Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 11 – 12- 2025 **Time:** 01:00pm – 04:00pm

School: SOE	**Program:** B.Tech.-PET	
Course Code: PET1010	**Course Name:** Carbon capture and Utilisation for sustainability	
Semester: VII	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	10	4	34	26	26

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	Identify the correct product pair formed in pre-combustion CO_2 capture: A. O_2 and N_2 B. CO_2 and H_2 C. CO and N_2 D. CO_2 and CH_4	**2 Marks**	**L1**	**CO2**
2.	Identify the world's first commercial-scale post-combustion CCS power plant. A. Petra Nova B. Boundary Dam C. Sleipner D. Salah	**2 Marks**	**L1**	**CO2**

3.	Select the option that correctly *defines* the purpose of using fly ash and cement kiln dust in CO_2 mineralization. A. They increase CO_2 emissions during industrial operations. B. They act as fuels for heating carbonation reactors. C. They help convert CO_2 into stable, solid carbonate minerals. D. They reduce the alkalinity of the mineralization process.	**2 Marks**	**L1**	**CO3**
4.	Identify the most common method for long-distance CO_2 transport. A. Trucks B. Ships C. Pipelines D. Rail transport.	**2 Marks**	**L1**	**CO3**
5.	Outline the distance beyond which shipping becomes more economical than offshore pipelines. A. 50 km B. 150 km C. 350 km D. 1000 km	**2 Marks**	**L1**	**CO4**
6.	Name the storage type used by the Sleipner project. A. Permafrost B. Saline aquifers C. Sand dunes D. Coal mines.	**2 Marks**	**L1**	**CO4**
7.	Name two geological formations increasingly studied for carbon storage diversification.	**2 Marks**	**L1**	**CO4**
8.	Choose the correct option. **Column A (Storage Type)** / **Column B (Description)** A. Saline aquifer — i. Long-term CO_2 dissolution & trapping B. Depleted oil field — ii. CO_2 used for enhanced recovery C. Basalt formations — iii. CO_2 mineralizes into solid carbonates D. Terrestrial carbon storage — iv. CO_2 absorbed and stored by vegetation/soil E. Ocean carbon storage — v. CO_2 is injected into the deep ocean to dissolve slowly F. Geological storage (general) — vi. Storage in deep underground rock formations Which is the correct match? A. A-i, B-ii, C-iii, D-iv, E-v, F-vi B. A-iii, B-i, C-ii, D-iv, E-v, F-vi	**2 Marks**	**L1**	**CO5**

	C. A-i, B-iii, C-iv, D-vi, E-ii, F-v D. A-ii, B-iv, C-i, D-iii, E-v, F-vi			
9.	Recognize which mineralization method injects CO_2 into basalt or ultramafic rocks. A. Ex situ mineralization B. Oxy-fuel mineralization C. In situ mineralization D. Cryogenic mineralization	**2 Marks**	**L1**	**CO5**
10.	Select the natural reservoir holding the largest terrestrial carbon stock. A. Plant biomass B. Microbial biomass C. Soil carbon storage D. Atmospheric CO_2	**2 Marks**	**L1**	**CO5**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	Summarize the objectives of CCUS and review its role as a transitional technology in the global energy sector.	**10 Marks**	**L2**	**CO1**
	b.	Compare pipeline and ship transport of CO_2 and explain when ship transport becomes more economical than pipeline transport.	**10 Marks**	**L2**	**CO3**
		Or			
12.	**a.**	Explain the oxy-fuel combustion method of carbon capture and contrast its benefits and limitations with either pre-combustion or post-combustion capture.	**10 Marks**	**L2**	**CO1**
	b.	Examine the potential long-term role of BECCS and DAC in removing CO_2 from the atmosphere, and justify whether integrating both technologies provides a stronger pathway to net-negative emissions than relying solely on DAC.	**10 Marks**	**L2**	**CO3**

13.	**a.**	Illustrate the ex-situ mineralization process with the key chemical reactions involved, and demonstrate the mechanism of in situ mineralization by interpreting how CO_2 becomes permanently stored within reactive rocks.	**20 Marks**	**L3**	**CO3**
		Or			
14.	**a.**	A 1200 MW coal-based power plant operates at an annual capacity factor of 80% with a baseline emission intensity of 0.85 tCO_2/MWh. To enhance sustainability, the plant introduces co-	**20 Marks**	**L3**	**CO3**

		firing with 25% biomass (on an energy basis) and installs a CCUS system capable of capturing 92% of total CO_2 emissions. The baseline CO_2 emissions consist of 0.60 tCO_2/MWh from fossil sources and 0.25 tCO_2/MWh from biogenic sources. Biogenic CO_2 is considered carbon-neutral when emitted, but it becomes negative when captured and stored. **a.** Determine the total CO_2 captured per MWh, distinguishing between fossil and biogenic portions. **b.** Compute the residual (post-capture) fossil and biogenic CO_2 emissions. **c.** Calculate the overall net CO_2 emissions (tCO_2/MWh) and the annual net CO_2 removals ($MtCO_2$/yr) for the plant. Use the formula below for calculation. Total Annual Generation (MWh/yr) =Capacity (MW)×Capacity Factor × Hours per Year.			

15.	**a.**	Explain the ocean carbon sequestration mechanisms such as air–sea gas exchange, carbonate chemistry, and biological pump.	**20 Marks**	**L2**	**CO4**
		Or			
16.	**a.**	Classify CO_2 capture using nanomaterials, algae, and biochar, and compare their CO_2 removal efficiencies.	**20 Marks**	**L2**	**CO4**

17.	**a.**	Categorize engineered ocean carbon sequestration methods (direct injection, ocean fertilization, upwelling, alkalinity enhancement, marine permaculture) and compare their advantages and limitations.	**20 Marks**	**L4**	**CO5**
		Or			
18.	**a.**	Debate the advantages and limitations of terrestrial storage (soil carbon, forests, biodiversity gains) and criticize why it faces competition for land use compared with geological storage.	**20 Marks**	**L4**	**CO5**