Indian Institute of Technology Kharagpur

RV

End Spring Semester Examination 2011

Date of Examination: ..... Time: 3 hrs Full Marks: 50 No. of Students: 37

Department: Agricultural and Food Engineering Department

Subject: Irrigation and Drainage Engineering (**No.** AG 31004)

Course: Third Year B. Tech (Hons.)

Instructions: All questions are compulsory. Assume reasonable data if not available in question. Question paper consists of 2 pages.

Q.1	In a saturated soil system, the two open ditch drains are spaced 25 m apart and extended up to impermeable layer. The depth of water in ditch drain (1) is 6 m and drain (2) is 5 m from impervious layer. Assume hydraulic conductivity of soil is 0.2 m per day. Determine through i) The discharge per unit width of saturated soil mass. ii) Total discharge for 400 m long land strip. iii) The head at a distance of 15 m.	3
Q.2	i) What is drainable porosity? ii) Explain briefly the procedure for determination of drainable porosity. iii) The bulk density of soil is 1.30 g/cc and soil moisture content at saturation (Zero capillary pressure by dry weight) is 40 %. When capillary pressure is increased to 50 cm the moisture content is reduced to 30 %. Assume density of water is 1. Determine the drainable porosity.	3
Q.3	Data collected from an experimental field are as follows : a) Present water content 18%, b) water content at field capacity 23%, c) permanent wilting percentage 9%, d) bulk density of surface soil 1300 kg/ m^3 .Calculate i) Total water content in the top 30 cm. ii) Depth to which 27.5 mm of irrigation water would wet this uniform soil, iii) The available water in the soil up to top 30 cm when soil is at field capacity.	3
Q.4	Name structures which are used for conveyance of irrigation water from higher level to lower level. Write components and their function of any one of these structures.	3
Q.5	Calculate the potential evapotranspiration (PET) using Thornthwaite method for a place at 42° North during April. Use the value of exponent a as 1.6 and **adjustment factor** as 1.12.	3

Month	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***
Temp ^{0} C	5	5.5	12	16	23	24
Month	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
Temp ^{0} C	21	19	18	16	12.5	11.5

Q.6	A deciduous orchard is to be irrigated when half of the available water in top 76 cm is used up, how often must the orchard be irrigated? The class A pan is evaporating 5.6 cm of water per week. The clay loam soil holds 5 cm of available water in top 30 cm and 4.32 cm in each additional 30 cm of subsoil. The pan coefficient is 0.65. The irrigation is given at 50 % of available soil moisture depletion.	3
Q.7	Compute the time required to irrigate a square field of 4 ha to depth of 5 cm with two movable laterals 200 m long, each fitted with 16 sprinklers at an interval of 13 m on each lateral. A sprinkler applies 1.25 cm of water per hour and the laterals are spaced at 20 m interval. Five hours are required to move the laterals each time. (P.T.O.) ***Continued in page 2***	3

	Continuation page 2	
Q.8	What are the major contributors to clogging of micro irrigation emission devices? Suggest suitable measures to control clogging of drippers.	4
Q.9	i) List the different steps to design a sprinkler irrigation system. ii) State general rules those are followed for making different layout of a sprinkler irrigation system	4
Q.10	i) List different methods to measure water flow in a) open channels and b) pipes. ii) Draw a neat diagram and show all the components of a parshall flume. iii) Using Bernoulli's principle show that discharge through an Orifice is given by $Q = Cc\ A(2gh)^{1/2}$ where A= area of Orifice, Cc = Coefficient, g= Acceleration due to gravity, and h= Head of water causing flow.	4
Q.11	Determine the runoff for 5 years recurrence interval of 48 hours maximum rainfall of 120 mm from a watershed with a 400 ha row crop contoured good grass land and 100 ha good pasture land. The hydrologic soil groups for these sub watersheds are C and B respectively. The corresponding curve numbers for these sub watersheds are 80 and 60 respectively under average AMC conditions. Determine i) Rainfall excess(Runoff)from the watershed ii) Design discharge of surface drainage system using data given above. The applicable equation for watershed for design discharge is $\mathbf{Q=0.013\ C\ A^{0.83}}$ where, Q= Discharge (m^3 / s), C=A constant that varies with drainage condition and A= Area of watershed (km^2). iii) Cross section of drainage channel to be laid on 0.1 % slope on silt loam soil. Manning coefficient (n) of channel bed is 0.04. Use side slope of channel as 1.5:1.	5
Q.12	At experimental farm of Agricultural and Food Engg. Dept IIT Kharagpur, Litchi is planted in 5 ha (500 m x 100 m) area at a spacing of 5m x 5m. The crop is irrigated by drip irrigation system. Three emitters of 4 lph are used to irrigate each tree. Assume wetting percent as 40%. A well is located at the centre of field. 12 mm internal diameter laterals are placed at each row of plantation. The sub main is laid at the centre of field. The maximum pan evaporation observed during summer is 8 mm per day. The pan coefficient is 0.7. The crop coefficient is 0.8. Determine the **i)** daily irrigation requirement of all plants, **ii)** daily irrigation time, **iii)** required discharge of pump that could irrigate 50% plant in first stage and remaining 50% in second stage, **iv)** total length of lateral and total number of emitters	6
Q.13	Compare and contrast between any four of the following **i)** Mole drain and Interceptor drain **(ii)** Flumes and Weirs **(iii)** Furrow irrigation and Check basin irrigation (iv) Water requirement and Irrigation requirement (v) Piezometer and Tensiometer	6