BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
SECOND SEMESTER 2022-2023
COMPREHENSIVE EXAMINATION-ENGINEERING HYDROLOGY (CLOSE BOOK + OPEN BOOK)

Course No: CE F321 **Date: 17-05-2022 (Wed)**
Duration: 180 min (FN) **Max. Marks: 90**

Instructions:
1. There are two parts. Part-A is closed book (**40 marks, 60 min duration**) and Part-B is open book (**50 marks, 120 min duration**)
2. You will be given Part-B only after completing Part-A
3. In Part-B, show all calculations/steps in detail.

PART-A (CLOSED BOOK)

(Maximum Marks: 40, Duration: 60 min)

First 20 questions carry 1 mark each and last 10 questions carry 2 marks each.

1. _____ unit hydrograph is derived from theory and experience, and its purpose is to simulate basin diffusion by estimating the basin lag based on a certain formula or procedure.
2. _____ aquifers are typically lenses of rock formation or clay layer of finite aerial extent appearing in the unconfined zones of groundwater.
3. For flood routing, differential forms of 'equation of continuity for unsteady flow' and 'equation of motion for a flood wave derived from momentum equation' are together known as _____ equations.
4. A barrier placed in an actively eroding gully to trap sediment carried down the gully during periodic flow events is known as _____.
5. Time taken for a drop of water from the farthest part of the catchment to reach the outlet is known as _____.
6. In Muskingum's equation, what does 'K' represent?_____.
7. In _____ irrigation, water is applied directly to the root zone of the crops using buried tubes below the soil surface.
8. In case of level pool routing, the peak of the outflow hydrograph must intersect the inflow hydrograph (True/False)_____.
9. Limiting case of unit hydrograph with time tending to zero is known as_____.
10. _____hydrograph is a D-h unit hydrograph with ordinates showing the percentage of surface runoff occurring in successive periods of equal percentile intervals in D-h.
11. Quantity of water available in excess of safe yield during the periods of high flood is known as _____.

12. _____is provided in the dam to reduce uplift pressure and for inspecting dam structure.
13. _____ is the vertical drop in the height between the water level in the well prior to pumping, and the water level in the well during pumping.
14. _____ is an opening in the dam near the ground level, which is used to clear the silt accumulation in the reservoir side.
15. The points on both sides of the crest segment in a hydrograph where there is change in the curvature of the hydrograph are known as points of _____.
16. _____ dam in China is affecting earth's rotation as per NASA's reports.
17. Rows of trees or shrubs planted to protect agricultural area from the wind and soil erosion is known as _____.
18. The full form of WEPP used by Daily Erosion Project in USA is _____.
19. Capacity of an aquifer to transmit water through its entire thickness is given by _____.
20. Sediment Delivery Ratio is the ratio of _____ to _____ .
21. In case of Universal soil loss equation, A = RKLSCP; K and C represent _____ and _____ respectively.
22. When an urban region is converted to forest region, peak of the hydrograph _____and the lag time_____.
23. Two prominent mechanical ways to control gulley erosion are _____ and _____.
24. USLE was modified by Williams (1975) to RUSLE by replacing _____ factor with a _____ factor
25. _____ is part of a river or channel where there is a sharp change in channel slope.
26. Any two types of sprinkler irrigation are _____ and _____.
27. _____ and _____ are two primary assumptions of a unit hydrograph.
28. Primary purposes of flood routing are to attain _____ and increase the _____.
29. To derive nD-h unit hydrograph from a D-h unit hydrographs, the commonly used methods are _____ and _____.
30. National Research Council (1997) defines precision agriculture as _____

_____

_____

Please submit Part-A in first 60 minutes. All the best!

PART-B (OPEN BOOK)

(Maximum Marks: 50, Duration: 120 min)

Q1. Hydrologist needs to perform tests in an unconfined aquifer of radius 0.15 m and thus, two observation wells namely X and Y are bored at distances 25 m and 40 m respectively from the center of the pumping well. When the bore machine pumps the water at a rate of 10l/s, the depth of water in the pumping well is observed to be 10 m above the horizontal impervious layer up to which it was driven. Assume that the grain size of aquifer is 0.25 cm and permeability is 0.001 m/s, kinematic viscosity of water is 0.01 cm^2/s. While using formulas, take log to the base 'e', i.e., ln. **[10 M]**

a. Estimate the depth of water above impervious layer in wells X and Y.

b. Calculate the Reynolds number of flow at the pumping well and wells X and Y.

Q2. The average monthly inflow into a reservoir is given below. Determine the minimum storage required in 'cumec.day' to meet a uniform demand of 90 m^3/s. While performing calculations, take two complete cycles and assume that the next cycle to have same flows as the present year. In case, the reservoir capacity is 7500 cumec-day, estimate the maximum uniform rate (using graph paper) of withdrawal possible from the reservoir. **[10 M]**

Month	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Monthly inflow (Mm^3)	20	60	200	300	200	150	100	80	60	40	30	25

Q3. (a) A watershed is in the form of a sector of a circle of radius r metres and angle θ radians. A t hr. storm with rainfall excess of x cm, produces a surface runoff hydrograph with linear rising and recession segments, having a base equal to k times the duration. Determine the peak of the surface runoff hydrograph (in cumecs only) in terms of given parameters. **[5 M]**

(b) The ordinates of a 4-hr unit hydrograph of a catchment are given below.

Time (h)	0	4	8	12	16	20	24	28	32	36	40	44
Ordinate of 4h UH (m^3/s)	0	20	60	150	120	90	70	50	30	20	10	0

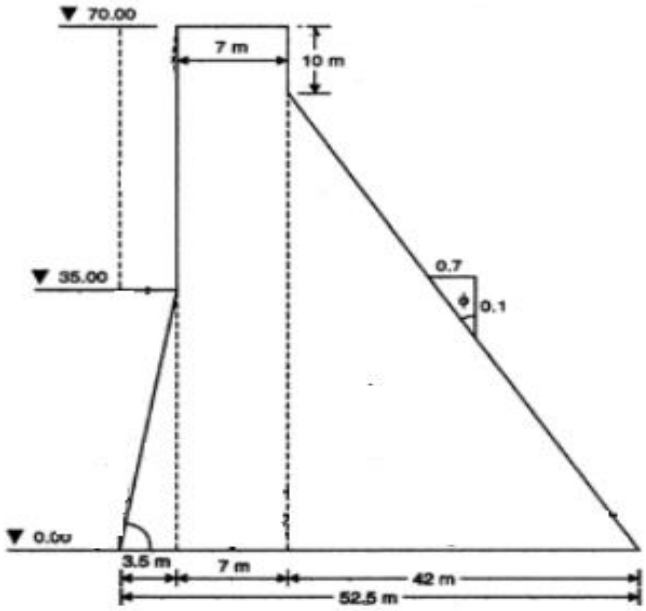
Derive the flood hydrograph in the catchment due to the storm given below:

Time from start of storm (h)	0	4	8	12

Accumulated rainfall (cm)	0	5.0	5.8	8.8

The phi-index for the catchment can be assumed to be 0.25 cm/h and a constant base flow of 20 m^3/s is appropriate. Use graph paper for hydrograph related calculations. **[10 M]**

Q4. Hoover dam shown in figure below requires stability checks under reservoir empty as well as reservoir full conditions. Assume the water level to be at the top of the dam and no presence of tail water. The dam designer would like to provide drainage holes 6.5 m downstream of the upstream face. Assume the uplift pressure at heel (100%), at toe (0%) and at drainage holes (1/3rd of uplift pressure at heel). Unit weight of concrete = 24 kN/m^3, shear strength of concrete = 1400 KN/m^3 and $\mu = 0.7$. Unit weight of water = 9.81 KN/m^3. Calculate all possible forces under reservoir empty and full conditions and check stability analysis by applying necessary checks. Show values of forces and moments in a table. Take $\mu = 0.7$ and q = 1400 KPa. **[15 M]**



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