(b) A river has total available resources of 900 units. The river basin has one reservoir and two more are contemplated. A minimum of 200 units are allocated to existing reservoir. Determine optimal allocation to the three reservoirs with following net benefits (in Million Rs) for different levels of supply from different reservoirs. (3)

| Supply (units) | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 |
|---|---|---|---|---|---|---|---|---|---|
| **Net benefits for** | | | | | | | | | |
| Reservoir 1 | 150 | 350 | 500 | 620 | 800 | 850 | 870 | 890 | 900 |
| Reservoir 2 | 200 | 400 | 550 | 750 | 890 | 1000 | 1050 | 1090 | |
| Reservoir 3 | 230 | 480 | 600 | 720 | 830 | 940 | 1000 | | |

8(a) What is a Standard operating policy (SOP) of reservoir operation? Fill the missing data in the following table operation by SOP of a reservoir having 350 units capacity. Here $S_t$, $Q_t$, $D_t$, $E_t$, $R_t$, , $Q_t$ denote the storage, inflow, demand, evaporation, release and spill respectively during time period t and $S_{t+1}$ is the storage in the subsequent time period t+1 (3)

| t | $S_t$ | $Q_t$ | $D_t$ | $E_t$ | $R_t$ | $S_t$ | $Q_t$ |
|---|---|---|---|---|---|---|---|
| 1 | 201.00 | 70.61 | 51.68 | 10 | --- | --- | 0.00 |
| 2 | 208.93 | 348.40 | 127.85 | 8 | 127.85 | --- | --- |
| 3 | 350.00 | 42.29 | 203.99 | 8 | --- | --- | 0.00 |
| 4 | 180.30 | 23.78 | 203.99 | 6 | --- | --- | 0.00 |
| 5 | 0.00 | 15.00 | 0.00 | 6 | --- | 9.00 | 0.00 |

(b) How do you get the solution of a shortest root problem? Explain with the help of a suitable example. (3)

**END**

*Total No. of Pages 4* *Roll No. .....*

**SEVENTH SEMESTER** **B. Tech. CIVIL (EVENING)**

**SUPEMENTARY EXAMINATION** ***FEB-2019***

**CCE- 409 WATER RESURCES MANAGEMENT**

*Time: 3:00 Hours* *Max. Marks : 40*

**Note : Question One is compulsory. Attempt Two questions from Part A and Three from Part B. Assume suitable missing data, if any.**

1 Answer eight parts of the question

[a] Write a brief note on application of optimization and simulation techniques for water resources systems analysis

[b] Write a brief note on probable physical, economical and environmental effects to be kept in mind while planning for water resources project.

[c] Explain the terms: curse of dimensionality, planning horizon and analysis of different un-certainties in water resources.

[d] Write brief note on ANN application in water resources systems.

[e] Enlist various factors which affect erosion by water. Explain various forms of soil erosion in a catchment due to runoff.

[f] Write a brief note on land capability based on land slope.

[g] Compare various structural methods of soil management.

[h] Describe the factors influencing rainwater harvesting.

[i] Derive Muskinghum equation used for the development of IUH.

[j] State the method of flow routing used as short term method of forecasting for the Yamuna water level in Delhi.

[k] What do you mean by PMF? How do you obtain it? (1.5*8)

**PART- A**

2(a) A drainage basin has 160 $km^2$ area, 7 hours time of concentration and 10 hours as storage constant with the following information about inter-isochrone area distribution, determine 1 hour unit hydrograph upto its peak value. (2.5)

| Time (h) | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 |
|---|---|---|---|---|---|---|---|
| Inter isochrones Area ($km^2$) | 10 | 22 | 36 | 43 | 35 | 10 | 4 |

1 2 2 8 1

(b) Design a 140 m long bench terrace for a land having an average slope of 18%. The soil is clay loam. The terrace channel has uniform grade 0.5%. Maximum intensity rainfall expected during the 10 years recurrence interval 10 cm//hr. The values of K, x, a and n may be taken as 6.0, 0.22, 0.5 and 0.8 respectively. (2.5)

3(a) During a flood the water surface at a section in a river was found to increase at a rate of 10.5 cm/h. The slope of the river is 1/3300 and the normal discharge for the river stage read from a steady rating curve was $150 m^3/s$. If the velocity of flood wave can be assumed as 2.5 m/s, determine the actual discharge. (2.5)

(b) An unregulated stream provides the following volumes through each successive 4-day period over 40 day duration at a possible reservoir site. What should be reservoir capacity needed to ensure maintaining 75% of the average flow over these 40 days, if the reservoir is full to start with? (2.5)

| Day | 00 | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Runoff volume($Mm^3$) | 00 | 10 | 6 | 3 | 4 | 3 | 2 | 1.6 | 6 | 16 | 11 |

4(a) A rectangular parking lot is 140 m x 280 m long. The time of overland flow across the pavement to the longitudinal gutter along the centre is 18 minutes and the estimated total time of concentration to the down stream end of the gutter is 24 minutes. The runoff coefficient is 0.9. If rainfall of intensity 6 cm /hr falls on the lot for 3 minute and stops abruptly, determine the hydrograph upto its peak magnitude. (2.5)

(b) A factory is proposed to be located on the edge of the 200 year flood plain of a river. If the design life of the factory is 30 years, what is the reliabillity that it will not be flooded during its design life? (2.5)

**PART- B**

5(a) Minimize $Z= 3x_1+4x_2$

Subject to

$x_1+3x_2 \geq 15$

$3x_1+5x_2 \leq 72$

$2x_1+x_2 = 24$

$x_1, x_2 \geq 0$ (3)

(b) A sequence of inflows (in thousand cumec) for 30 time periods is given below. Prepare a 3x3 inflow transition probability matrix by calculating transition probabilities by discretising the inflows into three intervals 0-2,2-4,4-6 (3)

| T | $Q_t$ | T | $Q_t$ | T | $Q_t$ |
|---|---|---|---|---|---|
| 1 | 2.4 | 11 | 4.8 | 21 | 2.6 |
| 2 | 2.3 | 12 | 4.1 | 22 | 1.3 |
| 3 | 1.5 | 13 | 5.5 | 23 | 2.4 |
| 4 | 1.1 | 14 | 5.9 | 24 | 1.6 |
| 5 | 2.1 | 15 | 3.2 | 25 | 3.4 |
| 6 | 2.4 | 16 | 4.3 | 26 | 2.6 |
| 7 | 4.2 | 17 | 5.3 | 27 | 3.5 |
| 8 | 4.6 | 18 | 3.2 | 28 | 2.6 |
| 9 | 5.1 | 19 | 1.2 | 29 | 1.4 |
| 10 | 3.2 | 20 | 4.6 | 30 | 4.5 |

6 (a) Using the benefit cost analysis, determine the optimal scale of development for the following alternatives for a small water resources project. Cost and benefits for different alternatives are given in million Rs. (3)

| Alternative | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Cost | 7 | 16 | 35 | 69 | 95 | 127 | 154 | 184 |
| Benefits | 7 | 21 | 48 | 94 | 140 | 180 | 197 | 207 |

(b) Annual peak flows at a location are known to be exponentially distributed with a mean of 1100 $Mm^3$. Find the peak flow which has an exceedance probability of 0.75. (3)

7(a) An irrigation project is to be developed. There is 1800 ha-m of water available annually. Two high value speciality crops, A and B are considered for which water consumption requirements are 1 ha-m per ha and 0.85 ha-m per ha respectively. It has also been determined that the planting of more than 400 ha of crop A and 600 ha of crop B would cause an adverse effect on the market for these special crops. It has been estimated that each ha devoted to crop A will result Rs 3 lacs profit, while one ha of crop B will net Rs 5 lacs. Solve the problem for optimality. (3)