

UNIVERSITY OF RUHUNA
Third Examination in B.Sc. in Agriculture Resource Management and Technology (Part II)
February 2022

Field Practices in Agricultural Engineering (EN3201)

Time 2 ½ hrs

Index No:

Structured and Essay Type

Answer the questions of Part A (questions 1 & 2) in the space provided.

Use the given answer book to answer the questions of Part B.

Answer only three questions in Part B

Only non programmable calculators are permitted.

All question carry equal marks.

Part A

01. (a). Bulk density, true density, porosity and field capacity of soils are very important parameters that needed to be considered in irrigation scheduling.

(i) Why determination of porosity of soil is important in agriculture?

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(10 Marks)

(ii) Data taken from a bulk density determination test using a core sampler are as follows.

Mass of empty core sampler	= 250.35 g
Mass of core sampler with wet soil	= 482.80 g
Height of core sampler	= 5.64 cm
Diameter of core sampler	= 5.50 cm
Moisture in dry basis	= 21.85 %

(I) Calculate the bulk density of the soil.

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(15 Marks)

(II) If the true density of the soil is 2.5 gcm⁻³, what would be the porosity of the soil?

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(10 Marks)

(b). A graduate student wants to determine the field capacity of the above soil. He is going to use field method for the determination of field capacity of the soil. If the initial moisture content of the soil is 14% in dry basis at the beginning of the study, what would be the total amount of water needed to be added to the soil for the saturation of soil column 1.2x1.2x1.2 m?

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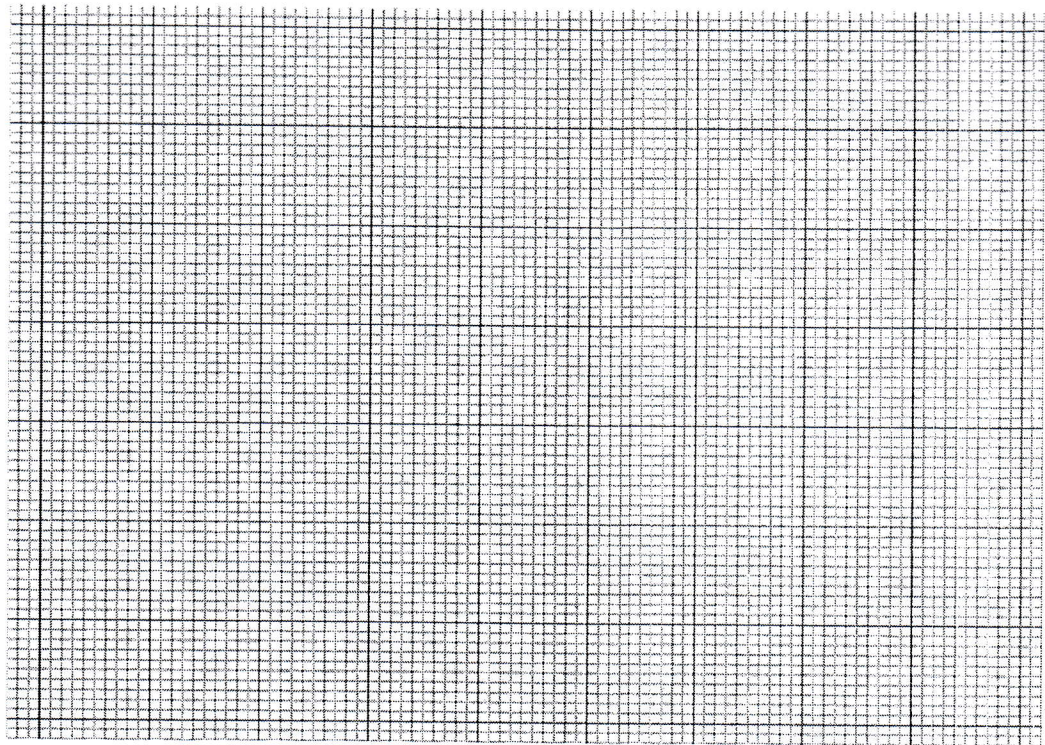
(25 Marks)

(c). The student decided to determine the field capacity at 80 cm depth of the soil. He took soil samples at different time intervals at 80 cm depth of soil after the saturation of the soil and the results are as follows.

Time Interval (h)	Mass of empty moisture cans (g)	Mass of moisture cans with wet soil (g)	Mass of moisture cans with dry soil (g)	Moisture % in dry basis
12	21.0	60.5	49.5	
24	20.0	55.0	46.4	
36	21.3	71.4	59.9	
48	20.8	71.3	61.5	
60	22.0	82.0	71.5	
72	19.7	83.8	72.6	
84	19.2	66.5	58.8	
96	20.4	62.7	55.6	

(i). Calculate moisture content (dry basis) at each time intervals (complete last column of the above table)
 (15 Marks)

(ii). Plot the moisture content against the time in the given graph sheet
 (15 Marks)



(iii). Determine the basic field capacity of the soil at 80 cm depth using drawn graph (mark the basic field capacity in the graph).

(10 Marks)

02. (a) Volume of water received to 36 buckets from a sprinkler performance test are given in the table below in descending order. The top and bottom area of the buckets are 180 cm^2 and 112 cm^2 .

320	317	311	311	305	300
297	296	288	286	260	258
240	238	238	234	230	228
224	223	220	196	194	190
170	168	166	160	158	140
138	126	118	116	112	110

(i) Calculate the average depth of catch.

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(15 Marks)

(ii) Calculate the minimum depth of catch

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(10 Marks)

(iii) Pattern efficiency

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(10 Marks)

(iv) Comment whether you are satisfied with the performance of the sprinkler

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(10 Marks)

(b) Fill the following table using the information related to arc welding and gas welding.

	Arc Welding	Gas welding
Temperature (value)		
Current (value)		
Required Flux (yes/No)		
Emit harmful radiation (yes/No)		
Energy source		
Use of electrode(yes/No)		
Formation of slag (yes/No)		
Can be used to mettle cutting (yes/No)		
Explosive (yes/No)		
Operating pressure for normal operation (Value)		

(20 marks)

(c)(I) Two Centrifugal water pumps were fixed together in the following manner (figure 01). Derive an equation for total head of the given water pumps in the figure 01, Considering: H = Total head, f= friction head, Hs= suction head, Hd= delivery head.

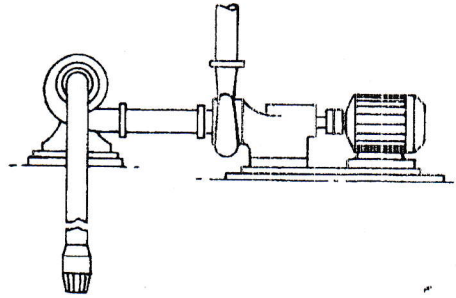


Figure 01

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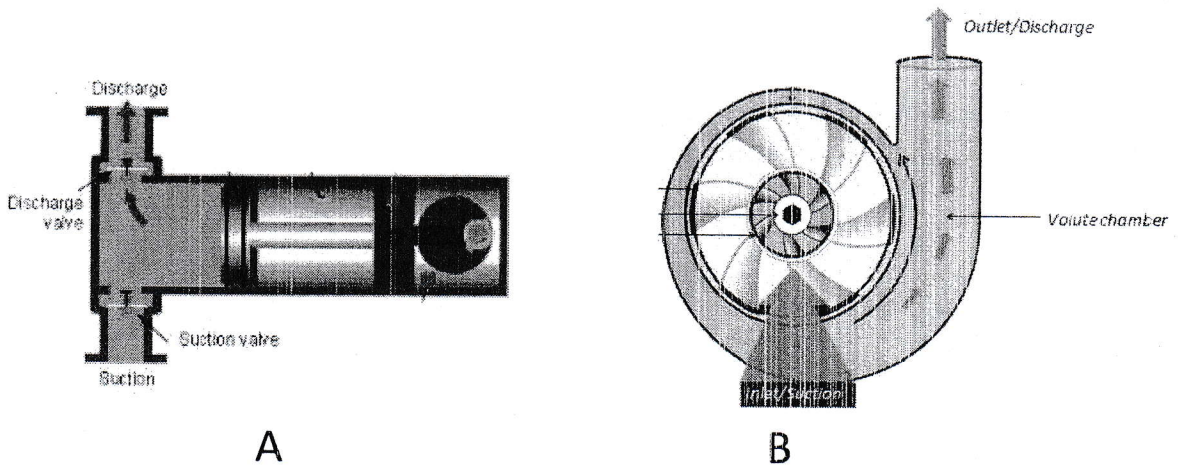
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(20 marks)

(ii) Identify the following pump types in figure 02.



A

B

Figure 02

A.

B.

(10 marks)

(iii) Which one is 'positive displacement' one?.....

(05 marks)

Part B

Answer only Three questions.

01. (a) Using suitable equations explain how to calculate following parameters.

- (i) Moisture Availability Index
- (ii) Potential Evapotranspiration
- (iii) Mean monthly temperature
- (iv) Average annual rainfall

(20 marks)

(b) Using following data, calculate the potential evapotranspiration for rice.

Month	Temp (°C)	Relative humidity	Crop factor
January	30	75	1.2
Feb	25	80	1.3
Mar	30	85	1.1
April	30	80	1.2

(30 marks)

(c) (i) What do you mean by permeability coefficient?

(10 marks)

(ii) Using Darcy's law, derive an equation for permeability coefficient with suitable illustrations.

(20 marks)

(iii) In a constant head permeability test in a laboratory, the following data are given:
 $L=250$ mm, $A= 105\text{cm}^2$. If the k is 0.014cm/s and a flow rate is 120cm^3 must be maintained through the soil, what would be the head difference across the, h across the specimen?

(20 marks)

02. (a) (i) Differentiate the working principle and operating condition of lever operated knap sack sprayer and compression type sprayer using suitable sketches.

(30 marks)

(ii) A Farmer wants to spray Captan 80W to strawberry using compression type sprayer with 12 L volume of tank. A test strip is 80m long and one side (one half) of the bushes can be sprayed with one pass with in 40 min to measure delivery rate. Required amount of water to refill the spray tank after one pass is 2.8 L. The strawberries are in rows 10m apart. Determine

- a. Nozzle discharge(L/min)
- b. Application rate (L/ha)
- c. Area sprayed by a full tank (ha)

(30 marks)

(b) Field data collected during tensiometer calibration is given below.

Table1. Field data collected during tensiometer calibration

Date	Time	Tensiometer Reading (centibars)	Sample Number	Weight of Moist Soil (g)	Weight of oven dried soil (g)
1-Nov	10:00 AM	0	-		
2-Nov	12:00 PM	5	1	23.3	19.8
3- Nov	12:00 PM	5	2	23.1	20.1
3- Nov	6:00 PM	9	3	14.7	13.1
4- Nov	1:00 PM	17	4	16.2	14.7
4- Nov	7:00 PM	26	5	20.4	18.8
5- Nov	12:00 PM	37	6	13.9	12.9
5- Nov	6:00 PM	51	7	17.3	16.2
6- Nov	2:00 PM	68	8	19.6	18.4

- (i) Draw a calibration curve using tensiometer reading and moisture content (dry basis) in soil samples (25 marks)
- (ii) After calibrating above tensiometer was installed in the field. If the recorded reading is 40 after 2 days, what is the soil moisture content of this soil? (15 marks)

03. (a) (i) List out the agriculture related activities where compacting of soil is necessary. (05 marks)
- (ii) Briefly explain how the result of a Standard proctor test is used in a soil compacting operation. (10 marks)
- (iii) Suppose your final year research supervisor asked you to conduct your proctor test adding 2% water content by soil weight at each compaction attempt although in the theory class handout has instructed you to add 5% moisture in each compaction attempt. With a suitable sketch of a graph explain how these two methods will make impact on your results. (15 marks)

- (b) Briefly explain the working principle of two wheel tractor operated Japanese Reversible Moldboard plough using suitable sketches. (20 marks)

- (c) (i) "Nanomaterials are behave differently compared to bulk material". Discuss this statement with special reference to material properties. (25 marks)

- (ii) Discuss properties of newly designed materials for future world by giving examples. (25 marks)

04. (a) (i) What is infiltration and infiltration rate? Briefly explain.
- (ii) List the factors that affect for the infiltration rate of a soil?
- (iii) Distinguish the infiltration rate and basic infiltration?
- (iv) How do you use basic infiltration rate of a soil for the irrigation?

(40 marks)

- (b) (i) What do you mean by 'Uniformity coefficient' of soil sample?
(ii) "Aggregate stability is significantly correlated with crop yields when other conditions are equal". Comment on the statement.

(20 marks)

- (c)(i) Differentiate the instrument used in gas cutting and gas welding.
(ii) Discuss the relative importance of Soldering and Brazing compare to gas welding.

(20 marks)

- (d) (i) You were asked to calculate the machine field capacity (ha/hr) of a two wheel operated rotary tiller. Give the steps you need to follow to achieve this activity.
(ii) If you are asked to calculate the field efficiency of this rotary tiller operation what are the required data?

(20 marks)

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