

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-6 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code:

GREEN TECHNOLOGY AND SUSTAINABLE DEVELOPMENT (3160514)

Unit 1: Principles of Green Technology and Green Engineering

Repeated Questions:

1. **Define/Explain Process Intensification.**
 - (W25 - Q1a, 03 marks)
 - (W23 - Q1b, Part of 04 marks)
 - (S22 - Q3a, 03 marks)
 - (S25 - Q5a, 03 marks)
 - (W24 - Q1c, Part of 07 marks)
 - (S23 - Q1c, 07 marks)
 - (S24 - Q1a, 03 marks)
2. **Explain the role of chemical engineering in green technology. / Discuss the role of a chemical engineer in Green Technology.**
 - (W25 - Q3a, 03 marks)
 - (W23 - Q1a, 03 marks)
 - (S22 - Q1a, 03 marks)
 - (S25 - Q3a, 03 marks)
 - (W24 - Q1a, 03 marks)
 - (S24 - Q1b, Part of 04 marks)
 - (W22 - Q1a, 03 marks)
3. **Enlist the twelve principles of green chemistry and discuss them in detail. / Enlist the 12 principles of Green Chemistry. Explain any three in detail.**
 - (W25 - Q1c, 07 marks)
 - (W23 - Q1c, 07 marks)
 - (S22 - Q1c, 07 marks)
 - (S25 - Q1c, 07 marks)
 - (S24 - Q2a, 03 marks)
 - (W22 - Q1c, 07 marks)

Other Important Questions:

- Discuss Green Processes in detail. (W23 - Q1a, 03 marks)
 - Explain the concept of green chemistry. (S23 - Q1a, 03 marks)
 - Discuss the importance of green chemistry and its role in chemical industry. (S23 - Q1b, 04 marks)
 - Discuss in brief about major challenges for implementing green technology in a chemical industry. (S22 - Q1b, 04 marks) (W22 - Q1b, Part of 04 marks)
 - Explain the concept of Sustainable Development. (W25 - Q1b, 04 marks) (S22 - Q3b, 04 marks)
 - Discuss in detail sustainable development. (S23 - Q3 OR a, 03 marks)
 - Discuss the classification of Process intensification with suitable example. (W24 - Q1c, 07 marks) (S23 - Q1c, 07 marks)
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Unit 2: Green Synthesis and Catalysis

Repeated Questions:

- 1. Define ionic liquid with suitable examples.**
 - (W25 - Q3b, 04 marks)
 - (S22 - Q2a, 03 marks)
 - (S25 - Q1b, 04 marks)
 - (W22 - Q3 OR b, 04 marks)
 - (S24 - Q5 OR a, Part of 03 marks)
- 2. Describe the synthesis of Dimethyl Carbonate as a green reagent in chemical industry.**
 - (W25 - Q5b, Part of ? marks)
 - (W23 - Q4b, 04 marks)
 - (S22 - Q2b, 04 marks)
 - (W24 - Q2b, 04 marks)
- 3. Explain the importance of Microwave and Ultrasound assisted reactions towards green synthesis. Give example of any one.**
 - (W25 - Q3c, 07 marks)
 - (S22 - Q2c, 07 marks)
 - (W23 - Q4 OR c, Part of 07 marks)
 - (W24 - Q4 OR b, 04 marks) [Ultrasound only]
 - (W22 - Q2a, 03 marks) [Ultrasonic only] (W22 - Q3 OR a, 03 marks) [Microwave only]
- 4. Explain the importance of green solvents towards green synthesis with few examples. / Discuss the importance of green solvents with examples.**
 - (W25 - Q3 OR c, 07 marks)
 - (S22 - Q2 OR c, 07 marks)
 - (S25 - Q1a, 03 marks)
 - (W24 - Q5a, 03 marks)
 - (S23 - Q2 OR c, 07 marks)
 - (W22 - Q3a, 03 marks)
- 5. Explain why using reactions with high atom economy is important for sustainable development.**
 - (W25 - Q5 OR b, Part of ? marks)
 - (W23 - Q4 OR b, 04 marks)
 - (W24 - Q1b, 04 marks)
 - (W22 - Q2b, 04 marks)
- 6. Explain the concept of green nanotechnology with suitable examples.**
 - (W25 - Q5 OR a, Part of ? marks)
 - (W23 - Q4c, 07 marks)
 - (S22 - Q3 OR b, 04 marks)
 - (S25 - Q3b, 04 marks)
 - (W24 - Q2a, 03 marks)
 - (S24 - Q2b, 04 marks)
 - (W22 - Q2c, 07 marks)

Other Important Questions:

- Define green oxidation reaction with a suitable example. (W23 - Q4a, 03 marks) (W24 - Q3b, 04 marks)
- Define photochemical reactions with suitable examples. (W23 - Q4 OR a, 03 marks) (S25 - Q5 OR b, 04 marks) (W24 - Q4 OR a, 03 marks) (S23 - Q2b, 04 marks) (S24 - Q5 OR a, Part of 03 marks)
- Explain briefly about Supercritical CO₂ as a green solvent. (S24 - Q3a OR b, 04 marks)
- Write a brief note on, "Green solvents and their importance and applications". (S23 - Q2 OR c, 07 marks)
- Describe the synthesis of green reagents with a suitable example. (W23 - Q5 OR b, 04 marks)

Unit 3: Green Industrial Processes

Repeated Questions:

1. **Explain the greener approach towards reduction of pollution for dyes and pesticides industries. / polymer and pesticides / pharmaceutical and dyes.**
 - (W25 - Q4 OR c, 07 marks) [Pharma & Dyes]
 - (W23 - Q5c, 07 marks) [Polymer & Textile]
 - (S22 - Q3c, 07 marks) [Polymer & Textile]
 - (S22 - Q3 OR c, 07 marks) [Pharma & Dyes]
 - (S25 - Q4c, 07 marks) [Polymer & Textile]
 - (W24 - Q3c, 07 marks) [Dyes & Pesticides]
 - (S23 - Q3c, 07 marks) [Dyes & Pesticides]
 - (S24 - Q3a OR c, 07 marks) [Polymer & Pesticides]
 - (S24 - Q3 OR c, 07 marks) [Textile & Dyes]
 - (W22 - Q3c, 07 marks) [Pesticides]
 - (W22 - Q3 OR c, 07 marks) [Pharma & Dyes]
2. **Discuss one unit operation in detail which can help create a cleaner product.**
 - (W25 - Q4 OR b, Part of ? marks)
 - (S22 - Q5b, Part of ? marks)
 - (W24 - Q5 OR b, 04 marks)

Other Important Questions:

- Explain the greener approach towards reduction of pollution for pesticides industries. (W25 - Q4c, 07 marks)
 - Discuss the greener approach towards reduction of pollution for waste water industries and textile industries. (W24 - Q3 OR c, 07 marks) (S23 - Q3 OR c, 07 marks)
 - Discuss the greener approach in polymer and textile industries to reduce pollution. (S25 - Q4c, 07 marks)
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Unit 4: Meaning of Sustainable Development

Repeated Questions:

1. **Enlist the three principal dimensions of Sustainable Development and explain any one in detail. / Explain briefly the three principal dimensions of Sustainable Development.**
 - (W25 - Q3 OR b, 04 marks)
 - (S22 - Q3 OR a, 03 marks)
 - (S25 - Q2 OR c, 07 marks)
 - (W24 - Q2c, 07 marks) (W24 - Q3 OR a, 03 marks)
 - (S23 - Q2 OR c, 07 marks)
 - (S24 - Q3a, 03 marks)
 - (W22 - Q3b, 04 marks)
2. **Enlist the 17 sustainable goals. / Enlist all 17 Sustainable Development Goals (SDGs) and explain any three goals in details.**
 - (W23 - Q2a, 03 marks)
 - (S24 - Q1c, 07 marks)

Other Important Questions:

- Discuss three pillars of sustainability. (W23 - Q2b, 04 marks)
 - Describe sustainability challenges and possibilities for major technical systems and for their transformation to meet sustainability requirements. (W23 - Q2c, 07 marks) (W22 - Q2 OR c, 07 marks)
 - What are the measures for overcoming the challenges of sustainable development goals? (W23 - Q2 OR c, 07 marks) (W24 - Q2 OR c, 07 marks)
 - Discuss how a systems approach helps in achieving sustainable development goals. (S24 - Q2c, 07 marks)
 - Discuss the various challenges in achieving sustainability. (S24 - Q2 OR c, 07 marks)
 - Explain the individual responsibility towards Sustainable Development. (W25 - Q4a, 03 marks)
 - Discuss the company's responsibilities to employ the green emerging technologies for sustainable development. (W25 - Q4 OR a, Part of ? marks) (S25 - Q2b, Part of ? marks) (W22 - Q5b, Part of ? marks)
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Unit 5: Concepts of Cleaner Technologies

Repeated Questions:

1. **Explain the concept of cleaner production (CP). / Write the definition of Cleaner Production and Waste.**
 - (W25 - Q2a, 03 marks)
 - (W23 - Q3a, 03 marks) (W23 - Q3 OR a, 03 marks)
 - (S22 - Q4a, 03 marks)
 - (W24 - Q3a, 03 marks)
 - (S23 - Q4a, 03 marks) [Four principles]
 - (S24 - Q3 OR a, 03 marks)
 - (W22 - Q4a, 03 marks)
2. **Discuss the environmental management hierarchy.**
 - (W25 - Q4b, 04 marks)
 - (W23 - Q3b, 04 marks)
 - (S22 - Q4b, 04 marks)
 - (S25 - Q5 OR c, Part of 07 marks)
 - (W24 - Q5b, 04 marks)
 - (S23 - Q5 OR b, 04 marks)
 - (W22 - Q4 OR b, 04 marks)
3. **Discuss cleaner production with reference to wastewater minimization in Diethyl Malonate production.**
 - (W25 - Q2 OR c, 07 marks)
 - (S22 - Q4c, 07 marks)
 - (S25 - Q2c, 07 marks)
 - (W24 - Q4 OR c, 07 marks)
 - (W22 - Q4 OR c, 07 marks)
4. **Enlist various cleaner production tools and discuss their working methodology and applications. / Enlist Cleaner Production tools and Discuss them in detail.**
 - (W25 - Q2c, 07 marks)
 - (W23 - Q3 OR c, 07 marks)
 - (S22 - Q4 OR b, Part of 04 marks)
 - (W24 - Q4b, 04 marks)
 - (S25 - Q4 OR a, 03 marks)
 - (S23 - Q4 OR a, 03 marks)
 - (S24 - Q4a, 03 marks)
 - (W22 - Q4c, 07 marks)
5. **Discuss the barriers and motivators in cleaner production in process industries. / Explain the various barriers and motivators in cleaner production.**
 - (W25 - Q2b, 04 marks)
 - (S22 - Q4 OR a, 03 marks)
 - (W22 - Q4b, 04 marks)
6. **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.**
 - (W25 - Q5 OR c, Part of ? marks)
 - (S22 - Q5c, Part of ? marks)
 - (W24 - Q5 OR c, 07 marks)
 - (S23 - Q5c, 07 marks)
 - (W22 - Q5 OR c, Part of ? marks)
7. **Illustrate the "Principles of Process Optimization" to achieve Waste Minimization in a plant producing "Vinyl Acetate (VA)" or any other example. / Describe the "Principles of Process Optimization"...**
 - (W25 - Q5c, Part of ? marks)

- (S22 - Q5 OR c, Part of ? marks)
- (W24 - Q5c, Part of ? marks)
- 8. **Discuss in brief the green laws compliance.**
 - (W25 - Q3 OR a, 03 marks)
 - (W23 - Q5a, 03 marks)
 - (S22 - Q5a, 03 marks)
 - (S25 - Q3 OR a, 03 marks)
 - (S24 - Q5b, 04 marks)

Other Important Questions:

- Discuss the merits and demerits of CP. / cleaner production. (W23 - Q3 OR b, 04 marks) (S25 - Q2a, Part of ? marks) (S23 - Q4 OR b, 04 marks) (S24 - Q4c, Part of 07 marks) (W22 - Q4 OR a, 03 marks)
- Discuss the role of cleaner production in survival and sustainable development of chemical industries. / achieving sustainability. (S22 - Q4 OR c, 07 marks) (S25 - Q3c, 07 marks) (S23 - Q5b, 04 marks) (S24 - Q4 OR b, 04 marks)
- Discuss CP case studies: Ammonical nitrogen recovery from wastewater. (W23 - Q3c, 07 marks) (S24 - Q5 OR c, 07 marks)
- Discuss advantage and disadvantage of cleaner production in chemical process industries. (S25 - Q2a, Part of ? marks)
- Describe cleaner production techniques to produce Diethyl Malonate. (S25 - Q2c, 07 marks)
- Discuss energy conservation as a tool for cleaner production. (S22 - Q5 OR b, 04 marks) (S25 - Q3 OR b, 04 marks)
- Discuss the benefits of Good House Keeping. (S25 - Q4 OR b, 04 marks) (W24 - Q4a, 03 marks) (S23 - Q4b, 04 marks)
- Explain cleaner production concept with Fluoride removal from wastewater as a case study. (S25 - Q4 OR c, 07 marks) (S23 - Q4c, 07 marks)
- Discuss in detail the methodology of energy audit. / Discuss the type of energy Audit. (S25 - Q5c, 07 marks) (W24 - Q5 OR a, 03 marks) (S23 - Q5a, 03 marks) (S23 - Q5 OR c, 07 marks)
- Define: Source Reduction, Cleaner Technology, Good Housekeeping. (S25 - Q5 OR a, 03 marks) (S23 - Q5 OR a, 03 marks)
- Explain the methodology involved for effectively carrying out cleaner production. (S24 - Q4b, Part of ? marks)
- Write a short note on the relation between Cleaner Production (CP) and Energy Management System (EMS). (S24 - Q4 OR a, 03 marks) (W25 - Q5a, Part of ? marks) (W22 - Q5a, Part of ? marks)
- Discuss the role of industries, government, and institutions in successful implementation of cleaner production. / the role of government and institution in cleaner production technology. (S24 - Q4 OR c, 07 marks) (S23 - Q3b, 04 marks)
- Write a short note on Green Productivity and emerging technologies. (S24 - Q5 OR b, 04 marks)
- Explain anyone unit operation which can help in producing cleaner product. (W22 - Q5 OR a, 03 marks)
- Define Green laws compliance with suitable example. (W22 - Q5 OR b, Part of ? marks)

Other Important Questions (Unit 5 - Continued):

- Enlist the various responsibilities for action of companies towards cleaner production. / Enlist the various responsibilities of companies towards cleaner production. (S22 - Q5 OR a, 03 marks) (S25 - Q4a, 03 marks)
- Discuss process change as 'Source of Waste reduction'. (W24 - Q4c, 07 marks) (S23 - Q4 OR c, 07 marks)

Unit 6: Challenges and Practical Implementation

(Note: This unit covers topics often integrated into questions from other units, particularly Unit 5. The following questions are explicitly aligned with the "Challenges and Practical Implementation" theme.)

Repeated Questions:

1. **Discuss the company's responsibilities to employ the green emerging technologies for sustainable development.**
 - (W25 - Q4 OR a, Part of ? marks)
 - (S25 - Q2b, Part of ? marks)
 - (W22 - Q5b, Part of ? marks)
2. **Discuss in brief about major challenges for implementing green technology in a chemical industry.**
 - (S22 - Q1b, 04 marks)
 - (S25 - Q4b, 04 marks)
 - (S23 - Q2a, 03 marks)
 - (W22 - Q1b, Part of 04 marks)

Other Important Questions:

- List out the major challenges for implementing green technology in a chemical industry. (S23 - Q2a, 03 marks)
- Discuss the role of government and institution in cleaner production technology. (S23 - Q3b, 04 marks)
- Responsibilities and potentials of companies for action. (Implied in multiple questions listed under Unit 5, e.g., S22 - Q5 OR a, S25 - Q4a).
- Write a short note on Green Productivity and emerging technologies. (S24 - Q5 OR b, 04 marks)
- Green laws compliance. (Covered extensively under Unit 5's repeated questions).
- Case studies in Green Technology. (Covered under Unit 5 questions on Diethyl Malonate, Ammoniacal Nitrogen recovery, Fluoride removal, H-acid, Paracetamol, Vinyl Acetate).
