



## 16PL404 ENHANCED OIL RECOVERY METHODS

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P	WA/RA	SSH/HSR	CS	SA	S	BS
45	-	20	20	50	-	-	5	5

### Course Description and Objectives:

Understanding of secondary / tertiary recovery of crude oils of specific reservoirs. Following the selection criteria to which reservoir suits for specific EOR techniques. Post project monitoring. Knowledge of maintenance of injection wells / Production wells.

### Course Outcomes:

The student will be able to:

- Knowledge of ignition of injection wells in case of thermal EORs
- Knowledge of handling of chemicals like CO<sub>2</sub>, Surfactants, Polymers etc.
- Handling of injection wells in case of any leakage or blowout situations

### SKILLS:

- ✓ Have the knowledge of that specific reservoir before designing of any EOR project
- ✓ Be a very good team members in the multidiscipline team where key decisions can be taken in this project work
- ✓ Be a very good operator and maintenance engineer of EOR techniques
- ✓ Take all safety precautions while handling of various types of chemicals used in EOR.
- ✓ Become good reservoir managers / production engineers in monitoring the reservoir after post project activities
- ✓ Handle the wells during work over operations.

**UNIT - 1****L-9**

**Introduction:** Historical background and review of primary and secondary recovery, injection rate and pressures in secondary recovery. Flood Patterns and Coverage.

**UNIT - 2****L-9**

**Microscopic displacement of fluids in a reservoir:** Capillary forces, viscous forces, phase trapping, mobilization of trapped phases.

**Macroscopic displacement of fluids in a reservoir:** Areal sweep efficiency, vertical sweep efficiency, displacement efficiency, mobility ratio, well spacing.

**UNIT - 3****L-9**

**Flow of immiscible fluids through porous media.** Continuity equation, equation of motion, solution methods Water flooding, Fractional flow equation, Frontal advance theory. Recovery efficiency, permeability heterogeneity.

**Water flooding performance calculations:** Frontal advance method, viscous fingering method, Stiles method, Dykstra-Parsons Method, Water for water flooding.

**UNIT - 4****L-9**

**Chemical Flooding:** Polymer flooding and mobility control processes, Micellar/ polymer flooding, phase behavior of micro-emulsions, phase behavior and IFT, wettability alterations, Alkali flooding.

**Miscible Displacement Processes:** Mechanism of miscible displacement, phase behavior related to miscibility, high pressure gas injection, enriched gas injection, LPG flooding, Carbon dioxide flooding, alcohol flooding.

**UNIT - 5****L-9**

**Thermal Recovery Processes:** mechanism of thermal flooding, hot water flooding, cyclic steam injection, estimation of oil recovery from steam drive, in-situ combustion, air requirement for in-situ combustion. Microbial oil recovery. EOR Project Evaluation.

**LABORATORY EXPERIMENTS****List of Experiments :**

Total hours : 20

1. Laboratory experiment on Enhanced Oil recovery with Nitrogen injection.
2. Laboratory experiment on Enhanced Oil recovery with Carbon Di Oxide injection.
3. Core flood Experiment  
Thermal Core-flooding, Polymer Core-flooding, ASP Core-flooding, Miscible Gas EOR  
Water-flood EOR, Recovery Efficiency, Chemical EOR
4. Special Core Analysis  
Relative Permeability, Wettability, Capillary Pressure, Formation damage studies  
Phase behavior study
5. CT Scanning Core for Reservoir Characterization.
6. Reservoir Characterization with NMR Techniques.
7. Modelling and Interpretation of a 5 spot reservoir.
8. Modelling and Interpretation of water flood.
9. Modelling and Interpretation of polymer flood.
10. Modelling and Interpretation of steam flood.

**TEXT BOOKS:**

1. Applied Enhanced Oil Recovery, Aural Carcoane, Prentice Hall, 1992.
2. Enhanced Oil Recovery, Larry W. Lake, Prentice Hall, 1998.

**REFERENCE BOOKS:**

1. Enhanced Oil Recovery Processes and Operations, E.C. Donaldson, G.V.Chillingarian, T.F. Yew, Elsevier, 1998.
2. Enhanced Oil Recovery: Proceedings of the Third European Symposium on Enhanced Oil Recovery, F. John Fayers, Elsevier, 1981.
3. Enhanced Oil Recovery, Marcel Latil, Editions Technip, 1980.

**ACTIVITIES:**

- Case study on microscopic and macroscopic of fluids behaviour in a reservoir.
- Case study on different types of flooding techniques.