

## Faculty of Engineering & Technology

### Secondary Recovery of Petroleum

#### Information :

**Course Code :** PE 503

**Level :** Undergraduate

**Course Hours :** 3.00- Hours

**Department :** Department of Petroleum Engineering

#### Instructor Information :

| Title               | Name                                          | Office hours |
|---------------------|-----------------------------------------------|--------------|
| Associate Professor | Adel Mohamed Salem Ragab                      | 5            |
| Lecturer            | El Saeid Mohamed El Saeid Eissa               | 2            |
| Teaching Assistant  | Mohamed Osama Mohamed Abbas                   |              |
| Teaching Assistant  | Taha Abdelhamid Abdelmaqsoud Abdelhamid Yehia |              |
| Teaching Assistant  | Reham Shawket Mostafa Taha Khalaaf            |              |

#### Area Of Study :

The main objective of the course is to acquaint the students with the secondary recovery methods and their applications and is to give a solid background to the students on course of water flooding. Moreover, it provides a complete review of all aspects of water flood schemes being the most proven, lowest cost, and applicable to various types of reservoirs.

#### Description :

Oil recovery by water injection. Effects of wettability, capillary pressure, relative permeability, mobility ratio on displacement, sweep, and recovery efficiencies. Piston-like and Buckley-Leverett models. Fractional flow and frontal advance equation. Oil recovery prediction methods for linear and pattern water floods in single and multi-layered reservoirs.

#### Course outcomes :

##### **a.Knowledge and Understanding: :**

|     |                                                                                                                                                                                                                                 |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 - | Describe recovery expectations from reservoirs under primary depletion or pressure maintenance utilizing water or immiscible gas injection                                                                                      |
| 2 - | Describe reasons and causes for less than theoretically possible recovery                                                                                                                                                       |
| 3 - | Describe appropriate methods (with their target applications, benefits, and limitations) for improving oil recovery from reservoirs under primary depletion or pressure maintenance utilizing water or immiscible gas injection |
| 4 - | Select mechanisms responsible for recovery improvement in various IOR                                                                                                                                                           |

##### **b.Intellectual Skills: :**

|     |                                                                                           |
|-----|-------------------------------------------------------------------------------------------|
| 1 - | Select the suitable flooding patterns for water flooding operations                       |
| 2 - | Calculate the overall recovery efficiency: displacement, areal, and vertical efficiencies |
| 3 - | Predict the recovery performance for layered reservoir                                    |
| 4 - | Compare EOR methods using screening criteria                                              |

**c. Professional and Practical Skills: :**

|     |                                                                                                                     |
|-----|---------------------------------------------------------------------------------------------------------------------|
| 1 - | Apply appropriate methods (with their target applications, benefits, and limitations) for improving oil recovery.   |
| 2 - | Select a chemical (surfactant, polymer/micellar) etc. for chemical flooding, on the basis of their known properties |
| 3 - | Select the suitable flooding patterns for water flooding operations                                                 |

**d. General and Transferable Skills: :**

|     |                                                         |
|-----|---------------------------------------------------------|
| 1 - | Collaborate effectively within multidisciplinary teams. |
| 2 - | Acquire entrepreneurial skills.                         |
| 3 - | Refer to relevant literature.                           |

**Course Topic And Contents :**

| Topic                                                             | No. of hours | Lecture | Tutorial / Practical |
|-------------------------------------------------------------------|--------------|---------|----------------------|
| Introduction to secondary recovery and EOR Screening criteria     | 10           | 6       | 4                    |
| Secondary Oil Recovery: Water Flooding                            | 10           | 6       | 4                    |
| Overall Recovery Efficiency                                       | 8            | 6       | 2                    |
| Displacement Efficiency, Buckley and Leverett                     | 10           | 6       | 4                    |
| Areal Sweep Efficiency                                            | 8            | 4       | 4                    |
| Vertical Sweep Efficiency                                         | 8            | 5       | 3                    |
| Methods of Predicting Recovery Performance for Layered Reservoirs | 9            | 6       | 3                    |
| Chemical EOR, Thermal EOR, and Miscible/Immiscible EOR            | 6            | 3       | 3                    |
| Technical Challenges and Futures Techniques                       | 6            | 3       | 3                    |

**Teaching And Learning Methodologies :**

|                       |
|-----------------------|
| Interactive lecturing |
| Problem solving       |
| Experiential Learning |

**Course Assessment :**

| Methods of assessment | Relative weight % | Week No | Assess What |
|-----------------------|-------------------|---------|-------------|
| Assignment            | 10.00             |         |             |
| Final Exam            | 40.00             |         |             |
| Mid- Exam             | 30.00             |         |             |
| Participation         | 10.00             |         |             |
| Quizzes               | 10.00             |         |             |

**Recommended books :**

- James J. Sheng, Ph. D.: *Modern Chemical Enhanced Oil Recovery, Theory and Practice*, Gulf Professional Publishing is an imprint of Elsevier, Elsevier Inc., 2011.
2. Teknica Petroleum Services Ltd : *Enhanced Oil Recovery*, Calgary, Alberta, 2001.
3. Aurel Carcoana : *Applied enhanced oil recovery*, Prentice-Hall, Inc., 1992.
4. Erle C. Donaldson, George V. Chilingarian, and The Fu Yen: *Enhanced Oil Recovery II, Processes and Operations*, Elsevier science Publishers B.V., 1989.
5. Van Poollen, H. K., and Associates : *Fundamentals of Enhanced Oil Recovery*, Penn Well Publishing company, Tulsa, Oklahoma, 1980.
6. Marcel Latil, et. Al. : *Enhanced Oil Recovery*, Institut Francais du Petrole, 1980.  
(Translated from the French by Paul ELLIS)