

HPSC AEE

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Subject Knowledge Test
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Max Time: 03 hours

Maximum marks: 150

Note: Attempt any fifteen (15) questions. All questions carry equal marks (10 marks each).

Q:1 What do you mean by pathogen? Write the names of major pathogen groups. What determines the kinds and concentration of pathogens in wastewater? Define the meaning of fecal-oral route in the transmission of diseases. Why are coliform bacteria used as indicators of drinking water quality? Discuss the limitation of coliforms as an indicator. Why is a positive test for fecal coliform in a public water supply considered more serious than a positive test for total coliforms? (10)

Q:2 Discuss different environmental quality monitoring required at Landfills sites. (10)

Q:3 Define an ecosystem. What are the common characteristics of most of the ecosystems? Discuss the detailed structure of an ecosystem. (10)

Q:4 What are the causes and effects of soil agricultural pollution? How can it be controlled? (10)

Q:5 What do you mean by biodiversity? Explain level of biodiversity. What are the threats to biodiversity? (10)

Q:6 (a) Define hazardous waste. Discuss in detail: the categories and characteristics of hazardous waste. (6)

(b) List four major provisions of CERCLA. (4)

Q:7 Design a continuous flow stir tank (complete mix) type activated sludge process plant to treat 20 MLD domestic waste water. BOD_5 of settled waste water to the reactor is 200 mg/L and is desired of treated effluent 30 mg/L. Assume that the plant will be operated at following conditions. (10)

- i) Water contains adequate trace nutrients and nitrogen and phosphorus for the growth of biomass.
- ii) Peak flow rate is 2.5 times the daily average flow.
- iii) Influent biomass concentration X_0 to reactor is negligible ($X_0 = 0.0$ mg/L)
- iv) MLSS in reactor $X = 3500$ mg/L
- v) Concentration of recycled sludge $X_r = 10000$ (mg of MLSS/L)
- vi) MLVSS is 80% of MLSS. (i.e $MLVSS/MLSS = 0.80$)
- vii) Design mean cell residence time = (MCRT) = $\theta_c = 10$ d
- viii) Effluent contains 25 mg/L of biological solids of which 65% is biodegradable
- ix) BOD_5 is 68% of ultimate BOD (i.e $BOD_5/BOD_L = 0.68$) and BOD rate constant $K' = 0.1$ per day

Q:8 Explain the procedure of designing an irrigation channel using Lacey's theory. Compare Kennedy's and Lacey's theories for the design of irrigation channels in alluvial soil. (5)

Design an irrigation channel to carry a discharge of 5 cumec. Assume $N = 0.0225$ and $m = 1$. The channel has a bed slope of 0.2 m/Km. (5)

Q =

N m

Q:9. (a). Explain the term hydraulic jump. Derive an expression for the depth of hydraulic jump in terms of the upstream Froude number. (5)

(b) A sluice gate discharges water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4m. The width of the channel is 8m. Determine whether a hydraulic jump will occur and if so, find its height and loss of energy per kg of water. Also determine power lost in hydraulic jump. (5)

Q:10 What is linear programming? What are the advantages and disadvantages of linear programming? What is the major assumption in a linear programming model? What are the application areas of linear programming? (10)

Q:11 What are the objectives of "Time Study"? (4)

(a) Briefly describe the procedure to be followed for "Time Study" by "Stopwatch method." (3)

(b) Explain the terms: Rating, standard time, Fatigue allowance. (3)

Q:12 Discuss objectives, power and functions of pollution boards, consent of state board and penalties for violation of the provision of THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974 (10)

Q.13 Determine the chemical composition of the organic fraction, without and with Sulphur and without and with water, of a residential MSW with the typical composition as shown in table below. (10)

Component	Wet weight Kg	Dry weight Kg	Percent by weight (Dry basis)					
			C	H	O	N	S	Ash
Food waste	15.0	3.9	46.0	6.8	39.6	2.2	0.4	5.0
Paper	39.0	35.9	42.5	5.8	45.0	0.5	0.4	5.8
Card board	8.0	6.2	43.0	5.9	45.	6.0	3.0	5.0
Plastics	8.0	6.8	59.0	8.2	23.8	-	-	9.0
Textiles	4.0	2.0	53.0	6.6	33.2	4.6	0.15	2.5
Rubber	1.0	0.5	78.0	10.0	-	2.0	-	10.0
Leather	1.0	0.4	60.0	8.0	11.6	10.0	0.4	10.0
Yard wastes	22.0	8.8	48.5	6.0	37.0	3.4	0.3	4.5
Wood	2.0	1.6	49.5	6.0	42.7	0.2	0.1	1.5
Total	100	66.1						

✓ Q.14 (a) What are the salient aspects of Environmental Impact Assessment notification for development projects? What type of environmental information about any project is necessary for public? (5)

✓ (b) In any Democratic society, people hold the power to shape public opinion and government policy. Effective public consultation and participatory decision-making can play a critical role in avoiding conflicts between the people and developers, thereby both the physical environment for future generations and the business environment for investors. What important steps can be taken for this purpose? (5)

✓ Q.15. Classify different types of solar thermal collectors and show the constructional details of a flatplate collector. Write the advantages and disadvantages of concentrating collector over flat-plate types of solar collector. (10)

Q.16. The following excerpt from an article “Hazardous Waste Time Bomb still Ticking” appeared in the leading Newspaper. Among the standard means of industrial waste disposal, a landfill can be either a hole in the ground or, in more sophisticated situations a quarry or specially excavated site resting on a bed of clay. Clay is the key to the technology. Supporters of landfill disposal say a clay bed of adequate thickness is proof against poisonous leakage. But pollution probe (A public advocacy organization) remains unconvinced. “We are not supporters of landfill technology”. Miss Kavya Said “Clay just slows down the leachate: it doesn’t contain it. It’s really a dinosaur technology”. (10)

(a) Comment on the views of landfill supporters and opponents as stated in excerpt. Do you agree or disagree with either side, or neither and what effect should these views have on the choice of methods for the disposal of hazardous industrial waste? Explain. (5)

(b) List several waste management alternatives (excluding deep-well injection and storage in salt caverns) that can be used by industry to lessen the amount of industrial waste residues being placed in a landfill. Note one advantage and one disadvantage for each alternative. (5)

Q:17 Why is direct government involvement necessary for the control of environmental quality?

The term zero discharge has been frequently used in regard to pollution in the recent past, particularly in India. Why insistence on Zero discharge is not practical in some Instances?

(10)

Q:18 A number of instruments or methods for environmental control are available. Which of these methods, or combinations thereof or schemes of your (describe) would you choose for the control of the following pollution problems?

(10)

- (a) Motor vehicle exhausts
- (b) Pulp mill effluents and exhausts
- (c) Noise and dust conditions from quarry located close to a Village
- (d) Operation of a major airport close to a metropolitan area.

State the reasons for your choice and explain briefly how the system might work.
