NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING

PETROLEUM ENGINEERING PROGRAM

PP413 – OIL DRILLING II

I. GENERAL INFORMATION

CODE	**:**	PP413 Oil Drilling II
SEMESTER	**:**	7
CREDITS	**:**	5
HOURS PER WEEK	**:**	6 (Theory – Practice)
PREREQUISITES	**:**	PP323 Oil Drilling I
CONDITION	**:**	Compulsory

II. COURSE DESCRIPTION

This course prepares students for the understanding and application of drilling technologies for oil and gas wells. Students analyzes the drilling process using a drilling rig containing all necessary equipment to circulate the drilling fluid, hoist and turn the pipe, control downhole, remove cuttings from the drilling fluid, and generate on-site power for these operations. Drilling operations under different well conditions are analyzed.

III. COURSE OUTCOMES

At the end of the course, students:

1. Understand the process of creating oil wells by drilling.
2. Identify the required operations and equipment for well drilling.
3. Identify the components of drilling fluids and the pumping process.
4. Understand the process how rock cuttings are generated and swept up by the drilling fluid.
5. Understand the process of casing – steel piping, providing structural integrity to the drilled wellbore.
6. Identify and size the required power generation equipment required to complete al drilling operations according to well characteristics and conditions.

IV. LEARNING UNITS

1. HYDRAULICS

Rheology. Fluid flows in pipes / Viscosity / Strain stress and strain speed / Fluid classification / Newtonian fluids. Non-Newtonian fluids / Flow regime classification: laminar flow, turbulent flow / Flow models. Newtonian model. Description and general equation / Bingham plastic model. General equation. Yield point / Plastic viscosity Pseudo plastic model. General equation. Consistency index. Behavior index.

2. NEWTONIAN FLUIDS

Newtonian fluids in pipes. Reynolds number / Pressure drop in piping system / Laminar flow in pipes / Hagen and Poiseuille law / Pressure drop equation / Turbulent flow in pipes / Fanning friction factor and relation with Reynolds number / Karman number and transmission factor. Flow velocity. Lam equation / Turbulent flow in rings. Equivalent diameter and pressure drop.

3. NON-NEWTONIAN FLUIDS

Plastic viscosity and yield point computation / Shear stress and strain velocity using Fann viscosity-meter / Power law and viscosity-meter method for multiple velocities / Laminar flow of Non-Newtonian fluids in

pipes / Computation of pressure drop using Bingham method / Power law and direct reading method / Laminar flow in rings. Critic velocity and pressure drop computation using Bingham method / Turbulent flows in rings. Pressure drop at surface conditions. Equivalent length / Leak off test and fit test / Ring pressure analysis in static and dynamic conditions / Maximum permissible surface pressure (mpps) / Hydraulic programs development / Scott method / Pressure drop in the drill flow stream / Pump power /

4. COATING PIPES

Coating pipes used in petroleum wells. Types of coating pipes / Production liner / Design of piping networks / Pipe dimensioning and selection. Outside diameter. Unit weight. Material degree / Connection types.

5. LOADS ON COATING PIPES

Axis stress / Internal pressure / Collapse pressure / Collapse zoning / Limiting collapse pressure per zone / Effect of combined stresses / Plasticity ellipsoid / Collapse pressure under axis stress and internal pressure / Fault model for yield stress conditions / Effect of curvature on the coating / API method / Casing / Depth selection criteria / Weight of equivalent sludge / Swoop margins / Drift / Weights and degrees computation / Casing design methods.

6. DIRECTIONAL DRILLING

Why directional drilling / Parts of a directional well / Slope / Slope measurement tools / Types of directional wells / Radius of curvature and lifting angle / Mathematical analysis of slant-type wells / Orientation, direction, azimuth and guide angle / Direction measurement tools / Trajectory computation methods / Tangential method / Average angle method / Minimum curvature method.

7. DIRECTIONAL TOOLS AND HORIZONTAL WELLS

Bent sub, oriented sub, monel, single shot, multi shot / Techniques and procedures for well deflecting / Deep engine / Deep assembly (bha) / Types of horizontal wells / Curvature radius of horizontal wells / Types of deep assemblies / Top drive.

VI. METHODOLOGY

The course is carried out in theory and practice sessions. In theory sessions, the instructor introduces concepts, theorems and applications. In practice sessions, several problems are solved and their solution is analyzed considering real-world working conditions. At the end of the course, students should submit and defend an integrating paper and project. In all sessions, students' active participation is encouraged.

VII. EVALUATION FORMULA

The final grade PF is calculated as follows:

PF = (EP + EF + PC) / 3

EP: Mid-Term Exam EF: Final Exam
PC: Average of six practical work reports

VIII. BIBLIOGRAPHY

1. **AZAR J.J., and ROBELLO Samuel**
   Drilling Engineering
   PennWell Books, 2014
2. **BAKER Ron**
   A Primer of Oilwell Drilling
   Book Monkey Inc., 2012