GUJARAT TECHNOLOGICAL UNIVERSITY

BE 6 SEMESTER – OLD PAPER – SUMMER 2022 TO SUMMER 2026 – QUESTION BANK

Subject Name & Code: Green Technology and Sustainable Development - 3160514

Chapter 1: Principles of Green Technology and Green Engineering

Repeated Questions:

1. Role of Chemical Engineering in Green Technology:

- **Q.** Explain the role of chemical engineering in green technology. / Discuss the role of chemical engineering in green technology. **(SUMMER 2022, 3 Marks; WINTER 2022, 3 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks)**

2. Principles of Green Chemistry:

- **Q.** Enlist the twelve principles of green chemistry and discuss them in detail. / Enlist the principles of Green Chemistry. Explain any three in detail. **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 7 Marks)**

3. Process Intensification:

- **Q.** Define process intensification. / Explain in brief. 'Process intensification' / Explain the concept of Process Intensification / Explain the term Process intensification in brief **(SUMMER 2022, 3 Marks; SUMMER 2023, 3 Marks; SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks)**
- **Q.** Discuss the classification of Process intensification with suitable example. **(SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks)**

Other Important Questions:

1. Green Chemistry – Concept and Importance:

- **Q.** Explain the concept of green chemistry. **(SUMMER 2023, 3 Marks)**
- **Q.** Discuss the importance of green chemistry and its role in chemical industry. **(SUMMER 2023, 4 Marks)**
- **Q.** Explain the term green chemistry and its importance with suitable example. **(SUMMER 2026, 3 Marks)**
- **Q.** Differentiate the green chemistry and green products with ordinary chemistry and products. **(SUMMER 2026, 4 Marks)**

2. Green Processes:

- **Q.** Discuss Green Processes in detail. **(WINTER 2023, 3 Marks)**

3. Process Intensification:

- **Q.** Illustrate the concept of process intensification with neat and clean diagram. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** Define process intensification (PI) and explain the role of PI in sustainable development. **(WINTER 2023, 4 Marks)**

Chapter 2: Green Synthesis and Catalysis

Repeated Questions:

1. Ionic Liquids and Green Solvents:

- **Q.** Define ionic liquid with suitable examples. **(SUMMER 2022, 3 Marks; WINTER 2022, 4 Marks OR; WINTER 2023, 4 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 4 Marks)**
- **Q.** Explain the importance of green solvents towards green synthesis with few examples. / Discuss the importance of green solvents and give few examples of the same / Write a brief note on, 'Green solvents and their importance and applications' / Discuss the importance of green solvents / Discuss the importance of green solvents with examples / Discuss in detail. 'Green solvents' **(SUMMER 2022, 7 Marks OR; WINTER 2022, 3 Marks; SUMMER 2023, 7 Marks; WINTER 2023, 3 Marks OR; WINTER 2024, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 3 Marks OR)**

2. Green Reagents:

- **Q.** Describe the synthesis of Dimethyl Carbonate as a green reagent in chemical industry. **(SUMMER 2022, 4 Marks; WINTER 2023, 4 Marks; WINTER 2024, 4 Marks; WINTER 2025, 4 Marks)**

3. Microwave and Ultrasound Assisted Reactions:

- **Q.** Explain the importance of Microwave and Ultrasound assisted reactions towards green synthesis. Give example of anyone. / Explain the importance of ultrasonic assistant reactions towards green synthesis / Explain the importance of microwave assistant reactions towards green synthesis **(SUMMER 2022, 7 Marks; WINTER 2022, 3 Marks; WINTER 2022, 3 Marks OR; WINTER 2025, 7 Marks)**

4. Green Nanotechnology:

- **Q.** Explain the concept of green nanotechnology. **(SUMMER 2022, 4 Marks OR; WINTER 2022, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 4 Marks; WINTER 2024, 4 Marks OR; WINTER 2024, 3 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 3 Marks OR)**

5. Green Reactions (Atom Economy, Photochemical and Oxidation Reactions):

- **Q.** Explain why using reactions with high atom economy is important for sustainable development. **(WINTER 2022, 4 Marks; WINTER 2023, 4 Marks OR; WINTER 2024, 4 Marks; WINTER 2025, 4 Marks OR)**
- **Q.** Define photochemical reactions with suitable examples. **(SUMMER 2023, 4 Marks; WINTER 2023, 3 Marks OR; SUMMER 2024, 3 Marks; WINTER 2024, 3 Marks OR; SUMMER 2025, 4 Marks)**
- **Q.** Define green oxidation reaction with a suitable example. **(WINTER 2023, 3 Marks; WINTER 2024, 4 Marks)**

Other Important Questions:

1. Green Synthesis and Green Reagents:

- **Q.** Define green synthesis with suitable example. **(SUMMER 2026, 3 Marks)**
- **Q.** Describe the synthesis of green reagents with a suitable example. **(WINTER 2023, 4 Marks OR)**
- **Q.** Write a brief note on, "synthesis of green reagents and their applications". **(SUMMER 2026, 7 Marks OR)**

2. Microwave and Ultrasound Assisted Reactions:

- **Q.** Explain the benefits and limitations of ultrasound & microwave- assisted reactions toward sustainable development. **(WINTER 2023, 7 Marks OR)**
- **Q.** Discuss the microwave assistant reactions in detailed explanation. **(SUMMER 2026, 4 Marks)**

3. Ionic Liquids and Supercritical CO_2:

- **Q.** Discuss briefly about the role of Ionic Liquids in green synthesis. **(SUMMER 2024, 3 Marks OR)**
- **Q.** Explain briefly about Supercritical CO_2 as a green solvent. **(SUMMER 2024, 4 Marks OR)**

Chapter 3: Green Industrial Processes

Repeated Questions:

1. Polymer and Textile Industries:

- **Q.** Explain the greener approach towards reduction of pollution for polymer and textile industries. / Explain the greener approach towards reduction of pollution for waste water industries and textile industries / Explain in detail. 'The greener approach towards reduction of pollution for polymer industries' **(SUMMER 2022, 7 Marks; WINTER 2023, 7 Marks; WINTER 2024, 7 Marks OR; SUMMER 2025, 7 Marks; SUMMER 2026, 7 Marks OR)**

2. Pharmaceutical and Dyes Industries:

- **Q.** Explain the greener approach towards reduction of pollution for pharmaceutical and dyes industries. / Explain in detail. 'The greener approach towards reduction of pollution for pharmaceutical industries' **(SUMMER 2022, 7 Marks OR; WINTER 2022, 7 Marks OR; WINTER 2024, 7 Marks OR; WINTER 2025, 7 Marks OR; SUMMER 2026, 7 Marks; SUMMER 2026, 7 Marks)**

3. Dyes and Pesticides Industries:

- **Q.** Explain the greener approach towards reduction of pollution for dyes and pesticides industries. **(WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2025, 7 Marks OR)**

Other Important Questions:

1. Pesticides Industries:

- **Q.** Explain the greener approach towards reduction of pollution for pesticides industries. **(WINTER 2025, 7 Marks)**

2. Classification of Green Industrial Processes:

- **Q.** Classify the various green industrial processes. **(SUMMER 2026, 4 Marks)**

Chapter 4: Meaning of Sustainable Development

Repeated Questions:

1. Concept of Sustainable Development:

- **Q.** Explain the concept of Sustainable Development. / Discuss in detail sustainable development in detail **(SUMMER 2022, 4 Marks; SUMMER 2023, 3 Marks OR; WINTER 2025, 4 Marks)**

2. Dimensions of Sustainable Development:

- **Q.** Enlist the three principal dimensions of Sustainable Development and explain anyone in detail. / Explain briefly the three principal dimensions of Sustainable Development / Enlist the three principal dimensions of Sustainable Development / Discuss three pillars of sustainability **(SUMMER 2022, 3 Marks OR; WINTER 2022, 4 Marks; WINTER 2023, 4 Marks; SUMMER 2024, 3 Marks; SUMMER 2024, 3 Marks OR; WINTER 2024, 3 Marks OR; WINTER 2025, 4 Marks OR)**
- **Q.** Explain the three principal dimensions of sustainable development with suitable examples. **(SUMMER 2023, 7 Marks OR; WINTER 2024, 7 Marks; SUMMER 2025, 7 Marks OR; SUMMER 2026, 7 Marks)**

3. Sustainability Challenges and Measures:

- **Q.** Describe sustainability challenges and possibilities for major technical systems and for their transformation to meet sustainability requirements. **(WINTER 2022, 7 Marks OR; WINTER 2023, 7 Marks)**
- **Q.** What are the measures for overcoming the challenges of sustainable development goals? **(WINTER 2023, 7 Marks OR; WINTER 2024, 7 Marks OR)**
- **Q.** Discuss the various challenges in achieving sustainability. **(SUMMER 2024, 7 Marks; SUMMER 2026, 3 Marks)**

4. Sustainable Development Goals (SDGs):

- **Q.** Enlist all 17 Sustainable Development Goals (SDGs) and explain any three goals in details. / Enlist the 17 sustainable goals **(WINTER 2023, 3 Marks; SUMMER 2024, 7 Marks)**

Other Important Questions:

1. Systems Approach and Sustainability Challenges:

- **Q.** Discuss how a systems approach helps in achieving sustainable development goals. **(SUMMER 2024, 7 Marks)**
- **Q.** Explain in brief. "Sustainability challenges and possibilities" **(SUMMER 2026, 3 Marks)**

2. Individual Responsibility:

- **Q.** Explain the individual responsibility towards Sustainable Development. **(WINTER 2025, 3 Marks)**

Chapter 5: Concepts of Cleaner Technologies

Repeated Questions:

1. Cleaner Production – Concept, Definitions and Principles:

- **Q.** Explain the concept of cleaner production (CP). **(SUMMER 2022, 3 Marks; WINTER 2022, 3 Marks; WINTER 2023, 3 Marks; SUMMER 2024, 3 Marks OR; WINTER 2024, 3 Marks; WINTER 2025, 3 Marks)**
- **Q.** Define: (1) Source Reduction (2) Cleaner Technology / Write the definition of Cleaner Production and Waste / Define: Source Reduction, Cleaner Technology, Good Housekeeping **(SUMMER 2023, 3 Marks OR; WINTER 2023, 3 Marks OR; SUMMER 2025, 3 Marks OR)**
- **Q.** Enlist the four principles of Cleaner Production. / Discuss in brief. 'The Cleaner Production and its principles' **(SUMMER 2023, 3 Marks; SUMMER 2026, 3 Marks OR)**

2. Barriers, Merits and Demerits of Cleaner Production:

- **Q.** Discuss the barriers and motivators in cleaner production in process industries. **(SUMMER 2022, 3 Marks OR; WINTER 2022, 4 Marks; WINTER 2025, 4 Marks)**
- **Q.** Discuss the merits and demerits of cleaner production in process industries. **(WINTER 2022, 3 Marks OR; SUMMER 2023, 4 Marks OR; WINTER 2023, 4 Marks OR; SUMMER 2024, 7 Marks; WINTER 2024, 3 Marks OR; SUMMER 2025, 3 Marks; SUMMER 2026, 4 Marks OR)**

3. Role of Cleaner Production in Sustainability:

- **Q.** Discuss role of cleaner production in survival and sustainable development of chemical industries. / Discuss role of cleaner production in sustainable development of chemical industries **(SUMMER 2022, 7 Marks OR; SUMMER 2023, 4 Marks; SUMMER 2025, 7 Marks)**
- **Q.** Justify the role of cleaner production in achieving sustainability. **(SUMMER 2024, 4 Marks OR; SUMMER 2026, 7 Marks)**

4. Cleaner Production Tools, Good House Keeping and Process Change:

- **Q.** Enlist various cleaner production tools and discuss their working methodology and applications in chemical industries. / Enlist Cleaner Production tools and Discuss them in detail / Enlist the cleaner Production Tools / Enlist the tools used for cleaner production / Enlist cleaner production tools and discuss their methodology and applications / Describe in detail. 'The cleaner production tools' **(SUMMER 2022, 4 Marks OR; WINTER 2022, 7 Marks; SUMMER 2023, 3 Marks OR; WINTER 2023, 7 Marks OR; SUMMER 2024, 3 Marks; WINTER 2024, 4 Marks; SUMMER 2025, 3 Marks OR; WINTER 2025, 7 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Discuss the benefits of Good House Keeping. / Write a brief note on 'Good House Keeping' **(SUMMER 2023, 4 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 4 Marks OR; SUMMER 2026, 4 Marks)**
- **Q.** Discuss process change as 'Source of Waste reduction'. **(SUMMER 2023, 7 Marks OR; WINTER 2024, 7 Marks)**

5. Cleaner Production and Environmental Management:

- **Q.** Discuss the relation between CP and EMS. / Write a short note on the relation between Cleaner Production (CP) and EMS / Justify the relation of cleaner production (CP) and environmental management system (EMS) **(WINTER 2022, 3 Marks; SUMMER 2024, 3 Marks OR; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks OR)**
- **Q.** Explain the Environmental Management Hierarchy. **(SUMMER 2022, 4 Marks; WINTER 2022, 4 Marks OR; SUMMER 2023, 4 Marks OR; WINTER 2023, 4 Marks; WINTER 2024, 4 Marks; SUMMER 2025, 4 Marks OR; WINTER 2025, 4 Marks; SUMMER 2026, 4 Marks)**

6. Unit Operations and Process Optimization:

- **Q.** Discuss one unit operation in detail which can help create a cleaner product. / Discuss any one unit operation involved to generate a cleaner product **(SUMMER 2022, 4 Marks; WINTER 2022, 3 Marks OR; WINTER 2025, 4 Marks OR; SUMMER 2026, 4 Marks OR)**
- **Q.** Illustrate the "Principles of Process Optimization" to achieve Waste Minimization in a plant producing "Vinyl Acetate (VA)" or any other example. **(SUMMER 2022, 7 Marks OR; WINTER 2022, 7 Marks; WINTER 2024, 7 Marks; WINTER 2025, 7 Marks)**

7. Energy Conservation and Energy Audit:

- **Q.** Discuss energy conservation as a tool for cleaner production. / Define the energy conservation as a tool for cleaner production **(SUMMER 2022, 4 Marks OR; SUMMER 2025, 4 Marks OR; SUMMER 2026, 3 Marks)**
- **Q.** Discuss the type of energy Audit. / Classify the energy audit methods in detail with suitable example **(SUMMER 2023, 3 Marks; WINTER 2024, 3 Marks OR; SUMMER 2026, 7 Marks OR)**
- **Q.** Discuss the energy audit methodology and its steps. **(SUMMER 2023, 7 Marks OR; SUMMER 2025, 7 Marks)**

8. Cleaner Production Case Studies and Waste Minimization:

- **Q.** Discuss cleaner production with reference to wastewater minimization in Diethyl Malonate production. / Describe cleaner production techniques to produce Diethyl Malonate **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks OR; WINTER 2024, 7 Marks OR; SUMMER 2025, 7 Marks; WINTER 2025, 7 Marks OR)**
- **Q.** Discuss in detail applications of "Cleaner Production Principles" with special reference to liquid effluent waste minimization for the following industrial products: (i) H-acid & (ii) Paracetamol. / Discuss in detail applications of "Cleaner Production Principles" with special reference to liquid effluent waste minimization for the production of Paracetamol / Describe the applications of Cleaner Production Principles with reference to minimize waste liquid effluent to produce Paracetamol in detail **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks OR; SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks OR; SUMMER 2025, 7 Marks OR; WINTER 2025, 7 Marks OR)**
- **Q.** Explain cleaner production with case study: Fluoride removal from wastewater. **(SUMMER 2023, 7 Marks; SUMMER 2025, 7 Marks OR; SUMMER 2026, 7 Marks OR)**
- **Q.** Discuss CP case studies: Ammonical nitrogen recovery from wastewater. **(WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks OR)**

Other Important Questions:

1. Methodology of Cleaner Production:

- **Q.** Explain the methodology involved for effectively carrying out cleaner production. **(SUMMER 2024, 4 Marks)**

Chapter 6: Challenges and Practical Implementation

Repeated Questions:

1. Challenges of Implementing Green Technology:

- **Q.** Discuss in brief about major challenges for implementing green technology in a chemical industry. **(SUMMER 2022, 4 Marks; WINTER 2022, 4 Marks; SUMMER 2023, 3 Marks; SUMMER 2025, 4 Marks)**

2. Green Laws Compliance:

- **Q.** Discuss in brief the green laws compliance. / Define Green laws compliance with suitable example / Explain the Green laws compliance with suitable example **(SUMMER 2022, 3 Marks; WINTER 2022, 4 Marks OR; WINTER 2023, 3 Marks; SUMMER 2024, 4 Marks; SUMMER 2025, 3 Marks OR; WINTER 2025, 3 Marks OR)**

3. Responsibilities of Companies:

- **Q.** Discuss the company's responsibilities to employ the green emerging technologies for sustainable development. / Enlist the various responsibilities for action of companies towards cleaner production / Enlist the various responsibilities of companies towards cleaner production **(SUMMER 2022, 3 Marks OR; WINTER 2022, 4 Marks; SUMMER 2025, 4 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks OR)**

4. Role of Government and Institutions:

- **Q.** Discuss the role of government and institution in cleaner production technology. / Discuss the role of industries, government, and institutions in successful implementation of cleaner production **(SUMMER 2023, 4 Marks; SUMMER 2024, 7 Marks OR)**

Other Important Questions:

1. Role of Chemical Engineer and Industry:

- **Q.** Discuss the role of a chemical engineer in Green Technology and Sustainable Development. **(SUMMER 2024, 4 Marks)**
- **Q.** Justify the role of industry in cleaner production technology. **(SUMMER 2026, 4 Marks OR)**

2. Green Productivity and Emerging Technologies:

- **Q.** Write a short note on Green Productivity and emerging technologies. **(SUMMER 2024, 4 Marks OR)**

****