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UNIVERSITY OF SWAZILAND

DEPARTMENT OF GEORAPHY, ENVIRONMENTAL SCIENCE AND PLANNING

MAIN EXAMINATION: DECEMBER, 2015

B.Sc. II

TITLE OF PAPER	:	WATER RESOURCES

COURSE NUMBER	:	GEP 228

TIME ALLOWED	:	THREE (3) HOURS

INSTRUCTIONS	:	ANSWER 2 QUESTIONS FROM EACH SECTION
		ILLUSTRATE YOUR ANSWERS WITH APPROPRIATE DIAGRAMS

MARKS ALLOCATED	:	ALL QUESTIONS CARRY EQUAL MARKS

GEP 228:   WATER RESOURCES   **(Main, December, 2015)**

SECTION A: ANSWER ANY TWO QUESTIONS

QUESTION 1

Use the flow chart in Figure 1 as well as Figures 2 to 3 to determine the climates of the following places using the information that is provided.   (25 marks)

1. Manzini (Swaziland)

	J	F	M	A	M	J	J	A	S	O	N	D	
T (°C)	24	23	22	20	18	15	16	17	19	20	21	23	
P(mm)	135	118	10	74	24	20	10	22	65	100	142	115	835

2. Bata (Equatorial Guinea)

	J	F	M	A	M	J	J	A	S	O	N	D	
T (°C)	27	27	27	27	26	24	25	25	26	26	26	27	
P(mm)	24	23	33	34	24	13	3	18	10	34	47	24	287

3. New York (U.S.A)

	J	F	M	A	M	J	J	A	S	O	N	D	
T(°C)	-1	-9	-2	8	15	20	22	21	16	9	-1	-7	
P(mm)	2	23	36	53	89	104	81	81	81	56	33	25	685

FLOW CHART FOR KÖPPEN'S CLIMATE CLASSIFICATION

FIGURE 1

Figure 1: First, divide the year into two six-month seasons: April-September and October-March, representing Summer or Winter in their respective hemispheres.
If 70% or more of the annual precipitation total falls into one of these two seasons, then that season is considered to have a precipitation concentration.
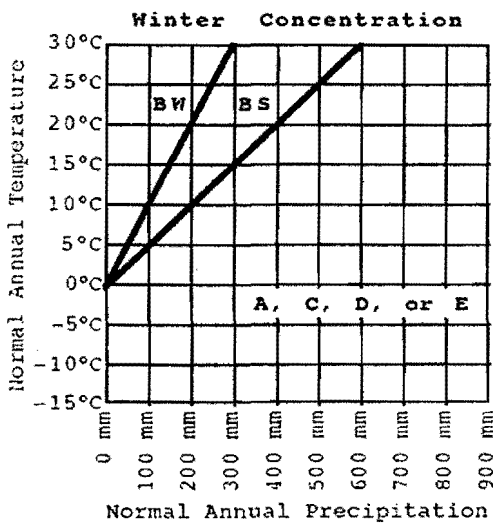If not, then precipitation is considered to fall evenly throughout the year.

Even Distribution

BW   BS

A, C, D, or E

Normal Annual Temperature
Normal Annual Precipitation

Summer Concentration

B W   B S

A, C, D, or E

Normal Annual Temperature
Normal Annual Precipitation

Winter Concentration

B W   B S

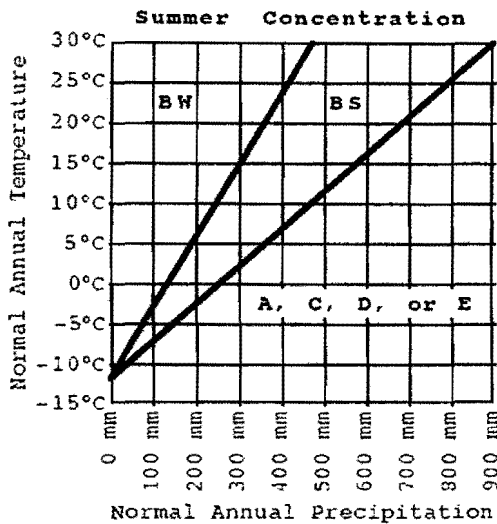A, C, D, or E

Normal Annual Temperature
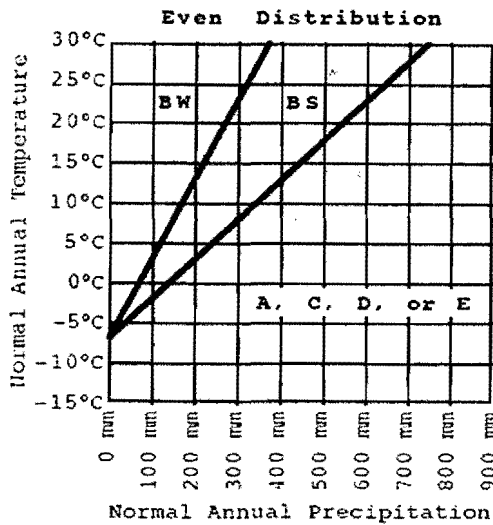Normal Annual Precipitation
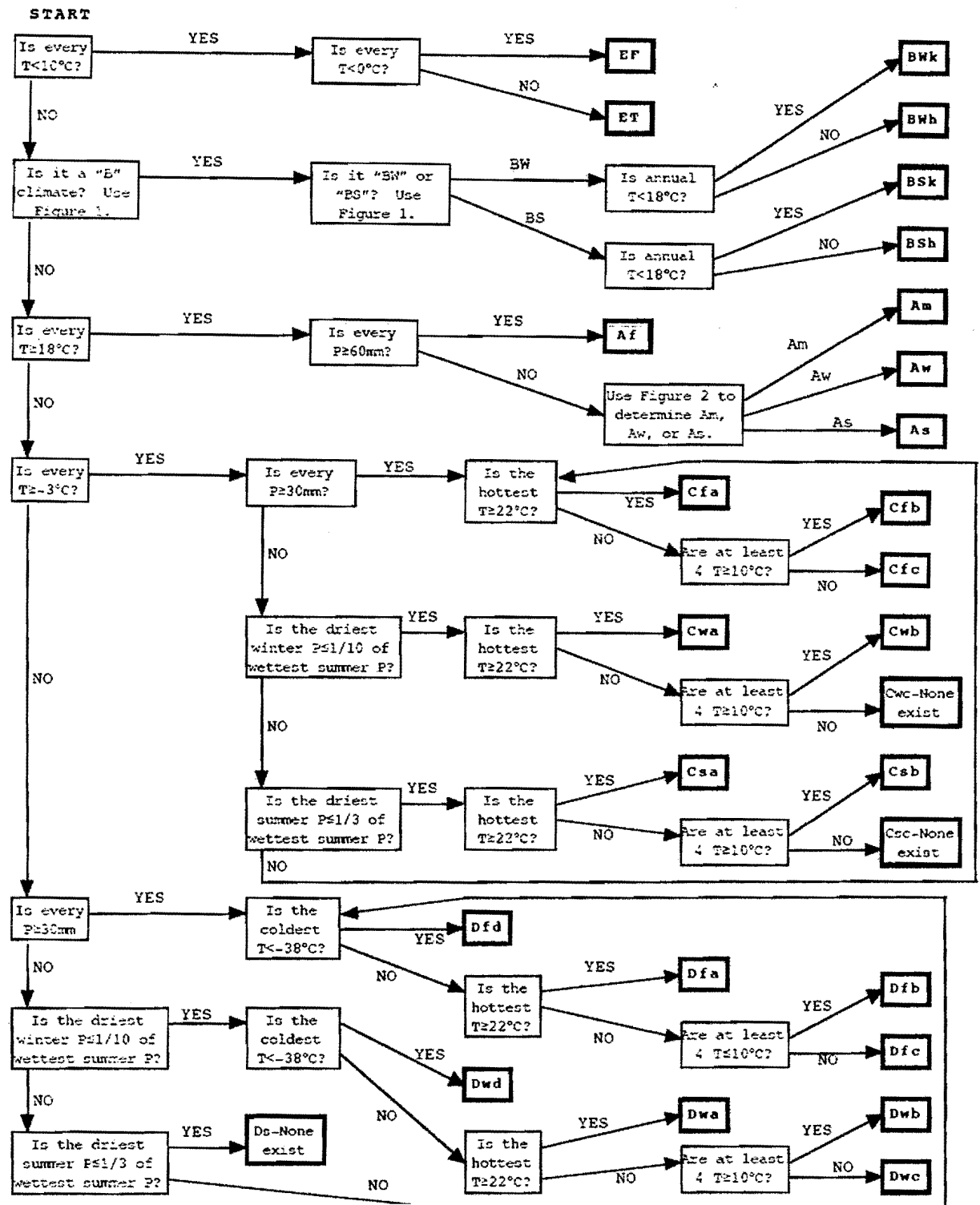
FIGURE 2

Figure 2: First, divide the year into two six-month seasons: April-September and October-March, representing Summer or Winter in their respective hemispheres.
If 70% or more of the annual precipitation total falls into one of these two seasons, then that season is considered to have a precipitation concentration.
If not, then precipitation is

Am

Af

Aw, As

Annual Precipitation
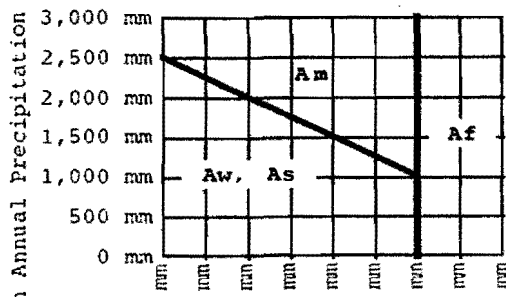
FLOW CHART FOR KÖPPEN'S CLIMATE CLASSIFICATION

T and P refer to normal monthly values of Temperature and Precipitation

START

Is every T<10°C? — YES → Is every T<0°C? — YES → **EF**

Is every T<0°C? — NO → **ET**

Is every T<10°C? — NO → Is it a "B" climate? Use Figure 1.

Is it a "B" climate? Use Figure 1. — YES → Is it "BW" or "BS"? Use Figure 1.

Is it "BW" or "BS"? Use Figure 1. — BW → Is annual T<18°C? — YES → **BWk** ; NO → **BWh**

Is it "BW" or "BS"? Use Figure 1. — BS → Is annual T<18°C? — YES → **BSk** ; NO → **BSh**

Is it a "B" climate? Use Figure 1. — NO → Is every T≥18°C?

Is every T≥18°C? — YES → Is every P≥60mm? — YES → **Af**

Is every P≥60mm? — NO → Use Figure 2 to determine Am, Aw, or As. — Am → **Am** ; Aw → **Aw** ; As → **As**

Is every T≥18°C? — NO → Is every T≥-3°C?

Is every T≥-3°C? — YES → Is every P≥30mm? — YES → Is the hottest T≥22°C?

Is the hottest T≥22°C? — YES → **Cfa**

Is the hottest T≥22°C? — NO → Are at least 4 T≥10°C? — YES → **Cfb** ; NO → **Cfc**

Is every P≥30mm? — NO → Is the driest winter P≤1/10 of wettest summer P? — YES → Is the hottest T≥22°C?

Is the hottest T≥22°C? — YES → **Cwa**

Is the hottest T≥22°C? — NO → Are at least 4 T≥10°C? — YES → **Cwb** ; NO → **Cwc-None exist**

Is the driest winter P≤1/10 of wettest summer P? — NO → Is the driest summer P≤1/3 of wettest summer P? — YES → Is the hottest T≥22°C?

Is the hottest T≥22°C? — YES → **Csa**

Is the hottest T≥22°C? — NO → Are at least 4 T≥10°C? — YES → **Csb** ; NO → **Csc-None exist**

Is every T≥-3°C? — NO → Is every P≥30mm?

Is every P≥30mm? — YES → Is the coldest T<-38°C? — YES → **Dfd**

Is the coldest T<-38°C? — NO → Is the hottest T≥22°C? — YES → **Dfa**

Is the hottest T≥22°C? — NO → Are at least 4 T≥10°C? — YES → **Dfb** ; NO → **Dfc**

Is every P≥30mm? — NO → Is the driest winter P≤1/10 of wettest summer P? — YES → Is the coldest T<-38°C? — YES → **Dwd**

Is the coldest T<-38°C? — NO → Is the hottest T≥22°C? — YES → **Dwa**

Is the hottest T≥22°C? — NO → Are at least 4 T≥10°C? — YES → **Dwb** ; NO → **Dwc**

Is the driest winter P≤1/10 of wettest summer P? — NO → Is the driest summer P≤1/3 of wettest summer P? — YES → **Ds-None exist**

QUESTION 2

(a) Explain why an air mass that is forced up a mountain range cools down. (5 marks)

(b) An air mass at an elevation of 2550m has a temperature of about 9.5°C. What will be the temperature of this air mass at an elevation of 13750m if it is cooling at the dry adiabatic rate? (15 marks)

(c) 'The inter-tropical convergence zone is not stationary'. Discuss the validity of this statement. (5 marks)

(25 Marks)

QUESTION 3

(a) Explain one theory of precipitation formation. (15 marks)

(b) Explain why maximum precipitation occurs below mountain summits in the tropics while in temperate regions it occurs at mountain summits. (10 marks)

(25 Marks)

SECTION B: ANSWER ANY TWO QUESTIONS

QUESTION 4

(a) Explain why water is regarded as a renewable resource. (10 marks)

(b) Discuss the role of hydrology in social economic development. (15, marks)

(25 Marks)

QUESTION 5

(a) Explain the importance of measuring and/or estimating evaporation in water resources planning and management. (10 marks)

(b) Estimate the evaporation from a free water surface for the month of January using the

(25 marks)

QUESTION 6

(a) Define a unit hydrograph. (5 marks)

(b) Explain the assumptions of the unit hydrography theory. (10 marks)

(c) Table 1 below shows the total runoff hydrography and base flow ordinates from a rain storm that lasted for one day for the Mtilane River. The effective rainfall was estimated to be 2.9 mm. Derive the one day unit hydrograph. (10 marks)

(25 marks)

Table 1. Total runoff hydrograph and base flow ordinates for the Mtilane River at Lozihta bridge.

Time (in days)	Total RO Hyd. Ordinates (m^3/s)	Base flow ordinates (m^3/s)
1	0.48	0.48
2	1.06	0.35
3	2.05	0.28
3.5	3.2	0.23
4	2.05	0.28
5	1.5	0.4
6	1.05	0.55
7	0.84	0.6
7.5	0.65	0.65