



# NATIONAL UNIVERSITY OF ENGINEERING

## COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING

### PETROLEUM ENGINEERING PROGRAM

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#### PP421 – COMPLETION AND STIMULATION OF OIL WELLS I

##### I. GENERAL INFORMATION

<b>CODE</b>	: PP421 Completion and Stimulation of Oil Wells I
<b>SEMESTER</b>	: 8
<b>CREDITS</b>	: 5
<b>HOURS PER WEEK</b>	: 6 (Theory–Practice)
<b>PREREQUISITES</b>	: PP323 Oil Drilling I, PP411 Well Electric Logs.
<b>CONDITION</b>	: Compulsory
<b>DEPARTMENT</b>	: Petroleum and Natural Gas Engineering

##### II. COURSE DESCRIPTION

The course prepares the student for the process of making a well ready for production (or injection). It involves the preparation of the bottom of the hole to the required specifications running in the production tubing and associated down hole tools, as well as perforating and stimulating as required. Students understand the methods and processes of well cementation, formation stimulation by acidification and hydraulic fracturing in exploration and exploitation stages.

##### III. COURSE OUTCOMES

At the end of the course, students:

1. Analyze well conditions and formations for planning well operation activities.
2. Calculate parameters of pressure, temperature, volume and flow, required for operation activities.
3. Describe how to perform the operation according to location and available equipment, tools and materials.
4. Explain and organize the personal that participate in well development on possible dangers and risks and how to control them safely.
5. Conduce and coordinate well development operations.
6. Assess and evaluate operation results.

##### IV. LEARNING UNITS

###### 1. WELLS COMPLETION

Introduction / Definition and characteristics / Objectives and stages in the completion of wells / Functions of surface cemented liners, intermediate and in production / Types of well completions by depth, geographic location / Reservoirs and technological advancement.

###### 2. WELLS CEMENTATION

**Cement mixtures.** Mixture rheology and thixotropy / Fluids involved in a cementation (Newtonian and non-Newtonian) / Types of flow during cementation (cap, laminar, turbulent) / Determination of type of mixture fluids (laboratory) / Calculation of mixture parameters (viscosity, density, etc.).

**Primary cementation.** Definitions / Requirements and evaluation of wells / Equipment and devices used in cementing (on surface and inside the well) / Functions of equipment and devices / Cementing operation process / Factors affecting the cementation / Cementation planning

**Formulas and calculations for cementing.** Determination of the type of cement to use / Formulas, equations and tables to be used in the cementation of wells / Calculation of the

mixture volume and displacement flow of the mixture / Calculation of friction and hydrostatic pressures in the system during cementation / Calculation of required volume of washing fluids and pill / Verification that the pressures generated in annular space do not fracture the formations / Solving cementing problems

**Secondary cementation.** Cementation of two or more stages / Liner cementation / Forced cementation / Placement of cement stoppers. Cases / Solving cementation problems / **Assessment of cementation results.** CBL and VDL adhesion records / Interpretation of records and results.

### 3. DEPTH CONTROL

Required equipment / Use of cable and pipes / Factors affecting cable or pipe elongation / Operation process using records of spontaneous potential (SP) and Gamma Ray Neutronic (GR/N) / Correcting elongation effects problems.

### 4. LATERAL DRILLING

Introduction / Factors affecting lateral drilling / Cannons (types or classes) / High energy cannons (jet type): explosive load, design type, development of high energy, damage of tunnel, phase and density of shooting / Lateral drilling techniques, with cable, with pipe / Technologies of lateral drilling: positive pressure (over balance), negative pressure (under balance), advantages and disadvantages / Calculations to perform lateral drilling with negative pressure / Problems.

### 5. DAMAGES

Definition / Porosity and permeability: effects / Damages: origin, causes, types / Pseudo damages, causes / Evaluation of damages: reduction of flow capacity / Formation tests / Pressure build-up tests / Horner method. Formulas and problems.

### 6. ACIDIZING

Injection of chemical for cleaning-up the formation / Improving the flow of reservoir fluids / Strong acids to dissolve rock formations.

### 7. FRACTURING

Fracture creation and extension / Increasing surface area for formation fluids to flow into the well / Hydraulic fracturing / Injection of high pressure fluids.

## V. LABORATORY AND PRACTICAL EXPERIENCES

- Determination of the type of fluid in cement mixtures
- Field visits. Analysis of completion process, procedures, methods, used materials, tools and equipment.

## VI. METHODOLOGY

The course takes place in theory, practice, laboratory sessions and field visits. In theory sessions, faculty presents concepts, techniques, methods, equipment and tools applied in cementation, depth control operations, lateral drilling, hydraulic fracturing and acidizing. In practice sessions, problems are solved and their solution analyzed. In field visits, students observe operations procedures, techniques, materials, equipment and tools. At the end of the course students present and defend a final project.

## VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

$$PF = (EP + EF + PP) / 3$$

EP: Mid-term Exam

EF: Final Exam

PP: Average of Practical Works

## VIII. BIBLIOGRAPHY

1. DOWELL.  
Cementing Engineering Manual.
2. SCHLUMBERGER.  
Field Data Handbook. Depth Control.
3. WEEKS  
Formation damage.