Ref No. –Ex/CE/PC/B/T/222 /2023

B.E.C.E. 2nd YEAR EXAMINATION, 2023

(2nd Semester)

SUBJECT: **Water Resource Engineering - I**

Full Marks 100

Time: Three hours

Use a separate Answer-Script for each part

No. of Questions | **Part I (60 Marks)** | **Marks**

Answer all the questions. Answer should be brief and to the point. All the notations have their usual meaning. Assume relevant data if not provided. All the relevant drawings should be in pencil.

Section-A (CO1)

Q1. **Differentiate between (write the important points only):** 2×5

AET and PET; PWP and PMP; El Nino and La Nina with related to precipitation; φ-index and W-index; Water detention and water retention in hydrological cycle

Q 2.a) **Write true or false with proper justification:** 1×2

i. If slope of an area will be flat then rate of runoff will increase.

ii. If temperature of water increases, then rate of infiltration will decrease.

b) Results of an infiltrometer test of a catchment area are provided below. Determine the Horton's infiltration capacity equation **graphically** for the area. 7+1

Time from the beginning of storm (min)	5	10	15	20	30	40	60	80	100
Cumulative infiltration in mm	21.5	37.7	52.2	65.8	78.4	89.5	101.8	112.6	123.4

Q 3.a) **Match the following:**

Column A	Column B
Precipitation	Green-Ampt equation
Evaporation	Symon's gauge
Evapotranspiration	Meyer's formula
Infiltration	Blaney Criddle's formula

1×4

b) **Match the following:**

Column A	Column B
Isopleth	Line joining equal rainfall depth
Isopluvial line	Line joining equal rainfall intensity
Isohyet	Line joining equal evaporation

1×3

c) **Fill in the blanks** 1×3

i. To simulate the evaporation rate for a water body the evaporation rate data obtained from an evaporimeter should be multiplied by _____

ii. If pressure of a particular area decreases then the evaporation rate will be _____

[Turn over

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No. of Questions	**Part I (60 Marks)**	Marks
	iii. Let the probability of occurrence of 24 hour maximum rainfall equal to or greater than 200 mm in Kolkata is 50. Then _____ is the probability of nonoccurence of the stated rainfall event in 25 successive years.	
Q4.a)	The catchment area of a reservoir is 30 km^2. A uniform precipitation of 0.5 cm/h for 2h was observed on 31st October, 2022 at 8am. 50% of the runoff reached the reservoir immediately after the precipitation. A canal carrying a discharge of 1.5m^3/s is taken from the reservoir. The rate of evaporation observed was 0.8 mm/m^2/h. The seepage loss was observed to be 50% of the evaporation loss. Find the elevation of the reservoir on 31st October, 2022 at 8 pm considering the area of the reservoir is 0.5km^2 and elevation was 103.5m from datum level at 8am.	5
b)	Determine the adequacy of raingauge station for a sub-basin having seven numbers of rain gauges. Annual rainfalls recorded by the rain gauges are given below. Consider 5% error in the estimation of mean annual rainfall.	5

Rain-gauge Stations:	P	Q	R	S	T	U	V
Annual rainfall (mm):	130	142.1	118.2	108.5	165.2	102.1	146.9

Section-B (CO2)

Q5.a)	**Differentiate between (write important points only):** Intrinsic permeability and hydraulic conductivity; transmissibility and hydraulic diffusivity; specific storage and storage coefficient.	2×3
b)	**Write true or false with proper justification:**	1×4
	i. For practical purposes the limit of the validity of Darcy's law can be taken as upto Re =10.	
	ii. Actual velocity through soil and discharge velocity are not synonymous.	
	iii. The rate of recovery for unconfined aquifer is more than rate of recovery of confined aquifer.	
	iv. For leaky aquifer lower value of leakage factor means high leakage rate.	
Q6.	With a neat sketch, deducing the expression for a 30 cm dia well completely penetrating in unconfined aquifer of depth 25m at a steady state condition determine the drawdown at the well surface when coefficient of permeability is 45m/d, radius of influence is 350m and constant rate of discharge is 45lps.	5+2+3

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B.E. CIVIL ENGINEERING SECOND YEAR SECOND SEMESTER – 2023

SUBJECT: Water Resource Engineering - I

Time: 3 hours **Full Marks: 100**

Instructions: Use Separate Answer scripts for each part.

Part – II (40 Marks)
Answer Any 3 (three) Question 3x 13 = 39 marks
One marks for neatness and to the point answer.

<table>
<tr><th>Sl. No.</th><th>Question</th><th>CO</th><th>Marks</th></tr>
<tr><td>1</td><td>a)What is a hydrograph ? What is its significance ?
b) Draw an ideal hydrograph explain its various components .
c)How these components are influenced by different physiographic and climatic factors ?
d)What are the limitations of an Unit hydrograph? Can ERH overcome these limitations</td><td>[CO4]</td><td>[3+4+4+2]</td></tr>
<tr><td>2</td><td>a) What are the methods to separate base flow in a river for obtaining UH.? What is the purpose of doing so ?

b)Given below are observed flows from a storm of 6-hr duration on a stream with a catchment area of 520 km ^{2}
<table>
<tr><td>Time (hr)</td><td>0</td><td>6</td><td>12</td><td>18</td><td>24</td><td>30</td><td>36</td><td>42</td><td>48</td><td>54</td><td>60</td><td>66</td><td>72</td></tr>
<tr><td>Q m^3/sec</td><td>0</td><td>100</td><td>250</td><td>200</td><td>140</td><td>100</td><td>70</td><td>50</td><td>35</td><td>25</td><td>15</td><td>4</td><td>0</td></tr>
</table>
Derive the ordinates of 6-hrs UH. Also draw the neat UH plot.
.</td><td>[CO4]</td><td>[4+2 +7]</td></tr>
<tr><td>3</td><td>a) What do you understand by Run-off for a catchment? What are natural flow and delayed underflow ?
b)The mean monthly rainfall and temperature of a catchment near Patna are shown below : Estimate the annual runoff volume and the corresponding run-off coefficient by Khoslas run off formula
<table>
<tr><td>Month</td><td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td><td>Jul</td><td>Aug</td><td>Sept</td><td>Oct</td><td>Nov</td><td>Dec</td></tr>
<tr><td>Temp (^{0}C)</td><td>24</td><td>27</td><td>32</td><td>33</td><td>31</td><td>26</td><td>24</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td></tr>
<tr><td>Rainfall (mm)</td><td>7</td><td>9</td><td>11</td><td>45</td><td>107</td><td>71</td><td>106</td><td>132</td><td>158</td><td>145</td><td>65</td><td>15</td></tr>
</table></td><td>[CO4]</td><td>[2+2 +7]</td></tr>
<tr><td>4.</td><td>a) The volume of natural flow in the river is 119 Mm3 ,Annual rainfall is 2034 mm.if the catchment area is 178 Km^2 estimate the rainfall – runoff rato of the catchment.
b)
An outfall has to drain 400 ha of land with a maximum length of travel of 1.4 km. The general slope of the catchment is 1 in 800 and its run off Co-eff. is 0.55. Estimate the peak flow by the Rational method for designing the culvert for a 50 year flood.
Information on the 50 year storm is given below:-
Duration in (min) – 10 15 30 45 60 100
Rainfall (mm) – 20 23 30 45 54 65</td><td>[CO4]</td><td>[4 + 9]</td></tr>
</table>

5	a) Observed rainfall and Runoff on annual basis are given in following Table. Develop the rainfall-runoff correlation equation for this catchment. Also estimate the correlation coefficient .If the the annual rainfall is 100 cm what will be the annual run off ? b) Compare the flood discharge values using following empirical formula for catchment area of 145 km^2. a)Dickens b)Inglis $C_D = 26$	[CO4]	[9+4]

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Annual Rainfall (cm)	90	111	38.7	130	145.5	99.6	145.8	61	120.2
Annual Run- off (cm)	32	50.7	6.6	65	76.5	43	67.8	8.4	49.8