BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

JUN 2024

DEPARTMENT OF ENGINEERING AND PHYSICS

PROGRAMME: BSc HONOURS AGRICULTURAL ENGINEERING PART II

AEH207: ENGINEERING HYDROLOGY

DURATION: 3 HOURS TOTAL MARKS: 100

INSTRUCTIONS TO CANDIDATES
Answer any FOUR (4) questions. Each question carries 25 marks.

Question 1

a) Briefly explain the impact of overexploitation of groundwater resources in human settlements. [10]

b) Describe any three (3) methods to estimate potential evapotranspiration [15]

Question 2

a) Explain the meaning of the following terms as applicable to engineering hydrology:

i. Infiltration capacity [2]

ii. Runoff flux [2]

iii. Unsaturated zone [2]

iv. Isohyet [2]

v. Saturated overland flow [2]

b) Distinguish between variable source areas concept and partial areas concept [5]

c) A local real estate company is planning to construct new residential houses on a plot 280ha situated close to Astra Campus. The site will consist of 70% single family units and 30% asphalt and concrete pavement. Preliminary investigations indicate a slope of 3.5% and a maximum flow path of 3000m. Hydrological data obtained by the Engineering hydrologist indicate a rainfall intensity of 75mm/hr. Estimate the peak runoff rate for a 20-yr storm at this new establishment. [10]

Question 3

a) Outline five (5) factors affecting evaporation in arable lands. [15]

b) Describe the effect of anthropogenic activities on the hydrologic cycle [10]

Question 4

a) A new housing estate consists of 30% road (asphalt), 20% roofs, 10% parking area (concrete) and the rest garden. What is the approximate runoff coefficient? (Show working) [5]

b) Suggest measures to reduce overexploitation of groundwater resources in Southern Africa. [8]

c) Explain the significance of the water balance [12]

Question 5

a) An Engineering hydrologist was contracted to design a hydraulic structure to contain recurrent flooding in Muzarabani. Hydrological data obtained indicated an average rainfall intensity of 175 mm/hr in a catchment with an area of 50 km^2. The runoff coefficient for a 3-hour storm event in the context of rational method is 0.90. Determine whether a hydraulic structure designed to withstand a flood with peak discharge of no greater than 1600 m^3/s would have failed during a recent flood event. [6]

b) Describe three (3) mechanisms of lifting air masses. [9]

c) Outline the procedure of measuring infiltration capacity. [10]

Question 6

a) A well is located in an aquifer with a conductivity of 14.9 m/day and a storativity of 0.0051. The aquifer is 20.1 m thick and is pumped at a rate of 2725 m^3/day. What is the drawdown at a distance of 7.0 m from the well after 1 day of pumping? [12]

b) State and describe three methods of discharge measurement in surface water resources [13]

Appendix

Values of the function W(u) for various values of u

u	$W(u)$	u	$W(u)$	u	$W(u)$	u	$W(u)$
1×10^{-10}	22.45	7×10^{-8}	15.90	4×10^{-5}	9.55	1×10^{-2}	4.04
2	21.76	8	15.76	5	9.33	2	3.35
3	21.35	9	15.65	6	9.14	3	2.96
4	21.06	1×10^{-7}	15.54	7	8.99	4	2.68
5	20.84	2	14.85	8	8.86	5	2.47
6	20.66	3	14.44	9	8.74	6	2.30
7	20.50	4	14.15	1×10^{-4}	8.63	7	2.15
8	20.37	5	13.93	2	7.94	8	2.03
9	20.25	6	13.75	3	7.53	9	1.92
1×10^{-9}	20.15	7	13.60	4	7.25	1×10^{-1}	1.823
2	19.45	8	13.46	5	7.02	2	1.223
3	19.05	9	13.34	6	6.84	3	0.906
4	18.76	1×10^{-6}	13.24	7	6.69	4	0.702
5	18.54	2	12.55	8	6.55	5	0.560
6	18.35	3	12.14	9	6.44	6	0.454
7	18.20	4	11.85	1×10^{-3}	6.33	7	0.374
8	18.07	5	11.63	2	5.64	8	0.311
9	17.95	6	11.45	3	5.23	9	0.260
1×10^{-8}	17.84	7	11.29	4	4.95	1×10^{0}	0.219
2	17.15	8	11.16	5	4.73	2	0.049
3	16.74	9	11.04	6	4.54	3	0.013
4	16.46	1×10^{-5}	10.94	7	4.39	4	0.004
5	16.23	2	10.24	8	4.26	5	0.001
6	16.05	3	9.84	9	4.14		

END OF QUESTION PAPER!!!