International Institute of Information Technology Hyderabad
Hydro Informatics – spring 2024

Date: 30/01/2024 **Quiz-1 Examination** **Total Marks: 50**

Fill the following blanks: Each one carries 2 marks **(10 x 2 = 20 Marks)**

1) Spatial interpolation is the .....
2) The amount of precipitation expressed as the depth in ...cm/in..... which falls on a level surface, and is measured by ..rain guage....
3) Watershed is defined as .....
4) Through fall is a ..vegetation se jo bota hai.....
5) Efficiency of representation of any earth surface by a raster depends on the ..size of the cell.
6) Global hydrological cycle is defined as .....
7) .shp represents for ...shape file..... and .prj represents for ..... in the vector file formats.
8) A vector point data becomes .....in raster data representation
9) Resolution of raster data represents.....
10) Hydroinformatics is ..branch of inf.. where we use info & com tech to address issues related to water.

Answer the following questions:

1) (a) A catchment with an area of 1500 m^2 received 1.250 m of precipitation. Calculate the total rainfall occurred in the year (in m^3) **(3 Marks)**

(b) The velocity of water in a river flow is 15 m/s and the area of the river 20 m^2 at a specific segment. Find the discharge or flow rate of the river at that segment. **(3 Marks)**

2) **One of four monthly-read rain gauges on a catchment area develops a fault in a month when the other three gauges record 48, 58 and 69 mm respectively. If the average annual precipitation amounts of these three gauges are 741, 769 and 855 mm respectively and of the broken gauge 707 mm, estimate the missing monthly precipitation at the latter.** **(8 marks)**

3) **Discuss about the overlaying of different data layers and data representation in GIS and also differentiate between the raster and vector data using a table.** **(8 marks)**

4) **What do you understand about the global and regional water resource systems, discuss about them using diagrams. How can you adopt or utilise the GIS in any water resource system for problem solving, explain the procedure in detail.** **(8 marks)**

R V
Surface storage.

climate
↓
↓
quantity
& quality

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MID Examination

Date: 29/02/2024 **Total Marks: 60**

Instructions:

- A calculator is allowed in the examination.

Answer the following questions:

1) Explain the scaling of a water resources system using GIS (using vector and raster data). What are the challenges (advantages and disadvantages) in formulating a water resources system using vector and raster data? **(10 Marks)**

2) How you define the trend of a hydroclimatic data? Explain the procedure of Mann-Kendall trend test and how you perform significance test of trend of a hydroclimatic data. **(10 Marks)**

3) Explain various dependency measures of Pearson. Spearman's. and Kendall's coefficients **(10 Marks)**

4) The rainfall duration (X) and depth of rainfall (Y) are following the individual Cumulative Distribution Functions (CDF) as follows: **(10 Marks)**

$F_x(x) = 1 - e^{-x} \quad x \geq 0$

$F_Y(y) = 1 - e^{-2y} \quad y \geq 0$

The joint CDF of X and Y is following the bivariate distribution:

$F_{x,y}(x,y) = 1 - e^{-x} - e^{-2y} + e^{-x-2y-xy} \qquad x, y \geq 0$

Find the joint Probability Distribution Function (PDF) of both rainfall duration (X) and depth (Y).

5) Explain drought and various forms of droughts **(5 Marks)**

6) Explain the formulation of Standardised Precipitation Index (SPI) and how to characterize the drought frequency, intensity, areal extent, and duration of drought using SPI of any region **(10 Marks)**

7) Water is flowing through a pipe with a velocity of 30 m/s. Area of pipe = 10 m^2. What is the volume/discharge (in m^3/s) of water flowing through pipe in a given time? **(2 Marks)**

8) A catchment with an area of 1750 X 10^6 m^2 received 1.25 m of precipitation. Calculate the total rainfall occurred over the region in the year (in m^3) **(2 Marks)**

9) What is Hydroinformatics? **(1 Mark)**

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END-Examination

Date: 01/05/2024 **Total Marks: 100**

Instructions:

- Calculator is allowed in the examination
- Write the correct option in the answer script for the MCQs

I) Answer the multiple-choice questions (MCQs).

1) The mass curve of a storm shows the total rainfall accumulated over time. What does the slope of the mass curve represent? **[1 mark]**
   A) The total duration of the storm
   B) The average rainfall intensity throughout the storm
   C) The intensity of rainfall at various time intervals
   D) The time of peak rainfall during the storm

2) What does GIS stand for? **[1 mark]**
   A) Geographic Information System B) Geographical Investigation Service
   C) Global Information System D) Geolocation Information Service

3) Meteorological drought is characterised by: **[1 mark]**
   A) A long-term deficiency in precipitation compared to an average
   B) A shortage of surface water in streams, lakes, and reservoirs
   C) Periods of insufficient soil moisture to meet the needs of crops
   D) The social and economic impacts of water shortages

4) If the water is flowing through a pipe with a velocity of 30 m/s and the area of the pipe is 10 m^2, what is the volume of water flowing through the pipe in a given second? **[1 mark]**
   A) 10 m^3/s B) 20 m^3/s C) 300 m^3/s D) 400 m^3/s

5) Which process in the hydrologic cycle is responsible for water moving from the surface of the Earth into the atmosphere? **[1 mark]**
   A) Condensation B) Precipitation C) Evaporation D) Infiltration

6) Which of the following statements is TRUE about the Mann-Kendall Trend Test? **[1 mark]**
   A) It is a parametric test that assumes a normal distribution of the data.
   B) It is a non-parametric test suitable for detecting monotonic trends (increasing or decreasing) over time.
   C) It is used to measure the strength of the linear relationship between two variables.
   D) It requires a minimum sample size of 100 data points to be reliable.

7) The null hypothesis (H_0) in a significance test represents: **[1 mark]**
   A) The observation you are trying to prove.
   B) The assumption that there is no effect or relationship between variables.
   C) The opposite of the alternative hypothesis.
   D) A specific value you expect for a test statistic.

8) What is the method to determine the magnitude of the trend for the precipitation? **[1 mark]**
   A) Mann-Kendall method B) Pettitt-Test method C) Sen's slope test D) Linear trend method

9) Following is the spatial interpolation method **[1 mark]**
   A) Mann-Kendall method B) Pettitt-Test method C) Kendall's Tau D) Inverse Distance Weight Method

10) Unit of intensity of rainfall **[1 mark]**
    A) mm B) cm C) mm/h D) m^3/s

$I = \frac{P}{t} = \frac{mm}{s}$

II) Answer the following long answer questions

1. What is precipitation? How to measure rainfall? Explain briefly about various forms of graphical representations of rainfall data and rainfall intensity. **[5 marks]**
2. Differentiate between a vector and raster data in terms of mapping of a water body, river stretch, river basin/catchment/watershed, natural, forested and constructed lands. **[10 marks]**
3. A time series of any hydrological data (e.g. rainfall) is available for about 30 years. Explain the procedure to test the trend, magnitude of the trend and change point of the trend of any hydrological data. **[10 marks]**
4. Raster-1 contains slope values for a specific area, while Raster-2 represents Flood Hazard Risk with binary values indicating flooded (1) and non-flooded (0) pixels. (a) Create a binary raster indicating slope variability, specifically identifying cells with slope values exceeding 25 as susceptible to landslides. (b) Create the 'Total Hazard Risk' raster for this area by integrating the Flood Hazard raster and the landslide susceptibility raster derived from the preceding step. (Q4b- Hint: Use binary raster files). **[5 marks]**

16	28	40	36
29	33	43	34
30	21	38	45
28	12	32	51

Raster-1

1	1	1	0
1	1	1	0
0	0	0	

Raster-2

5. How to handle missing data of any hydrological data (e.g. rainfall) using spatial interpolation methods. Explain any two such approaches. **[8 marks]**
6. What is the use of dependence measures in hydrological studies? Explain Kendall's rank correlation coefficient and how to test its significance using hypothesis testing. **[10 marks]**
7. A mountainous region experiences rainfall patterns characterised by two variables, namely Duration (X) and Total Rainfall (Y): find the joint pdf value where rainfall = 10 mm and duration = 1 hr. $F_X(x) = 1 - e^{x}\ (x \geq 0)$; $F_Y(y) = 1 - e^{2y}\ (y \geq 0)$; The joint CDF of X and Y is following the bivariate distribution: $F_{X,Y}(x, y) = 1 - e^{x} - e^{2y} + e^{x+2y+x}$ $(x, y \geq 0)$ **[6 marks]**
8. How to study the central tendency and dispersion of any given hydrological data? **[4 marks]**
9. Define the following terms: (a) Hydrograph, (b) Hyetograph, (c) Mass curve, (d) Rating curve (e) Infiltration curve **[5 marks]**
10. How to characterise the drought using rainfall data for any given region? **[6 marks]**
11. Explain the hydrological cycle and various components. **[5 marks]**
12. How do you measure stream flows, evaporation and infiltration? **[6 marks]**
13. A storm lasting 3 hours begins at 6:30 AM and concludes at 9:30 AM. The rainfall readings in mm at 15-minute intervals are recorded by the rain gauge. The recorded rainfall values are given in the table below. Construct the hyetograph of this storm for a uniform interval of 15 minutes. **[10 marks]**

Time	6:30	6:45	7:00	7:15	7:30	7:45	8:00	8:15	8:30	8:45	9:00	9:15	9:30
Rainfall (mm)	0.0	12.4	14	13.2	15	12.3	11.3	10.3	9.5	9.9	12.3	11.4	13.4