate the rheological properties of Drilling fluid as per requirement			
4	CO4	Identify different component of mud conditioning system			
5	CO5	Review a cementing job			

Name and Signature of the Course Instructor:

DAC Observation and Approval:

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Course Code: **PET2003**	**Course Title:** **Fundamentals of Oil and Gas Well Drilling Technology** **Type of Course:** **1] Program Core** **2] Theory only**	**L- P- C**	3	0	3
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	Fundamentals of Drilling Engineering deals with understanding the processes and selecting the equipment required for drilling a stable wellbore and providing it with casing for preventing various wellbore problems. This course discusses about various mechanical systems used for drilling a well bore and how to design them. This course is both conceptual and analytical in nature and require the knowledge on basic science.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Oil and Gas Well Drilling Technology and attain **Skill Development** through **Participative Learning** techniques.				
Course Outcomes:	On successful completion of the course the student shall be able to: CO1: Compute the load capacity and power requirement of various rig components, CO2: Choose appropriate drill string components according to pressure requirements, CO3: Select appropriate casing string according to pressure requirements, CO4: Classify drilling bits based on the drilling mechanism.				
Course Content:					
Module 1:	Drilling Rig Components	Assignment / Quiz	Programming	10 Periods	
Topics: Drilling fluid and cementation; Introduction to Oil Well Drilling; Drilling Rig Component: Hoisting system, Derrick and derrick capacity, Circulation system, Rotary system, Pressure control system, Power systems.					
Module 2:	Drill String Design	Assignment / Quiz	Programming	09 Periods	
Topics: Functions and components of drill string; Drill collar design; Drill pipe design: Collapse calculation, Burst calculation; Drill string washout; Drill string vibration; Shock sub.					
Module 3:	Casing Design	Assignment / Quiz	Group discussion	09 Periods	
Topics: Functions of casing; Type of casing; Casing seat selection; Collapse, burst and tension calculation: Based on mechanical properties, Based on mud and hole characters.					
Module 4:	Drill Bit and Rig Hydraulics	Article Review	Presentation	08 Periods	
Topics: Drill bit - Types of drill bits; Roller cone bit design: Milled tooth bit and Insert bit; PDC bit design; Diamond bit design; Drilling cost calculation. Rig hydraulics - Pressure loss in circulation system; Pressure loss through bit; Bit velocity and area calculation; Bit hydraulic optimization.					
Targeted Application and Tools that can be used: Application: Targeted for Upstream oil and gas industry as a Drilling Engineer in Upstream Oil and Gas Industry / Mineral Exploration Company Tool used: Drillworks Predict (Landmark Halliburton)					
Text Book: T1. Deepak Sharma, "Oil Well Drilling Technology", 1st Edition, 2015, Venus Books Publications. T2. H. Rabia, Graham and Trotman, "Oil Well Drilling Engineering: Principles and Practice", 1st Edition, 1986, Springer.					
References: R1. Drilling Engineering, Heriot Watt Institute of Petroleum Engineering, Herriot Watt University, 2005. R2. V.K. Jain, A.B. Sharma, R. Dhupar, R.P. Patel, D. Das Gupta, A. K. Joshi, and R. Shanker, "ONGC – Drilling Operation Practices Manual", 1st Edition, 2007, Shiva Offset Press, Dehradun. R3. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie Charrier; 1985; 1st Edition; 1985; PennWell Books R4. V.K. Jain, A.B. Sharma, R. Dhupar, R.P. Patel, D. Das Gupta, A. K. Joshi, and R. Shanker, "ONGC – Drilling Operation Practices Manual", 1st Edition, 2007, Shiva Offset Press, Dehradun **E-resources:** 1. Presidency University e-access portal: https://presiuniv.knimbus.com/user#/home 2. Dr. Petro YouTube channel: Drilling Rig Components Animated- https://youtu.be/JiGXLWcwIq 3. Drilling Rig Online Courses YouTube channel: Drill String components and their functions https://youtu.be/M6tic_OcNPY					

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4. Encyclopedia of petrochemistry YouTube channel: Casing and Cementing- https://youtu.be/iMUsMOopwpU 5. Harvest Chemical YouTube channel: Bit Hydraulics-https://youtu.be/I178EdbDV_Y 6. Case Studies: Best Practice Case Studies for Drilling Engineers: https://www.drillingpoint.com/ 7. Robert F. Mitchell, "Fundamentals of Drilling Engineering", 1st Edition, 2016, Society of Petroleum Engineers, Inc. https://www.amazon.in/Fundamentals-Drilling-Engineering-Robert-Mitchell-ebook/dp/B01L0O8WJA	
Topics relevant to "**SKILL DEVELOPMENT**": Drill bit - Types of drill bits; Roller cone bit design: Milled tooth bit and Insert bit; PDC bit design for **Skill Development** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by:	Dr. Deepjyoti Mech, Dr. Kalpajit Hazarika, Mr. Bhairab Jyoti Gogoi
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Handout (AY 2022-2023)

Date of Issue: 07/09/2022
Revised on: N/A

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2021-25
Semester / Year	:	III / 2nd
Course Code / Title	:	PET2003 / Fundamentals of Oil and Gas Well Drilling Technology
Course Credit Structure	:	3L - 0P – 3C
Contact Hours	:	40
Course Instructor In-charge	:	Mr. Bhairab Jyoti Gogoi
Course Instructor	:	Mr. Utkarsh Lall

Program Outcomes (POs):

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences**.**

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:
NIL

Course Description:

Fundamentals of Drilling Engineering deals with understanding the processes and selecting the equipment required for drilling a stable wellbore and providing it with casing for preventing various wellbore problems. This course discuss about various mechanical systems used for drilling a well bore and how to design them. This course is both conceptual and analytical in nature and require the knowledge on basic sciences.

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Fundamentals of Oil and Gas Well Drilling Technology and attain **Skill Development** through **Participative Learning** techniques.

Course Outcomes (COs):
On successful completion of the course, the student shall be able to:
CO1: Compute the load capacity and power requirement of various rig components,
CO2: Choose appropriate drill string components according to pressure requirements,
CO3: Select appropriate casing string according to pressure requirements,
CO4: Classify drilling bits based on the drilling mechanism.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	H	M	M	L	L	L	L	L	L	H	L	L
CO2	H	H	M	L	L	L	L	L	L	H	L	L
CO3	H	H	L	M	M	L	M	M	M	H	M	M
CO4	H	H	L	M	M	L	H	M	M	H	M	L
H = High, M = Moderate, L = Low												

Course Content (Syllabus):

Module I: Drilling Rig Components [9 hours - Application Level]
Drilling fluid and cementation; Introduction to Oil Well Drilling; Drilling Rig Component: Hoisting system, Derrick and derrick capacity,Circulation system, Rotary system, Pressure control system, Power systems.

Module II: Drill String Design [9 hours - Application Level]
Functions and components of drill string; Drill collar design; Drill pipe design: Collapse calculation, Burst calculation; Drill string washout; Drill string vibration; Shock sub.

Module III: Casing Design [9 hours - Application Level]
Functions of casing; Type of casing;Casing Seat Selection; Collapse, burst and tension calculation: Based on mechanical properties, Based on mud and hole characters.

Module IV: Drill Bit and Rig Hydraulics [8 hours - Comprehension Level]
Drill bit - Types of drill bits; Roller cone bit design: Milled tooth bit and Insert bit; PDC bit design; Diamond bit design; Drilling cost calculation. Rig hydraulics - Pressure loss in circulation system; Pressure loss through bit; Bit velocity and area calculation; Bit hydraulic optimization.

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Delivery Procedure (Pedagogy):

This is a theory based course. Most of the lectures will be taken with the help of Power Point Presentations and White Board. Videos will be shown for the better understanding of selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. Assignments, Quiz Competition and Poster Presentation will carry 25% weightage under Continuous Internal Assessment (CIA). Review classes will be conducted to clear doubts and to evaluate the level of understanding of the each student individually. If required some classes may be engaged in virtual mode under unavoidable circumstances.

Following procedures will be adopted in the course for delivering the content:

(a) Self Learning Topics (SLT):

Drill line design consideration
Dog leg and dogleg severity
Metal fatigue
Biaxial and compression load
Mud carrying capacity

(b) Experiential Learning Topics (ELT):

-Article Review [Module-IV] [Foundation/Skill Development]

(1) Drilling Parameter Optimization of an Oil Well using Machine Learning(Team Activity)
(2) Downhole Problems in Drilling Engineering (Team Activity)
(3) Casing Design Considerations for an offshore well (Team Activity)

-"Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link https://presiuniv.knimbus.com/user#/home. It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)

(c) Participative Learning Topics (PLT):

- Quiz on Drilling Rig Components [Module-I][Skill Development]
- Quiz on Drilling String Design [Module-II][Skill Development]
- Quiz on Casing Design [Module-III][Skill Development]
- Peer Learning on Components of Hoisting System

-After completion of each module a QUIZ will be conducted. The mode of conduction can be either ONLINE or OFFLINE which will be intimated 2-3 day prior to the date of conduction. After completion of all three quiz, marks will be considered for evaluation.

(d) Problem Based Learning Topics (PBLT):

- Exercise Numericals on Pressure Loss Calculations in Circulation System
- Student needs to submit the problem assignments before the due date.

Reference Materials:

Text Book:

T1. Deepak Sharma, "Oil Well Drilling Technology" Venus Books; 1st Edition; 2016; Random Publications, Delhi
T2. Formulas and Calculation for Drilling, Production and workover, Norton J. Lapeyrouse; 2nd Edition; 2012; Gulf Publishing

References:

R1. Notes of Drilling Technology, Dept. of Petroleum Engineering, Herriot Watt University
R2. H. Rabia, Graham and Trotman, "Oil Well Drilling Engineering: Principles and Practice"; 1st Edition; 1986; Springer
R3. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie Charrier; 1985; 1st Edition; 1985; PennWell Books
R4. V.K. Jain, A.B. Sharma, R. Dhupar, R.P. Patel, D. Das Gupta, A. K. Joshi, and R. Shanker, "ONGC – Drilling Operation Practices Manual", 1st Edition, 2007, Shiva Offset Press, Dehradun

E-Resources:

1. Presidency University e-access portal: https://presiuniv.knimbus.com/user#/home
2. Dr. Petro YouTube channel: Drilling Rig Components Animated- https://youtu.be/JjGXsLWcwI0
3. Drilling Rig Online Courses YouTube channel: Drill String components and their functions- https://youtu.be/M6tic_OcNPY
4. Encyclopedia of petrochemistry YouTube channel: Casing and Cementing- https://youtu.be/iMUsMOopwpU
5. Harvest Chemical YouTube channel: Bit Hydraulics-https://youtu.be/I178EdbDV_Y
6. Case Studies: Best Practice Case Studies for Drilling Engineers: https://www.drillingpoint.com/

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7. Robert F. Mitchell, "Fundamentals of Drilling Engineering", 1st Edition, 2016, Society of Petroleum Engineers, Inc. https://www.amazon.in/Fundamentals-Drilling-Engineering-Robert-Mitchell-ebook/dp/B01L0O8WJA

Guideline to Students:

(a) About the Course:

Knowledge of this course will be applied for solving contemporary drilling and drilling related-environmental problems, and sustainable exploration of oil and gas resources. A structured approach would be taken so that it will provide the opportunity to engage, relate and contextualize the fundamentals of the Drilling Engineering.

(b) Notification / Announcement related to the Course:

All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2021', Regulation No. PU/AC-15/10/06_2021, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2022/09/Academic-Regulations-2021.pdf) and go through the Section Nos. 1.0 through 25.0.

Course Schedule:

Module-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
01	Overview of the Program and Course	12-09-2022	12-09-2022	L01
02	Module I	15-09-2022	06-10-2022	L02 – L10
03	Continuous Internal Assessment 1: Quiz			-
04	Module II	07-10-2022	28-10-2022	L11 – L19
05	Continuous Internal Assessment 2a: Quiz			-
06	Continuous Internal Assessment 2b: Course based problems			-
07	Discussion of Mid Term Exam Question Pattern	31-10-2022	31-10-2022	L20
08	Mid Term Exam	03-11-2022	07-11-2022	-
09	Discussion of Mid Term Exam Questions and Answers	10-11-2022	10-11-2022	L21
10	Module III	11-11-2022	01-12-2022	L22 – L30
11	Continuous Internal Assessment 3: Quiz			-
12	Module IV	02-12-2022	19-12-2022	L31 – L38
13	Continuous Internal Assessment 4: Article Review			-
14	Course Integration	22-12-2022	22-12-2022	L39
15	Discussion of End Term Exam Question Pattern	23-12-2022	23-12-2022	L40
16	End Term Exam	05-01-2023	25-01-2023	-
17	Discussion of End Term Exam Questions and Answers			-

Schedule of Instruction:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No. / Date	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference

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1	L01 / 12-09-2022	Overview of the Program and Course	Overview of the Program and Course	-	PowerPoint Presentation	N/A
Module I						
2	L02 / 15-09-2022	Drilling Rig Components	Drilling Fluid and Cementation,Introduction to types of rigs	CO1	Lecture, Video	R2 CH14/CN
3	L03 / 16-09-2022		Drilling Rig Components: Hoisting System	CO1	Lecture and PPT	R2 CH14/CN
4	L04 / 19-09-2022		Load Calculation	CO1	Lecture and PPT	R2 CH14/CN
5	L05 / 22-09-2022		Types of Rotary System	CO1	Lecture and PPT	R2 CH14/CN
6	L06 / 23-09-2022		Mud Flow Path, Rig site pumps, pump calculation	CO1	Lecture and PPT	R2 CH14/CN
7	L07 / 26-09-2022		Rig Power Calculation, Mud Pump Calculations	CO1	Lecture and PPT	R2 CH14/CN
8	L08 / 29-09-2022		Introduction and types of Derrick	CO1	Lecture and PPT	R2 CH14/CN
9	L09 / 30-09-2022		Derrick and Derrick Capacity	CO1	Lecture and PPT	R2 CH14/CN
10	L10/ 6-10-2022		Description of BOP, Types of BOP	CO1	Lecture and PPT	R2 CH14/CN
	-		Continuous Internal Assessment 1 : Quiz	-	-	-
Module II						
11	L11 / 7-10-2022	Drill String Design	Functions of drill pipe, Drill collar, Accessories	CO2	Lecture and PPT	R2 CH10/CN
12	L12 / 10-10-2022		Description and types	CO2	Lecture and PPT	R2 CH10/CN
13	L13 / 13-10-2022		Drill collar design	CO2	Lecture and PPT	R2 CH10/CN
14	L14 / 14-10-2022		Buckling Calculations	CO2	Lecture and PPT	R2 CH10/CN
15	L15 / 17-10-2022		Collapse and Burst calculation for drill pipe design	CO2	Lecture and PPT	R2 CH10/CN
16	L16 / 20-10-2022		Dog Leg Severity	CO2	Lecture and PPT	R2 CH10/CN
17	L17 / 21-10-2022		MOP Calculations	CO2	Lecture and PPT	R2 CH10/CN
18	L18 / 27-10-2022		Reasons and effects	CO2	Lecture and PPT	R2 CH10/CN
19	L19 / 28-10-2022		Drill String Vibration, Shock Subs	CO2	Lecture and PPT	R2 CH10/CN
-	-		Continuous Internal Assessment 2a : Quiz	CO2	-	-
-	-		Continuous Internal Assessment 2b : Course based problems	CO2	-	-
20	L20 / 31-10-2022		Discussion of Mid Term Exam Question Pattern	CO1 and CO2	PowerPoint Presentation	N/A

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			Mid Term Exam	CO1 and CO2	N/A	N/A
21	L21 / 10-11-2022		Discussion of Mid Term Exam Questions and Answers	CO1 and CO2	PowerPoint Presentation	N/A
Module III						
22	L22 /11-11-2022	Casing Design	Introduction, function and type	CO3	Lecture and PPT	R2 CH04/CN
23	L23 / 14-11-2022		Based on the mud density and circulation pressure	CO3	Lecture and PPT	R2 CH03/CN
24	L24 / 17-11-2022		Introduction to collapse, burst and tension	CO3	Lecture and PPT	R2 CH05/CN
25	L25 / 18-11-2022		Based on mechanical parameters	CO3	Lecture and PPT	R2 CH05/CN
26	L26 / 21-11-2022		Casing Seat Selection	CO3	Lecture and PPT	R2 CH05/CN
27	L27 / 24-11-2022		Based on mud parameters	CO3	Lecture and PPT	R2 CH05/CN
28	L28 / 25-11-2022		Collapse design	CO3	Lecture and PPT	R2 CH05/CN
29	L29 / 28-11-2022		Burst design and Tension Design	CO3	Lecture and PPT	R2 CH05/CN
30	L30 / 01-12-2022		Mechanical Strength of Casing	CO3	Lecture and PPT	R2 CH05/CN
-	-		Continuous Internal Assessment 3 : Quiz	-	-	-
Module IV						
31	L31 / 02-12-2022	Drill Bit and Rig Hydraulics	Function and types of bit	CO4	Lecture and PPT	R2 CH09/CN
32	L32 / 05-12-2022		Milled roller cone bit	CO4	Lecture and PPT	R2 CH09/CN
33	L33 / 08-12-2022		Insert bit	CO4	Lecture and PPT	R2 CH09/CN
34	L34 / 09-12-2022		Introduction to basic design	CO4	Lecture and PPT	R2 CH09/CN
35	L35 / 12-12-2022		Drilling cost calculation	CO4	Lecture and PPT	R2 CH09/CN
36	L36/ 15-12-2022		Pressure loss in circulation system and bit	CO4	Lecture and PPT	R2 CH08/CN
37	L37/ 16-12-2022		Bit area and velocity calculation, Hydraulic optimization	CO4	Lecture and PPT	R2 CH08/CN
38	L38/ 19-12-2022		Bit Nozzle Size Calculation	CO4	Lecture and PPT	R2 CH08/CN
	-	-	Continuous Internal Assessment 4: Article Review	-	-	-
39	L39 / 22-12-2022	Course Integration	Course Integration	CO1 through CO4	PowerPoint Presentation	N/A

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40	L40 / 23-12-2022		Discussion of End Term Exam Questions and Answers	CO3 and CO4	PowerPoint Presentation	N/A
			End Term Exam	CO1 through CO4	N/A	N/A

Topics relevant to "**SKILL DEVELOPMENT**": Drill bit - Types of drill bits; Roller cone bit design: Milled tooth bit and Insert bit; PDC bit design for **Skill Development** through **Participative Learning techniques**. This is attained through the Presentation as mentioned in the assessment Schedule.

Assessment Schedule:

Module-wise Micro Level planning for course assessment schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time (Date may Change)
01	Continuous Internal Assessment 1: Quiz	L02 – L10	CO1	-	10	5%	-
02	Continuous Internal Assessment 2a: Poster presentation	L11 - L19	CO2	-	10	5%	-
03	Continuous Internal Assessment 2b: Course based problems	L11 - L19	CO2	-	10	5%	-
04	Mid Term Examination	L02 – L19	CO1, CO2	2	50	25%	03-11-2022 to 07-11-2022
05	Continuous Internal Assessment 3: Quiz	L22 - L30	CO3	-	10	5%	-
06	Assignment: Article writing – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://presiuniv.knimbus.com/user#/home). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)	L31 - L38	CO4	-	10	5%	-
07	End Term Examinations	L03 - L38	CO1, CO2, CO3, CO4	3	100	50%	05-01-2023 to 25-01-2022

Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2021', Regulation No. PU/AC-15/10/06_2021, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2022/09/Academic-Regulations-2021.pdf) and go through the Section Nos. 1.0 through 25.0. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, Head of the Department, and Dean (School of Engineering) for further assistance.

Contact Timings in the Chamber for any Discussion:

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Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1	A rotary system consists of kelly, swivel, rotary table. The swivel helps to to allow the kelly and drill pipe to rotate while allowing the travelling block to be stationary. During drilling the swivel is allowed to rotate or not? Justify your answer.	6	CO1	Comprehension
2	Weight on the Bit, or WOB, is the amount of downward force exerted on the drill bit provided by thick-walled tubular pieces in the drilling assembly that are known as drill collars. The downward force of gravity on these steel tubes provide force for the drill bit in order to effectively break the rock. Weight on bit should be less than buoyant weight of drill collar. Describe the above statement along with consequences that can happen when WOB is kept higher than the drill collar weight .	6	CO2	Comprehension
3	Hoisting system is required to move the working set of equipment in and out of the well bore. The working set of equipment include casing during cementing and drill pipe during drilling. Casing weight is always greater than drill pipe weight. Considering the following, which operation(Cementing, Drilling or Logging) will take maximum power and why?	6	CO3	Comprehension
4	Roller-cone bit design goals expect the bit to achieve a low cost per foot drilled. The design criteria also requires the bit to have a long downhole life that minimizes requirements for tripping.It should ensure that the three legs must be equally loaded during drilling. Explain the factors that are considered when designing and manufacturing a three-cone bit.	6	CO4	Comprehension

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Compute the load capacity and power requirement of various rig components	50
2	CO2	Choose appropriate drill string components according to pressure requirements	45
3	CO3	Select appropriate casing string according to pressure requirements	45
4	CO4	Classify drilling bits based on the drilling mechanism	45

Signature of the Course Instructor In-charge:

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Signature of the Course Instructor:

This course has been duly verified and approved by the D.A.C.

Signature of the Chairperson D.A.C.:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1	Continuous Internal Assessment 1: Quiz	-	-	
2	Continuous Internal Assessment 2a: Quiz	-	-	
3	Continuous Internal Assessment 2b: Course based problems	-	-	
4	Mid Term Examination	03-11-2022 to 07-11-2022	03-11-2022 to 07-11-2022	
5	Continuous Internal Assessment 3: Quiz	-	-	
6	Assignment: Article writing – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link	-	-	

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	(https://presiuniv.knimbus.com/user#/home). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)			
7	End Term Examinations	05-01-2023 to 25-01-2022	05-01-2023 to 25-01-2022	
8				
9				
10				

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Compute the load capacity and power requirement of various rig components	50		

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2	CO2	Choose appropriate drill string components according to pressure requirements	45		
3	CO3	Select appropriate casing string according to pressure requirements	45		
4	CO4	Classify drilling bits based on the drilling mechanism	45		

Name and Signature of the Course Instructor: Mr. Utkarsh Lall

D.A.C. Observation and Approval:

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Course Code: **PET2007**	**Course Title:** **Oil and Gas Surface Facility Design** **Type of Course:** **1] Program Core** **2] Laboratory Integrated**		**L-T-P-C**	2	0	2	3
Version No.:	1.0					
Course Pre-requisites:	NIL					
Anti-requisites:	NIL					
Course Description:	The purpose of this course is to enable the students to appreciate the need for surface production facilities. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematical and computing. The course develops the critical thinking and analytical skills. The course also enhances the programming abilities through assignments. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to visualize the real system performance.					
Course Objectives:	The objective of the course is to familiarize the learners with the concepts of Oil and Gas Surface Facility Design and attain **Skill Development** through **Experiential learning techniques**.					
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: state the surface production facilities and importance of separations, CO2: identify the different types of phase separator for handling different fluids and environment, CO3: discuss different treating equipment, emulsion treatment and desalting systems, CO4: explain produced water treatment systems for hydrocarbon extraction and water purification					
Course Content:						
Module 1:	Basic Facilities of Surface Production	Assessment 1: Assignment	Quiz	08 Periods		
Topics: Subsurface Process and Equipment, Properties of Reservoir fluids and Phase behavior studies Surface Production facilities: Various types of facilities - Basic system configuration design & selection of facilities: Wellhead and manifold – Separation - Initial separation pressure - Stage Separation, Selection of Stages.						
Module 2:	Phase Separation	Assessment 2: Assignment / Quiz	Simulation	10 Periods		
Topics: Two phase liquid and gas separation: Functional sections of a gas-liquid separator – Sizing of two phase separators- Equipment description of different separators. Three phase oil, gas and water separation: Equipment description - Horizontal separators - Derivation of equation - Free-water knockout - Flow splitter - Horizontal three-phase separator with a liquid "Boot" - Vertical separator.						
Module 3:	Crude Oil Treatment	Assessment 3: Assignment / Quiz	Data Collection and Analysis	09 Periods		
Topics: Equipment description of various treaters and heaters - Indirect & Direct fired heaters - Vertical heater-treaters - Horizontal heater treaters - Electrostatic heater-treaters - Emulsion treating theory – Agitation - Field optimization - Emulsion treating methods - Bottle test considerations.						
Module 4:	Produced Water Treatment	Assessment 4: Case Study	Poster Presentation	09 Periods		
Topics: Oil desalting systems - Produced water treating systems: Characteristics of produced water - Sand and other suspended solids - Dissolved gases - Oil in water emulsions - Dissolved oil concentrations - Dispersed oil - Gravity separation – Coalescence – Dispersion – Miscellaneous Equipments.						
List of Laboratory Tasks: Experiment No. 1: Introduction to HONEYWELL – UNISIM Design Experiment No. 2: Flash calculation and phase envelope Level 1: Perform Flash calculation for a crude oil using Peng Robinson Equation of state. Level 2: Perform Flash calculation for a crude oil and draw the phase envelope using Peng Robinson Equation of state. Experiment No. 3: Simulation of separation process Level 1: Find the concentration of components of crude oil leaving a separator at a given Temperature and Pressure Condition. Level 2: Find the concentration of components of crude oil leaving a stage separator at a given Temperature and Pressure condition. Experiment No. 4: Simulate a desalter using the P&ID given in the text.						
Targeted Application and Tools that can be used: Applications: Process Engineer, Surface facilities engineer, Plant Design. Professional Software: UNISIM Design, ASPEN HYSYS						

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Text Book: T1: Ken Arnold and Maurice Stewart, "Surface Production Operations", Vol. 1, 2nd Edition, Gulf Professional Publishing, 1999. T2: W.L. Mc Cab and J.C. Smith and Peter Harriott, Unit operations in Chemical Engineering, 5th Edition, Mc Graw Hill, 1993.	
References: R1: Petroleum and Gas Field Processing, H.K.Abdel-Aal and Mohamed Aggour and M.A. Fahim, 1st Edition,Marcel Dekkar Inc., 2003. **e-resources:** 1. https://cheguide.com/flash_raoult.html 2. https://ifsolutions.com/two-phase-separator-vs-three-phase-separator-differences/ 3. https://www.youtube.com/watch?v=J_9b69F-Seg 4. https://www.netsolwater.com/what-is-effluent-treatment-plant-and-etp-working-process.php?blog=107	
Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. The course attainment will be assessed through assessment component mentioned in course handout.	
Catalogue prepared by:	Dr. Deepjyoti Mech, Mr. Sugat Srivastava, Mr. Ankur Neog, Mr. Anmol Bhargava
Recommended by the Board of Studies on:	11th Meeting of the Board of Studies held on 5th September 2020
Date of Approval by the Academic Council:	13th Meeting of the Academic Council held on 6th November 2020

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Course Code: **PET2011**	**Course Title:** **Oil and Gas Downstream Operations** **Type of Course:** **1] Program Core** **2] Laboratory Integrated**	**L- P- C**	3	2	4
Version No.:	1.0				
Course Pre-requisites:	1) Introduction to Petroleum Refining and Crude Oil Components 2) Applied Statistics- Basic concept of statistical calculation 3) Process Control and Instrumentation: Types of process control and valves 4) Thermodynamics of Reservoir Fluids: Rheological properties of fluids				
Anti-requisites:	NIL				
Course Description:	The purpose of this course is to enable the student to understand the basics of Engineering about downstream operation of petroleum industry. They will learn definition and estimation of properties of process materials and engineering approach to problem solving using material and energy balance equations. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematics. The course develops the critical thinking and analytical skills.				
Course Objectives:	The objective of the course is to familiarize the learners with the concepts of Oil and Gas Downstream Operations and attain **Skill Development** through **Experiential Learning** techniques.				
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: describe the different product specification in downstream CO2: define the different gas properties CO3: apply the material balance in different process calculation CO4: classify the different types of fuel combustion				
Course Content:					
Module 1:	Overall Refinery Operations and Indian Scenario	Assignment	Data Collection		10 Periods
Topics: Overall refinery operations. Refinery feed stocks: Crude oil Classification-Composition and Properties-Composition of petroleum crude suitable for asphalt/coke manufacture – Evaluation of crude oils. Indian Petrochemical Industry- Feed stocks – Process description and Process variables-Naphtha cracking-Gas cracking and Gas reforming.					
Module 2:	Petroleum Products and their Specifications	Assignment	Data Collection		10 Periods
Topics: LPG- Gasoline- Diesel fuels- Jet and turbine fuels –Lube oils-Heating oils – Residual fuel oils - Wax and Asphalt- Petroleum coke- All Product specifications-Product blending. Chemicals from gas reforming: Methanol- Acetic acid- Ammonia and urea. Chemicals from ethylene: Ethylene oxide-Monoethylene glycol-Ethyl benzene-Styrene. Polymers: LDPE, HDPE & LLDPE and Polypropylene – PVC - Polystyrene.					
Module 3:	Crude Distillation	Poster Presentation	Programming		11 Periods
Topics: Atmospheric and Vacuum distillation units, Auxiliary equipment such as desalters, pipe-still heaters and heat exchanger trains etc. Catalytic reforming processes for petroleum and petrochemical feed stocks ,Isomerization Processes -Feed stocks-Feed preparation – Yields					
Module 4:	Thermal and Catalytic Cracking Processes	Assignment	Data Collection		12 Periods
Topics: Visbreaking- Delayed Coking, Fluid Catalytic cracking and Hydrocracking, Feed stocks Catalysts - Process variables, Product Recoveries Yield estimation, Naphtha, Kerosene, Diesel, VGO &Resid, Hydrotreating / Hydroprocessing – Feed stocks – Process description and Process variables.					

List of Laboratory Tasks:

Experiment No. 1: Determine the refractive index of different petroleum product.
Level 1: Determine the refractive index of petrol diesel at different temperature,
Level 2: Determine the refractive index of blended petrol diesel at different temperature.

Experiment No. 2: Determine the flash and fire point of bio-fuel.
Level 1: Determine the flash and fire point of bio-fuel by Pensky Martin,
Level 2: Determine flash and fire point of blended biofuel.

Experiment No. 3: **Extraction of different product from crude oil using distillation column**
Level 1: Extraction of different product from crude oil using distillation column
Level 2: Determination of class of crude, characterization index and correlation factor using distillation colomn.

Experiment No. 4: Measurement of strength consistency using penetrometer.
Level 1: Determine strength consistency of different grades of bitumen,
Level 2: Determine strength consistency of different grades of bitumen at different temperature.

Experiment No. 5: **Determine the calorific value of given fuel**

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Level 1: Determine the calorific value of given fuel **Level 2:** Determine the calorific value of blended fuel **Experiment No. 6: Determine the viscosity of high density products using redwood II viscometer**. **Level 1:** Determine the viscosity of grease naptha by redwood II at different temperature, **Level 2**: Compare the viscosity of these products at different temperaure. **Experiment No. 7: To study of Characteristics of Diaphragm actuated pneumatic Linear control valve and Equal percentage valve.** **Level 1:** To find the flow rate for the valve Characteristics, **Level 2:** To plot the valve trip characteristics graph.	
Targeted Application and Tools that can be used: Application area is vast, i.e in all of the Process Engineering Industries in operation such as Distillation column, Solvent Adsorption and extraction and fuel testing services.	
Text Book: T1: Roychoudhury, U "Fundamental of Petrochemical Engineering". PHI Learning	
References: R1: Margo Andy, "Petroleum and Petrochemical Industry", Willey	
Topics relevant to "**SKILL DEVELOPMENT**": As it is a laboratory integrated course, all the experiments are designed for **Skill Development** through **Experiential Learning techniques**. The course attainment will be assessed through assessment component mentioned in course handout.	
Catalogue prepared by:	Dr. Kalpajit Hazarika, Dr. Deepjyoti Mech, Mr. Ankur Neog
Recommended by the Board of Studies on:	12th Meeting of the Board of Studies held on 9th August 2021
Date of Approval by the Academic Council:	16th Meeting of the Academic Council held on 23rd October 2021

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Course Code: **PET2014**	**Course Title:** **Geophysical Methods for Oil and Gas Exploration** **Type of Course:** **1] Program Core** **2] Theory Only**	**L- P- C**	3	0	3
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	The aim of this Course is to understand different Oil and Gas exploration techniques used in industry. It is a theory-based course where an overview of petroleum exploration methods will be discussed. Global Oil and Gas Exploration Scenario with Role of Sedimentology, Biostratigraphy, Geochemistry and Microfossils in Oil and Gas Exploration will be discussed. Basic concepts, principles and limitations different Geophysical Methods like Gravity Survey, Magnetic Survey, Electromagnetic Survey and Seismic Survey will be discussed along with their applications in Oil and Gas Exploration.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Geophysical Methods for Oil and Gas Exploration and attain **Skill Development** through **Participative Learning** techniques.				
Course Outcomes:	On successful completion of the course, the student shall be able to: CO1: Explain basic features associated with the origin and maturation of petroleum CO2: Describe the geochemical methods for hydrocarbon detection CO3: Summarize the Magnetic and gravity survey method as well as interpret the related anomalies, CO4: Demonstrate the theory and working behind different seismic exploration methods.				
Course Content:				

Module 1:	Geological Concepts of petroleum	Assessment 1: Assignment /Quiz	Literature Survey	03 Periods
Topics: Formation of Petroleum accumulations, Kerogen formation, Van Krevelen Diagram; Surface indications of petroleum accumulation. Fossils and it's application in Hydrocarbon Exploration. Uses of Foraminifera, Calcareous nanofossils, Nanoliths and Ostracods; Importance of palynology and micropaleontology.				
Module 2:	Geochemical Methods	Assessment 2: Assignment / Quiz	Data Collection	03 Periods
Topics: Introduction to Geochemical methods, Seepage, Seepage activity, direct and indirect methods of geochemical exploration, benefits of geochemical prospecting, limitations and uncertainties of geochemical exploration				
Module 3:	Gravity Survey and Magnetic Survey	Assessment 3: Assignment / Quiz	Programming Task	10 Periods
Topics: Introduction to gravity surveying, gravimeters, gravity corrections, applications of gravity measurements, Magnetic survey: The earth's geomagnetic field, field instruments, magnetic response of simple shapes, Rock magnetism, Types of magnetism, magnetic anomalies and correction and their application.				
Module 4:	Seismic Survey	Assessment 4: Case Study	Data Collection and Analysis	16 Periods
Topics: Waveforms: Theory of seismic reflectance, Seismic wave veolocity of rock, Reflection seismogram, shot gathers and CMP gathers, Attenuation of seismic energy along ray paths; Equipment used in seismic survey, Multichannel reflection survey design; Interpretation of seismic reflection data.				

Targeted Application and Tools that can be used:

Application: Exploration Geochemist / Geologist / Geophysicist in Oil and Gas / Mineral Exploration companies

Tools: MS Excel, Grapher, Decision Space G1 Edition (Professionally used Landmark Halliburton Software)

Text Book:

T1. T1: Philip Kearey, Michael Brooks and Ian Hill, 2002. An Introduction to Geophysical Exploration, 3rd Edition, Blackwell Science.

T2: W.M. Telford, L.P. Geldart and R.E. Sheriff, 1990. Applied Geophysics, 2nd Edition, Cambridge University Press.

References

R1. R1: Milton B. Dobrin, and Carl H. Savit, 1988. Introduction to Geophysical Prospecting, 4th Edition, McGraw Hill.

R2: M.B. Ramachandra Rao, 1993. Outlines of Geophysical Prospecting: A Manual for Geologists, EBD Educational Pvt Ltd.

Class Note (CN) /Materials/Other materials

E-resources

1. E-remote access portal: https://presiuniv.knimbus.com/user#/home
2. Basics of Hydrocarbon exploration: https://www.youtube.com/watch?v=eT9bXXKEtTk
3. Technical Guidance to Exploration & Production Plans: http://dx.doi.org/10.1007/978-3-030-45250-6_1
4. HELP (Hydrocarbon Exploration and Licensing Policy: https://www.youtube.com/watch?v=xvdetYz7UIA
5. Using 3D Seismic Exploration to Find and Drill for Oil and Natural Gas Sources

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https://www.youtube.com/watch?v=8h35KsRD0c0	
Topics relevant to "**SKILL DEVELOPMENT**": Gravity surveying, gravimeters, gravity corrections, applications of gravity measurements for **Skill Development** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by:	Dr. Deepjyoti Mech, Dr. Kalpajit Hazarika, Mr. Bhairab Jyoti Gogoi, Mr. Ankur Neog
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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PRESIDENCY UNIVERSITY

(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Hand Out

Date of Issue: 11-03-2022

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2021-25
Semester / Year	:	IV / 2nd
Course Code / Title	:	PET 2014 / Geophysical methods for Oil and Gas Exploration
Course Credit Structure	:	3L 0T 0P 3C
Contact Hours	:	39L+0T+0P = 39
Course Instructor In-charge	:	Ms. Jain Mariyate Wilson
Course Instructor	:	Ms. Jain Mariyate Wilson
Course URL Edhitch	:	https://www.edhitch.com/

Program Outcomes (POs) :

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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PO08: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO09: **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:

Nil

Course Description:

The aim of this Course is to understand different Oil and Gas exploration techniques used in industry. It is a theory-based course where an overview of petroleum exploration methods will be discussed. Global Oil and Gas Exploration Scenario with Role of Sedimentology, Biostratigraphy, Geochemistry and Microfossils in Oil and Gas Exploration will be discussed. Basic concepts, principles and limitations different Geophysical Methods like Gravity Survey, Magnetic Survey, Electromagnetic Survey and Seismic Survey will be discussed along with their applications in Oil and Gas Exploration.

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Geophysical Methods for Oil and Gas Exploration and attain **Skill Development** through **Participative Learning** techniques.

Course Outcomes (COs):

On successful completion of the course, the student shall be able to:
CO1: Explain basic features associated with the origin and maturation of petroleum,
CO2: Describe the geochemical methods for hydrocarbon detection,
CO3: Summarize the Magnetic and gravity survey method as well as interpret the related anomalies,
CO4: Demonstrate the theory and working behind different seismic exploration methods.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	M	L		L	L		M		H	H		L
CO2	M	M		M	M		L		L	H		L
C03	M	M		L	L		L		L	H		L
CO4	M	M		L	L		M		M	H		L
H = High, M = Moderate, L = Low												

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Course Content (Syllabus):

Module I: Geological Concepts of petroleum [3 Classes] [Knowledge Level]

Formation of Petroleum accumulations, Kerogen formation, Van Krevelen Diagram; Surface indications of petroleum accumulation. Fossils and it's application in Hydrocarbon Exploration. Uses of Foraminifera, Calcareous nanofossils, Nanoliths and Ostracods; Importance of palynology and micropaleontology.

Module II: Geochemical Methods [3 Classes] [Knowledge Level]

Introduction to Geochemical methods, Seepage, Seepage activity, direct and indirect methods of geochemical exploration, benefits of geochemical prospecting, limitations and uncertainties of geochemical exploration

Module III: Gravity and Magnetic Survey [10 Classes][Comprehension Level]

Introduction to gravity surveying, gravimeters, gravity corrections, applications of gravity measurements, Magnetic survey: The earth's geomagnetic field, field instruments, magnetic response of simple shapes, Rock magnetism, Types of magnetism, magnetic anomalies and correction and their application.

Module IV: Seismic Survey [16 Hours] [Comprehension level]

Waveforms: Theory of seismic reflectance, Seismic wave veolocity of rock, Reflection seismogram, shot gathers and CMP gathers, Attenuation of seismic energy along ray paths; Equipment used in seismic survey, Multichannel reflection survey design; Interpretation of seismic reflection data.

Delivery Procedure (Pedagogy):

This is a theory-based course. Most of the lectures will be taken with the help of Power Point Presentations and White Board. Videos will be shown for the better understanding of selective topics. Flip Class Room sessions will be conducted on selective topics. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students. Assignments, Quiz Competition and Poster Presentation will carry 20% weightage under Continuous Internal Assessment (CIA). Review classes will be conducted to clear doubts and to evaluate the level of understanding of each student individually. Most of the lectures will be delivered offline
Following procedures will be adopted in the course for delivering the content:

Self - Learning Topics:

- Plate Tectonics & Continental Drift – Search for the Mechanism of Plate Movement
- Sedimentology
- Single channel marine reflection profiling
- Seismic Tomography

Experiential Learning:

Article Review [Foundation/Skill Development/Environmental Sustainability]

- ***Group 1:*** *Hydrocarbon Origin Theory*
- ***Group 2:*** *Uncertainty and Risk Involved in Hydrocarbon Exploration: Indian Scenario*
- ***Group 3:*** *Geochemical Exploration Techniques*

Participative Learning:

QUIZ (Unit I, II) [Skill Development]

Problem Solving: Subject related exercise (Unit III & IV) [Skill/Employability]

- Numerical on Gravity survey corrections
- Numerical on Seismic Survey

Reference Materials:

Text Book(s):

T1: Philip Kearey, Michael Brooks and Ian Hill, 2002. An Introduction to Geophysical Exploration, 3rd Edition, Blackwell Science.

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T2: W.M. Telford, L.P. Geldart and R.E. Sheriff, 1990. Applied Geophysics, 2nd Edition, Cambridge University Press.

Reference Book(s):

R1: Milton B. Dobrin, and Carl H. Savit, 1988. Introduction to Geophysical Prospecting, 4th Edition, McGraw Hill.

R2: M.B. Ramachandra Rao, 1993. Outlines of Geophysical Prospecting: A Manual for Geologists, EBD Educational Pvt Ltd.

E-resources:

1. E- remote access portal: https://presiuniv.knimbus.com/user#/home
2. Basics of Hydrocarbon exploration: https://www.youtube.com/watch?v=eT9bXXKBtTk
3. Technical Guidance to Exploration & Production Plans: http://dx.doi.org/10.1007/978-3-030-45250
4. HELP (Hydrocarbon Exploration and Licensing Policy: https://www.youtube.com/watch?v=xvdetYz7UIA
5. Using 3D Seismic Exploration to Find and Drill for Oil and Natural Gas Sources: https://www.youtube.com/watch?v=8h35KsRD0c0

Any other Reference:

Class Note (CN)

Webpage: http://www.arthapedia.in/index.php?title=New_Exploration_and_Licensing_Policy_(NELP)

Guideline to Students:

(a) About the Course:

This is a theory-based course which will provide fundamental concepts of oil and gas exploration processes. Assignments will be given to each student time-to-time after completion of considerable portion of the syllabus. Submission of assignment on time is mandatory for all the students.

(b) Notification / Announcement related to the Course:

All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0.

Course Schedule:

Module-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
01	Overview of the Course	23-03-2022	20-06-2022	1
02	Module I	25-03-2022	30-03-2022	7
03	Module II	1-04-2022	6-04-2022	7
04	Discussion on Test 1 Question Pattern	22-04-2022	22-04-2022	01
05	Test 1	25-04-2022	27-04-2022	-
06	Discussion on Test 1 solutions	29-04-2022	29-04-2022	01
07	Continuous Internal Assessment			-
08	Module III	08-04-2022	10-05-2022	9

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09	Discussion on Test 2 Question Pattern	20-05-2022	20-05-2022	01
10	Test 2	23-05-2022	26-05-2022	-
11	Discussion on Test 2 Questions and Answers	27-05-2022	27-05-2022	01
12	Continuous Internal Assessment: Assignment			-
13	Module IV	11-05-2022	21-06-2022	9
14	Course Integration	22-06-2022	22-06-2022	01
15	Discussion on End Term question Pattern	21-06-2022	21-06-2022	01
16	End Term Examinations	27-06-2022	9-07-2022	

Schedule of Instruction:

Module-wise Micro Level planning for course delivery schedule is provided below:

1	L01	Overview of the programme and Course		C01, CO2, CO3, CO4		
2	L02	Geological concept of exploration	Introduction to hydrocarbon exploration	CO1	Class presentation / Whiteboard	T1 Ch01
3	L03		Formation and maturation of petroleum: oil window and gas window	CO1	Class presentation / Whiteboard	CN
4	L04		Paleontology & palynology	CO1	Class presentation / Whiteboard	CN
Module I Completed						
5	L05	Geochemical methods	Introduction to Geochemical methods, Seepage, Seepage activity	CO2	Class presentation / Whiteboard	CN
6	L06		direct and indirect methods of geochemical exploration	CO2	Class presentation / Whiteboard	CN
7	L07		benefits of geochemical prospecting, limitations and uncertainties of geochemical exploration	CO2	Class presentation / Whiteboard	CN
Module II completed						

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08	L08	Gravity Surveying	Introduction	CO2	Class presentation / Whiteboard	T1 Ch06 T2 Ch02
09	L09		Gravimeters	CO2	Class presentation / Whiteboard	T1 Ch06 T2 Ch02
10	L10		Gravity correction [Tidal, Free Air, Bougouer]	CO2	Class presentation / Whiteboard	T1 Ch06
11	L11		Interpretation of gravity measurements	CO2	Class presentation / Whiteboard	T1 Ch06 T2 Ch02
12	L12		Applications of gravity measurements	CO2	Class presentation / Whiteboard	T2 Ch02
13	L13	Magnetic Surveying	Introduction: Geomagnetic field of the earth, Magnetic substances and properties	CO3	Class presentation / Whiteboard	T1 Ch07 T2 Ch03
14	L14		Magnetic anomalies	CO3	Class presentation / Whiteboard	T1 Ch07
15	L15		field instruments of magnetic survey	CO3	Class presentation / Whiteboard	T1 Ch07
16	L16		Magnetic Reductions	CO3	Class presentation / Whiteboard	CN
17	L17		Application of magnetic survey	CO3	Class presentation / Whiteboard	T1 Ch07
Module III Completed						
18	L18	Seismic Reflection Surveying	Introduction to Seismic Surveying	CO4	Class presentation / Whiteboard	CN
19	L19		The reflection seismogram	CO4	Class presentation / Whiteboard	CN
20	L20		Multi-channel reflection survey design	CO4	Class presentation / Whiteboard	CN
21	L21		Time corrections	CO4	Class presentation / Whiteboard	CN
22	L22		Filtering of seismic data	CO4	Class presentation / Whiteboard	T1 Ch04 CN

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23	L23	Seismic Refraction Surveying	Vertical seismic profiling	CO4	Class presentation / Whiteboard	T2 Ch04 CN
24	L24		Interpretation of seismic reflection data	CO4	Class presentation / Whiteboard	CN
25	L25		Geometry of refracted ray paths; Planar interfaces	CO4	Class presentation / Whiteboard	CN
26	L26		Geometry of refracted ray paths; non-Planar interfaces	CO4	Class presentation / Whiteboard	CN
27	L27		Wave fronts and ray tracing	CO4	Class presentation / Whiteboard	CN
28	L28		Refraction profiling	CO4	Class presentation / Whiteboard	CN
29	L29		Seismic tomography	CO4	Class presentation / Whiteboard	CN
30	L30		Applications of seismic reflection surveying	CO4	Class presentation / Whiteboard	CN
31	L31		Applications of seismic reflection surveying	CO4	Class presentation / Whiteboard	CN
32	L32		Case study - I	CO4	Class presentation / Whiteboard	CN
33	L33		Case study – I continued	CO4	Class presentation / Whiteboard	CN
34	L34	Course Integration	Course summary and relation with other courses of the program	CO4	Class presentation / Whiteboard	CN

Topics relevant to "**SKILL DEVELOPMENT**": Gravity surveying, gravimeters, gravity corrections, applications of gravity measurements for **Skill Development** through **Participative Learning techniques**. This is attained through the Presentation as mentioned in the assessment Schedule.

Assessment Schedule:

Unit-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time
01	Test 1	Module I and	CO1, CO2	1	30	15%	

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		Module II					
02	Test 2	Module III and Module IV	CO3- CO4	1	30	15%	
03	End Term Examinations	Module I through Unit IV	CO1 – CO4	3	100	50%	
04	CIA: Assignment: Literature Review – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (:https://presiuniv.knimbus.com/user#/home). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.)	Module I, II	CO1 -CO2	15 min	10	05%	
05	Quiz	Module III, IV	CO3-CO4		20	10%	
06	Poster presentation	Module III, IV	CO3-CO4	1 hour	10	05%	

Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2017/08/Academic-Regulations-2020.pdf) and go through the Section Nos. 1.0 through 24.0. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, Head of the Department, and Dean (School of Engineering) for further assistance.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level

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2	What are macerals? What are the three types of macerals? How is vitrinite reflectance used as an indication for maturity of source rocks?	2	CO1	Knowledge
3	How the presence of brine in petroleum is abundant zones a supporting tenet of the organic theory of origin?	3	CO1	Comprehension
5	What are geochemical surveying methods? How it can be used for hydrocarbon exploration?	5	CO2	Knowledge
6	What are the various limitations, uncertainties and benefits associated with geochemical methods with respect to other hydrocarbon exploration methods?	10	CO2	Knowledge
7	How and why do the methods of reduction of gravity and magnetic data differ?	5	CO3	Comprehension
8	What is gravity surveying? Is it necessary to correct all the variations before interpreting the data? If yes, explain how the variations can be corrected?	5	CO3	Knowledge
9	What is a time slice or a seis crop?	2	CO4	Knowledge
10	What is Vertical Seismic Profiling? What are it's advantages over conventional surface seismic survey?	4	CO4	Comprehension

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Explain basic features associated with the origin and maturation of petroleum	25%
2	CO2	Describe the geochemical methods for hydrocarbon detection	25%
3	CO3	Summarize the Magnetic and gravity survey method as well as interpret the related anomalies	25%
4	CO4	Demonstrate the theory and working behind different seismic exploration methods.	25%

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

Signature of the Chairperson DAC:

Course Completion Remarks and Self-Assessment:

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Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

Course Outcome Attainment:

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Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Explain basic features associated with the origin and maturation of petroleum	25%		
2	CO2	Describe the geochemical methods for hydrocarbon detection	25%		
3	CO3	Summarize the Magnetic and gravity survey method as well as interpret the related anomalies	25%		
4	CO4	Demonstrate the theory and working behind different seismic exploration methods.	25%		

Name and Signature of the Course Instructor:

DAC Observation and Approval:

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Course Code: **PET2026**	**Course Title:** **Introduction to Computational Fluid Dynamics** **Type of Course:** **1] Open Elective** **2] Theory Only**	**L- P- C**	3	0	3
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	This course intends to give an overview of the Computational Fluid Dynamics and the flow modelling. The students will develop a strong foundation in numerical methods like FDM and FVM as they would apply the knowledge to formulate the equations. The course is theoretical in nature with special emphasis on the numerical modelling. Students should have strong background in mathematics, heat, and momentum and programming in order to excel in this course. It will lay the foundation of computational programming for the students.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Introduction to Computational Fluids Dynamics and attain **Skill Development** through **Problem Solving** methodologies.				
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: Describe the basic mechanism of computational fluid dynamics CO2: Apply Finite difference and Finite volume method for diffusion problems CO3: Explain discretization and its importance in numerical simulations CO4: Solve diffusion equation using Finite Volume Method				
Course Content:					
Module 1:	Introduction to Computational Fluid Dynamics	Term Paper	Data Collection and Review Paper	08 Periods	
Topics: Computational Fluid Dynamics: What, When, and Why?, CFD Applications, Numerical versus Analytical versus Experimental, Modeling vs Experimentation, Fundamental principles of conservation, Reynolds transport theorem, Conservation of mass, Conservation of linear momentum: Navier-Stokes Equation, Conservation of Energy, General Scalar Transport Equation.					
Module 2:	Introduction to Numerical Techniques in Computational Fluid Dynamics	Assignment	Programming	10 Periods	
Topics: Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems -Parabolic equations – Explicit and Implicit schemes -Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.					
Module 3:	Discretization	Assignment	Programming	06 Periods	
Topics: Discretization Principles: Preprocessing, Solution, Postprocessing, Finite Element Method, Finite difference method, Well posed boundary value problem, Possible types of boundary conditions, Conservativeness, Boundedness, Transportiveness, Finite Volume Method (FVM), Illustrative examples: 1-D steady state heat conduction without and with constant source term, 1-D unsteady state diffusion problems: implicit, fully explicit and Crank-Nicholson scheme.					
Module 4:	Finite Volume Method	Assignment	Programming	08 Periods	
Topics: Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems: Physical consistency, Overall balance, FV Discretization of a 1-D steady state diffusion type problem, Composite material with position dependent thermal conductivity, Four basic rules for FV Discretization of 1-D steady state diffusion type problem, Source term linearization, Implementation of boundary conditions.					
Targeted Application and Tools that can be used: Application: CFD Engineer / Flow Dynamics / Numerical Modelling Engineer Tools: ANSYS FLUENT, OPENFOAM, and ANSYS CFX (Professionally used Software)					
Text Book: T1. John D. Anderson Jr., "Computational Fluid Dynamics: The basics with Applications", McGraw Hill Education.					
References: R1. H. Versteeg, W. Malalasekra "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Pearson edition. R2. JiyuanTu, Guan Yeoh, Chaoqan Liu, "Computational Fluid Dynamics: A Practical Approach", Second edition, Elsevier. **e-resources:** 1. https://puniversity.informaticsglobal.com/login 2. https://www.youtube.com/watch?v=jQHp49OyPn8					

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3. https://www.youtube.com/watch?v=NlLy-u61yyk 4. https://www.youtube.com/watch?v=ygOcv4ynZ8A	
Topics relevant to "SKILL DEVELOPMENT": Introduction to Numerical Techniques in Computational Fluid Dynamics for **Skill Development** through **Problem Solving** methodologies. This is attained through the **Assignment** as mentioned in the assessment component.	
Catalogue prepared by:	Dr. Deepjyoti Mech, Dr. Kalpajit Hazarika, Mr. Bhairab Jyoti Gogoi, Mr. Ankur Neog
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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Course Code: **PET3003**	**Course Title: Offshore Drilling and Petroleum Production Practices** **Type of Course: 1] Program Core** **2] Theory only**	**L- P- C**	3	0	3
Version No.:	2.0				
Course Pre-requisites:	NIL				
Anti-requisites:	NIL				
Course Description:	This course is theory course. The main objective of this course is to focus on the sea behavior and the platforms used for drilling & production operation. It also helps to understand drilling and production practices used in offshore environment and problems associated with offshore operation. This course is both conceptual and analytical in nature. With the knowledge of basic sciences are preferable to register in this course.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Offshore Drilling and Petroleum Production Practices and attain **Skill Development** through **Problem Solving** techniques.				
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: Discuss the offshore sea environment and station keeping mechanism of offshore structures, CO2: Explain various fixed offshore drilling and production structures, CO3: Summarize various floating offshore platforms, CO4: Distinguish between the offshore production facilities.				
Course Content:					
Module 1:	Introduction to Offshore and Sea Environment	Assignment	Literature Survey and Group Discussion	04 Periods	
Topics: Introduction, Historical development of offshore Structures, Deep water challenges and offshore disasters, Functions of offshore structures, Water Depth classification, Offshore India. Classification Societies and Industry Standard Groups Buoyancy and Gravity Principals, Metacenter, Station keeping, Motions of floating vessel.					
Module 2:	Fixed Offshore Drilling and Production Platform	Quiz	Model Making	07 Periods	
Topics: Bottom Supported structures- Minimal platforms, Jacket structures, Gravity based structures, Jack ups, Subsea templates and pipelines; Complaint structures- Articulated Platforms, Complaint tower, Guyed tower.					
Module 3:	Floating Offshore Drilling and Production Platforms	Quiz	Data Collection and Programming	15 Periods	
Topics: Floating offshore drilling units- introduction to Mobile offshore drilling units, semisubmersible, Drill ships; Floating offshore production units: Floating production systems (FPS) structures- Semisubmersibles, SPARS, Conventional TLP, Mini TLP; Floating storage and offloading (FSO) systems- Ship shaped vessels; Floating production systems (FPS)- Ship/barge;, Mooring systems, Dynamic positioning system.					
Module 4:	Offshore Production Facilities	Assignment	Literature Survey and Group Discussion	09 Periods	
Topics: Oil and Gas Separation, Treatment of Oil, Treatment of Gas, Treatment of Produced, Water, Storage of Oil and, Gas, Transportation of Oil and Gas .					
Targeted Application and Tools that can be used: Application: Offshore Drilling / Production / Structural / Pipeline Engineer in Oil and Gas Industry Tools: Marine Riser, Riser Tensioner, Engineer's Desktop (Landmark Halliburton software), Petrel					
Text Book: T1. S. Chakrabarti, "Handbook of Offshore Engineering", Volume 1 and 2, Elsevier (2005) . T2. S. Laik "Offshore Petroleum Drilling and Production" CRC Press, Taylor and Francis, 2018					
References: R1. The Technology of Offshore Drilling: Completion and Production ETA Offshore Seminars, Inc R2. Dr. Ignatius Louis Prashanth , Onshore Gas Drilling Hardcover – 1 January 2022 **E-resources:** 1. Presidency University e-Resource: https://puniversity.informaticsglobal.com/login 2. Basics of Soil Mechanics I https://nptel.ac.in/courses/114/106/114106015/ 3. Offshore Structures Under Special Loads Including Fire Resistance https://nptel.ac.in/courses/114/106/114106043/					
Topics relevant to "**SKILL DEVELOPMENT**": Bottom Supported structures- Minimal platforms and Jacket structures for **Skill Development** through **Problem Solving** methodologies. This is attained through assessment component mentioned in course handout.					

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Catalogue prepared by:	Dr. Suman Paul, Dr. Deepjyoti Mech, Dr. Kalpajit Hazarika, Mr. Bhairab Jyoti Gogoi, Mr. Anmol Bhargava, Mr. Sugat Srivastava
Recommended by the Board of Studies on:	14th Meeting of the Board of Studies held on 27th July 2022
Date of Approval by the Academic Council:	18th Meeting of the Academic Council held on 3rd August 2022

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Course Code: **PET3006**	**Course Title:** **Advanced Petroleum Reservoir Engineering** **Type of Course:** **1] Core Course** **2] Theory Only**		**L-T-P-C**	3	0	3
Version No.:	1.0				
Course Pre-requisites:	1] PET 2004 – Fundamentals of Reservoir Engineering 2] PET 3005 – Fluid Flow through Porous Media				
Anti-requisites:	NIL				
Course Description:	The purpose of this course is to provide the practical application of the concepts like MBE and GOR equations in predicting the oil reservoir performance under different scenarios of drive mechanisms as well as in depth study of water influx models, immiscible displacement and reservoir management concepts. This course is both conceptual and analytical in nature and requires good knowledge of mathematics and programming. The course also enhances the programming skills of the students through different assignments.				
Course Objective:	The objective of the course is to familiarize the learners with the concepts of Advanced Petroleum Reservoir Engineering and attain **Skill Development** through **Problem Solving** techniques.				
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: interpret different Water influx models, CO2: explain immiscible drive mechanism for Improved Oil Recovery through water and gas flooding, CO3: compute different natural drive indices in a combination drive in an oil reservoir, CO4: discuss the reservoir management concepts.				
Course Content:					
Module 1:	Water Influx	Assignment	Programming	09 Periods	
Topics: Classification of Aquifers: Degree of Pressure Maintenance, Aquifer Boundary, Flow Regimes, Flow Geometry, Water Influx Models: Steady state models – Pot Aquifer, Schilthuis; Pseudo steady State model – Fetkovich; Unsteady State Models – van Everdingen and Hurst.					
Module 2:	Improved Oil Recovery and Immiscible Displacement	Case Study	Simulation	09 Periods	
Topics: Secondary Recovery Techniques, Water Flooding: Factors, Procedure, Patterns. Recovery Efficiencies, Frontal Displacement and Advancement Theories.					
Module 3:	Oil Reservoir Performance	Assignment	Programming	09 Periods	
Topics: Reservoir Performance Prediction: Instantaneous GOR, Reservoir Saturation Equations, Undersaturated Oil Reservoir, Saturated Oil Reservoir, Tracy's Method. Oil Well Performance: Inflow Performance Relationship, Vogel's Equation. Relating Reservoir Performance with Time.					
Module 4:	Introduction to Reservoir Management	Term paper	Class Presentation	09 Periods	
Topics: Reservoir Management: Definition, History, Concept. Reservoir Management Process: Setting Goals, Developing Plans, Economic Implementation. Reservoir Management Economics: Time Value of Money, NPV, IRR					
Targeted Application and Tools that can be used: Application Areas: Waterflooding, Reservoir performance prediction 1] MBal (Software package) 2] CMG – IMEX (Software Package)					
Text Book: T1: Dake L. P. "Fundamentals of Reservoir Engineering", 17th Impression, Elsevier.					
References: R1: Ahmed, T., "Advanced Reservoir Engineering and Management" Elsevier. R2: Ahmed, T., "Reservoir Engineering Handbook", Elsevier. R3: Archer, J.S., Wall, C.G., "Petroleum Engineering Principles and Practice" Graham and Trotman Inc. **E-resources:** 1. Presidency University e-access portal:https://presiuniv.knimbus.com/user#/home 2. Reservoir Engineering Analyses : https://www.youtube.com/watch?v=NBJC_KVo4Ug 3. Advanced Petroleum Reservoir Engineering https://www.youtube.com/watch?v=m9PLxDOu5WI					
Topics relevant to "**SKILL DEVELOPMENT**": Water Influx Models: Steady state models – Pot Aquifer, Schilthuis for **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.					
Catalogue prepared by:	Dr. Kalpajit Hazarika, Mr. Bhairab Jyoti Gogoi, Mr. Indraneel Agasty, Mr. Anmol Bhargava, Mr. Sugat Srivastava				

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PRESIDENCY UNIVERSITY Registrar BANGALORE

Recommended by the Board of Studies on:	11th Meeting of the Board of Studies held on 5th September 2020
Date of Approval by the Academic Council:	13th Meeting of the Academic Council held on 6th November 2020

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(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

Course Handout AY: 2022-2023

Date of Issue: 23-01-23

School	:	School of Engineering
Department	:	Department of Petroleum Engineering
Name of the Program	:	B.Tech. in Petroleum Engineering
P.R.C. Approval Ref.	:	PU/AC-18.5/PET14/2020-24
Semester / Year	:	VI Sem / 3rd Year
Course Code / Title	:	PET3006 / Advanced Petroleum Reservoir Engineering
Course Credit Structure	:	3L – 0P – 3C
Contact Hours	:	40 (L)
Course Instructor In-charge	:	Dr. Deepjyoti Mech
Course Instructor	:	Dr. Deepjyoti Mech
Course URL of Edhitch	:	

Program Outcomes (POs):

B. Tech. Program in Petroleum Engineering is designed to prepare graduates to attain following Program Outcomes:

PO1: **Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**

PO2: **Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**

PO3: **Design / Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.**

PO4: **Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.**

PO5: **Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.**

PO6: **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.**

PO8: **Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.**

PO9: **Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.**

PO10: **Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.**

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Prerequisites:

NIL

Course Description:

The purpose of this course is to provide the practical application of the concepts like MBE and GOR equations in predicting the oil reservoir performance under different scenarios of drive mechanisms as well as in depth study of water influx models, immiscible displacement and reservoir management concepts. This course is both conceptual and analytical in nature and requires good knowledge of mathematics and programming. The course also enhances the programming skills of the students through different assignments.

Course Objective:

The objective of the course is to familiarize the learners with the concepts of Advanced Petroleum Reservoir Engineering and attain **Skill Development** through **Problem Solving** techniques.

Course Outcomes (COs):

On successful completion of the course the students shall be able to:
1] Interpret different Water influx models.
2] Explain immiscible drive mechanism for Improved Oil Recovery through water and gas flooding.
3] Compute different natural drive indices in a combination drive in an oil reservoir.
4] Discuss the reservoir management concepts.

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	H	M	M	L	L		L	L	L	H	L	L
CO2	H	H	M	L	L		L	L	L	H	L	L
CO3	H	H	L	M	M		M	M	M	H	M	M
CO4	H	H	L	M	M		H	M	M	H	M	L
H = High, M = Moderate, L = Low												

Course Content (Syllabus):

Module 1: Water Influx [9 Classes] – Application Level

Classification of Aquifers: Degree of Pressure Maintenance, Aquifer Boundary, Flow Regimes, Flow Geometry, Water Influx Models: Steady state models – Pot Aquifer, Schilthuis; Pseudo steady State model – Fetkovich; Unsteady State Models – van Everdingen and Hurst.

Module 2: Improved Oil Recovery and Immiscible Displacement [9 Classes] – Comprehension Level

Secondary Recovery Techniques, Water Flooding: Factors, Procedure, Patterns. Recovery Efficiencies, Frontal Displacement and Advancement Theories.

Module 3: Oil Reservoir Performance [9 Classes] – Application Level

Reservoir Performance Prediction: Instantaneous GOR, Reservoir Saturation Equations, Undersaturated Oil Reservoir, Saturated Oil Reservoir, Tracy's Method. Oil Well Performance: Inflow Performance Relationship, Vogel's Equation. Relating Reservoir Performance with Time

Module 4: Introduction to Reservoir Management [9 Classes] – Comprehension Level

Reservoir Management: Definition, History, Concept. Reservoir Management Process: Setting Goals, Developing Plans, Economic Implementation. Reservoir Management Economics: Time Value of Money, NPV, IRR

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Delivery Procedure (Pedagogy):

This is a theory based course. All the lectures will be taken with the help of Power Point Presentations and Lecture. Videos will be shown for the better understanding of selective topics. Assignments will be given to each student. Some topics related the course will be given to the students and students has to go through the existing work related to the topic and prepare a presentation on it. This presentation has to be presented and discussed in groups. Self-learning topics will be given to students. Students need to go through these topics before the respective topics are taught in class for better understanding. Report Submission, Quiz Competition, Poster Presentation, and Group Discussion will carry 20% weightage under Continuous Internal Assessment (CA). Review classes will be conducted to clear doubts and to evaluate the level of understanding of each student individually.

Following procedures will be adopted in the course for delivering the content:

(a) Self Learning Topics (SLT):

- Types of Aquifer. (Module -I)
- Secondary Recovery Technique. (Module -II)

(b) Experiential Learning Topics (ELT): Any one of the following activities will be conducted:

-Article Review [Foundation/Skill Development]

(1) History and Development of MBE (Team Activity)
(2) Decline Curve Analysis (Team Activity)

(c) Participative Learning Topics (PLT): Any one of the following activities will be conducted:

- Quiz[Skill Development]

(d) Problem Based Learning Topics (PBLT):

- Presentation on Reservoir Management Process

Reference Materials:

Text Book:

T1. Dake L. P. "Fundamentals of Reservoir Engineering", 17th Impression, Elsevier.
T2. Meehan, D.N., 2012. Advanced Reservoir Management and Engineering. Gulf Professional.

References:

R1. Ahmed, T., "Advanced Reservoir Engineering and Management" Elsevier.
R2. Ahmed, T., "Reservoir Engineering Handbook", Elsevier.
R3. Archer, J.S., Wall, C.G., "Petroleum Engineering Principles and Practice" Graham and Trotman Inc.

e-resources:

1. Presidency University e-access portal:https://presiuniv.knimbus.com/user#/home
2. Reservoir Engineering Analyses : https://www.youtube.com/watch?v=NBJC_KVo4Ug
3. Advanced Petroleum Reservoir Engineering https://www.youtube.com/watch?v=m9PLxDOu5WI

Guideline to Students:

(a) About the Course:

This course deals with various concepts for evaluating reservoir. The course will introduce methods to predict performance of oil and gas reservoir. The course is both theoretical and problem solving. It develops the critical thinking and analytical skills in students. The course also enables the students to develop basic financial planning skills through assignments.

(b) Notification / Announcement related to the Course:

All the course related notifications will be displayed on the Department Notice Board or the same will be shared through email/ Whatsapp. All the announcements will be made during the regular lecture hours as well.

(c) Academic Regulation

The students are advised to download the 'Academic Regulations, 2021', Regulation No. PU/AC-15/10/06_2021, from Presidency University, Bengaluru website (https://presidencyuniversity.in/wp-content/uploads/2022/09/Academic-Regulations-2021.pdf) and go through the Section Nos. 1.0 through 25.0.

Course Schedule:

Module-wise Macro Level planning for course delivery schedule is provided below:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods

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01	Overview of the Program and Course			1
02	Module I			9
03	Module II			9
04	Continuous Assessment: Assignment 1 on Module 1 and Module 2			-
05	Discussion of Mid Term Exam Question Pattern			1
06	Mid Term Exam			-
07	Discussion of Mid Term Exam Questions and Answers			1
08	Module III			9
09	Module IV			9
10	Continuous Assessment: Assignment 2 on Module 3 and Module 4			-
11	Course Integration			1
12	Discussion of End Term Exam Question Pattern			1
13	End Term Exam			-
14	Discussion of End Term Exam Questions and Answers			-

Schedule of Instruction:

Module-wise Micro Level planning for course delivery schedule is provided below:

Sl. No.	Session No. / Date	Lesson Title	Topics	Course Outcome Number	Delivery Mode	Reference
1	L01	Overview of the Program and Course	Overview of the Program and Course	-	PowerPoint Presentation	N/A
Module I						
2	L02	**Water Influx**	Classification of Aquifers:	CO1	Lecture and PowerPoint Presentation	Class Notes
3	L03		Degree of Pressure Maintenance,	CO1	PowerPoint Presentation / Videos	CN
4	L04		Aquifer Boundary,	CO1	PowerPoint Presentation / Videos	T1 / CN
5	L05		Flow Regimes,	CO1	PowerPoint Presentation / Videos	T1 / CN
6	L06		Flow Geometry,	CO1	PowerPoint Presentation / Videos	T1 / CN
7	L07		Water Influx Models: Steady state models –	CO1	Lecture & presentation	T1 / CN
8	L08		Pot Aquifer, Schilthuis;	CO1	Lecture & Presentation	CN
9	L09		Pseudo steady State model – Fetkovich;	CO1	Lecture & Presentation	CN
10	L10		Unsteady State Models – van Everdingen and Hurst.	CO1	Lecture & Presentation	CN
	CA01		Continuous Internal Assessment-1			

Module II						
11	L11	**Improved Oil Recovery and Immiscible Displacement**	Secondary Recovery Techniques,	CO2	PowerPoint Presentation / Videos	CN
12	L12			CO2		T1 / CN
13	L13			CO2		T1 / CN
14	L14		Water Flooding: Factors, Procedure, Patterns.	CO2	Lecture & Presentation	CN
15	L15			CO2	Lecture & Presentation	CN
16	L16			CO2	Lecture & Presentation	T1 / CN
17	L17		Recovery Efficiencies	CO2	Lecture & Presentation	T1 / CN
18	L18			CO2	Lecture & Presentation	CN
19	L19		Frontal Displacement and Advancement Theories	CO2	Lecture & Presentation	T1 / CN
20	L20			CO2	PowerPoint Presentation	N/A
21	L21			CO2	PowerPoint Presentation	N/A
	CA02		Continuous Internal Assessment-2			
Module III						
22	L22	**Oil Reservoir Performance**	Reservoir Performance Prediction: Instantaneous GOR	CO3	Lecture & Presentation	T1 CH17 / CN
23	L23			CO3	Lecture & Presentation	T1 CH17 / CN
24	L24		Reservoir Saturation Equations	CO3	Lecture & Presentation	T1 CH17 / CN
25	L25		Undersaturated Oil Reservoir	CO3	Lecture & Presentation	T1 CH17 / CN
26	L26		Saturated Oil Reservoir	CO3	Lecture & Presentation	T1/ CN
27	L27		Tracy's Method	CO3	Lecture & Presentation	CN
28	L28		Oil Well Performance: Inflow Performance Relationship,	CO3	Lecture & Presentation	CN
29	L29		Vogel's Equation.	CO3	Lecture & Presentation &Video	CN
30	L30		Relating Reservoir Performance with Time.	CO3	Lecture & Presentation	CN
Module IV						
31	L31	**Introduction to Reservoir Management**	Reservoir Management: Definition, History, Concept.	CO4	PowerPoint Presentation	T1/ CN
32	L32		Reservoir Management Process: Setting Goals	CO4	PowerPoint Presentation	T1/ CN
33	L33		Developing Plans	CO4	PowerPoint Presentation / Videos	T1 CH18 / CN
34	L34		Economic Implementation	CO4	PowerPoint Presentation	CN
35	L35			CO4	PowerPoint Presentation	CN

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36	L36		Reservoir Management Economics: Time Value of Money, NPV, IRR	CO4	Lecture & Presentation	T1 CH18 / CN
37	L37			CO4	Lecture & Presentation	CN
38	L38			CO4	Lecture & Presentation &Video	CN
39	L39			CO4	Lecture & Presentation &Video	CN
	CA03		Continuous Assessment: Assignment 2 on Module 3 & Module 4	CO4	N/A	N/A
40	L40	Course Integration	Course Integration	CO1 through CO4	PowerPoint Presentation	N/A
41	L41	-	Discussion of End Term Exam Questions and Answers	CO3 and CO4	PowerPoint Presentation	N/A
			End Term Exam	CO1 through CO4	N/A	N/A
			Discussion of End Term Exam Questions and Answers	CO1 through CO4	PowerPoint Presentation	N/A

Topics relevant to "**SKILL DEVELOPMENT**": Water Influx Models: Steady state models – Pot Aquifer, Schilthuis for **Skill Development** through **Problem Solving methodologies**. This is attained through the Assignment as mentioned in the assessment Schedule.

Assessment Schedule:

Module-wise Micro Level planning for course assessment schedule is provided below:

Sl. No.	Assessment Type	Contents	Course Outcome Number	Duration in Hours	Marks	Weightage	Venue, Date, and Time (Date may Change)
01	CA: Assignment 1: Literature Review – "Submission of e-resource Review Report along with a Screenshot of the Student visiting the e-resource" (Review of Digital/e-resources from Presidency University link (https://puniversity.informaticsglobal.com/login). It is mandatory to submit a screenshot of accessing digital resources, otherwise, it will not be evaluated.) Numerical problem solving on water influx.	Module 1 & Module 2	CO1 and CO2	-	10	5%	
02	Mid Term Exam	Module 1 and Module 2	CO1 and CO2		60	30%	
03	CA: Assignment 2: Quiz	Module 3 and Module 4	CO3 and CO4	-	20	10%	

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04	CA: Assignment 2: Poster	Module 3 and Module 4	CO3 and CO4	-	10	5%	
05	End Term Exam	Module 1 through Module 4	CO1 through CO4		100	50%	-

Course Clearance Criteria:

The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website and go through the Section Nos. 1.0 through 24.0. Website: https://presidencyuniversity.in/university-document/. The students may consult with the Course Instructor, Instructor In-Charge, Class Coordinator, and Head of the Department, for further assistance.

Minimum requirements for clearing any Course are mentioned below:

- **Minimum Attendance Requirement:**
  The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website and refer to Section No. 7.0.
- **Academic Performance Evaluation and Grading System:**
  The students are advised to download the 'Academic Regulations, 2020', Regulation No. PU/AC-13/16/11_2020, from Presidency University, Bengaluru website and refer to Section No. 8.0.
- **Make-up Exam Policy:**
  If any student misses an evaluation component, he/she may be granted a make-up. In case of an absence that is foreseen, the make-up request should be personally made to the Instructor In-Charge, well ahead of the scheduled evaluation component. Reasons for unanticipated absences that qualify a student to apply for make-up include medical emergencies or personal exigencies. In such an event, the student should contact the Instructor In-Charge as soon as practically possible.

Contact Timings in the Chamber for any Discussion:

Students may meet the Course Instructor either during the Chamber Consultation Hour (CCH) as mentioned in their respective Section Time Table or take a prior appointment for the consultation. Students may clear their doubts from the Course Instructor during CCH.

Sample Thought Provoking Questions:

Sl. No.	Question	Marks	Course Outcome No.	Bloom's Level
1.	The pressure history of water drive oil reservoir is given below: **t (days) p(psi)** 0 4000 120 3950 220 3910 320 3880 420 3840 The aquifer is under steady-state flowing condition with an estimated water influx constant of 80 bbl/day/psi. Using the steady state model, calculate and plot the cumulative water influx as a function of time	10	CO1	Comprehension
2.	What annual compounded interest rate is being paid on a $500 loan if the lender requires it to be repaid with five equal end-of-year payments of $115.49?	10	CO4	Comprehension

Target Set for Course Outcome attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage
1	CO1	Interpret different Water influx models.	35

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2	CO2	Explain immiscible drive mechanism for Improved Oil Recovery through water and gas flooding	35
3	CO3	Compute different natural drive indices in a combination drive in an oil reservoir	35
4	CO4	Discuss the reservoir management concepts	35

Signature of the Course Instructor In-charge:

Signature of the Course Instructor:

This course has been duly verified and approved by the D.A.C.

Signature of the Chairperson D.A.C.:

Course Completion Remarks and Self-Assessment:

Sl. No.	Activity as listed in the Course Schedule	Scheduled Completion date	Actual Completion Date	Remarks
1	**Continuous Internal Assessment: 1** – Literature Survey Literature Review of Digital/e-resources from Presidency University link shared below. It is mandatory to submit a screenshot accessing digital resources, otherwise, it will not be evaluated. Link to Presidency University e-resources: https://presiuniv.knimbus.com			
2	**Continuous Internal Assessment** 2: Quiz			
3	Mid Term Examination			
4	**Continuous Internal Assessment 3**: Poster presentation			

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5	**Continuous Internal Assessment 4**: Seminar			
6	End term Final Examination			

Any Specific Suggestion / Observation on Content / Coverage / Pedagogical Methods:

Course Outcome Attainment:

Sl. No.	CO No.	Course Outcome	Target Set for Attainment in Percentage	Actual CO Attainment in Percentage	Remarks on Attainment and Measures to Enhance the Attainment
1	CO1	Interpret different Water influx models.	35		
2	CO2	Explain immiscible drive mechanism for Improved Oil Recovery through water and gas flooding	35		
3	CO3	Compute different natural drive indices in a combination drive in an oil reservoir	35		
4	CO4	Discuss the reservoir management concepts	35		

Name and Signature of the Course Instructor: Mr. Utkarsh Lall

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D.A.C. Observation and Approval:

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DEPARTMENT OF PETROLEUM ENGINEERING

Ref. No.: PU/SOE/PET/SD/PIC/2022-23/CIR/01 Date: 01/05/2023

Circular

Academic Year: 2022 – 2023 **Course:** PET2005 **Semester:** 4th

Dear students of 4PET-1,

It is to inform you all that a "Experiential Learning" activity for the course **PET2005 Fundamental of Instrumentation and Control Engineering** is schedule on 05/05/2023, from 9:00 AM to 10:50AM (OFFLINE MODE).

It is mandatory for all the student to remain present during the activity session and take part in numerical solving.

Dr. Sourav Mukherjee

Instructor In-charge

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ANNEXURE-I

Sl. No.	ID No.	Student Name
1	20211PET0001	MOHAMED SAADULLAH S
2	20211PET0002	ROSHAN T
3	20211PET0003	SYED LUQMAN J
4	20211PET0004	BELIM MOH SAAD MOHAMMEDBHAI
5	20211PET0005	MOHAMMAD SUHAIL
6	20211PET0008	VANKALA JAI SPHOORTHI
7	20211PET0009	AFEEZ
8	20211PET0010	HITHESH T
9	20211PET0011	GANUGA ROSHAN
10	20211PET0012	MOHAMED NAIF NIHAD ALI
11	20211PET0013	DEEPAK JADHAV
12	20211PET0014	DARSHAN D P
13	20211PET0015	MOHAMMAD YASIR BYAKOD
14	20211PET0016	ASMA THASNIM
15	20211PET0017	IBRAHIM NAWAZ M
16	20211PET0018	SANDEEP IYAGAR
17	20211PET0019	KIRAN EKIRAN
18	20211PET0020	YASHWANTH GOWDA M
19	20211PET0021	MAYUR P
20	20211PET0022	YASHWANTH S
21	20211PET0023	MOHAMMED SHABAZ KHALANDER D
22	20211PET0024	BOLLAMA REDDY HIMAVENKATA MANKANTHA
23	20211PET0025	FAZIL SHAREEF H A
24	20211PET0026	PATEL MOHAMMED ADNAN MOHAMMED GOUS
25	20211PET0027	SYED USMAN
26	20211PET0028	ZOYA FALAK
27	20201PET0027	YARRAMSETTI CHAITANYA SRI
28	20191PET0050	SHAIK GOUSPEER VALI
29	20221LPE0001	SHAIK TABISH RIYAZAHMED

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REPORT ON EXPERIENTIAL LEANING

Circular Date and No.	Dt: 01/05/2023 PU/SOE/PET/SD/PIC/2022-23/CIR/01	**Date of Event**	05.05.2023
Type of learning	Skill development	**Event Type:**	Experiential Learning
Mode of Event:	Offline	**No. of Participant(s):**	29
Course Code/Course Name	PET2005 FUNDAMENTAL OF INSTRUMENTATION AND CONTROL ENGINEERING		
Department	Department of Petroleum Engineering		
Instructor In charge	Dr. Sourav Mukherjee Assistant Professor, Department of Petroleum Engineering		

Event objective	The event was conducted to test the knowledge of students on the topic related to the experiential learning in petroleum industry with a primary objective of improving the understanding of students through experiments.
Topic discussed	Different experiments based on Fundamental of Instrumentation and Process Control Concepts
Outcome of the event	i. Improvement in understanding of theory concepts. ii. Improvement in students' ability to be more observant and inquisitive.
Assessment	i. Type of Assessment: Experiential learning ii. Task Assigned:

Grp. No.	ID No.	Student Name	Topic for Experiment
1	20211PET0001	MOHAMED SAADULLAH S	CALIBRATION OF THERMOCOUPLE
	20211PET0002	ROSHAN T	
	20211PET0003	SYED LUQMAN J	
	20211PET0004	BELIM MOH SAAD MOHAMMEDBHAI	
	20211PET0005	MOHAMMAD SUHAIL	
	20211PET0008	VANKALA JAI SPHOORTHI	
2	20211PET0009	AFEEZ	SINGLE TANK SYSTEM
	20211PET0010	HITHESH T	
	20211PET0011	GANUGA ROSHAN	

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	20211PET0012	MOHAMED NAIF NIHAD ALI	
	20211PET0013	DEEPAK JADHAV	
	20211PET0014	DARSHAN D P	
	20211PET0015	MOHAMMAD YASIR BYAKOD	
3	20211PET0016	ASMA THASNIM	NON-INTERACTING SYSTEM
	20211PET0017	IBRAHIM NAWAZ M	
	20211PET0018	SANDEEP IYAGAR	
	20211PET0019	KIRAN EKIRAN	
	20211PET0020	YASHWANTH GOWDA M	
	20211PET0021	MAYUR P	INTERACTING AND NON INTERACTING SYSTEM
	20211PET0022	YASHWANTH S	
	20211PET0023	MOHAMMED SHABAZ KHALANDER D	
	20211PET0024	BOLLAMA REDDY HIMAVENKATA MANKANTHA	
4	20211PET0018	SANDEEP IYAGAR	MANOMETER
	20211PET0019	KIRAN EKIRAN	
	20211PET0020	YASHWANTH GOWDA M	
	20211PET0021	MAYUR P	
	20211PET0022	YASHWANTH S	
5	20211PET0025	FAZIL SHAREEF H A	FLUID FLOW CONTROLLER
	20211PET0026	PATEL MOHAMMED ADNAN MOHAMMED GOUS	
	20211PET0027	SYED USMAN	
	20211PET0028	ZOYA FALAK	
	20201PET0027	YARRAMSETTI CHAITANYA SRI	
	20191PET0050	SHAIK GOUSPEER VALI	
	20221LPE0001	SHAIK TABISH RIYAZAHMED	

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Event photo

Attendance sheet

Sl. No.	ID No.	Student Name	Attendance
1	20211PET0001	MOHAMED SAADULLAH S	P
2	20211PET0002	ROSHAN T	P
3	20211PET0003	SYED LUQMAN J	P
4	20211PET0004	BELIM MOH SAAD MOHAMMEDBHAI	P
5	20211PET0005	MOHAMMAD SUHAIL	P
6	20211PET0008	VANKALA JAI SPHOORTHI	P
7	20211PET0009	AFEEZ	P
8	20211PET0010	HITHESH T	P
9	20211PET0011	GANUGA ROSHAN	P

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		10	20211PET0012	MOHAMED NAIF NIHAD ALI	P
		11	20211PET0013	DEEPAK JADHAV	P
		12	20211PET0014	DARSHAN D P	P
		13	20211PET0015	MOHAMMAD YASIR BYAKOD	A
		14	20211PET0016	ASMA THASNIM	P
		15	20211PET0017	IBRAHIM NAWAZ M	P
		16	20211PET0018	SANDEEP IYAGAR	P
		17	20211PET0019	KIRAN EKIRAN	P
		18	20211PET0020	YASHWANTH GOWDA M	P
		19	20211PET0021	MAYUR P	P
		20	20211PET0022	YASHWANTH S	P
		21	20211PET0023	MOHAMMED SHABAZ KHALANDER D	P
		22	20211PET0024	BOLLAMA REDDY HIMAVENKATA MANKANTHA	P
		23	20211PET0025	FAZIL SHAREEF H A	P
		24	20211PET0026	PATEL MOHAMMED ADNAN MOHAMMED GOUS	P
		25	20211PET0027	SYED USMAN	P
		26	20211PET0028	ZOYA FALAK	P
		27	20201PET0027	YARRAMSETTI CHAITANYA SRI	P
		28	20191PET0050	SHAIK GOUSPEER VALI	P
		29	20221LPE0001	SHAIK TABISH RIYAZAHMED	P

Signature of Instructor In charge
Dr. Sourav Mukherjee
Assistant Professor
Department of Petroleum Engineering

Dr. Suman Paul
Professor and Head
Department of Petroleum Engineering

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DEPARTMENT OF PETROLEUM ENGINEERING

Ref. No.: PU/SOE/PET/SD/HMTPE/2022-23/CIR/01 Date: 11/10/2022

Circular

Academic Year: 2022 – 2023 **Course:** PET2008 **Semester:** 6th

Dear students of 6PET-1,

It is to inform you all that a "Experiential Learning" activity for the course **PET2008 Heat and Mass Transfer for Petroleum Engineering** is schedule on 18/10/2022, from 9:00 AM to 10:40 AM (OFFLINE MODE).

It is mandatory for all the student to remain present during the activity session and take part in numerical solving.

Dr. Abhinav Kumar
Instructor In-charge

REGISTRAR

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REPORT ON EXPERIENCIAL LEANING

Circular Date and No.	Dtd: 11/10/2022 PU/SOE/PET/SD/HMTPE/2022-23/CIR/01	**Date of Event**	18.10.2022
Type of learning	Skill development	**Event Type:**	Experiential Learning
Mode of Event:	Offline	**No. of Participant(s):**	27
Course Code/Course Name	PET2008 Heat and Mass Transfer for Petroleum Engineering		
Department	Department of Petroleum Engineering		
Instructor In charge	Dr. Abhinav Kumar Assistant Professor, Department of Petroleum Engineering		

Event objective	The event was conducted to test the knowledge of students on the topic related to the experiential learning in petroleum industry with a primary objective of improving the understanding of students through experiments.
Topic discussed	Different experiments based on Heat Transfer Concepts
Outcome of the event	i. Improvement in understanding of theory concepts. ii. Improvement in students' ability to be more observant and inquisitive.
Assessment	i. Type of Assessment: Experiential learning ii. Task Assigned:

Grp. No.	ID No.	Student Name	Topic for Experiment
1	20201PET0001	Sohael K S	Computer controlled heat transfer through composite wall
	20201PET0004	Rachan Balakrishna Shetty	
	20201PET0006	Praveen B	
	20201PET0008	Nallabhotula Dushyanth	
2	20201PET0033	Shekar	Parallel/ Counter flow heat transfer
	20201PET0010	Pradeep Kumar Rathod	
	20201PET0011	A M Rizwan	
	20201PET0012	Mohammed Shazan	
	20201PET0014	Zaheed Ahmed	
3	20201PET0015	Mujtba Aamir Ahmed	Emissivity Measurement
	20201PET0031	Bandla Hareesh	

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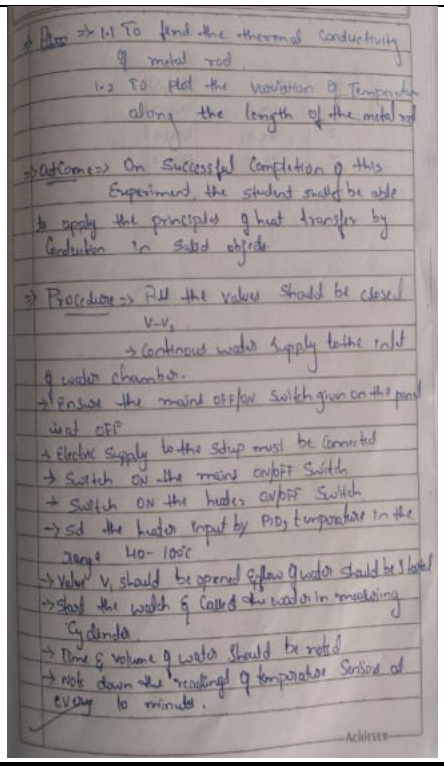
	20201PET0018	Nuthan M S	
	20201PET0019	Pranav A	
	20201PET0021	R Janardhan Reddy	
4	20201PET0022	Mohammed Shadim D K	Heat transfer in forced convection
	20201PET0023	Prathivraj S	
	20201PET0026	Ajmal Akbar Babu	
	20201PET0030	Aqib Ahmed Sharieef	
	20201PET0016	Sidharth Murli	
5	20201PET0009	Kotishwaran V	Thermal conductivity of metal rod
	20201PET0034	Kommineni Hemanth	
	20201PET0029	Pavan Goud	
	20201PET0017	Bhoomika Satish	
6	20191PET0011	Fayaz Pasha	Unsteady heat transfer
	20211LPE0001	Muhammed Swalih V P	
	20191PET0009	C S Nishant	
	20201PET9001	Mohammed Shahid	

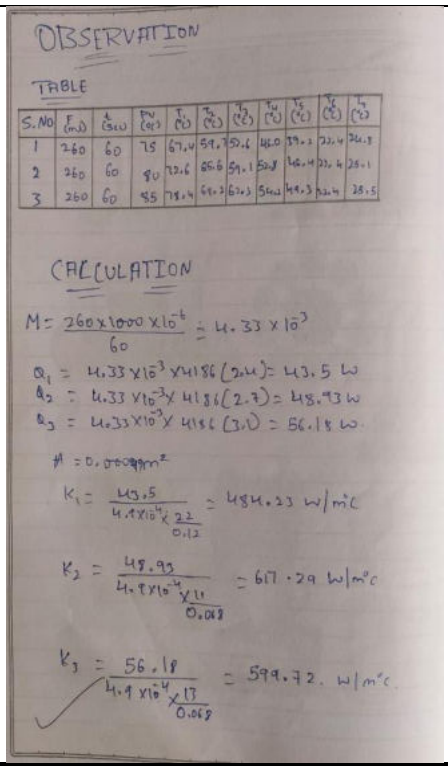
iii. Sample answers by students:



Aim => 1.1 To find the thermal conductivity of metal rod.
1.2 To plot the variation of Temperature along the length of the metal rod

=> Outcome => On successful completion of this Experiment, the student shall be able to apply the principles of heat transfer by Conduction in solid objects

=> Procedure => All the valves should be closed V-V,
→ Continuous water supply to the inlet of water chamber.
→ Ensure the main off/on switch given on the panel is at OFF
→ Electric supply to the setup must be connected
→ Switch on the main ON/OFF switch
→ Switch ON the heater ON/OFF switch
→ Set the heater input by PID, temperature in the range 40-100°C
→ Valve V, should be opened & flow of water should be started
→ Start the watch & collect the water in measuring cylinder.
→ Time & volume of water should be noted
→ note down the readings of temperature sensor at every 10 minutes.



OBSERVATION

TABLE

S.NO	F (ml)	t (sec)	PW (%)	T_1 (°C)	T_2 (°C)	T_3 (°C)	T_4 (°C)	T_5 (°C)	T_6 (°C)	T_7 (°C)
1	260	60	75	67.4	59.7	50.6	46.0	39.2	32.4	26.8
2	260	60	80	72.6	66.6	59.1	50.8	46.4	32.4	28.1
3	260	60	85	78.4	69.3	63.3	54.2	49.3	32.4	28.5

CALCULATION

$M = \frac{260 \times 1000 \times 10^{-6}}{60} = 4.33 \times 10^{-3}$

$Q_1 = 4.33 \times 10^{-3} \times 4186 (2.4) = 43.5$ W

$Q_2 = 4.33 \times 10^{-3} \times 4186 (2.7) = 48.93$ W

$Q_3 = 4.33 \times 10^{-3} \times 4186 (3.1) = 56.18$ W

$A = 0.$ [illegible] m^2

$K_1 = \frac{43.5}{4.9 \times 10^{-4} \times \frac{22}{0.12}} = 484.23$ W/m°C

$K_2 = \frac{48.93}{4.9 \times 10^{-4} \times \frac{11}{0.08}} = 617.29$ W/m°C

$K_3 = \frac{56.18}{4.9 \times 10^{-4} \times \frac{17}{0.08}} = 599.72$ W/m°C

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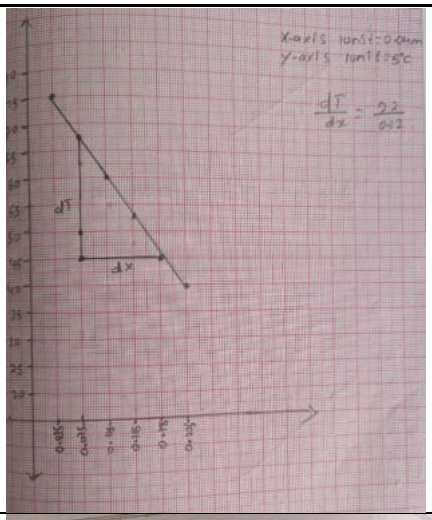
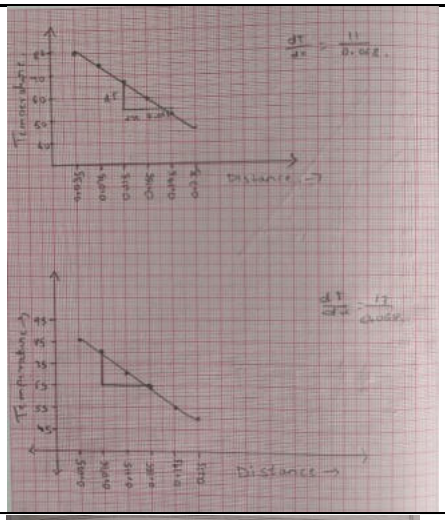
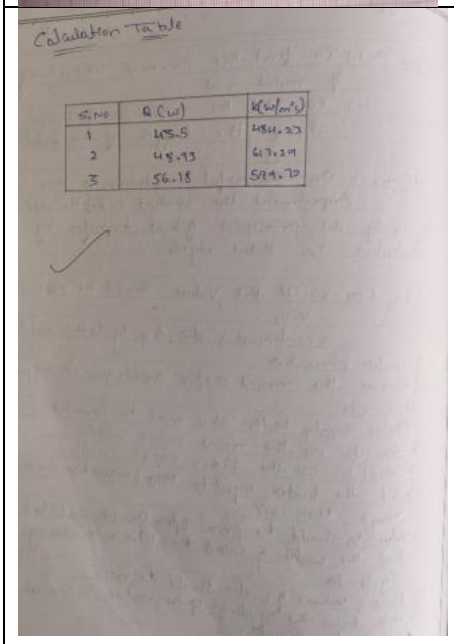
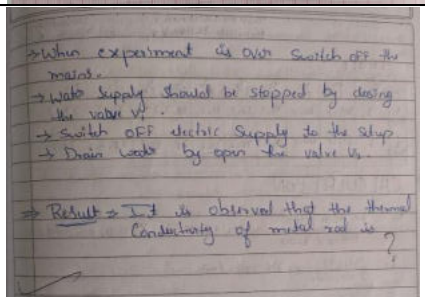






Calculation Table

S.NO	Q (w)	K(w/m²)
1	45.5	484.23
2	48.93	617.29
3	56.18	594.72



→ When experiment is over switch off the mains.
→ Water supply should be stopped by closing the valve V_1.
→ Switch OFF electric supply to the setup.
→ Drain water by open the valve V_2.

⇒ Result ⇒ It is observed that the thermal conductivity of metal rod is ?

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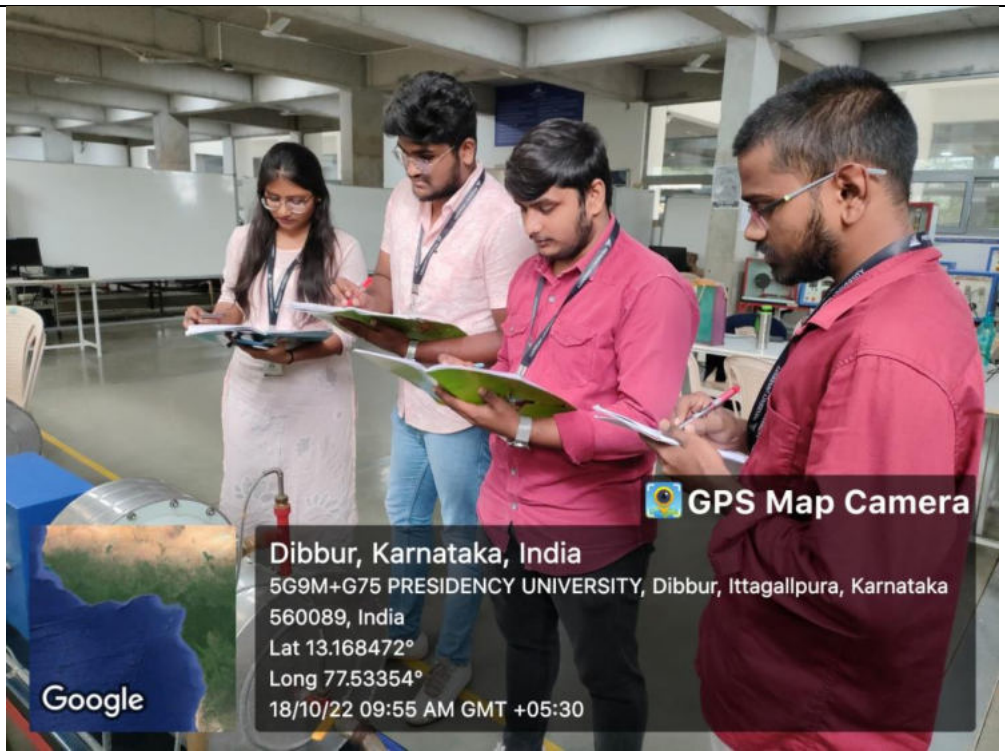
Event photo



Attendance sheet

Sl. No.	ID No.	Student Name	Attendance
1	20201PET0001	Sohael K S	P
2	20201PET0004	Rachan Balakrishna Shetty	P
3	20201PET0006	Praveen B	P
4	20201PET0008	Nallabhotula Dushyanth	P
5	20201PET0009	Kotishwaran V	P
6	20201PET0010	Pradeep Kumar Rathod	P
7	20201PET0011	A M Rizwan	P
8	20201PET0012	Mohammed Shazan	P
9	20201PET0014	Zaheed Ahmed	P
10	20201PET0015	Mujtba Aamir Ahmed	P
11	20201PET0016	Siddharth Murali	P

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		12	20201PET0017	Bhoomika Satish	P
		13	20201PET0018	Nuthan M S	P
		14	20201PET0019	Pranav A	P
		15	20201PET0021	R Janardhan Reddy	P
		16	20201PET0022	Mohammed Shadim D K	P
		17	20201PET0023	Prathivraj S	P
		18	20201PET0026	Ajmal Akbar Babu	P
		19	20201PET0029	Pavan Goud	P
		20	20201PET0030	Aqib Ahmed Sharieef	P
		21	20201PET0031	Bandla Hareesh	P
		22	20201PET0033	Shekar	P
		23	20201PET0034	Kommineni Hemanth	P
		24	20201PET9001	Mohammed Shahid	P
		25	20191PET0009	C S Nishant	P
		26	20191PET0011	Fayaz Pasha	P
		27	20211LPE0001	Muhammed Swalih V P	P

Signature of Instructor In charge
Dr. Abhinav Kumar
Assistant Professor
Department of Petroleum Engineering

Dr. Suman Paul
Professor and Head
Department of Petroleum Engineering

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DEPARTMENT OF PETROLEUM ENGINEERING

Ref. No.: PU/SOE/PET/SD/IOGRS/2022-23/CIR/01 Date: 18/04/2023

Circular

Academic Year : 2022 – 2023 **Course:** PET2010 **Semester:** 6th

Dear students of 6PET-1,

It is to inform you all that a "Experiential Learning" activity for the course **PET 2010 Introduction to Oil and Gas Reservoir Simulation** is schedule on 02/05/2023, from 1:20 PM to 2:10 PM (OFFLINE MODE).

It is mandatory for all the student to remain present during the activity session and take part in the activity

Barasha Deka.

Dr. Barasha Deka

Instructor In-charge

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REPORT ON EXPERIENTIAL LEARNING

Circular Date and No.	Dtd: 18/04/2023 PU/SOE/PET/SD/IOGRS/2022-23/CIR/01	**Date of Event**	02.05.2023
Type of learning	Skill development	**Event Type:**	Experiential Learning
Mode of Event:	Offline	**No. of Participant(s):**	27
Course Code/Course Name	PET2010 Introduction to Oil and Gas Reservoir Simulation		
Department	Department of Petroleum Engineering		
Instructor In charge	Dr. Barasha Deka Assistant Professor, Department of Petroleum Engineering		

Event objective	The event was conducted to test the knowledge of students on the topic related to the experiential learning in petroleum industry with a primary objective of improving the understanding of students through experiments.
Topic discussed	CMG Simulator
Outcome of the event	i. Improvement in understanding of theory concepts. ii. Improvement in students' ability to be more observant and inquisitive.
Assessment	i. Type of Assessment: Experiential learning ii. Task Assigned: Geometric Modelling - Input and Modify model dimensions and geometry as per given conditions iii. Sample answers by students:

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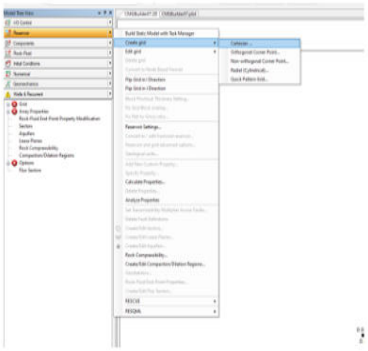
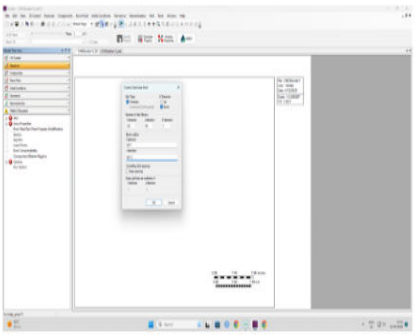
Exp.– Geometric Modelling

Input and Modify model dimensions and geometry as per given conditions

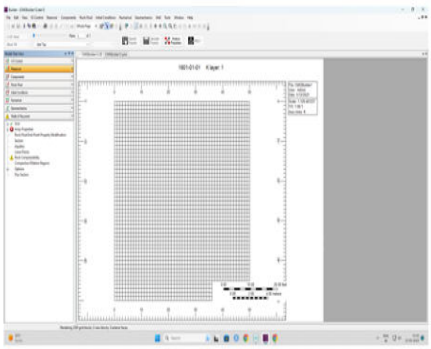


Under*Reservoir>Create Grid>Cartesian.*



We input the values accordingly as shown in the figure above,

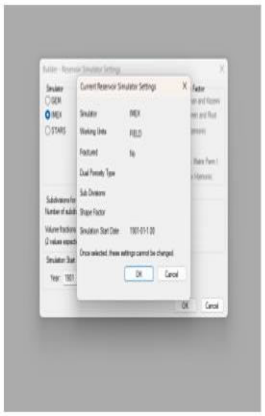
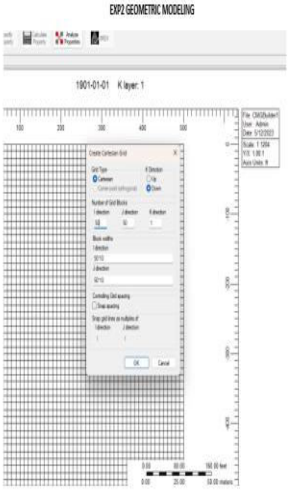
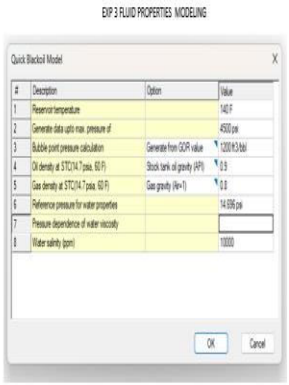
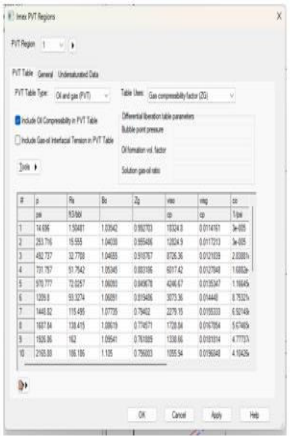
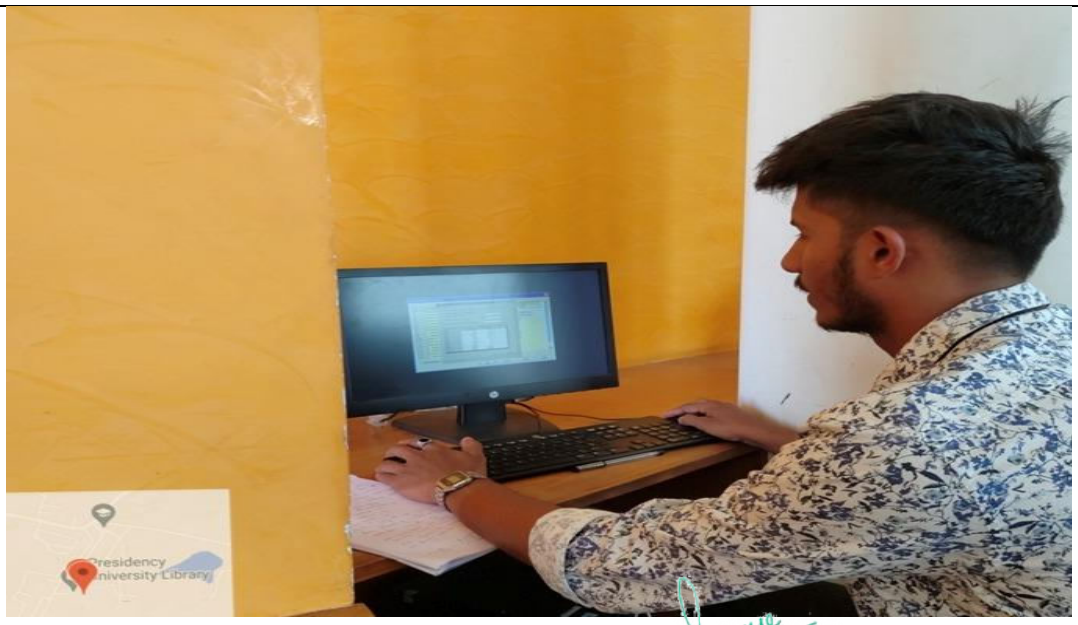
The below Cartesian grid is created



EXP.03 – FLUID PROPERTIES MODELLING

FLUID PROPERTIES THAT CAN BE QUANTIFIED IN A GIVEN SIMULATOR

Select components > Black oil model

	 EXP1 CMG INTRODUCTION   EXP2 GEOMETRIC MODELING  EXP 3 FLUID PROPERTIES MODELING  EXPERIMENT 4 FLUID PROPERTIES MODELING  EXPERIMENT 5 DEFINE POROSITY AND PERMIABILITY
Event photo	

Attendance sheet

Sl. No.	ID No.	Student Name	Attendance
1	20201PET0001	Sohael K S	P
2	20201PET0004	Rachan Balakrishna Shetty	P
3	20201PET0006	Praveen B	P
4	20201PET0008	Nallabhotula Dushyanth	P
5	20201PET0009	Kotishwaran V	P
6	20201PET0010	Pradeep Kumar Rathod	P
7	20201PET0011	A M Rizwan	P
8	20201PET0012	Mohammed Shazan	P
9	20201PET0014	Zaheed Ahmed	P
10	20201PET0015	Mujtba Aamir Ahmed	P
11	20201PET0016	Siddharth Murali	P
12	20201PET0017	Bhoomika Satish	P
13	20201PET0018	Nuthan M S	P
14	20201PET0019	Pranav A	P
15	20201PET0021	R Janardhan Reddy	P
16	20201PET0022	Mohammed Shadim D K	P
17	20201PET0023	Prathivraj S	P
18	20201PET0026	Ajmal Akbar Babu	P
19	20201PET0029	Pavan Goud	P
20	20201PET0030	Aqib Ahmed Sharieef	P
21	20201PET0031	Bandla Hareesh	P
22	20201PET0033	Shekar	P
23	20201PET0034	Kommineni Hemanth	P

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		24	20201PET9001	Mohammed Shahid	P
		25	20191PET0009	C S Nishant	P
		26	20191PET0011	Fayaz Pasha	P
		27	20211LPE0001	Muhammed Swalih V P	P

Barasha Deka.

Signature of Instructor In charge
Dr. Barasha Deka
Assistant Professor
Department of Petroleum Engineering

Paul

Dr. Suman Paul
Professor and Head
Department of Petroleum Engineering

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DEPARTMENT OF PETROLEUM ENGINEERING

Ref. No.: PU/SOE/PET/SD/RFM/2022-23/CIR/01 Date: 15/05/2023

Circular

Academic Year: 2022 – 2023 **Course:** PET2012 **Semester:** 4th

Dear students of 4PET-1,

It is to inform you all that a "problem solving / numerical solving" activity for the course **PET2012 Reservoir Fluid Mechanics** is schedule on 25/05/2023, from 9:00 PM to 10:40 AM (OFFLINE MODE). It is mandatory for all the student to remain present during the activity session and take part in numerical solving.

Dr. Abhinav Kumar
Instructor In-charge

REGISTRAR

REPORT ON EXPERIENCIAL LEANING

Circular Date and No.	Dtd: 15/05/2023 PU/SOE/PET/SD/RFM/2022-23/CIR/01	**Date of Event**	25.05.2023
Type of learning	Skill development	**Event Type:**	Experiential Learning
Mode of Event:	Offline	**No. of Participant(s):**	29
Course Code/Course Name	PET2012 Reservoir Fluid Mechanics		
Department	Department of Petroleum Engineering		
Instructor In charge	Dr. Abhinav Kumar Assistant Professor, Department of Petroleum Engineering		

Event objective	The event was conducted to test the knowledge of students on the topic related to the experiential learning in petroleum industry with a primary objective of improving the understanding of students through experiments.
Topic discussed	Different experiments based on Reservoir Fluid Mechanics Concepts
Outcome of the event	i. Improvement in understanding of theory concepts. ii. Improvement in students' ability to be more observant and inquisitive.
Assessment	i. Type of Assessment: Experiential learning ii. Task Assigned:

Grp. No.	ID No.	Student Name	Topic for Experiment
1	20211PET0001	Mohamed Saadullah S	Minor Losses in Pipe
	20211PET0003	Syed Luqman J	
	20211PET0004	Belim Moh Saad Mohammedbhai	
	20211PET0005	Mohammad Suhail	
2	20211PET0008	Vankala Jai Sphoorthi	Major Losses in Pipe
	20211PET0009	Afeez	
	20211PET0010	Hithesh T	
	20211PET0011	Ganuga Roshan	
	20211PET0012	Mohamed Naif Nihad Ali	

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3	20211PET0013	Deepak Jadhav	Reynold's Number
	20211PET0014	Darshan D P	
	20211PET0015	Mohammad Yasir Byakod	
	20221LPE0001	Shaik Tabish Riyazahmed	
	20211PET0017	Ibrahim Nawaz M	
4	20211PET0018	Sandeep Iyagar	Discharge of Fluid
	20211PET0019	Kiran Ekiran	
	20191PET0050	Shaik Gouspeer Vali	
	20211PET0021	Mayur P	
	20211PET0022	Yashwanth S	
5	20211PET0023	Mohammed Shabaz Khalander D	Impact of Jet
	20211PET0024	Bollama Reddy Himavenkata Mankantha	
	20211PET0025	Fazil Shareef H A	
	20211PET0026	Patel Mohammed Adnan Mohammed Gous	
	20211PET0027	Syed Usman	
6	20211PET0028	Zoya Falak	Bernoulli's Theorem
	20201PET0027	Yarramsetti Chaitanya Sri	
	20211PET0020	Yashwanth Gowda M	
	20211PET0016	Asma Thasnim	
	20211PET0002	Roshan T	

iii. Sample answers by students:

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Bernoulli's Theorem Apparatus

- **OBJECTIVE:** To verify bernoulli's equation experimentally.
- **AIM:**
  1) To calculate the total energy at different points.
  2) To plot the graph between total energy vs distance.
- **INTRODUCTION:**
  - Bernoulli's theorem state that when there is a continuous connection between particles of a flowing mass of liquid, the total energy at any section of flow will remain the same provided there is no reduction or addition of energy at any point.
- **THEORY:**
  - This is the energy equation and is based on the law of conservation of energy. This equation states that at two sections of flow field the total energy remains the same provided that there is no loss or gain of energy between the two sections. This equation is valid only for steady flow. This equation is expressed as:

$$E = \frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2$$

- **OBSERVATIONS:**

S.No	R_1 (cm)	R_2 (cm)	$\frac{Q}{t}$ (L/s)	h_1 (cm)	h_2 (cm)	h_3 (cm)	h_4 (cm)	h_5 (cm)	h_6 (cm)	h_7 (cm)
1.	20	15	9.81	28	26	21.5	16	16.8	21	[illegible]
2.	20	15	8.56	29	24.4	19.4	3	14.5	19	[illegible]
3.	20	15	7.07	24	21	13.4	0	0	0.5	[illegible]

- **CALCULATIONS:**

Reading 1:

$R = \frac{R_1 - R_2}{100} = \frac{20-15}{100} = 0.05\ m$

$Q = \frac{A \times R}{t} = \frac{0.039 \times 0.05}{9.81} = 3.924 \times 10^{-4}\ m^3s^{-1}$

$V_1 = \frac{Q}{a_1} = \frac{3.924 \times 10^{-4}}{7.065 \times 10^{-4}} = 0.555\ ms^{-1}$

$V_2 = \frac{Q}{a_2} = \frac{3.924 \times 10^{-4}}{4.521 \times 10^{-4}} = 0.8679\ ms^{-1}$

$V_3 = \frac{Q}{a_3} = \frac{3.924 \times 10^{-4}}{3.140 \times 10^{-4}} = 1.2496\ ms^{-1}$

$V_4 = \frac{Q}{a_4} = \frac{3.924 \times 10^{-4}}{2.009 \times 10^{-4}} = 1.9532\ ms^{-1}$

$V_5 = \frac{Q}{a_5} = \frac{3.924 \times 10^{-4}}{3.140 \times 10^{-4}} = 1.2496\ ms^{-1}$

$V_6 = \frac{Q}{a_6} = \frac{3.924 \times 10^{-4}}{4.521 \times 10^{-4}} = 0.8679\ ms^{-1}$

$V_7 = \frac{Q}{a_7} = \frac{3.924 \times 10^{-4}}{7.065 \times 10^{-4}} = 0.555\ ms^{-1}$

- **DESCRIPTION:**
  - The present experimental setup for bernoulli theorem is self contained re-circulating unit. The set-up accompanies the sump tank, overhead tank, centrifugal pump for water circulation. Control valve and bypass valve is provided to regulate the flow of water to constant head tank. A test section made of perspex of varying cross-section is provided, which is having converging and diverging section. Piezometer tubes are fitted on this test section at specified points. The inlet of the conduit is connected to overhead tank. Discharge through test section can be measured with the help of measuring tank and stop watch.
- **UTILITIES REQUIRED:**
  1) Electricity supply: single phase, 230 V AC, 50 Hz, 5-15 Amp combined socket with earth connection. Earth voltage should be less than 5 Volts.
  2) Water supply (Initial fill)
  3) Floor drain required
  4) Floor area required: 1.6 m × 0.8 m
- **EXPERIMENTAL PROCEDURE:**
  - **STARTING PROCEDURE:**
    1) Ensure it is ensured that all on/off switches given on the panel are at off position.
    2) Set the values V_1 to V_6.

Reading 2:

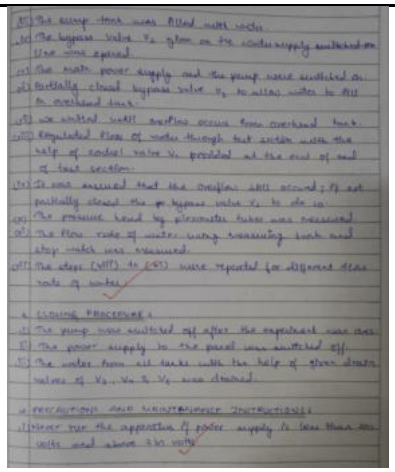
$Q = \frac{A \times R}{t} = \frac{0.039 \times 0.05}{8.56} = 4.487 \times 10^{-4}\ m^3s^{-1}$

$V_1 = \frac{Q}{a_1} = \frac{4.487 \times 10^{-4}}{7.065 \times 10^{-4}} = 0.6355\ ms^{-1}$

$V_2 = \frac{Q}{a_2} = \frac{4.487 \times 10^{-4}}{4.521 \times 10^{-4}} = 0.9926\ ms^{-1}$

$V_3 = \frac{Q}{a_3} = \frac{4.487 \times 10^{-4}}{3.140 \times 10^{-4}} = 1.4291\ ms^{-1}$

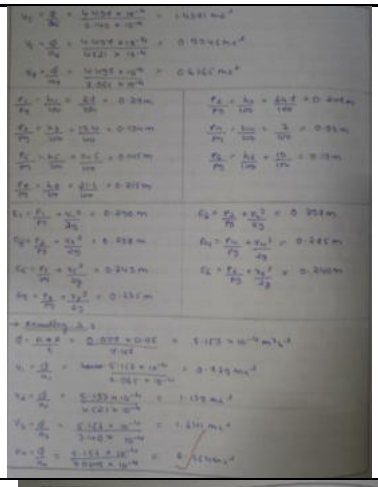
$V_4 = \frac{Q}{a_4} = \frac{4.487 \times 10^{-4}}{2.009 \times 10^{-4}} = 2.2334\ ms^{-1}$

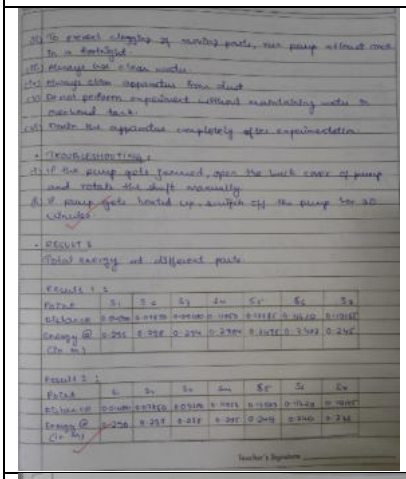


(8) The sump tank was filled with water.
(9) The bypass valve V_2 given on the water supply switched on till the time expired.
(10) The main power supply and the pump were switched on.
(11) Partially closed bypass valve V_2 to allow water to fill in overhead tank.
(12) We waited until overflow occurs from overhead tank.
(13) Regulated flow of water through test section with the help of control valve V_1 provided at the end of end of test section.
(14) It was assured that the overflow still occurs; if not partially closed the bypass valve V_2 to do so.
(15) The pressure head by piezometer tubes was measured.
(16) The flow rate of water using measuring tank and stop watch was measured.
(17) The steps (VII) to (15) were repeated for different flow rate of water.

• CLOSING PROCEDURE :
(1) The pump was switched off after the experiment was over.
(2) The power supply to the panel was switched off.
(3) The water from all tanks with the help of given drain valves of V_3, V_4 & V_5 was drained.

• PRECAUTIONS AND MAINTENANCE INSTRUCTIONS :
(1) Never run the apparatus if power supply is less than 180 volts and above 230 volts.





(2) To avoid clogging of moving parts, run pump without once in a fortnight.
(3) Always use clean water.
(4) Always clean apparatus from dust.
(5) Do not perform experiment without maintaining water in overhead tank.
(6) Make the apparatus completely after experimentation.

• TROUBLESHOOTING :
(1) If the pump gets jammed, open the back cover of pump and rotate the shaft manually.
(2) If pump gets heated up, switch off the pump for 20 minutes.

• RESULT :
Total energy at different points.

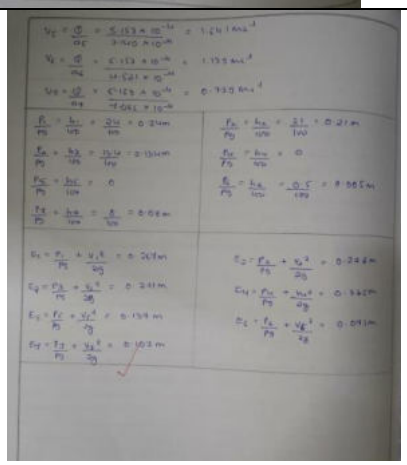
Result 1 :

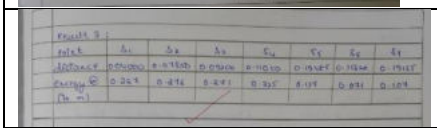
Point	E_1	E_2	E_3	E_4	E_5	E_6	E_7
Distance	0.09m	0.09m	0.09m	0.1m	0.11m	0.16m	0.19m
Energy @ (in m)	0.295	0.298	0.294	0.279	0.275	0.273	0.268

Result 2 :

Point	E_1	E_2	E_3	E_4	E_5	E_6	E_7
Distance	0.09m	0.09m	0.09m	0.1m	0.11m	0.16m	0.19m
Energy @ (in m)	0.298	0.298	0.298	0.297	0.295	0.290	0.286

Teacher's Signature _____





Result 3 :

Point	E_1	E_2	E_3	E_4	E_5	E_6	E_7
Distance	0.09m	0.09m	0.09m	0.11m	0.16m	0.19m	0.19m
Energy @ (in m)	0.298	0.296	0.291	0.285	0.279	0.271	0.269

Event photo

Attendance sheet

Sl. No.	ID No.	Student Name	Attendance
1	20211PET0001	Mohamed Saadullah S	P
2	20211PET0002	Roshan T	P
3	20211PET0003	Syed Luqman J	P
4	20211PET0004	Belim Moh Saad Mohammedbhai	P
5	20211PET0005	Mohammad Suhail	P
6	20211PET0008	Vankala Jai Sphoorthi	P
7	20211PET0009	Afeez	P
8	20211PET0010	Hithesh T	P
9	20211PET0011	Ganuga Roshan	P
10	20211PET0012	Mohamed Naif Nihad Ali	P
11	20211PET0013	Deepak Jadhav	P
12	20211PET0014	Darshan D P	P
13	20211PET0015	Mohammad Yasir Byakod	P
14	20211PET0016	Asma Thasnim	P

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15	20211PET0017	Ibrahim Nawaz M	P	
16	20211PET0018	Sandeep Iyagar	P	
17	20211PET0019	Kiran Ekiran	P	
18	20211PET0020	Yashwanth Gowda M	P	
19	20211PET0021	Mayur P	P	
20	20211PET0022	Yashwanth S	P	
21	20211PET0023	Mohammed Shabaz Khalander D	P	
22	20211PET0024	Bollama Reddy Himavenkata Mankantha	P	
23	20211PET0025	Fazil Shareef H A	P	
24	20211PET0026	Patel Mohammed Adnan Mohammed Gous	P	
25	20211PET0027	Syed Usman	P	
26	20211PET0028	Zoya Falak	P	
27	20201PET0027	Yarramsetti Chaitanya Sri	P	
28	20191PET0050	Shaik Gouspeer Vali	P	
29	20221LPE0001	Shaik Tabish Riyazahmed	P	

Signature of Instructor In charge
Dr. Abhinav Kumar
Assistant Professor
Department of Petroleum Engineering

Dr. Suman Paul
Professor and Head
Department of Petroleum Engineering

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DEPARTMENT OF PETROLEUM ENGINEERING

Ref. No.: PU/SOE/PET/SD/GMOGE/2022-23/CIR/01 Date: 18/04/2023

Circular

Academic Year : 2022 – 2023 **Semester:** 4th **Course:** PET2014

It is to inform that all the students of B.Tech 4th semester (Petroleum Engineering) are required to prepare and present posters on 02/05/2023 from 9:00 am to 9:50 am as per the groups and topics mentioned below for the course PET2014 Geophysical Methods for Oil and Gas Exploration. It is mandatory for all the student to remain present during the activity session and take part in poster presentation.

Grp. No.	ID No.	Student Name	Topic for Poster Presentation
1	20211PET0001	Mohamed Saadullah S	Resistivity method of geophysical survey
	20211PET0002	Roshan T	
	20211PET0003	Syed Luqman J	
	20211PET0004	Belim Moh Saad Mohammedbhai	
	20211PET0005	Mohammad Suhail	
2	20211PET0008	Vankala Jai Sphoorthi	Induced polarization method of geophysical survey
	20211PET0009	Afeez	
	20211PET0010	Hithesh T	
	20211PET0011	Ganuga Roshan	
	20211PET0012	Mohamed Naif Nihad Ali	
3	20211PET0013	Deepak Jadhav	Self-potential method of geophysical survey
	20211PET0014	Darshan D P	
	20211PET0015	Mohammad Yasir Byakod	
	20211PET0016	Asma Thasnim	

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	20211PET0017	Ibrahim Nawaz M	
4	20211PET0018	Sandeep Iyagar	Electromagnetic method of geophysical survey
	20211PET0019	Kiran Ekiran	
	20211PET0020	Yashwanth Gowda M	
	20211PET0021	Mayur P	
	20211PET0022	Yashwanth S	
5	20211PET0023	Mohammed Shabaz Khalander D	Radar method of geophysical survey
	20211PET0024	Bollama Reddy Himavenkata Mankantha	
	20211PET0025	Fazil Shareef H A	
	20211PET0026	Patel Mohammed Adnan Mohammed Gous	
	20211PET0027	Syed Usman	
6	20211PET0028	Zoya Falak	Comparison of different geophysical survey methods
	20201PET0027	Yarramsetti Chaitanya Sri	
	20191PET0050	Shaik Gouspeer Vali	
	20221LPE0001	Shaik Tabish Riyazahmed	

Barasha Deka.

Dr. Barasha Deka

Instructor In-charge

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REPORT ON EXPERIENCIAL LEANING/PROBLEM SOLVING/PARTICIPATIVE LEARNING

Circular Date and No.	Dtd: 18/04/2023 PU/SOE/PET/SD/GMOGE/2022-23/CIR/01	**Date of Event**	02.05.2023
Type of learning	Skill development	**Event Type:**	Participative Learning
Mode of Event:	Offline	**No. of Participant(s):**	29
Course Code/Course Name	PET2014 Geophysical Methods for Oil and Gas Exploration		
Department	Department of Petroleum Engineering		
Instructor In charge	Dr. Barasha Deka Assistant Professor, Department of Petroleum Engineering		

Event objective	This poster presentation event was conducted to test the knowledge of students on the topics related to Fundamentals of exploration geophysics.
Topic discussed	Different geophysical survey techniques
Outcome of the event	i. Improvement in presentation skill. ii. Improvement in public speaking and communication skill.
Assessment	i. Type of Assessment: Poster Presentation ii. Task Assigned:

Grp. No.	ID No.	Student Name	Topic for Poster Presentation
1	20211PET0001	Mohamed Saadullah S	Resistivity method of geophysical survey
	20211PET0002	Roshan T	
	20211PET0003	Syed Luqman J	
	20211PET0004	Belim Moh Saad Mohammedbhai	
	20211PET0005	Mohammad Suhail	
2	20211PET0008	Vankala Jai Sphoorthi	Induced polarization method of geophysical survey
	20211PET0009	Afeez	
	20211PET0010	Hithesh T	
	20211PET0011	Ganuga Roshan	

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	20211PET0012	Mohamed Naif Nihad Ali	
3	20211PET0013	Deepak Jadhav	Self-potential method of geophysical survey
	20211PET0014	Darshan D P	
	20211PET0015	Mohammad Yasir Byakod	
	20211PET0016	Asma Thasnim	
	20211PET0017	Ibrahim Nawaz M	
4	20211PET0018	Sandeep Iyagar	Electromagnetic method of geophysical survey
	20211PET0019	Kiran Ekiran	
	20211PET0020	Yashwanth Gowda M	
	20211PET0021	Mayur P	
	20211PET0022	Yashwanth S	
5	20211PET0023	Mohammed Shabaz Khalander D	Radar method of geophysical survey
	20211PET0024	Bollama Reddy Himavenkata Mankantha	
	20211PET0025	Fazil Shareef H A	
	20211PET0026	Patel Mohammed Adnan Mohammed Gous	
	20211PET0027	Syed Usman	
6	20211PET0028	Zoya Falak	Comparison of different geophysical survey methods
	20201PET0027	Yarramsetti Chaitanya Sri	
	20191PET0050	Shaik Gouspeer Vali	
	20221LPE0001	Shaik Tabish Riyazahmed	

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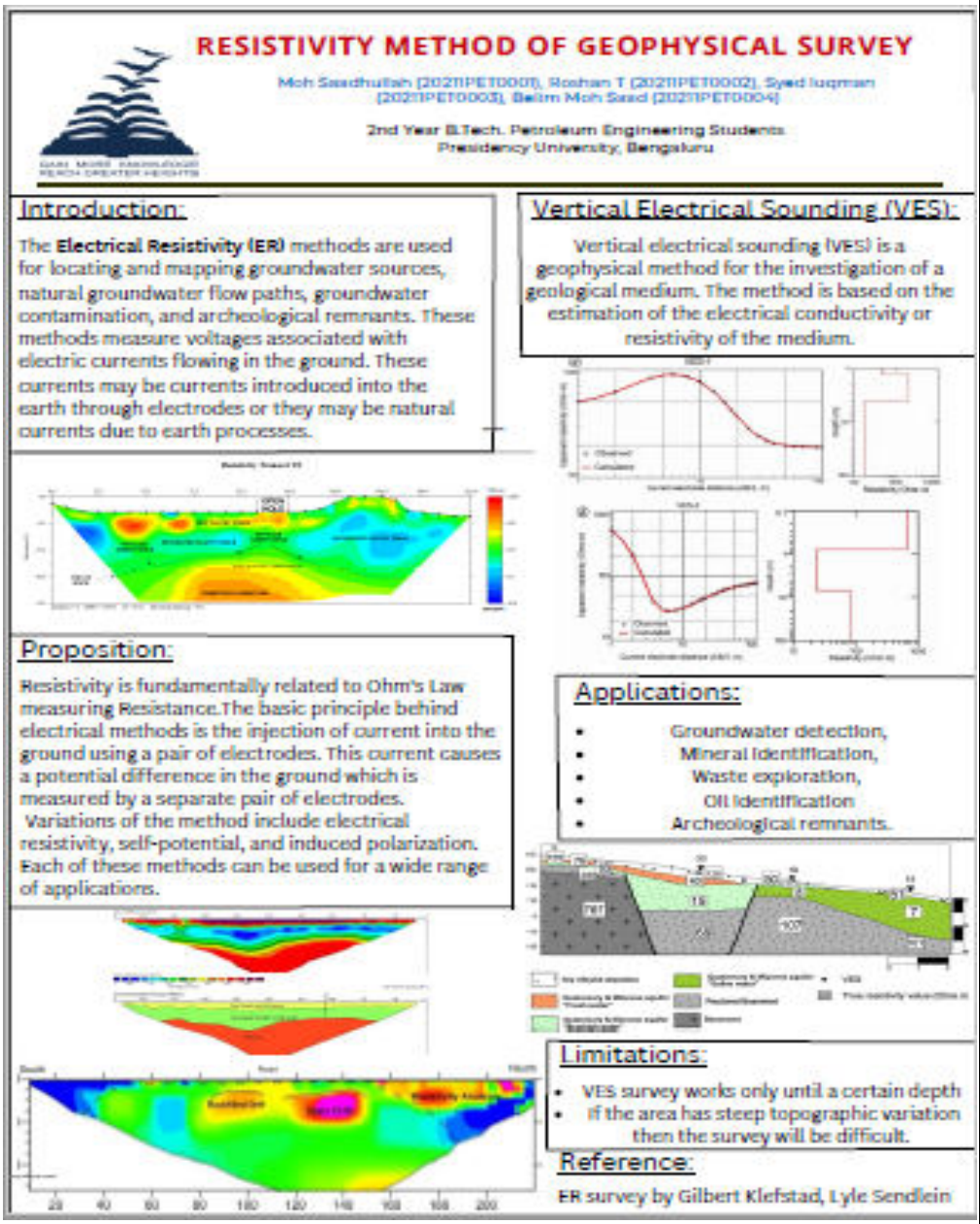
iii. Sample posters prepared by students:



RADAR METHOD OF GEOPHYSICAL SURVEY

FAZIL SHARKEF (20211PET0012), MOHAMMED SHABAZ (20211PET0021), MANKANTIRA(20211PET0024),
MOHAMMED ADNAN (20211PET0026), SYED USMAN (20211PET0027)
2nd Year B.Tech. Petroleum Engineering Student
Presidency University, Bengaluru
Course Name/Course Code: Geophysical Methods of Oil and Gas Exploration/PET 2014
Instructors Name: Dr. Barasha Deka

INTRODUCTION:

The Radar method of geophysical survey is a technique used to explore and study subsurface geological structures, archaeological remains, and other subsurface features using electromagnetic radiation. This method uses a radar signal that is transmitted into the subsurface and then detected and analyzed to create images of the subsurface features.

PRINCIPLE:

Radar works by transmitting a high-frequency electromagnetic signal into the subsurface, which is reflected back by subsurface features such as boundaries between different geological layers, buried objects, and voids. The reflected signal is then detected by the radar system and analyzed to create images of the subsurface features. In geophysical surveys, radar is used to map subsurface structures, locate buried objects, study geological structures and soil properties, and assess the stability of infrastructure.

TYPES:

1.Ground-penetrating radar **2.Airborne radar** **3.Satellite radar**

ADVANTAGES:

- Radar can penetrate through various surfaces to create subsurface images for non-invasive investigation of underground structures.
- It provides high-resolution images of subsurface layers, which can be used to identify geological formations, faults, and groundwater resources.
- Radar is a fast and efficient method of data collection, enabling the survey of large areas quickly and accurately.
- Radar data can be easily processed and analyzed using advanced software tools, allowing for detailed interpretation of subsurface features.

DISADVANTAGES:

- Radar can be limited by the properties of the material being surveyed, which can affect the penetration depth and quality of images obtained.
- It can be affected by interference from external sources, such as power lines, which can degrade the quality of data collected.
- Radar requires specialized equipment and trained personnel, which can increase the cost and complexity of surveys.
- Interpretation of radar data can be challenging, as features in the images may be difficult to identify and distinguish from each other.

CONCLUSION:

Radar is a useful geophysical tool for non-invasive investigation of underground structures and features, providing high-resolution images and fast data collection. However, limitations due to material properties, interference, and specialized requirements should be considered for effective use.

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Event photo

Attendance sheet

Sl. No.	ID No.	Student Name	Attendance
1	20211PET0001	Mohamed Saadullah S	P
2	20211PET0002	Roshan T	P
3	20211PET0003	Syed Luqman J	P
4	20211PET0004	Belim Moh Saad Mohammedbhai	P
5	20211PET0005	Mohammad Suhail	P
6	20211PET0008	Vankala Jai Sphoorthi	P
7	20211PET0009	Afeez	P
8	20211PET0010	Hithesh T	P
9	20211PET0011	Ganuga Roshan	P
10	20211PET0012	Mohamed Naif Nihad Ali	P
11	20211PET0013	Deepak Jadhav	P
12	20211PET0014	Darshan D P	P
13	20211PET0015	Mohammad Yasir Byakod	P
14	20211PET0016	Asma Thasnim	P

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15	20211PET0017	Ibrahim Nawaz M	P
16	20211PET0018	Sandeep Iyagar	P
17	20211PET0019	Kiran Ekiran	P
18	20211PET0020	Yashwanth Gowda M	P
19	20211PET0021	Mayur P	P
20	20211PET0022	Yashwanth S	P
21	20211PET0023	Mohammed Shabaz Khalander D	P
22	20211PET0024	Bollama Reddy Himavenkata Mankantha	P
23	20211PET0025	Fazil Shareef H A	P
24	20211PET0026	Patel Mohammed Adnan Mohammed Gous	P
25	20211PET0027	Syed Usman	P
26	20211PET0028	Zoya Falak	P
27	20201PET0027	Yarramsetti Chaitanya Sri	P
28	20191PET0050	Shaik Gouspeer Vali	P
29	20221LPE0001	Shaik Tabish Riyazahmed	P

Barasha Deka.

Signature of Instructor In charge
Dr. Barasha Deka
Assistant Professor
Department of Petroleum Engineering

Dr. Suman Paul
Professor and Head
Department of Petroleum Engineering

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DEPARTMENT OF PETROLEUM ENGINEERING

Ref. No.: PU/SOE/PET/SD/OGWT/2022-23/CIR/01 Date: 16/05/2023

Circular

Academic Year: 2022 – 2023 **Course:** PET2019 **Semester:** 6th

Dear students of 6PET-1,

It is to inform you all that a "problem solving / numerical solving" activity for the course **PET2019 Oil and Gas Well Test Analysis** is schedule on 29/05/2023, from 3:10 PM to 4:00 PM (OFFLINE MODE). It is mandatory for all the student to remain present during the activity session and take part in numerical solving.

Dr. Abhinav Kumar
Instructor In-charge

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REPORT ON PROBLEM SOLVING

Circular Date and No.	Dtd: 16/05/2023 PU/SOE/PET/SD/OGWT/2022-23/CIR/01	**Date of Event**	29.05.2023
Type of learning	Skill development	**Event Type:**	Problem Solving
Mode of Event:	Offline	**No. of Participant(s):**	27
Course Code/Course Name	PET2019 Oil and Gas Well Test Analysis		
Department	Department of Petroleum Engineering		
Instructor In charge	Dr. Abhinav Kumar Assistant Professor, Department of Petroleum Engineering		

Event objective	The event was conducted to test the knowledge of students on the topic related to the application of principle of superposition in petroleum industry with a primary objective of improving the problem-solving skills of students.
Topic discussed	Principle of Superposition
Outcome of the event	i. Improvement in problem solving skill. ii. Improvement in identifying problem statement.
Assessment	i. Type of Assessment: Problem Solving ii. Task Assigned: Figure shows the rate history of a well that is producing under transient flow condition for 15 hours. Given the following data: pi = 5000 psi; h = 20'; B = 1.1 bbl/STB; φ= 15%; μ= 2.5 cp; rw = 0.3'; ct = 20 X 10-6 psi-1; s = 0; k = 40 md. Calculate the sand face pressure after 15 hours.

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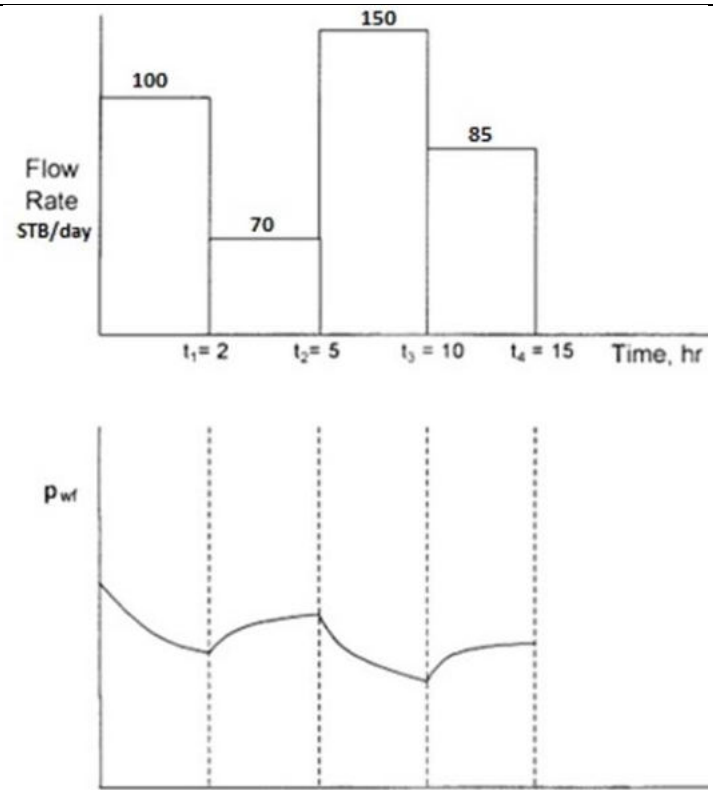
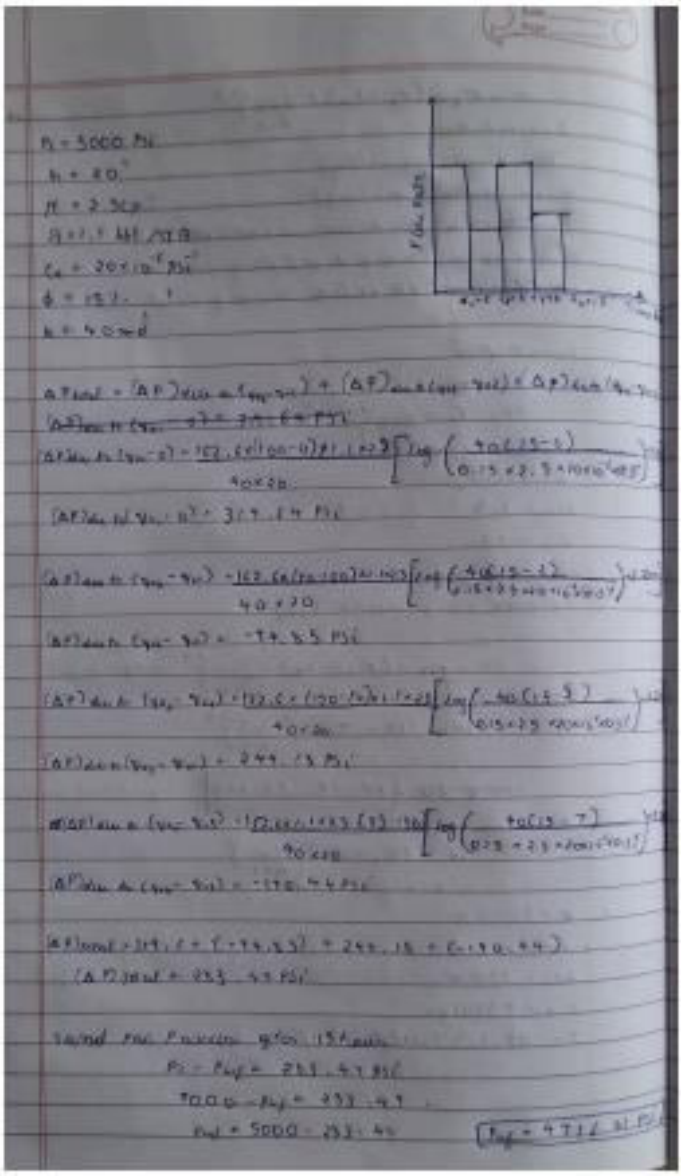


Figure: Production and pressure history of a well

iii. Sample answers by students:



Event photo

Attendance sheet

Sl. No.	ID No.	Student Name	Attendance
1	20201PET0001	Sohael K S	P
2	20201PET0004	Rachan Balakrishna Shetty	P
3	20201PET0006	Praveen B	P
4	20201PET0008	Nallabhotula Dushyanth	P
5	20201PET0009	Kotishwaran V	P
6	20201PET0010	Pradeep Kumar Rathod	P
7	20201PET0011	A M Rizwan	P
8	20201PET0012	Mohammed Shazan	P
9	20201PET0014	Zaheed Ahmed	P
10	20201PET0015	Mujtba Aamir Ahmed	P
11	20201PET0016	Siddharth Murali	P

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		12	20201PET0017	Bhoomika Satish	P
		13	20201PET0018	Nuthan M S	P
		14	20201PET0019	Pranav A	P
		15	20201PET0021	R Janardhan Reddy	P
		16	20201PET0022	Mohammed Shadim D K	P
		17	20201PET0023	Prathivraj S	P
		18	20201PET0026	Ajmal Akbar Babu	P
		19	20201PET0029	Pavan Goud	P
		20	20201PET0030	Aqib Ahmed Sharieef	P
		21	20201PET0031	Bandla Hareesh	P
		22	20201PET0033	Shekar	P
		23	20201PET0034	Kommineni Hemanth	P
		24	20201PET9001	Mohammed Shahid	P
		25	20191PET0009	C S Nishant	P
		26	20191PET0011	Fayaz Pasha	P
		27	20211LPE0001	Muhammed Swalih V P	P

Signature of Instructor In charge
Dr. Abhinav Kumar
Assistant Professor
Department of Petroleum Engineering

Dr. Suman Paul
Professor and Head
Department of Petroleum Engineering

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DEPARTMENT OF PETROLEUM ENGINEERING

Ref. No.: PU/SOE/PET/SD/APRE/2022-23/CIR/01 Date: 24/04/2023

Circular

Academic Year: 2022 – 2023 **Course:** PET3006 **Semester:** 6th

Dear students of 6PET-1,

It is to inform you all that a "problem solving / numerical solving" activity for the course **PET3006 Advanced Petroleum Reservoir Engineering** is schedule on 02/05/2023, from 1:20 PM to 2:10 PM (OFFLINE MODE).

It is mandatory for all the student to remain present during the activity session and take part in numerical solving.

Dr. Deepjyoti Mech

Instructor In-charge

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REPORT ON PROBLEM SOLVING

Circular Date and No.	Dtd: 24/04/2023 PU/SOE/PET/SD/APRE/2022-23/CIR/01	**Date of Event**	02.05.2023
Type of learning	Skill development	**Event Type:**	Problem Solving
Mode of Event:	Offline	**No. of Participant(s):**	27
Course Code/Course Name	PET3006 Advanced Petroleum Reservoir Engineering		
Department	Department of Petroleum Engineering		
Instructor In charge	Dr. Deepjyoti Mech Assistant Professor, Department of Petroleum Engineering		

Event objective	The event was conducted to test the knowledge of students on the topic related to the application of material balance equation in petroleum industry with a primary objective of improving the problem solving skills of students.
Topic discussed	Water Influx
Outcome of the event	i. Improvement in problem solving skill. ii. Improvement in identifying problem statement.
Assessment	i. Type of Assessment: Problem Solving ii. Task Assigned: A combination-drive reservoir contains 10 MMSTB of oil initially in place. The ratio of the original gas-cap volume to the original oil volume, i.e., m, is estimated as 0.25. The initial reservoir pressure is 3000 psia at 150°F. The reservoir produced 1 MMSTB of oil, 1100 MMscf of 0.8 specific gravity gas, and 50,000 STB of water by the time the reservoir pressure dropped to 2800 psi. The following PVT is available:

	3000 psi	2800 psi
Bo, bbl/STB	1.58	1.48
Rs, Scf/STB	1040	850
Bg, bbl/scf	0.00080	0.00092
Bt, bbl/STB	1.58	1.655
Bw, bbl/STB	1.000	1.000

The following data is also available:
Swi = 0.20, cw = 1.5 X 10-6 psi-1, cf = 1 X 10-6 psi-1

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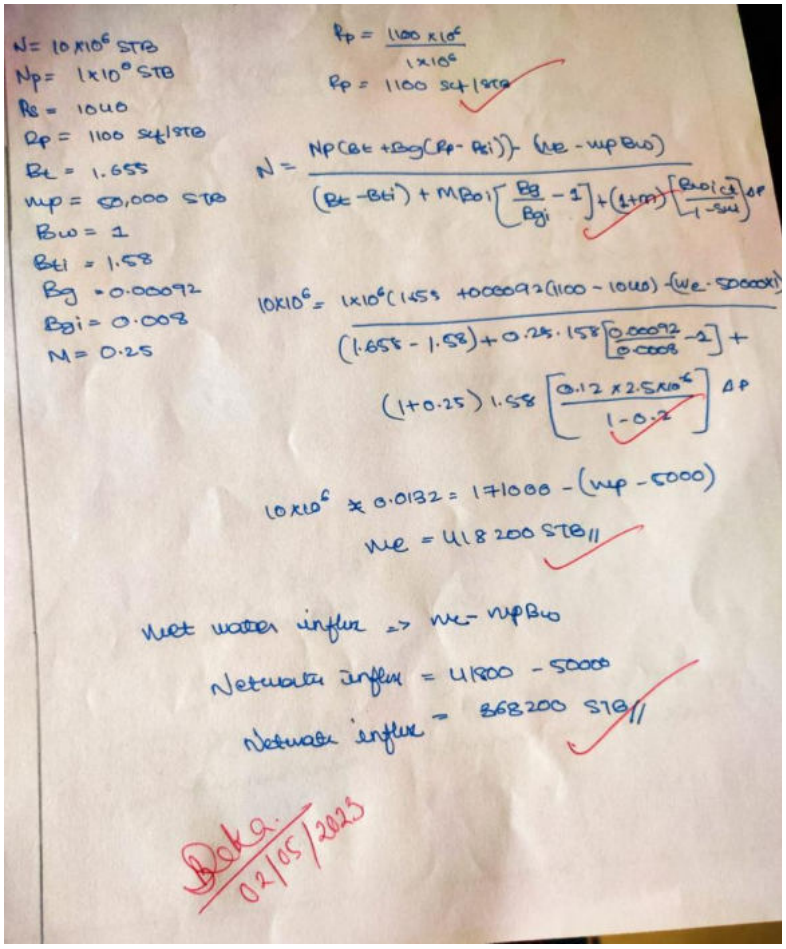
Interpret the following:

a) Cumulative water influx

b) Net water influx

iii. Sample answers by students:



$N = 10 \times 10^6$ STB
$N_p = 1 \times 10^6$ STB
$R_s = 1040$
$R_p = 1100$ scf/STB
$B_t = 1.655$
$W_p = 50{,}000$ STB
$B_w = 1$
$B_{ti} = 1.58$
$B_g = 0.00092$
$B_{gi} = 0.008$
$M = 0.25$

$R_p = \frac{1100 \times 10^6}{1 \times 10^6}$

$R_p = 1100$ scf/STB

$$N = \frac{N_p(B_t + B_g(R_p - R_{si})) - (W_e - W_p B_w)}{(B_t - B_{ti}) + M B_{oi}\left[\frac{B_g}{B_{gi}} - 1\right] + (1+m)\left[\frac{B_{oi}(c_f)}{1 - S_{wi}}\right]\Delta P}$$

$$10 \times 10^6 = \frac{1 \times 10^6(1.655 + 0.00092(1100 - 1040)) - (W_e - 50000)}{(1.655 - 1.58) + 0.25 \cdot 1.58\left[\frac{0.00092}{0.008} - 1\right] + (1+0.25)\,1.58\left[\frac{0.12 \times 2.5 \times 10^{-6}}{1 - 0.2}\right]\Delta P}$$

$10 \times 10^6 \times 0.0132 = 171000 - (W_p - 5000)$

$W_e = 418200$ STB

Net water influx => $W_e - W_p B_w$

Netwater influx = 418200 − 50000

Netwater influx = 368200 STB

Boka.
02/05/2023

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$N_p = 10 \times 10^6$ stb

$N_p = 1 \times 10^6$ stb

$R_s = 1040$

$R_p = 1100$ scf/stb

$B_t = 1.655$

$W_p = 50{,}000$ stb

$B_w = 1$

$B_{ti} = 1.58$

$B_g = 0.00092$

$B_{gi} = 0.008$

$m = 0.25$

$$R_p = \frac{1100 \times 10^6}{1 \times 10^6}$$

$R_p = 1100$ scf/stb

$$N = \frac{N_p\left[B_t + B_g(R_p - R_{si})\right] - (W_e - W_p B_w)}{(B_t - B_{ti}) + mB_{oi}\left(\frac{B_g}{B_{gi}} - 1\right) + (1+m)B_{oi}\left[\frac{S_{wi}c_t}{1-S_{wi}}\right]\Delta P}$$

$$10 \times 10^6 = \frac{1 \times 10^6\left[1.655 + 0.00092(1100 - 1040)\right] - (W_e - 50000)}{(1.655 - 1.58) + 0.25 \times 1.58\left(\frac{0.00092}{0.008} - 1\right) + (1+0.25)1.58 \cdot \left(\frac{0.2025 \times 10^{-6}}{1-0.2}\right)}$$

$$= 10 \times 10^6 \times 0.01342 = 171620 - (W_e - 50000)$$

$W_e = 4{,}182000$ stb

Net water influx $\Rightarrow W_e - W_p B_w$

$= 4182000 - 50000 = 3682000$ STB

02/05/2023

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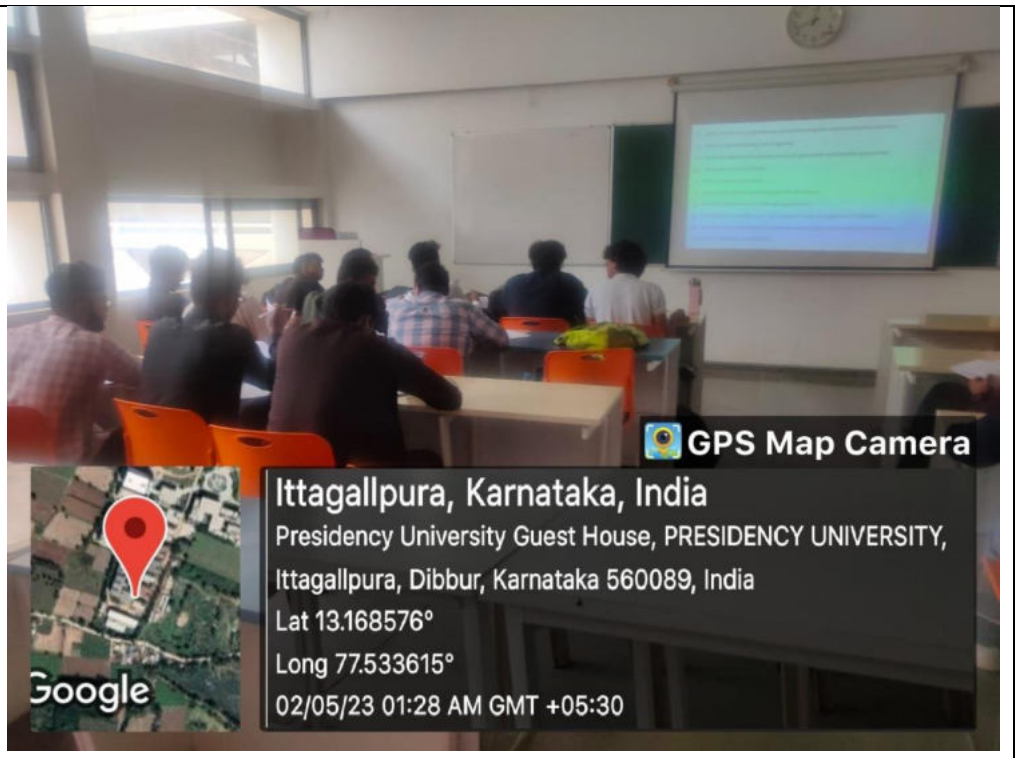
Event photo



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		26	20191PET0011	Fayaz Pasha	P
		27	20211LPE0001	Muhammed Swalih V P	P

Signature of Instructor In charge
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