COURSE SYLLABUS - SEMESTER I

GAS PROCESSING LEVEL I: PN 1405

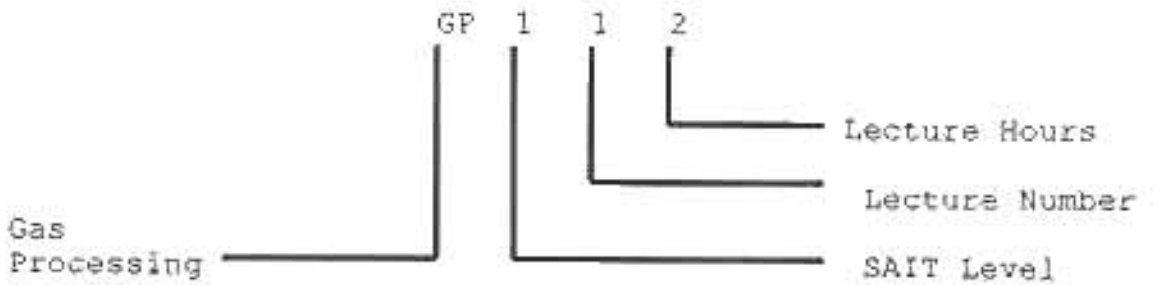
This course is designed to assist engineering students to understand the physical, chemical and engineering principles used in the handling of natural gas and its associated liquids and other compounds obtained from natural gas. How it is treated from its underground origin, through the treating processes to the production of pipeline sales gas.

Prerequisites: None

Textbooks: *Natural Gas Processing* Books C, B

Class Hours: See Timetable

Class: Reference Material Source and Lecture Time



Course Objectives

Unit 1: Gas Plant - Development and Types

Upon the successful completion of this unit, the student will be able to:

1. discuss the purpose of the various types of natural gas plants.
2. discuss the design and operation requirements of natural gas plants.
3. discuss the basic components which are required in a conventional gas plant.

Unit 2: Gas Plant - Process Description

Upon the successful completion of this unit, the student will be able to:

1. detail the basic equipment used in each of the process stages.
2. discuss the chemical requirements of each of the process stages.
3. describe how each of the process stages are interrelated.

Unit 3: Gas Plant - Process Flows

1. identify the individual sections of a gas processing plant.
2. describe the various processes which take place in each section.
3. trace the flow of each of the separated components, using a gas processing plant flow diagram.

Unit 4: Gas Plant - Inlet Separation

Upon the successful completion of this unit, the student will be able to:

1. discuss the purposes for which inlet separation equipment is installed.
2. discuss the design and operational requirements of inlet separation systems.
3. describe the instrumentation and safety devices fitted on inlet separators.

Unit 5: Gas Plant - Inlet Equipment and Operations

Upon the successful completion of this unit, the student will be able to:

1. describe the system requirements necessary to separate the gas mixture into three phases.
2. discuss the automatic instrumentation required on a typical inlet separator for unattended operation.
3. discuss inlet separator problems and the methods used to correct or prevent them.

Unit 6: Condensate Stabilization Systems

Upon the successful completion of this unit, the student will be able to:

1. discuss the functions which condensate stabilization systems accomplish.
2. discuss the market standards to which natural gasoline is produced.
3. describe the various processes by which condensate is stabilized.

Unit 7: Stabilization Equipment

Upon the successful completion of this unit, the student will be able to:

1. discuss the function that each individual piece of equipment performs in a condensate stabilization system.
2. trace the flow of condensate and gas through the system using a process flow diagram.
3. discuss the specific operating temperatures and pressures that are required to correctly stabilize condensate.

Unit 8: Stabilization Operations

Upon the successful completion of this unit, the student will be able to:

1. Detail the correct temperatures and pressure required for economic, safe Operation.
2. Describe the test procedures used to confirm "on specification" production.
3. Discuss the loading procedures and safety requirements for shipping stabilized Condensate.

Unit 9: Sweetening Processes

Upon the successful completion of this unit, the student will be able to:

1. detail the sales gas specifications which must be met.
2. discuss the operating cycle of the commonly used liquid and solid sweetening processes
3. trace the gas and solution flows through a sweetening plant using simple flow diagrams.

Unit 10: Sweetening Chemicals

Upon the successful completion of this unit, the student will be able to:

1. describe the operational alternatives presented by the use of different liquid sweetening agents.
2. list the solution circulation rates, permissible concentrations, grain loading and regeneration procedures required.
3. discuss the solid sweetening systems and the uses to which they are suited.

Unit 11: Sweetening Equipment

Upon the successful completion of this unit, the student will be able to:

1. discuss the function which each major piece of equipment performs.
2. trace the flow of amine and gas through the system using a flow diagram.
3. discuss the specific temperatures, pressures, and other controls which are required to sweeten gas.

Unit 12: Sweetening Operations

Upon the successful completion of this unit, the student will be able to:

1. discuss the causes of poor performance in a gas sweetening plant.
2. discuss the corrective procedures required to remedy upsets.
3. discuss methods of detecting and preventing corrosion and list how, if corrosion is not prevented, it causes severe operational problems.

Unit 13: Sulphur - Introduction

Upon the successful completion of this unit, the student will be able to:

1. identify the principal sources of sulphur.
2. list the chemical and physical properties of sulphur.
3. discuss the economic and environmental considerations of sulphur production.

Unit 14: Sulphur - Claus Process

Upon the successful completion of this unit, the student will be able to:

1. describe the oxidation reaction in the reaction furnace which is the first step in the Claus process.
2. describe the reaction between H_2S and SO_2 in the presence of a catalyst which is the heart of the Claus process.
3. describe the various factors which influence sulphur reactions in the Claus process.

Unit 15: Sulphur Processing Methods

Upon the successful completion of this unit, the student will be able to:

1. describe the straight-through Claus process for acid gases with high H_2S content.
2. describe the modified split-flow Claus process for acid gases with 15 to 50% H_2S content.
3. describe the modified split-flow Claus process for acid gases with 10 to 20% H_2S content.
4. trace the flows of air, gases, steam, water, and sulphur in each of the processes using a flow diagram.

Unit 16: Sulphur – Process Control

Upon the successful completion of this unit, the student will be able to:

1. describe the gas to air ratios required for maximum sulphur production.
2. discuss the plant temperatures required to ensure rapid and complete chemical reactions.
3. describe the tests which are carried out to monitor plant performance and check ambient air quality.

Unit 17: Sulphur Plant Operations

Upon the successful completion of this unit, the student will be able to:

1. discuss the problems which may occur during normal operations.
2. discuss the procedures to be followed during startup.
3. discuss the procedures to be followed during normal and emergency plant shutdowns.
4. discuss the handling, storage and shipping of sulphur.

Unit 18: Dehydration – Definitions, Testing

Upon the successful completion of this unit, the student will be able to:

1. discuss the measures necessary to dehydrate gas in the plant and field.
2. describe the problems which occur if the gas is not properly dehydrated.
3. describe the various tests which are taken to measure the effectiveness of gas dehydration.

Unit 19: Dehydration – Chemicals, Liquid Desiccants

Upon the successful completion of this unit, the student will be able to:

1. describe the measures used to reduce and control the water content in a gas stream.
2. describe the absorption of water from a gas stream using various liquid desiccants.
3. trace the flow of gas and liquid desiccants through glycol absorption systems using flow diagrams.

Unit 20: Dehydration – Glycol Equipment and Operation

Upon the successful completion of this unit, the student will be able to:

1. describe the equipment used in glycol dehydration systems.
2. discuss the normal operation of the system.
3. discuss the operational problems and describe the corrective actions.
4. be taken in a glycol dehydration system.

Unit 21: Dehydration – Solid Desiccants

Upon the successful completion of this unit, the student will be able to:

1. discuss the equipment used in solid desiccant systems.
2. discuss the procedures followed in the operation of solid desiccant systems.

3. trace the flow of gases in the normal and regeneration cycles using a flow diagram.

Unit 22: Refrigeration – External Process

Upon the successful completion of this unit, the student will be able to:

1. discuss the factors which are taken into consideration before selecting a refrigeration system.
2. describe the equipment required in a typical externally refrigerated process.
3. discuss the principles of operation of an externally refrigerated system.
4. describe the use of cascade type refrigeration systems.

Unit 23: Refrigeration – Cryogenic Process

Upon the successful completion of this unit, the student will be able to:

1. discuss the factors which are taken into consideration before selecting a turbo-expansion system.
2. describe the equipment required in a typical cryogenic process.
3. discuss the principles of operation of an expander plant.

Unit 24: Introduction to Fractionation

Upon the successful completion of this unit, the student will be able to:

1. discuss a simple one-stage distillation process.
2. describe how multistage fractional distillation processes separate materials based on differing boiling points.
3. discuss the factors which affect the efficiency of a fractional distillation process.

Unit 25: Fractionation Tower and Tray Design

Upon the successful completion of this unit, the student will be able to:

1. describe the main components of a typical fractionating tower.
2. discuss the direction of flow of the liquids and vapours in a fractionating tower.
3. discuss the advantages of various types of tray designs in a fractionating tower.

Unit 26: Fractionation Equipment

Upon the successful completion of this unit, the student will be able to:

1. describe the types of reboiling equipment utilized in the operation of a fractionating tower.
2. describe the types of condensing equipment utilized in the operation of a fractionation tower.
3. discuss the control methods used in the operation of fractionation tower associated equipment.

Unit 27: Fractionation Systems

Upon the successful completion of this unit, the student will be able to:

1. describe the components which make up a total fractionation system.
2. discuss the most suitable methods of fractionating hydrocarbon streams to minimize operational costs.
3. describe the operational requirements of depropanizer, debutanizer, and de-ethanizer towers and discuss the general temperatures and pressures at which these units operate.

Unit 28: Fractionation Operational Procedures

Upon the successful completion of this unit, the student will be able to.

1. describe the variables which must be controlled to produce specification products from a fractionator.
2. discuss the process changes required when malfunction of any part of the fractionating system occurs.
3. discuss in summary form how a typical fractionating system operates.
4. explain the procedures to follow when either product is off specification.

Unit 29: Hydrocarbon Treating – Caustic Systems

Upon the successful completion of this unit, the student will be able to:

1. describe the impurities found in hydrocarbons and detail the problems these materials would cause if not removed.
2. discuss the nonregenerative method of caustic treating.
3. discuss the regenerative methods of caustic treating.
4. discuss the process flows used in modified caustic treatment systems
5. discuss the advantages and disadvantages of the various systems

6. describe the operational problems encountered in these systems and discuss the corrective actions which are taken to remedy the problems.

Unit 30: Hydrocarbon Treating – Molecular Sieve Process

Upon the successful completion of this unit, the student will be able to:

1. describe how molecular sieves may be designed to selectively remove specific components from hydrocarbon streams.
2. describe the equipment utilized in a typical molecular sieve system.
3. discuss the advantages and disadvantages of a molecular sieve system.
4. describe the steps involved in operating a molecular sieve.

Unit 31: Hydrocarbons – Storage & Loading

Upon the successful completion of this unit, the student will be able to:

1. describe the differing requirements for, and types of, hydrocarbon storage.
2. describe the basic operational and safety requirements of a storage and loading system.

Unit 32: Sulphur Plant Tail Gas Cleanup

Upon the successful completion of this unit, the student will be able to:

1. describe the varied processes in which compressors are used.
2. discuss the two main classifications of compressors.
3. discuss the positive displacement reciprocating compressor types which have been developed to meet the needs of industry.

Unit 33: Gas Compression – Classifications and Types

Upon the successful completion of this unit, the student will be able to:

1. describe the varied processes in which compressors are used.
2. discuss the two main classifications of compressors.
3. discuss the positive displacement reciprocating compressor types which have been developed to meet the needs of industry.

Unit 34: Gas Compression – Compressor Components

Upon the successful completion of this unit, the student will be able to:

1. discuss the materials used in the construction of the compressor components and describe the physical characteristics which determine their selection.
2. discuss the function of the individual components and describe how they are combined to form the entire machine.
3. discuss the components which require special or frequent attention.

Unit 35: Gas Compression – Valves & Rod Packing

Upon the successful completion of this unit, the student will be able to:

1. discuss the major causes of compressor valve failures and detail the remedial actions required.
2. discuss the requirements for mechanical rod packing, with respect to selection and installation.
3. discuss the operational indicators of pending mechanical problems for these two compressor components.

Unit 36: Gas Compression – Rotary Machines

Upon the successful completion of this unit, the student will be able to:

1. identify the different designs of rotary compressors.
2. discuss the construction details of rotary compressors.
3. discuss the operational application of rotary compressors.

Unit 37: Gas Compression – Dynamic Compressors

Upon the successful completion of this unit, the student will be able to:

1. Discuss the principles of operation of the two basic types of axial compressors.
2. Describe the mechanical construction details of centrifugal and axial compressors.
3. Outline the operational characteristics of centrifugal and axial compressors.

Unit 38: Gas Compression – Auxiliaries, Stage Arrangements

Upon the successful completion of this unit, the student will be able to:

1. describe the mechanical configuration of separators and heat exchangers as used on gas compressors.
2. describe the operational and efficiency improvements which result from the installation of this equipment.
3. discuss the various stage configurations of compressors and describe where the auxiliary equipment is fitted on these stages.

Unit 39: Gas Compression – Basic Controls

Upon the successful completion of this unit, the student will be able to:

1. describe the operational characteristics of axial flow compressors.
2. describe the operational controls and instrumentation required to ensure stable compressor output.
3. detail the protective instrumentation installed to prevent compressor damage.

Unit 40: Gas Compression – Lubrication

Upon the successful completion of this unit, the student will be able to:

1. describe the functions of lubricants as utilized in gas and air compressors.
2. discuss how internal and external lubrication is supplied to compressors.
3. describe the various types of mechanical lubricators used.

Unit 41: Gas Compression – Drivers, Operational Procedures

Upon the successful completion of this unit, the student will be able to:

1. discuss the appropriate application for compressor drivers.
2. discuss the correct starting and stopping procedures for compressor drivers.
3. detail the protective devices which are installed on compressor drivers.

Evaluation

Final Exam 35%
Midterm 35%
Quizzes and Assignments..... 30%

Summary of PN1405 Course Hours

Lecture	42 hours
Exam/Quiz	6 hours
Total	48 hours