SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)
SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

VI SEMESTER

PEI303 – INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES

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Prepared by

Dr.R.ARIVALAHAN,

Professor/EIE

UNIT I - INTRODUCTION TO PETROLEUM REFINING AND FORMATION PROCESS				
Brief survey of petroleum formation, petroleum exploration, Petroleum production, Petroleum refining and its methods, refining capacity and consumption in India, constituents of Crude Oil, Recovery techniques – Oil – Gas separation, Processing wet gases.				
PART – A				
Q.No	**Questions**	**BT**	**CO**	**Competenc**
1.	How the petroleum formation take place?	BTL 2	**CO1**	Understand
2.	What is meant by petroleum exploration?	BTL 1	**CO1**	Remember
3.	List the different petroleum refining methods.	BTL 1	**CO1**	Remember
4.	What is meant by petroleum or crude oil ?	BTL 1	**CO1**	Remember
5.	State Engler's theory for the formation of petroleum.	BTL 1	**CO1**	Remember
6.	Mention the crude oil or petroleum contamination.	BTL 1	**CO1**	Remember
7.	Mention various hydrocarbons present in petroleum.	BTL 1	**CO1**	Remember
8.	List the different exploration technique to recover Petrol.	BTL 1	**CO1**	Remember
9.	Give the steps involved in oil-gas separation.	BTL 1	**CO1**	Remember
10.	Name the different petroleum exploration sites in Tamil Nadu.	BTL 1	**CO1**	Remember
11.	What is meant by petrochemical?	BTL 1	**CO1**	Remember
12.	Name the principle raw material used in petrochemical industry.	BTL 1	**CO1**	Remember
13.	Mention the constituents of crude oil.	BTL 1	**CO1**	Remember
14.	Mention the instruments used in refining of crude oil.	BTL 1	**CO1**	Remember
15.	List the steps involved in processing wet gases.	BTL 1	**CO1**	Remember
16.	Why is petrochemical preferred over other organic chemical?	BTL 2	**CO1**	Understand
17.	List the various recovery techniques in petroleum processing.	BTL 1	**CO1**	Remember
18.	What is the need for petroleum recovery.	BTL 1	**CO1**	Remember
19.	Sketch the P and I diagram of a gas separation process in a petroleum refinery	BTL 2	**CO1**	Understand
20.	Mention the difference between two phase and three phase oil separation.	BTL 1	**CO1**	Remember
21.	What is meant by cracking ?	BTL 1	**CO1**	Remember
22.	Mention the petroleum main product constituents.	BTL 1	**CO1**	Remember
23.	What is meant by hydro cracking ?	BTL 1	**CO1**	Remember
24.	Mention the Hydro carbons and Non-Hydro carbons obtained from crude oil.	BTL 1	**CO1**	Remember

PART – B				
1.	Analyze the process of extraction of oil from marine environment. (16)	BTL4	**CO1**	Analyze
2.	Illustrate in detail the method to discover petroleum mines under sea. (16)	BTL3	**CO1**	Apply
3.	Explain the petroleum refining consumption of India. (16)	BTL4	**CO1**	Analyze
4.	Illustrate the various process involved in wet gases with necessary diagram. (16)	BTL3	**CO1**	Apply
5.	Explain the constitutes of Crude oil (i) Hydro Carbon (ii) Non-Hydrocarbon. (8+8)	BTL4	**CO1**	Analyze
6.	Illustrate in detail the procedure involved in refining crude oil. (16)	BTL3	**CO1**	Apply
7.	Explain the petroleum recovering technique : (i) Primary Recovery Technique (ii) Secondary Recovery Technique (iii) Tertiary Recovery Technique. (5+5+6)	BTL4	**CO1**	Analyze
8.	Illustrate various methods of oil extraction in petroleum plant. (16)	BTL3	**CO1**	Apply
9.	Explain the constituents of crude oil how it can be separated. (16)	BTL4	**CO1**	Analyze
10.	(i)Analyze the various methods used in primary and secondary recovery in petroleum plants. (8) (ii)Explain the measurements done in those recovery processes. (8)	BTL 4	**CO1**	Analyze
11.	Analyze the various control loops involved in the separation of gas and water from crude oil. (16)	BTL4	**CO1**	Analyze
12.	Explain the refining capacity and consumption of petroleum products in India. (16)	BTL4	**CO1**	Analyze
13.	Illustrate the Stages for the formation of Petroleum. (16)	BTL3	**CO1**	Evaluate
14.	Explain the design and working of Scrubber with neat diagram. (16)	BTL 4	**CO1**	Analyze
15.	Illustrate the Schematic P&I Diagram of a typical crude oil distillation unit as used in petroleum crude oil refineries. (16)	BTL3	**CO1**	Apply
16.	Analyze the different products that are obtained from the refining crude oil. (16)	BTL 4	**CO1**	Analyze
17.	Draw the diagram of recovery of petroleum from the oil well and explain its operation. (16)	BTL3	**CO1**	Apply

UNIT II ATMOSPHERIC AND VACUUM DISTILLATION UNITS

P & I diagram of petroleum refinery, Atmospheric distillation process, Vacuum distillation process, Thermal cracking, Catalytic cracking, Catalytic reforming, and Utility plants – Air, N_2 , and cooling water.

PART – A

Q.No	Questions	BT	CO	Competenc
1	Define cracking.	BTL 1	**CO2**	Remember
2	Mention the different types of cracking.	BTL 1	**CO2**	Remember
3	Define catalytic cracking.	BTL 1	**CO2**	Remember
4	Define catalytic reforming.	BTL 1	**CO2**	Remember
5	What are free radicals?	BTL 1	**CO2**	Remember
6	What are the three stages of oil refining?	BTL 1	**CO2**	Remember
7	What is meant by thermal cracking?	BTL 1	**CO2**	Remember
8	Mention the different types of Thermal Cracking.	BTL 1	**CO2**	Remember
9	What is meant by atomic distillation process ?	BTL 1	**CO2**	Remember
10	Distinguish between catalytic cracking and catalytic reforming.	BTL 2	**CO2**	Understand
11	Mention the different types of Catalytic Cracking.	BTL 1	**CO2**	Remember
12	Mention some examples for knocking operation.	BTL 1	**CO2**	Remember
13	What is meant by knocking ?	BTL 1	**CO2**	Remember
14	How are industrial thermal cracking operations classified?	BTL 2	**CO2**	Understand
15	Mention the main elements of petroleum refinery.	BTL 1	**CO2**	Remember
16	In Distillation column, what are the different products can be obtained?	BTL 1	**CO2**	Remember
17	What are the products obtained from petroleum refinery?	BTL 1	**CO2**	Remember
18	Mention any four main products obtained from petro chemical industry.	BTL 1	**CO2**	Remember
19	Why Cooling water plant is necessary in petrochemical industry ?	BTL 2	**CO2**	Understand
20	Mention the main elements of Nitrogen plant in petrochemical industry.	BTL 1	**CO2**	Remember
21	How the petroleum is purified in different stages ?	BTL 2	**CO2**	Understand

22	Why Nitrogen plant is necessary in petrochemical industry ?	BTL 2	**CO2**	Understand
23	Mention the main elements of cooling water plant in petrochemical industry.	BTL 1	**CO2**	Remember
24	List the steps involved in Atmospheric distillation process.	BTL 1	**CO2**	Remember
	PART – B			
1.	Explain the P & I Diagram of a Petroleum Refinery Process. (16)	BTL 4	**CO2**	Analyze
2.	Explain (i) Atmospheric Distillation Process (ii) Vacuum Distillation Process. (16)	BTL 3	**CO2**	Apply
3.	Write a detail technical note on polymerization techniques in petroleum industries with examples. (16)	BTL 3	**CO2**	Apply
4.	With neat sketch explain the operation of thermal cracking. (16)	BTL 3	**CO2**	Apply
5.	With neat sketch explain the operation of catalytic reforming. (16)	BTL 3	**CO2**	Apply
6.	Explain the different products obtained from petrochemical industry. (16)	BTL 3	**CO2**	Apply
7.	Explain about catalytic reforming process. (16)	BTL 3	**CO2**	Apply
8.	With neat sketch explain the operation of Atmospheric Distillation Process. (16)	BTL 3	**CO2**	Apply
9.	With neat sketch explain the operation of Vacuum Distillation Process. (16)	BTL 3	**CO2**	Apply
10.	Differentiate thermal and catalytic cracking. (16)	BTL 4	**CO2**	Analyze
11.	What is meant by cracking? Explain the following types of cracking (i) Thermal Cracking (ii) Catalytic Cracking. (16)	BTL 4	**CO2**	Analyze
12.	List the products produced after cracking and also explain its use. (16)	BTL 4	**CO2**	Analyze
13.	Explain the following types of Thermal Cracking (i) Liquid phase Thermal Cracking (ii) Vapour phase Thermal Cracking. (16)	BTL 4	**CO2**	Analyze
14.	Explain the following types of : (i) Fixed type Catalytic Cracking (ii) Moving bed type Catalytic Cracking. (16)	BTL 4	**CO2**	Analyze
15.	With neat diagram, explain the operation Nitrogen plant used in petrochemical industry. (16)	BTL 3	**CO2**	Apply
16.	Explain the operation of Cracking and Knocking in Petrochemical Industry. (16)	BTL 3	**CO2**	Apply
17.	With neat diagram, explain the operation colling water system plant used in petrochemical industry. (16)	BTL 4	**CO2**	Analyze

UNIT III - INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES

Basics of field instruments, Parameters to be measured in Petrochemical industry, Distillation Column control, Selection of instruments, Basics of intrinsic safety of instruments, Area classification.

PART – A

Q.No	Questions	BT	CO	Competenc
1	What is meant by Distillation Column ?	BTL 1	**CO3**	Remember
2	Mention the different products obtained from petrochemical industry.	BTL 1	**CO3**	Remember
3	Write any four Pressure measuring instruments used in petrochemical Instruments.	BTL 1	**CO3**	Remember
4	Mention the basic five control schemes for distillation column.	BTL 1	**CO3**	Remember
5	Define term : (i) Reboiler (ii) Accumulator.	BTL 1	**CO3**	Remember
6	List any four parameters measured in petro chemical industry.	BTL 1	**CO3**	Remember
7	What are five Products controlled in Petrochemical Industry?	BTL 1	**CO3**	Remember
8	Mention the Temperature measuring instruments for Petrochemical Industry.	BTL 2	**CO3**	Understand
9	List the factors need to be consider for the selection of measuring instruments.	BTL 2	**CO3**	Understand
10	Draw the basic control scheme for Distillation Column.	BTL 2	**CO3**	Understand
11	Mention any Bottom product in Petrochemical Industry.	BTL 1	**CO3**	Remember
12	Mention any 4- safety instruments used in petrochemical industry.	BTL 1	**CO3**	Remember
13	What is the need of reboiler in Petrochemical Industry ?	BTL 1	**CO3**	Remember
14	What is meant by accumulation for Distillation column ?	BTL 1	**CO3**	Remember
15	List the four control valves used in Petrochemical Industry.	BTL 1	**CO3**	Remember
16	Mention the various chemicals from petroleum.	BTL 1	**CO3**	Remember
17	Difference between Petroleum and Petrol.	BTL 2	**CO3**	Understand
18	Mention any two Area zones considered in Petrochemical Industry.	BTL 1	**CO3**	Remember
19	List any four Indicating or Recording Instruments used as field instruments in petro chemical industry.	BTL 1	**CO3**	Remember
20	Differentiate the following products (i) Reflux Product (ii) Distillate Product	BTL 2	**CO3**	Understand

21	Why bottom product is heated with help of reboiler in Distillation column ?	BTL 2	**CO3**	Understand
22	What is meant by intrinsic safety Instruments?	BTL 1	**CO3**	Remember
23	What is the purpose of safety instruments ?	BTL 1	**CO3**	Remember
24	Mention any four Intrinsic safety instruments.	BTL 1	**CO3**	Remember
	PART – B			
1.	Explain the basics of Field Instruments used for the petrochemical industry. (16)	BTL 4	**CO3**	Analyze
2.	Explain the safety instruments used in Petrochemical Industry. (16)	BTL 4	**CO3**	Analyze
3.	Illustrate the Parameters to be Measured in Petrochemical Industry. Explain with suitable diagram. (16)	BTL 3	**CO3**	Apply
4.	Explain the control schemes for Distillation Column. (16)	BTL 4	**CO3**	Analyze
5.	Draw the diagram for Distillation Column Control, how the different products can be obtained? (16)	BTL 3	**CO3**	Apply
6.	Draw the control scheme for Distillation Column (i) Temperature Control (ii) Pressure Control Scheme. (16)	BTL 3	**CO3**	Apply
7.	Draw the control scheme for Distillation Column (i) Top Product Control (ii) Bottom Product Control. (16)	BTL 3	**CO3**	Apply
8.	Illustrate, how the Distillation Column is an example for 5X5 Process. (16)	BTL 3	**CO3**	Apply
9.	Explain the following terms in Distillation Column (i) Basic Control Scheme with Diagram (ii) Accumulation. (16)	BTL 4	**CO3**	Analyze
10.	Illustrate the factors need to consider for the Selection of Instruments in petrochemical industry. (16)	BTL 3	**CO3**	Apply
11.	Explain about the basics of Intrinsic Safety of Instruments. (16)	BTL 4	**CO3**	Analyze
12.	Analyze the following area zone (i) Gas Hazardous Zone (ii) Dust Hazardous Zone. (16)	BTL 4	**CO3**	Analyze
13.	Explain about (i) Temperature Measuring Instruments (ii) Pressure Measuring Instruments. (16)	BTL 4	**CO3**	Analyze
14.	Explain about (i) Gas Analyzer (ii) Chemical compassion Analyzer. (16)	BTL 4	**CO3**	Analyze
15.	Explain the following types of basic field instruments : (i) Measuring Instruments (ii) Transmitting Instruments. (16)	BTL 4	**CO3**	Analyze
16.	Analyse the Different Final Control Elements or Control valves used in Petrochemical Industries. (16)	BTL 4	**CO3**	Analyze
17.	Explain about Indicating or Recording Instruments acts as field instruments for petrochemical industries. (16)	BTL 4	**CO3**	Analyze

UNIT IV -STEAM AND CONDENSATE CONTROL				
Control of furnace, Reboiler Control, Reflux Control, Control of catalytic crackers, Control of heat exchanger, Control of cooling tower.				
PART – A				
Q.No	**Questions**	**BT**	**CO**	**Competenc**
1	Mention the parameters to be measured in the furnace.	BTL 1	**CO4**	Remember
2	List some examples for air fuel ratio scheme.	BTL 1	**CO4**	Remember
3	Why air fuel ratio adjustment is necessary for furnace?	BTL 2	**CO4**	Understand
4	Mention the safety interlocks used in the furnace.	BTL 1	**CO4**	Remember
5	What are the control measures of thermal crackers?	BTL 1	**CO4**	Remember
6	What is meant by reboiler ?	BTL 1	**CO4**	Remember
7	What is the need for composition controller in a petrochemical industry?	BTL 1	**CO4**	Remember
8	Define the control actions performed in catalytic cracking.	BTL 1	**CO4**	Remember
9	Mention the control parameters used for thermal cracking.	BTL 1	**CO4**	Remember
10	Brief about the control of thermal crackers and its process variables.	BTL 2	**CO4**	Understand
11	Mention the main elements of catalytic crackers.	BTL 1	**CO4**	Remember
12	What is meant by Heat exchanger?	BTL 1	**CO4**	Remember
13	Define the term Reflux ratio.	BTL 1	**CO4**	Remember
14	Why reflux ratio control is necessary for petrochemical industry?	BTL 2	**CO4**	Understand
15	Define the term: Air-fuel ratio for furnace.	BTL 1	**CO4**	Remember
16	What is meant by reboiler ?	BTL 1	**CO4**	Remember
17	Enumerate the reboiler control schemes used in petrochemical industry.	BTL 2	**CO4**	Understand
18	Compare cracking and reforming.	BTL 2	**CO4**	Understand
19	Sketch the block diagram of a distillation column control.	BTL 2	**CO4**	Understand
20	Differentiate the types of Heat exchangers : (i) Parallel Flow Type Heat Exchanger (ii) Coherent Flow type Heat Exchanger	BTL 2	**CO4**	Understand
21	Sketch the control scheme for reflux adjustment.	BTL 2	**CO4**	Understand
22	Why is meant by cooling tower ?	BTL 1	**CO4**	Remember

23	Mention the need of cooling tower in petrochemical industry.	BTL 1	**CO4**	Remember
24	List the controls involved in catalytic reformer.	BTL 1	**CO3**	Remember
	PART – B			
1.	Explain the measuring instruments used in the furnace with suitable diagram. (16)	BTL 4	**CO4**	Analyze
2.	Draw the control scheme implemented for the furnace and explain its operation. (16)	BTL 3	**CO4**	Apply
3.	With neat diagram explain the air-fuel ratio control in the furnace. (16)	BTL 3	**CO4**	Apply
4.	Draw and explain the control scheme implemented for the reboiler.	BTL 3	**CO4**	Apply
5.	Explain the reflux ratio control scheme with suitable diagram for petrochemical industry. (16)	BTL 3	**CO4**	Apply
6.	Draw and explain the control scheme implemented for the furnace. (16)	BTL 3	**CO4**	Apply
7.	Explain the measuring instruments used in the temperature control process with suitable diagram. (16)	BTL 3	**CO4**	Apply
8.	Draw and explain the control scheme implemented for the furnace. (16)	BTL 3	**CO4**	Apply
9.	Explain the control scheme for Furnace Control (i) Air Fuel ratio Control (ii) Temperature Control Scheme. (16)	BTL 3	**CO4**	Apply
10.	Explain the following types of Heat Exchangers (i) Parallel Flow Type Heat Exchanger (ii) Coherent Flow type Heat Exchanger. (16)	BTL 4	**CO4**	Analyze
11.	Draw the control scheme implemented for the Heat exchanger. (16)	BTL 4	**CO4**	Analyze
12.	Analyze how the bottom product can be controlled with the help of reboiler explain it. (16)	BTL 4	**CO4**	Analyze
13.	With neat diagram, explain the following control scheme for Heat Exchanger (i) Feedforward Control (ii) Feedback Control (iii) Cascade Control. (16)	BTL 4	**CO4**	Analyze
14.	Draw the control scheme for catalytic crackers. (16)	BTL 4	**CO4**	Analyze
15.	Draw the control Schemes for (i) Reboiler Control (ii) Reflux Control, (16)	BTL 3	**CO4**	Apply
16.	In cooling tower, Illustrate the following control schemes: (i) Fan Control (ii) Pump Control. (16)	BTL 3	**CO4**	Apply
17.	Draw the diagram for cooling tower and explain the parameters measured and controlled in the cooling tower. (16)	BTL 3	**CO4**	Apply

UNIT V - BOILER SAFETY AND PROCESS INTERLOCKS				
Basics of PLC, and Safety interlocks in furnace, separator, pump, and compressor. Basics of SIL, Introduction to Standards.				
PART – A				
Q.No	**Questions**	**BT**	**CO**	**Competenc**
1	Define Programmable Logic Controller (PLC).	BTL 1	**CO5**	Remember
2	Mention the basic components of a PLC.	BTL 1	**CO5**	Remember
3	List any two advantages of PLC over relay logic.	BTL 1	**CO5**	Remember
4	Mention any four PLC input devices and output devices used in process industries.	BTL 1	**CO5**	Remember
5	What is meant by pump?	BTL 1	**CO5**	Remember
6	Why are PLCs preferred in hazardous process plants**?**	BTL 2	**CO5**	Understand
7	Explain the term I/O module in a PLC system.	BTL 1	**CO5**	Remember
8	Summarize, how a PLC improves plant reliability**.**	BTL 2	**CO5**	Understand
9	What is separator in petrochemical industry?	BTL 2	**CO5**	Understand
10	Why are PLCs preferred in hazardous process plants**.**	BTL 2	**CO5**	Understand
11	What is a safety interlock**?**	BTL 1	**CO5**	Remember
12	Name any two furnace safety interlocks**.**	BTL 1	**CO5**	Remember
13	How does anti-surge interlock protect a compressor?	BTL 2	**CO5**	Understand
14	Why is motor overload interlocked with pump operation?	BTL 2	**CO5**	Understand
15	What is meant by compressor?	BTL 1	**CO5**	Remember
16	Name the international standard for functional safety.	BTL 1	**CO5**	Remember
17	Define the term: interlocks.	BTL 1	**CO5**	Remember
18	List any two pump safety interlocks.	BTL 1	**CO5**	Remember
19	Name any two safety interlocks used in a separator.	BTL 1	**CO5**	Remember
20	Define the relationship between risk and SIL**.**	BTL 2	**CO5**	Understand
21	Why is SIL four rarely used in process industries**?**	BTL 2	**CO5**	Understand
22	What is anti-surge control?	BTL 1	**CO5**	Remember
23	Name the international standard for functional safety**.**	BTL 1	**CO5**	Remember
24	Which standard is specific to process industries**?**	BTL 2	**CO5**	Understand
PART – B				
1.	Illustrate how the liquid level measurement and control through Pump with PLC for safety interlocks. (16)	BTL 3	**CO5**	Apply

2.	Draw the block diagram of Programmable Logic Controller(PLC) and explain each element. (16)	BTL 4	**CO5**	Analyze
3.	Illustrate the advantages of Ladder logic compare with relay logic. (16)	BTL 3	**CO5**	Apply
4.	Explain the working of a PLC with the help of a block diagram and apply it to control a motor start–stop operation. (16)	BTL 3	**CO5**	Apply
5.	Analyze how the temperature is measured through Temperature switch and control the solenoid. (16)	BTL 4	**CO5**	Analyze
6.	Analyze the advantages of PLC-based control over conventional relay logic in hazardous process plants. (16)	BTL 4	**CO5**	Analyze
7.	Illustrate how pressure measured in the vessel through pressure switch and control through compressor through PLC and Motor. (16)	BTL 3	**CO5**	Apply
8.	Sketch the furnace safety interlocks and apply them to a typical process heater with a neat interlock logic diagram. (16)	BTL 3	**CO5**	Apply
9.	Sketch pump safety interlocks and apply them to a centrifugal pump. (16)	BTL 3	**CO5**	Apply
10.	Draw the physical and Ladder diagram program for the process control application. (16)	BTL 3	**CO5**	Apply
11.	Analyze the interaction between air–fuel ratio control and safety interlocks in preventing furnace explosions. (16)	BTL 4	**CO5**	Analyze
12.	Explain compressor safety interlocks and apply them to a centrifugal compressor in a gas processing unit. (16)	BTL 4	**CO5**	Analyze
13.	Analyze the application of anti-surge control and safety interlocks in compressors. (16)	BTL 3	**CO5**	Apply
14.	Analyse how the Single Phase Motor and Three Phase Motor are controlled with PLC with safety interlock. (16)	BTL 4	**CO5**	Analyze
15.	Illustrate the concept of SIL and apply it to determine the SIL requirement for a furnace fuel shut-off system. (16)	BTL 3	**CO5**	Apply
16.	Illustrate the steps involved in SIL assessment and verification for a safety instrumented function, (16)	BTL 3	**CO5**	Apply
17.	Analyze the importance of compliance with international safety standards in preventing major industrial accidents. (16)	BTL 4	**CO5**	Analyze