ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination   **Summer Semester: 2021-2022**
Course No.: GS 4253   **Full Marks: 150**
Course Title: Ecology and Environment   **Time: 3 Hours**

There are 06 (Six) questions. **Answer all the questions.** Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks and corresponding CO and PO. Symbols convey their usual meanings. Assume reasonable values for any missing data/info.

1. Dhaka has long been grappling with air pollution issues. Recently, it has been ranked 7th in the list of cities worldwide with the worst air quality. Poor air quality in Dhaka city often makes global headlines due to fossil fuel combustion, biomass burning, emissions from unfit vehicles, brick kilns and massive development works. Also, the other air pollutant originates from the power plants, industrial facilities and residential cooking and heating. As city residents tend to live closer to busy roads with dense traffic, they are often exposed to higher pollution than residents in rural areas. On a particular day, the following air quality data have been recorded at a monitoring station:

   $PM_{2.5} = 190$ μg/m^3 (24-hr); $PM_{10} = 375$ μg/m^3 (24-hr); $O_3 = 0.09$ ppm (8-hr); $CO = 12.75$ ppm (8-hr); $NO_2 = 1.55$ ppm (Annual).

Breakpoints							
O_3 (ppm) 8 hr	O_3 (ppm) 1 hr	$PM_{2.5}$ (μg/m^3) 24 hr	PM_{10} (μg/m^3) 24 hr	CO (ppm) 8 hr	SO_2 (ppm) 24 hr	NO_2 (ppm) Annual	AQI
0.000-0.064	--	0-15.4	0-54	0.0-4.4	0.000-0.034	--	0-50
0.065-0.084	--	15.5-40.4	55-154	4.5-9.4	0.035-0.144	--	51-100
0.085-0.104	0.125-0.164	40.5-65.4	155-254	9.5-12.4	0.145-0.224	--	101-150
0.105-0.124	0.165-0.204	65.5-150.4	255-354	12.5-15.4	0.225-0.304	--	151-200
0.125-0.174	0.205-0.404	150.5-250.4	355-424	15.5-30.4	0.305-0.604	0.65-1.24	201-300
--	0.405-0.504	250.5-350.4	425-504	30.5-40.4	0.605-0.804	1.25-1.64	301-400
--	0.505-0.604	350.5-500.4	505-604	40.5-50.4	0.805-1.004	1.65-2.04	401-500

(a) Define 'Criteria Pollutants'. Mention the name of the criteria air pollutants that you think are responsible for the above-mentioned pollution scenario.   CO2,PO2 (5)

(b) Calculate AQI along with category descriptor according to USEPA. Also, identify the critical pollutant and report on its adverse health effects mentioning its specific sensitive group.   CO3,PO2 (8+6=14)

(c) Discuss the mechanisms of particulate matter deposition in the human respiratory system.   CO1,PO1 (05)

(d) As an engineer, suggest ways or techniques to control the emission of particulate matter and gaseous pollutants from industries.   CO4,PO2 (06)

2. Water sampling was done from Buriganga river near Old Dhaka point. The collected samples were sent to the laboratory for water quality tests. High levels of COD and other chemicals, such as nitrogen, ammonia and ammonium, nitrate, and phosphate, demonstrate the worst quality river water indicating the presence of eutrophication. It was observed to have such a high concentration of chemicals and heavy metals that it will surely affect both the human and fish population who rely heavily on the Buriganga water.

(a) What are the probable major sources that you think are responsible for water pollution stated here. Also, differentiate between point and non-point sources.
CO2,PO2
(3+3=6)

(b) Write a short note on 'Bio-magnification' and 'Thermal stratification in lakes'.
CO1,PO1
(3+3=6)

(c) Distinguish between BOD and COD. Why COD value is typically higher than BOD?
CO1,PO1
(5)

(d) Draw a typical BOD curve and state the reasons behind a jump on this curve.
CO2,PO2
(5)

(e) What are the factors affecting the BOD reaction rate constant? During the laboratory test conducted at 20°C room temperature, the BOD_5 of that collected waste water sample was found to be 200 mg/L. The value of rate constant k at 20°C is 0.23 per day. Determine the 5-day BOD of that same sample, if the test have been conducted at 25°C field temperature.
CO3,PO2
(2+6=08)

3. Recently, the people of Dhaka city experienced the hottest day in the capital. According to the met office, the highest temperature recorded was 40.4°C, the highest temperature in 58 years, making people's lives unbearable for over a week. That level of warming, measured against preindustrial levels, is likely to increase the frequency of deadly heatwaves and threaten coastal cities with rising sea levels. Researchers identified, one of the reason behind these heatwaves are increasing emission of greenhouse gases. Also, tree cover loss, deforestation or degraded forest land are other major reasons.

(a) What is 'Greenhouse Effect'? Mention the gases that are responsible for greenhouse effect.
CO1,PO1
(6)

(b) Describe the probable consequences of a warming planet. Also, discuss the reasons behind Ozone layer depletion.
CO2,PO2
(5+3=8)

(c) Every 3-8 years, South America and some parts of the US faces increased precipitation and flooding while Australia and Indonesia face drought. Explain briefly how a climate event causes this change.
CO4,PO2
(06)

(d) What actions are required to be taken to reduce the greenhouse gases emission? Also, mention the actions taken by UN addressing the issue of climate change.
CO2,PO2
(05)

4.(a) What are the 4 major domains of earth? What are the natural resources we can obtain from each domain?
CO1,PO1
(6)

(b) Write 5 examples of renewable energy source. Why this resource is said to be behaving like non-renewable resources despite of being a renewable one by origin.
CO1,PO1
(6)

(c) What do the 'SDGs' mean? How do the SDGs differ from the previous MDGs? State all the SDGs that are required to be fulfilled by every nation in the world.

CO2,PO2
(2+3+8=13)

5. (a) Describe the levels of ecological study.

CO1,PO1
(5)

(b) Explain the 10% rule on the basis of productivity along with a diagram. Find out the amount of energy at the trophic level of producers and tertiary consumers if the energy at the secondary consumer's level is 5252 kcal.

CO2,PO2
(10)

(c) Based on the energy flow diagram of Figure 01, compute the value of productivity at trophic level n, P_n and Ecological efficiency where the following information are provided: Exploitation efficiency = 20%, Assimilation efficiency = 35%, Production efficiency = 20% & P_{n-1} = 1000 J.

Also, quantify the following inputs of Figure 1 : Ingestion (I), Assimilation (A), Waste (W) and Respiration (R)
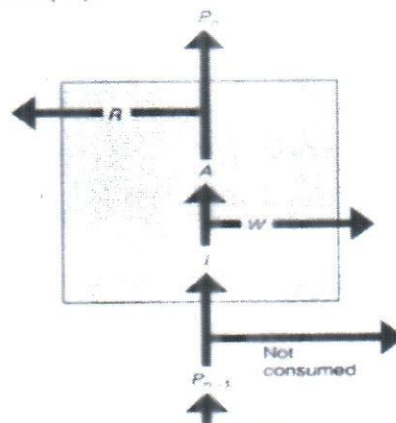
CO3,PO2
(10)

Figure 01

6. (a) Describe how the carrying capacity of a species has an influence in its existence.

CO1,PO1
(5)

(b) Distinguish between ecological deficit and ecological reserve.

CO4, PO2
(5)

(c) Analyze how you can minimize your ecological footprint.

CO4, PO2
(5)