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SUBJECT CODE = CEE024104

Roll No. of candidate | | | | | | | | | | |

2017

End Semester M.Tech (Civil Engineering) Examination

1st Semester

APPLIED HYDROLOGY

Full Marks- 70 Pass Marks- 21 Time- 3 hours

The figures in the margin indicate full marks.

PART A

Q.1 Answer all the questions **(1x16=16)**

a) What is a Hydrologic Cycle?
b) What is run-off?
c) What are isohyets?
d) What is meant by a flowing well?
e) What is an aquifer?
f) What is infiltration capacity?
g) Write the hydrologic equation when inflow is 'I', outflow is 'O' and 'Δs' is the change in storage.
h) What is a piezometer?
i) What is specific yield of an aquifer?
j) What is a 100-year flood?
k) List the parameters that describe a Gaussian Curve.
l) What is meant by an isotropic medium?
m) What does a 10% flood frequency mean?
n) What is meant by 'Yield of a well'?
o) Name the two structures of a Geographical Data Base.
p) If K_x, K_y and K_β are the hydraulic conductivities in horizontal, vertical and in a direction making an angle β with the horizontal, write the relation among the hydraulic conductivities.

PART B

Q. 2 Answer all the questions **(7x2=14)**

a)

(i) What is φ-index? **(2)**

(ii) A catchment of area of 0.25 km^2 is subjected to a storm with the following profile: **(5)**

Time (hr)	1	2	3	4	5	6
Rain (mm)	7	18	25	12	10	3

If the volume of storm run-off is 8250 m^3, estimate the φ-index (Neglect the effect of Evapotranspiration)?

b)

(i) On an average, how many times a 10-year floods occur in a 40-year period? What is the probability that exactly this number of 10-year flood will occur in a 40-year period? **(3.5)**

(ii) In a recuperation test, on a well 3m in diameter with normal water level 4 m below ground level, the pumping depresses water level to 12 m below ground level. Three hours after pumping is stopped, water level rises to 6 m. Determine: **(3.5)**

(a) Specific yield of the well
(b) Yield under a head of 3 m

PART C

Q.3. Answer [(a) & (b)] or (c)

(a) What is the terminal velocity for a light rain with a drop size of 0.6 mm at sea level (C_d = 1.07, ρ_a = 1.2 kg/m^3, ρ_w = 1000 kg/m^3)? If the air density drops by 50% at 5 km in the sky, will the same rain drop falls faster or slower? Calculate its velocity at this height (assume little change with 'g', ρ_w and C_d). Calculate the travel time for the raindrop to hit the ground from 5 km height (Use the average of two velocities and assume no updraft or downdraft with the air). **(5)**

(b) Over a 2-month period of time, a catchment is expected to receive 254 mm of rain with an expected evapotranspiration estimated at 85 mm and that lost to groundwater storage of 20 mm. There is no other significant storage in the watershed. What is the expected rainfall excess to a reservoir storage area if the catchment area is 65 km^2? How many people can be serviced if water use rate is 160 LPCD? **(5)**

OR

(c) The mass curve of rainfall in a storm of total duration 270 minutes is given below:

t	0	30	60	90	120	150	180	210	240	270
i	0	6	18	21	36	43	49	52	53	54

Note: t = Times since Start in Minutes; i = Cumulative rainfall in mm **(10)**

(i) Draw the hyetograph of the storm at 30 minutes time step.

(ii) Plot the maximum intensity-duration curve for this storm.

(iii) Plot the maximum depth-duration curve for the storm.

Q.4. The initial infiltration capacity f_0 of a catchment is estimated as 4.5 mm/hr, the time constant as 0.35/hr, and the capacity f_c as 0.4 mm/hr. Use Horton's equation to find i) the value of f_t at t = 10 min, 30 min, 1 hr, 2 hr, and 6 hr; ii) the total volume of infiltration over the 6-hr period. Assume continuously ponded condition. **(10)**

OR

Compute the ponding time and the depth of water infiltrated at ponding for a silt loam soil of 30% initial effective saturation, subject to rainfall intensities of (a) 1 cm/hr and (b) 5 cm/hr. Given Effective porosity (θ_e) = 0.486; Wetting front suction head (ψ) = 16.7 cm; and hydraulic conductivity (K) = 0.65 cm/hr. **(10)**

Q.5. The ordinates of a 4-hour Unit Hydrograph for a particular basin with an area of 630 km^2 are given below: **(10)**

Time	**Discharge**	**Time**	**Discharge**
0	0	14	70
2	25	16	30
4	100	18	20
6	160	20	6
8	190	22	1.5
10	170	24	0
12	110		

Derive the following:

(i) Ordinates of the S-Curve hydrograph (ii) The 2-hour UH

Further, plot the above graphs and determine the equilibrium discharge (Q_e) and the time at which it is attained.

OR

Describe the Unit Hydrograph Theory. What are the major assumptions and limitations involved in it? **(10)**

Q.6. Show that horizontal hydraulic conductivity in alluvium is normally greater than that in the vertical direction. What are the factors that govern the anisotropic conditions in consolidated geologic materials? **(10)**

OR

An aquifer of aerial extent of 100 km^2 is overlain by four strata as given below: **(10)**

Strata	Thickness (m)	K_x (m/day)	K_y (m/day)
1	1	1	0.25
2	3	2	0.30
3	2	1.5	0.20
4	4	0.025	0.005

(i) If a 4-hr storm occurs producing a total rainfall 100 mm, estimate the recharge into the aquifer, assuming that the piezometric surface in the aquifer is at the bottom of layer 4 and that all layers are saturated.

(ii) If the four layers are underlain by an impermeable strata instead of the aquifer, estimate the lateral flow per unit width through the layers, assuming that the layer dip by 1%.