4-1

University of Asia Pacific Department of Civil Engineering Final Examination – Spring 2024 Program: B.Sc. Engineering (Civil)

Course Ti Time: 3 h	tle: Transportation Engineering II ours	Credit Hour: 3:00	Course Code: CE 45 Full Marks: 120	51
1. a)	Briefly discuss different types of	rails.		(5)
b)	Calculate the minimum depth of sleepers with sleeper clear spacing is 13m. Determine minimum sleep	ballast for a Broad-Gauge g = 35 cm. The length of ea pers' density per km.	track with wooden the rail for this track	(6)
c)	Define check rail. List down the c	components of a permanent	t way.	(4)
d)	A 2-8-2 locomotive of N.G. is rec of the driving wheels of the engin 150 where an 8 degrees curve ex locomotive is capable of hauling.	uired to haul a train at 50 e is 50 tons. The train clim ists. Determine the heavies	km/h. The axle load bs a gradient of 1 in st train load that the	(10)
e)	Compute the length of a transition with a straight MG track having deficiency. Set the transition curv 19m intervals.	a curve that joins the ends og g a cant of 15 cm. Consi e by determining the shifts	of a 4° circular curve der maximum cant and offsets at every	(20)
2.	The pavement that needs to be consumption of the example two-way traffic on the example to grow at $\frac{1}{2}$ construction of pavement will be a in 2020. The percentage of traffic a terminal serviceability index (percentage for the design period and at is 40 years, and the vehicle mix is Passenger cars (1000 lb/axle) = 3 2-axle single-unit trucks (5000 lb 3-axle single-unit trucks (12000 l 3-axle tandem-unit trucks (15000 4-axle tandem-unit trucks (24000 lb 3) and the trucks (24000 lb 3) and the trucks (12000 lb 3) and the truck	onstructed is a four-lane diristing highway counted in 7% per annum. It is also completed 10 years after the con the design lane is 40% of) of 2.5 and SN of 4. Pre- lso calculate the design ES is as follows: %, /axle) = 20%, b/axle) = 17%. lb/axle) = 15%.	vided highway. The 2020 was 3,000 cvd o expected that the e traffic count taken b. The pavement has edict the cumulative AL if the design life	(20)
3.	Design a suitable pavement of a with an elastic modulus of 22 coefficient of 0.15 on a subgrade $1b/in^2$. It takes about 1 week for	n asphalt mixture surface 0,000 lb/in ² , a base laye having a resilient modulus the base course and 1 mod	for a rural highway or with a structural of elasticity of 5000 onth for the sub-base a reliability level of	(20)

course to drain out the water with a saturation of 3%. Use a reliability level of 85%. Consider the value of design ESAL as calculated in question no 2 (Q2/100). The CBR value of the sub-base course is 32. The resilient modulus of the base course and sub-base course is 20000 lb/in² and 10000 lb/in² respectively.

4. Design a concrete pavement for a six-lane urban expressway using the AASHTO (15 method where a 10-inch layer of untreated granular material is used as a subbase layer. The monthly value of the resilient modulus of roadbed soil and subbase is given in Table 1. If the rock depth is located 3 ft below the subgrade surface and the projected slab thickness is 12 in,

i) Estimate the effective modulus of the subgrade reaction. Andii) Check whether the projected slab thickness is sufficient for such kind of pavement or not.

[Consider design ESAL as 3.5×10^6 , the working stress of the concrete is 550 lb/in² and the modulus of elasticity is 4.5×10^6 lb/in². The load transfer coefficient is 3.0, the drainage coefficient is 0.9 and the reliability is 90%.]

Month	Roadbed Modulus (lb/in ²)	Sub-base Modulus (lb/in ²)	
January	13,000	200,000	
February	18,000	45,000	
March	22,000	60,000	
April	10,000	15,000	
May	6,000	35,000	
June	2,000	10,00,000	

Table 1: Soil Characteristics

5. Determine the tensile stress imposed by a semicircular wheel load of 1500 lb (10) imposed during the day and located at the edge of a concrete pavement with the following dimensions and properties (a) by using the Westergaard equation, and (b) by using the Ioannides equation.

Pavement thickness = 10"

 $\mu = 0.33$

 $E = 6.5 \text{ X } 10^6 \text{ lb/in}^2$

k = Assume the value from question no 4 (Q4)

Radius of loaded area = 2.5"

University of Asia Pacific Department of Civil Engineering Final Examination Spring 2024 Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering IIICredit Hours: 3.0Course Code: CE 411Time: 3 hoursFull Marks: 100 (10×10)

ANSWER ALL THE QUESTIONS. Any missing data can be assumed reasonably.

1. Use the Energy Method to calculate the plastic moment needed to prevent (i) beam mechanism, (ii) sidesway mechanism in the frame *abcd* loaded as shown in *Fig.1*.



- Calculate Plastic Moment capacity of the section shown in <u>Fig.2</u> if the section is made of elastic-fully plastic material.
 [Given: σ_{yp} = 48 ksi].
- 3. Determine the degree of kinematic indeterminacy (**doki**) and show the corresponding deflections and rotations of the 2D frame (*Fig.3a*) and 3D frame (*Fig.3b*) for the following cases
 - (i) Not considering boundary conditions
 - (ii) Considering boundary conditions
 - (iii) Neglecting axial deformations.



- 4. Use Stiffness Method (neglecting axial deformations) to calculate the value of applied load **F** required to cause buckling of the frame *abc* loaded as shown in <u>*Fig.4.*</u> [Given: $EI = 48 \times 10^4 \text{ k-ft}^2$].
- Frame structure *abcde* shown in *Fig.5* is subjected to a dynamic load, w = 10t (k/ft). Use *Constant Average Acceleration* (CAA) Method to calculate the rotation of joint c at time t = 0.10 sec [Given: EI = 48×10⁴ k-ft², μ = 0.0048 k-sec²/ft², Damping ratio of the system = 4.8%].

Identify zero-force members of the 2D truss loaded as shown in <u>Fig.6</u>. Determine the displacements of joints c and d. Also, calculate member force of ce. [Given: EA/L = 1200 k/ft].



- 7. Use Stiffness Method considering geometric nonlinearity and flexural deformations only to calculate the unknown rotations at **b**, **c** and deflection at **b** of the frame **abcd** loaded as shown in <u>Fig. 7</u>. [Given: $EI = 48 \times 10^3 k$ -ft²].
- 8. Use stiffness method to calculate rotations of joint b and d (θ_b, θ_d) and deflection at d of the 2D frame abcde loaded as shown in <u>Fig. 8.</u>
 [Given: EI = 48×10³ k-ft²].
- 9. Calculate 1st natural frequency of the frame shown in *Fig.9* using consistent mass matrices [Given: $EI = 48 \times 10^3 k/ft$, $\mu = 0.0048 k$ -sec²/ft²].
- 10. Use Stiffness Method (neglect axial deformations) to calculate rotations at joint a and c of the frame <u>abcde</u> loaded as shown in <u>Fig.10</u>, if the joint c is a circular foundation of radius 3.5 ft on the surface of subsoil (half- space) with shear wave velocity (v_s) equal to 1200 ft/sec.
 [Given: EI of the frame members= 60 × 10³ k-ft², Unit weight of soil = 120 pcf, Poisson's ratio of soil material= 0.25].



University of Asia Pacific Department of Civil Engineering Final Examination Spring 2024 Program: B. Sc. Engineering (Civil)

Course Title: Geotechnical E	ngineering II	Course Code: CE 441
Time: 3 Hours	Credit Hours: 3.0	Full Marks: 120

Answer all the questions

1. (a) What is subsurface exploration in terms of geotechnical engineering? Write down two general 3 guidelines for the selection of depth of boreholes required for a sub-surface exploration project.

(b) The outside and inside diameters of a split-spoon sampler are 50.8 mm and 34.93 mm, respectively. The outside and inside diameters of a Shelby tube sampler are 76.2 mm and 73 mm, respectively. Estimate the degree of disturbances for two soil samples; one obtained using the split-spoon sampler and the other using the Shelby tube. Using the criterion for evaluating degree of disturbance determine whether the samples are disturbed or undisturbed.

(c) Write down the names of any five (5) in-situ testing performed in the field under the field investigation phase of a sub-surface exploration program. Which one is most commonly used?

- (d) Write short note on any two of the following:
 - (i) Site reconnaissance (ii) Preliminary information for a conventional bridge project
 - (iii) Vane shear test

(e) Data (part) from a geotechnical site investigation as conducted at a site near Savar is tabulated below. Estimate the field SPT N-values. Ground water table was found to be located at a depth of 10 feet below the existing ground surface. Apply necessary corrections and calculate corrected SPT values as required (Use Appendix, as necessary). Also determine undrained cohesion and angle of internal friction for clay and sand, as applicable, at corresponding depths. No liner was used during drilling. Consider a hammer efficiency 57%.

				Blow Counts		
Soil Type as Obtained	γ (pcf)	γ _{sat} (pcf)	Depth below EGL (feet)	1 st 6-in	2 nd 6-in	3 rd 6-in
CLAY up to a depth of 15 feet	115	125	5	1	3	4
SAND below 15 to a depth of 40 feet	118	120	30	3	5	5

2. (a) Discuss, in short your understanding of shallow and deep foundation in the light of Df/B ratio.

(b) Using General Bearing Capacity Equation (GBCE), an entry-level engineer designed a square foundation as shown in the following **FIGURE** (A). In his design he did not consider the effect of ground water condition. Except that his calculations were correct and the footing size was found to be 3 ft X 3 ft with a factor of safety 3.

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His/her design was not properly reviewed and the structure was constructed. The site investigation revealed that the GW was actually at the EGL. You are now involved in reviewing this design. Considering the actual GW condition as shown in **FIGURE (B)**, what would be the actual ultimate load (P_u) that the column can take? Also calculate the actual FS the structure is having now.



3. (a) For the following concentric rectangular mat foundation determine P1, B and qa. Use the dimension for the columns as 12-inch by 12-inch.



(b) The plan of a mat foundation with column loads and dimensions (24 in x 24 in each for all columns) is shown in the figure below. Calculate soil pressures at points a, b and c and geometric centroid.



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4. A rectangular footing (8 ft X 12 ft), designed as per allowable bearing capacity based on shearing failure, is shown in the following figure. OCR of the cohesive deposit is 2.0. Estimate settlements for both sand and clay layers. Use qa = p = 5.0 ksf.



5. (a) For the following condition, calculate the allowable capacity of a 50-ft long single pile. Assume reasonable factor of safeties for end bearing and skin resistance. Also calculate the capacity considering group effect of pile group consisting of six piles forming a block. Use spacing of piles = 2.5 times the diameter of the piles. Finally estimate the design capacity.



(b) For the following condition, calculate the allowable capacity of a single pile. Assume reasonable 11 factor of safeties for end bearing and skin resistance.



6. (a) A cut is to be made in a soil that has a unit weight $\gamma = 110 \text{ lb/ft}^3$, cohesion c=650 lb./ft², and an 10 angle of internal friction $\phi=18^{\circ}$. The depth of the cut slope is 27.23 ft. If the factor of safety is 2.5, determine the angle of the cut slope made with the horizontal. Solve using Culman's method.

(b) A cut slope was excavated in saturated clay. The slope made an angle of 35° with the horizontal. Slope failure occurred when the cut reached a depth of 5.5 m. Previous soil explorations showed that a rock layer was located at a depth of 8.5 m below the ground surface. Assuming undrained conditions and that γ_{sat} =18.5 kN/m3

i. Determine the undrained cohesion of the clay.

ii. With reference to the toe of the slope, determine the distance the surface of sliding intersect the bottom of excavation.

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University of Asia Pacific Department of Civil Engineering Final Examination (Spring 2024) Program: B. Sc. Engineering (Civil)

Course Title: Professional Practices and CommunicationCourse Code: CE 403Time: 2 hoursCredit Hours: 2.00Full Marks: 100

[You must answer all the SEVEN questions (15+20+10+20+10+10+15)]

- 1. A garment industry decided to recruit 50 workers. The HR department prepared a contract for [6+4] all the new workers. The contract has the following clauses:
 - Workers have to work 10 hours a day, 60 hours a week, with a weekly rest day. There will be no limit for overtime work.
 - Workers are entitled to rest and meal for half an hour in a day.
 - Wages will be equal for male and female workers for work of equal nature or value.
 - Employer will not provide compensation to the workers for work-related injury, disability or death.
 - No worker is permitted to establish or join any kind of trade union inside the factory.

Suppose, you are going to sign the contract as a worker in that factory. *Discuss* whether the contract clauses are satisfactory or not according to the **Bangladesh Labor Law (BLL)** and *identify* the **problems** with the clauses mentioned above. *Write* your **course of action** in this situation. *[e.g., should you sign the contract or not.]*

2. Mr. Yusuf is a junior engineer working in the operation and maintenance department of an oil refinery. The effluent from the refinery is being discharged into a river just beside the factory. The general people living in that area use water from the river for their daily works. After working for a few days, Yusuf noticed that the effluent is showing a high concentration of a toxic chemical compound which cannot be removed using current treatment processes. He spoke to his supervisors to suggest an alternate treatment method so that the toxicity of the effluent can be controlled. However, his supervisor simply ignored the risk and asked Yusuf to continue without any further treatment.

In such scenario, Yusuf calls one of his former Professors for advice. Yusuf says, "I am really scared that the people living in this area will be seriously affected by using the toxic water for daily uses". He adds, "I tried to talk to my supervisors about the problem, but they seemed to be very careless about the violation of the standards for effluent discharge". Yusuf's Professor replies, "You cannot ethically continue your present job as you are one of the members of the operation and maintenance team".

The current scenario has now turned into a great dilemma for Yusuf. Under this situation, what options do Mr. Yusuf have? *Justify* your reasons.

- Hamid is a college student who wants to study law and become a renowned lawyer in future. [15] *Explain* whether Hamid will be considered as a professional based on the criteria of a profession or not.
- 4. *Define* "Moral Autonomy". *Explain* the factors influencing moral concern and skills [4+8+8] required to improve moral autonomy.
- 5. *Explain* the concepts of "Bribes" and "Kickbacks". *Compare* between gift and bribe. [5+5]
- 6. *Discuss* the advantages and disadvantages of multinational corporations for both the host [10] and home countries.
- 7. Consider yourself as a design engineer for a well-known construction company. You designed [15] a 20-storey residential building for your client and the construction of the building is about to complete. At this point, your client suddenly demanded to install heavy machineries to some floors because they plan to use half of the building as a garment factory. But the building is not designed for industrial use and setting up of heavy machineries to some floors will be of serious safety issue for the people living in the building.

However, the director of the company wants you to fulfill the client's demand as he does not want to lose such a powerful client. In this situation, what should you do? *Justify* your answers based on the priority of stakeholders as per the Code of Ethics of the American Society of Civil Engineers (ASCE).

University of Asia Pacific Department of Civil Engineering Final Examination Spring 2024 Program: B. Sc. Engineering (Civil)

Course Title: Environmer	tal Engineering IV	Course Code: CE 431
Time: 1.5 Hours	Credit Hour: 2.00	Full Mark: 100

There are <u>Three</u> questions. Answer <u>all</u> the questions [30+30+40 = 100]. (Assume any missing data)

- 1. (a) Show the pathway that hazardous waste travels in an environment connecting different (10) environmental reservoirs. State your opinion on how it is possible to reduce the impact of these hazardous substances on us consulting their pathways.
- (b) Consider you are an Engineer who works for a pharmaceutical industry in Bangladesh (10) that disposes a lot of toxic chemicals (hazardous) waste as part of the manufacturing process. Being established in a developing country, explain the general problems that you will expect in the treatment and disposal of this special category of waste. Explain the factors that you would have to consider if the company asks you to cite a landfill site for this type of waste.
- (c) Explain "Life Cycle Assessment" with example. If you want to establish an industry, (10) elaborate the factors that you should consider for effective recycle, reuse, collection and disposal of industrial waste.
- 2. (a) Determine the break-even time for a stationary container system with a separate transfer and transport system for transporting wastes collected from a municipal area to a landfill site. Use graph paper for the plot. Assume the following data while calculating: <u>Transportation cost:</u> Stationary container system using a 20 m³ compactor: BDT 4000/ hr Tractor-trailer transport unit with a capacity of 150 m³: BDT 5000/ hr <u>Other costs:</u> Transfer station operating cost: BDT 100/m³ Extra cost for unloading facilities: BDT 20/m³ <u>Other data:</u> Density of wastes in compactor = 400 kg/ m³ Density of wastes in transport unit = 200 kg/ m³
- (b) If you recommend a "transfer station" for a solid waste management system that you are (8) involved in developing, provide reasons both in favor of and against the decision. Also

Page 1 of 3

mention the factors that you have to consider while planning and designing transfer station.

(c) The pharmaceutical company of problem 1b) dumps waste every day @ a rate of 100 tons (10) per day into Balu river except Friday. Also, there is no waste collection system available in the surrounding residential area that generates 0.2 tons per capita per day with 4000 people and the ultimate destination for this waste is Balu river. If a waste collection vehicle to be bought for collecting the residential waste costs 80,000 BDT requiring 4 crew members with 20 BDT/hour wage rate @8 working hours/day for 7 days a week, calculate the cost of the total waste collection system for one year (no amortization required; consider yearly operational cost to be 8,000 BDT) if it is to be implemented in the area. Also calculate the total amount of waste that the river is receiving every month when there is no collection system available.

OR

A transfer station was built with an installation cost of 5,00,000 BDT with yearly operational cost being 50,000 BDT. The transfer station is meant to handle 500 tons/day operating 7 days a week. To be operated to and from the transfer station, a tractor-trailor was bought with 1,00,000 BDT which will require 10,000 BDT for yearly operation and maintenance. The truck carries 50 tons/trip. A driver appointed would require 4,000 BDT per month including benefits. The capital cost of the building and transfer trucks are to be amortized over a 20 year period using a 10% discount factor. Suppose it takes 45 minutes to make a one-way trip from the transfer station to the disposal site and 5 round trips per day are made. Find the total cost of transfer station and hauling cost in BDT per ton.

3 (a) Show the flow chart of anaerobic digestion and mention the uses of the final products of (8) the process. Why is the energy recovery rate higher in anaerobic digestion than the recovery from landfill?

OR

Based on the advantages and disadvantages of "Anaerobic digestion" and "Composting" system, which type of waste management system will you consider for your city, provide justification.

- (b) Briefly explain the recycling practices of developing countries and show a proposed (8) recycling scheme of your plan for an urban community.
- (c) Design a sanitary landfill that will be built in Keraniganj area which will be used ultimately for construction purpose after 20 years i.e. the land is being taken through lease by the Govt. Answer according to the steps given below:
 - i) Mention strategies for leachate management system for the landfill.
 - ii) Calculate the required landfill capacity for the current year for a population (6) size of 30,00,000 with per capita waste generation rate of 5.0 lb/capita/day

(4)

and compacted density of 40 lb/ft^3 . Assume that the daily cover consists of 10% of the landfill volume.

- iii) State certain options on how you can make the landfill environmentally (4) friendly.
- (d) Calculate the oxygen requirement of organic waste for composting with structural (10) formula $C_1H_{2,4}O_{0,9}$ and $C_1H_{2,4}O_{0,9}N_{0,02}$. Use the formula provided below.

$$C_n H_a O_b + \left(n + \frac{a}{4} - \frac{b}{2}\right) O_2 \rightarrow nCO_2 + \left(\frac{a}{2}\right) H_2 O$$

$$C_n H_a O_b N_c + \left(n + \frac{a}{4} - \frac{b}{2} - \frac{3c}{4}\right) O_2 \rightarrow nCO_2 + \left(\frac{a}{2} - \frac{3c}{2}\right) H_2 O + cNH_3$$

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$$CRF = \left[\frac{i(1+i)^n}{(1+i)^n}\right] \quad A = P\left[\frac{i(1+i)^n}{(1+i)^n}\right]$$

Where, A = Annual cost (BDT/yr) P = Purchase price, (BDT) i = interest rate, discount rate (yr⁻¹) n = amortization period (yr) CRF = Capital Recovery factor

University of Asia Pacific Department of Civil Engineering Final Examination Spring 2024 Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering V (Prestress	sed Concrete)	Course Code: CE 415
Time: 2 hours	Credit Hour: 2	Full Marks: 100

QUESTION 1

A T-shaped unbonded beam, as shown in **Figure 1**, is prestressed by prestressing steel with an effective stress of 180 ksi where $A_{ps} = 3.0$ in². The c.g.s. of the strands is 5 inch from the bottom of the beam. Analyze the beam to obtain the ultimate resisting moment following the ACI code. Material properties are, $f_{pu} = 270$ ksi, $f_{py} = 230$ ksi, $f'_c = 5$ ksi. [25]



QUESTION 2

(a) Design a preliminary section of a prestressed concrete beam to resist a total moment of 440 k-ft including girder self-weight moment of 50 k-ft. Assume a trial depth of the section of 42 inch. The effective prestress (f_{se}) for steel is 140 ksi, and allowable compressive stress for concrete under working load (f_c) is (-)1.2 ksi. [10]

(b) Condsidering the preliminary section obtained in 2(a) and allowing tension in the concrete, design the final section of the beam considering economy. [20]

A T-section is preferred for the both solutions where the thickness of flanges and web not exceeding 6 inch.

[Given, $f_t = -1.6 \text{ ksi}$, $f_b = -2 \text{ ksi}$, $f'_t = 0.30 \text{ ksi}$, $f'_b = 0.25 \text{ ksi}$, $f_0 = 170 \text{ ksi}$].

QUESTION 3

A posttensioned simple beam on a span of 28 ft is shown in **Figure 2**. It carries a superimposed live load P = 18 kips. The initial prestress in the steel is 300 kips, reducing to 260 kips after deducting all losses. Analyze the beam to obtain stress in the steel at midspan at service condition if:

- (a) the steel is bonded by grouting.
- (b) the steel is unbonded and entirely free to slip.

Assume unit-weight of concrete is 150 lb/ft³ and n = 6.



QUESTION 4

With neat sketches, explain the stress distribution of a simple supported prestressed concrete composite section for various loading stages. [15]

[10]

[20]

<u>Formula</u>

•
$$M_G/M_T \le 20\%, F = \frac{M_L}{0.5h}$$

- $M_G/M_T \ge 20\%, F = \frac{M_T}{0.65h}$
- $A_c = A_{ps} f_{se} / 0.5 f_c$
- Elastic design, allowing tension:

$$e_{1} + e_{2} = \frac{M_{G} + f_{t}'Ak_{b}}{F_{O}}, F = \frac{M_{T} - f_{b}'Ak_{t}}{k_{t} + e}$$

$$A_{c} = \frac{F_{O}h}{f_{b}c_{t} - f_{t}'c_{b}} \text{ (at transfer), } A_{c} = \frac{Fh}{f_{t}c_{b} - f_{b}'c_{t}} \text{ (under working load)}$$

$$A_{c} = \frac{F_{O}}{f_{b}} \left(1 + \frac{e - \binom{M_{G}}{F_{O}}}{k_{t}}\right) \text{ (at transfer),}$$

$$[where f: k f are sheelute values]$$

[where $f_b \& f_t$ are absolute values]

• $f_s = \frac{n}{L} \int \frac{My}{l} dx$ • $M = M_0 \left[1 - \left(\frac{x}{L/2}\right)^2 \right]$

•
$$p_p = \frac{A_{ps}}{bd}$$

•
$$T' = A_{ps} f_{ps}$$

•
$$f_{ps} = f_{pu}(1 - 0.5p_p \frac{f_{pu}}{f_{c'}})$$

•
$$f_{ps} = f_{se} + 10000 + \frac{f_c}{100p_p}$$

•
$$f_{ps} \leq f_{py}$$

•
$$f_{ps} \leq f_{se} + 60000$$

•
$$w_p = p_p f_{ps} / f_c' < 0.30$$

- $A_{pf} = 0.85 f_c'(b-b_w) h_f/f_{ps}$
- $A_{pw} = A_{ps} A_{pf}$
- $M_u = \Phi[A_{pw}f_{ps}(d-a/2)+0.85f_c'(b-b_w) h_f(d-h_f/2)]$

University of Asia Pacific Department of Civil Engineering Final Examination, Spring 2024 Program: B.Sc. in Civil Engineering

. A

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Cours Time There	e Title: Irrigation and Flood Control 3 Hours e are 5 (five) questions. Answer all the questions. Assume any missing data.	e: CE 461 Marks: 50
1(i)	Explain water logging along with its causes and the measures to control it.	3+2=5
1(ii)	E.C value of irrigated water is 1.2 milli mho/cm, E.C value of saturated soil extract is 12 milli mho/cm, estimate the leaching requirement. Estimate the required depth of water if the consumptive use of crop is 9.5 cm	5
2(i)	The culturable commanded area of a watercourse is 1800 hectares. Intensities of sugarcane and wheat crops are 30% and 40% respectively. The duties for the crops at the head of the watercourse are 750 hectares/cumec and 1800 hectares/cumec respectively. Compute (a) the discharge required at the head of the watercourse and (b) determine the design discharge at the outlet, assuming irrigation efficiency is equal to 80%.	3+2=5
2(ii)	A canal is required to irrigate 5,600 ha of Rabi crop (wheat). The Duty of the canal is 350 ha per cumec. Design an earthen irrigation canal to carry the required discharge with a velocity of 0.80 m/s. Assume side slopes 1:1 and bed slope 1 in 5000 and Mannings $n= 0.02$	5
3(i)	(i)Distinguish between flood and drainage congestion.(ii) Write down the causes of floods	2+3=5
3(ii)	Classify different types of floods in Bangladesh.	5
4(i)	Explain the phenomenon of the occurrence of catastrophic floods in Bangladesh.	5
4(ii)	Discuss briefly the impacts of flood.	5
5(i)	Discuss different types of measures of flood management. Distinguish between them.	2+3=5
动的	a Exclusive a coveringes and disket unitigor of flood control projects.	5

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