

**M.E. (Water Resources & Hydraulic Engg.) Examination, 2019**(First Year-2<sup>nd</sup> Semester)**WATER RESOURCES MANAGEMENT**

(Paper - X)

Time: Three Hours

Full Marks: 100

Answer any *four* questions

1. (a) What is the relation between sinking fund factor and capital recovery factor?  
 (b) Two mutually exclusive alternative water supply projects are given below:-

	Project A (Rs.)	Project B (Rs.)
Construction Cost	25,00,000 1 <sup>st</sup> stay 30,00,000 2 <sup>nd</sup> stay	14,00,000 1 <sup>st</sup> stay 25,00,000 2 <sup>nd</sup> stay 27,00,000 3 <sup>rd</sup> stay
Operation & Maintenance Cost	1,30,000/yr for 1 <sup>st</sup> 20 yrs 2,20,000/yr for 2 <sup>nd</sup> 20 yrs	70,000/yr for 1 <sup>st</sup> 10 yrs 1,10,000/yr for 2 <sup>nd</sup> 15 yrs 1,90,000/yr for 3 <sup>rd</sup> 15 yrs
Economic Life	40 years	50 years
Period of Analysis	30 years	30 years
Annual Benefits	30,00,000	34,00,000
Discount Rate	5%	5%

Which is the most economic project?

- (c) Intermittent flooding has occurred along a reach of river that has a capacity of 14 cumec. Study shows that the annual average cost of increasing the capacity by lining and strengthening could be approximated by  $C = 100Q - (400 + 4Q^2)$  where C is in thousands of Rs. and Q is the increased capacity in thousands of m<sup>3</sup>/s. The average annual benefits in thousand of Rs. would be  $B = -1050 + 230Q - 0.8Q^3$ . These expressions apply in the range from 12 to 28 cumec. What is the optimum capacity? Making reasonable assumptions, estimate the first cost of this project. State all assumptions clearly.

3+13+9=25

2. (a) Determine the average discharge that can be expected throughout the year. Draw the residual mass curve and obtain an expression for the range as developed by Hurst on the basis of the monthly flow data. The mean monthly flow data for a reservoir site are given below:

Month	Mean monthly flow (cumec)
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January	9
February	6
March	3
April	5
May	10
June	4
July	30
August	32
September	33
October	31
November	35
December	18

(b) State the difference between flow and residual mass curves with diagrams? Explain briefly selection of reservoir capacity of a storage reservoir.

17+8 = 25

3. (a) What is the process of erosion? Classify erosions and describe them in brief. What are the factors affecting erosion?

(b) State two empirical equations for the soil loss due to sheet and rill erosion developed by Musgrave and Agricultural Research Service of the United States Department of Agriculture and also to compare bed-material transport rate per unit channel width to predict the with bed load using Duboys formula.

(b) A reservoir has a capacity of  $10 \text{ Mm}^3$  and a drainage area of  $250 \text{ km}^2$ . The average annual runoff is  $400 \text{ mm}$  and the sediment yield is  $9810 \text{ kN per km}^2$ . The sediment has an average in place specific weight of  $1200 \text{ kN/m}^3$ . Calculate the time it will take for the reservoir to fill up with sediments. The trap efficiency  $Y$  may be approximated by

$$Y = 100 \left( 1 - \frac{1}{100X + 1} \right)^{1.5}$$

Where  $X$  is the capacity-inflow ratio.

8+7+10=25

4. (a) Differentiate between uncertainty and risk. What are the different types of uncertainties in Water Resources Engineering Projects? What is hydrologic and hydraulic uncertainty? Classify different uncertainty in brief with example.

(b) Determine the mean in cumec, coefficient of variation and standard deviation in cumec of the runoff using the rational equation with following parameter values.

Parameter	Mean	Coefficient of variation
C	0.8	0.09
I	100 mm/hr	0.5
A	2 ha	0.005

$Q = KCIA$ , Where  $K = 0.0028$  for SI units and  $Q$  is in  $\text{m}^3/\text{s}$

(c) The flow rate  $Q$  for a trapezoidal open channel can be expressed as  $Q = v (b+my) y$  where,  $v$ =Average velocity,  $b$ =bottom width,  $m$ =side slope,  $y$ =depth of flow.

The variables  $v$ ,  $b$ ,  $m$ ,  $y$  are subjected to measurement of errors. The mean and co-efficient of variation are as follows,

Parameter	Mean	Co-efficient of variation
$v$	0.9 m/sec	0.1
$b$	10 m	0.3
$m$	2	0.2
$y$	2.4 m	0.3

Use first-order uncertainty analysis, to estimate the mean and standard deviation of  $Q$  in cumec.

$$7+8+10=25$$

5. (a) Define drought. Classify different types of drought with scales.

b) Inflows during 3 seasons to a reservoir with storage capacity of 8 units are respectively 4, 2 and 6. Only discrete values 0, 2, 4, 6, ... are considered for storage and release. Outflows from reservoir are also included in the release. Reservoir storage at the beginning of the year is 0 unit. Release from the reservoir in a season in the following benefits which are same for all four seasons.

Release	Benefits
0	50
2	200
4	270
6	430
8	470
10	470
12	360
14	70

Obtain optimum release of sequence and net benefit  $5+20=25$

6. (a) What is Rooftop Rainwater Harvesting (RTRWH)? State some needs for RTRWH with advantages.

(b) There are three types of roof in the office building namely administrative building roof, car park with RCC roof and cycle stand with asbestos roof having individual areas  $250 \text{ m}^2$ ,  $160 \text{ m}^2$  and  $80 \text{ m}^2$  respectively. The average rainfall is considered as 1650 mm. Assume rate of filtration =  $2520 \text{ Lt/hr/m}^2$ ; average recharging depth = 60 m; Length and diameter of strainer = 30 m and 200 mm. Design RTRWH and recharging with sketches.

$$(7+18)=25$$

7. (a) What are the components of a hydrological drought? Discuss different methods for identification of hydrological drought events.

(b) A farmer has two types of alternate field model M1 and M2. M1 requires 6 hours of ploughing by tractor and 3 hours of irrigating the field by a pump, whereas each M2 model requires 4 hours of ploughing and 10 hours of irrigation. The farmer has 4 tractors and 6 pumps.

Each tractor works for 80 hours a week and each pump works for 120 hours a week. Profit on M1 model is Rs. 6 and M2 model is Rs. 8. Whatever produced in a week is to be sold in the market. How should the farmer allocate his production capacity on the two types of models so that he may make the maximum profit in a week by using Graphical Method?

$$10+15=25$$