NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING
PETROLEUM ENGINEERING PROGRAM

PP426 – HYDROCARBONS TRANSPORT AND STORAGE

I. GENERAL INFORMATION

CODE	**:**	PP426 Hydrocarbons Transport and Storage.
SEMESTER	**:**	8
CREDITS	**:**	4
HOURS PER WEEK	**:**	5 (Theory - Practice)
PREREQUISITES	**:**	PP414 Oil Production I
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Petroleum and Natural Gas Engineering

II. COURSE DESCRIPTION

The course aims to prepare student in the understanding and analysis of different methods and procedures for the safe and efficient transport and storage of hydrocarbons in industry, predicting and opportunely correcting problems that could arise in the process.

III. COURSE OUTCOMES

At the end of the course, students:

1. Design oil and gas separators according to particular needs.
2. Understand and analyze main oil and gas treatment processes.
3. Analyze the different methods, procedures and techniques for hydrocarbons transport and storage.
4. Take into account safety measures in every stage of transport and storage operations.
5. Solve problems about hydrocarbons transport and storage.

IV. LEARNING UNITS

1. OIL AND GAS SEPARATION

Typical diaphragm / P.T.C. rate of mass balance in separators / Separation pressure versus GPM curves based on well fluids / Separation problems.

2. SEPARATORS DESIGN CRITERIA

Equipment nomenclature / Types of separators / Advantages and disadvantages of different types / Gas capacity / Fluid capacity / Mist extractors / Calculations / Selection of a separator / Capacity of a 3-phase separator / Published curves by manufacturers / Fluid sampling.

3. OIL AND GAS EMULSIONS AND DESIGN OF TREATMENT EQUIPMENT

Emulsions. Introduction / Characteristics and relevant properties / Treatment methods / Separation of oil and water / Field practice / Design elements / Calculation of the capacity of a treatment equipment / Calculation of the capacity of a skimmer / Field problems.

4. OIL AND GAS TRANSPORT BY PIPELINES

Review of the fundamental concepts of fluid in pipes and their applications in field problems / Mechanical energy balance / Irreversible changes in a flow system / Flow equations / Hydraulic gradient / Total load / Working and testing pressures / Pressure losses due to friction / Equivalent lengths in pipes of different diameters / Pressure losses in valves and connections / Pumps: different types and principles of operation / Power.

5. PIPELINES DESIGN, CONSTRUCTION, LAYING AND MAINTENANCE

Design factors and elements / Calculation of pressure losses, pipe diameter and flow capacity in pipelines / Use of exponential correlations / Pipe roughness / Design of series and derivation systems / Complex fluids collection systems / Operations in pipelines laying / Pipe mechanical properties / Project specifications / Cathodic protection / Inspection and control / Economic considerations / Special characteristics of pipelines.

6. GAS TRANSPORT BY PIPELINES AND RECOLLECTION SYSTEM

Derivation of the general formula of gas flow in pipes / Standard forms of the flow equation / General considerations / Most used formulas. Weymouth, Panhandle and fixed Panhandle / Equivalence of diameters / Different arrangements / Influence of Z factor / Loss of heat in underground pipes / Gas compression work / Series and parallel systems / Pipe with variable flow / Complex systems / Practical applications / Design of parallel systems according to future increasing demand.

7. OPERATION AND ANALYSIS OF GAS PIPELINES AND HORIZONTAL FLOW OF TWO PHASES

Construction and operating conditions of pipelines / Storage capacity of gas pipeline / Comparison between analytical results and field tests. / Hardy Cross method for analysis of pressures in stem knots. / Theory of horizontal two-phases flow / Types of flow / Brief analysis of Bertuzzi, Tek and Poetman, Lockard and Martinelli, Baker and Eaton methods.

8. OTHER HYDROCARBONS TRANSPORT AND STORAGE SYSTEMS

Underwater transport / Transport by tanker / Classification / Upload and download of tankers / Transport scheme / Security measures / Costs / Initial storage at the well / Oil collection systems / Gas collection system / Gas compression / Steam recovery system / Types of storage tanks / Calculation of tankage / Storage in marine terminals / Roof tanks / Floating and flexible. / Spherical tanks and spheroids / Site selection and storage type / Prevention and control of fires / Methods to reduce losses by gravity conservation and equipment corrosion / Cost of storage.

9. DESIGN OF STEAM BALANCE SYSTEMS

Calculation of evaporation losses or vents / Use of monograms / Calculation of filling losses for different types of tanks. / Expansion of the steam-air mixtures / Storage pressures to prevent steam space.

V. METHODOLOGY

The course takes place in theory, practice and laboratory sessions. In the theory sessions, the teacher presents concepts and applications. In practice sessions, various problems are solved and their solution analyzed.. At the end of the course, students complete a project and defend it. Student's active participation is promoted.

VI. 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

VII. BIBLIOGRAPHY

1. M. MOHITPOUR, M.S. YOON, J.H. RUSSELL.
   Hydrocarbons Liquid Transmission Pipeline and Storage Systems, ASME Press, 2012
2. CARL L. YAWS.
   Transport Properties of Chemicals and Hydrocarbons, 2014.