1. Develop the expression for the value shown by a thermometer if it is suddenly exposed to an environment which is 30 °C lower than its initial value. If the time constant of the system is 1.5 minutes, tabulate the temperature indicated versus time. The initial reading of the thermometer is 48 °C. Give the approximate idea of time when steady state shall be reached.

OR

2. For the tank whose drawing shown here, develop the model for the height of liquid at any instant of time. It may be assumed that outlet flow is linearly dependent on the height of the liquid and inlet liquid flow is \( F_1 \, \text{m}^3/\text{min} \). Top x-area of the tank 30cm x 30cm while bottom x-area is 10cm x 30cm and height of the tank is 40 cm. Elaborate the assumption if any and its relevance. Explain whether the model so developed is linear or non linear with proper justification.

2. A process can be approximated by three first order lag in series with the time constants of 1, 2, and 6 seconds and steady state gain of 1, 2, and 6 unit respectively. Write the transfer function of the process. Develop the expression for the response of the process if input is suddenly increased by 150% of the input value and held there.
3. In the question 2 if the first second and third process correspond to the dynamics of controller, final control element and process of a feedback control configuration with measuring sensor having no dynamics calculate cross over frequency, phase gain, phase margin and net amplitude ratio.

OR

3'. Draw the Bode diagram of the process which is represented by the following transfer function.

\[ G(s) = \frac{K_p}{(\tau_1 s + 1)(\tau_2 s + 1)(\tau_3 s + 1)(\tau_4 s + 1)(\tau_5 s + 1)} \]

5(a) Develop the discrete time response of a digital PID controller.

5(b) Write short notes on sampler and hold elements. Discussing its role in digital computer control.

5(c) Calculate the inverse z-transform of the following expression by long division.

\[ \bar{y}(z) = \frac{1 + 2z^{-1} - 3z^{-2}}{3 + 5z^{-1} - z^{-2} + 4z^{-3}} \]
2013-14
B.TECH. (AUTUMN SEMESTER) EXAMINATION
CHEMICAL ENGINEERING
ENERGY RESOURCES AND UTILIZATION
CH-413

Maximum Marks: 60 Credits: 04 Duration: Three Hours

Answer all the questions.

1(a) Explore various possibilities for producing hydrogen from different sources. Briefly explain some of the storage forms of hydrogen. [08]

1(b) Discuss the impacts of renewable and non-renewable energy sources on the environment. [04]

OR

1'(a) What do you understand by coal carbonization? Explain in detail the process of high temperature carbonization. [08]

1'(b) Describe the working and construction of a Bomb calorimeter with the help of a neat sketch. [04]

2(a) Explain in detail different types of oil burners employed in chemical industries along with their advantages and disadvantages. [06]

2(b) What is meant by oxidation stability of gasoline? Describe lab tests for determining the same. What is the significance of these tests? [06]

3(a) Define biomass. What are the various methods of biomass conversion? [04]

3(b) Clearly explain the mechanism of biogas formation along with the production parameters and their effects on the process. [08]

OR

3'(a) Explain the working of a biogas plant with the help of a neat diagram. What are the important considerations for setting up such a plant for a small family? [08]

Contd……..2
3'(b) Compare merits and demerits of fixed head and floating head biogas plants. [04]

4(a) Differentiate between fertile and fissile fuels by giving suitable examples. [02]

4(b) What is the significance of stagnation temperature in the design of liquid flat plate collector? [03]

4(c) Estimate the monthly average daily global radiation on a horizontal surface at Baroda (22°00'N, 73°10'E) on March 16. If average sunshine hours per day is 9.30. Assume a = 0.28 and b = 0.48. [06]

5(a) Discuss in detail the scheme of energy saving in Nitrogenous fertilizers industry or Steel industry. [06]

5(b) List various devices for energy recovery in process industry. Explain the salient features and use of one such device for energy recovery from gases and vapours. [06]
Answer all the questions.

1(a) Discuss the difference between alcohol and aldehyde in terms of their methods of production and utility. [05]

1(b) Explain the method of production of Ethylene Oxide along with the economics, use patterns, properties and containers and regulations. [10]

OR

1(b') Explain the method of production of Phenol along with the economics, use patterns, properties and containers and regulations. [10]

2(a) Explain the process of natural rubber production briefly and what is rubber compounding. [07]

OR

2(a') Give the difference between thermosetting and thermoplastics (include at least two examples of each). Briefly discuss vulcanization of rubber. [07]

2(b) Explain the method of sulphate (Kraft) process and discuss the major engineering problems. [08]

3(a) What is the importance of fat splitting in chemical process industries? Explain any one fat splitting plant briefly. [06]

OR

3(a') Explain the significance of hydrogenation of oil and economics. [06]

3(b) Explain the method of production of detergents in detail. [09]

4(a) List the various petroleum refinery products and Enumerate major refining processes. [07]

4(b) Discuss in detail any one of the following refinery conversion process:
   (a) Catalytic cracking
   (b) Reforming [08]
1(a) Give a typical layout of an oil refinery. For any five process units in a modern refinery, give feed stocks used and products obtained. [07]

1(b) Why can't petroleum crude be distilled as individual components? What is the reason for providing vacuum for distilling crude residue? [05]

1(c) List various sources of gasoline in a refinery. [03]

2(a) Describe Merox extraction process with the help of a neat flow sheet. Differentiate between Merox sweetening and Merox extraction processes. [06]

2(b) Name the fractions obtained from Atmospheric Distillation Unit along with their boiling ranges. Explain the working of ADU with the help of a neat flowsheet. [09]

OR

2'(a) Discuss Hydrotreating process in a refinery with special reference to flow sheet and chemical reactions involved. [06]

2'(b) Explain the working of Vacuum Distillation Unit with the help of a flow sheet. What are the design alterations for the same? Also give the boiling ranges of the fractions obtained from VDU. [09]

3(a) Answer any two of the following:

(i) Give the reaction mechanism of thermal cracking.

(ii) How is Combination cracking different from conventional
Visbreaking process? What is fuel oil instability?

(iii) What are the typical operating conditions for Visbreaking process in a modern refinery?

(iv) List the main process variables in Delayed coking and discuss their effects on the process.

3(b) Briefly discuss the process of catalytic cracking along with a neat flowsheet.

4(a) Classify Catalytic reforming process depending upon the frequency of catalyst regeneration.

4(b) Mention five undesirable characteristics in lube oil stocks. Give names of the processes for removing them. Discuss one of them in detail.

4(c) Explain the mechanism of catalytic alkylation process as practised in a refinery.