



**NATIONAL OPEN UNIVERSITY OF NIGERIA PLOT 91, CADASTRAL ZONE,
NNAMDI AZIKIWE EXPRESSWAY, JABI – ABUJA
FACULTY OF SCIENCES,
DEPARTMENT OF CHEMISTRY
2025_2 EXAMINATIONS.**

COURSE CODE: CHM 415

COURSE TITLE: INDUSTRIAL CHEMICAL TECHNOLOGY II

COURSE UNIT: 2

TIME: 2 HRS

INSTRUCTION: Answer question one (1) and any other two questions

1a. Define the following:

- (i) Syngas (ii) Oxoprocess **(8 marks)**
- b. (i) Identify and describe the three main processes for producing syngas, including the type of feedstock used and the conditions under which each process operates. **(3 marks)**
(ii) Give two applications of Syngas. **(1 marks)**
- c. Discuss the significance of the water-gas shift reaction ($\text{CO} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + \text{H}_2$) in the context of syngas production. Include its impact on hydrogen yield, its importance for specific industrial processes, and its role in CO_2 removal. **(6 marks total)**
- d. Explain with equations the following processes:
(i) Steam reforming (ii) Water-gas shift reaction (iii) Dry reforming reaction
(iv) Boudouard reaction **(12 marks)**
(Overall total = 30 marks)

2a. State at least two applications of crude oil and natural gas in the industrial production of materials. **(5 marks)**

- b. Highlight the contributions of organic raw materials, such as fossil fuels and biomass, to the production of base chemicals, intermediates, and final products. **(5 marks total)**
- c. Explain the differences between dry and wet natural gas **(4 marks)**
- d. (i) What is the primary reaction involved in the production of water gas, and what are its main components? **(2 mark).**
(ii) How does the water-gas shift reaction modify the H_2/CO ratio in syngas, and why is this important? **(2 mark).**
(iii) What are the key temperature ranges for the high-temperature (HT) and low-temperature (LT) shift reactors in the water-gas shift reaction, and what types of catalysts are used in each? **(2 mark).**
(Overall total = 20 marks)

- 3a. (i) Differentiate between wet and dry processes of manufacturing cement. **(2 marks)**
(ii) Give two advantages and two disadvantages of wet and dry process respectively. **(4 marks).**
- b. Describe the impact of safety and environmental regulations on the cost of operating a chemical plant. **(4 marks)**
- c. Compare the chemical composition of coal with that of crude oil **(6 marks)**
- d. Explain the key methods of manufacturing glass and the various uses of ceramics. Include one example of a product or application for each method and use. **(4 marks)**
(Overall total = 20 marks)

- 4a. Highlight five of the main properties of plastics and mention two advantages and disadvantages of each plastic. **(5 marks)**
- b. Classify plastics based on their (i) setting behaviour (ii) chemical composition **(8 marks)**
- c. (i) Explain the chemical process of sulphite pulp manufacture. **(5 marks)**
- d. List two each of the major and minor air pollution. **(2 marks)**
- (Overall total = 20 marks)**

- 5a. (i) What are the major sources of nuclear waste? **(2 marks)**
(ii) Identify and describe two methods each for managing gaseous, liquid, and solid waste. Include how each method is applied and its purpose. **(6 marks total)**
- b. Discuss the causes and effects of the following environmental issue:
(i) Ozone layer (ii) green house effect (iii) Acid rain (iv) Photochemical smog. **(8 marks)**
- c. Explain the role of flue gas desulfurization in controlling air pollution and discuss its environmental and economic implications. **(4 marks)**
- (Overall total = 20 marks)**