BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

AEH 211

Department of Engineering and Physics

Bachelor of Science Honours Degree in Agricultural Engineering

Principles of Agricultural Machinery

3 hours (100 Marks)

Instructions:

1. This paper contains 6 questions
2. Answer any **FOUR** questions, each of which carries 25 marks

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Question 1

a) Write the terms which matches the following statements:
   i. Part of the mouldboad plough the helps to counteract the side pressure exerted by the furrow slice. **[2 marks]**
   ii. A flat, rolling disc with sharpened edge which provides clean smooth furrow wall by cutting the furrow vertically. **[2 marks]**
   iii. A heavy duty tool designed to operate below the normal depth to break the plough pan. **[2 marks]**
   iv. A PTO driven implement used for quick seedbed preparation and soil tillage. **[2 marks]**
   v. An accessory shaped like a miniature plough which cuts a small ribbon of soil and helps deflect standing trash. **[2 marks]**

b) Explain the functions of the following parts of a disc plough.
   i. Headstock **[2 marks]**
   ii. Furrow/tail wheel **[2 marks]**

c) Explain why there is less likelihood of a plough sole being formed when using a disc plough as compared to a mouldboard plough. **[6 marks]**

d) Explain how you would make the following adjustments on an ox-drawn mouldboard plough:

i. Adjustment of depth, **[3 marks]**
ii. Adjustment of width. **[2 marks]**

Question 2

a) Write down the terms described by the following statements:
   i. The type of cultivator that has a strong tine with a cutting shovel or sweep mounted in either a single row or several rows, **[2 marks]**
   ii. A harrow that consists of wide, flat or curved bars employed for secondary tillage and weed control, **[2 marks]**
   iii. An additional components provided on disc harrows to assist the harrow for better penetration. **[2 marks]**

b) List four uses of disc harrows in secondary tillage operations. **[4 marks]**

c) With the aid of diagrams briefly describe the following gang assemblies on disc harrows:
   i. Single acting, **[5 marks]**
   ii. Tandem, and **[5 marks]**
   iii. Offset. **[5 marks]**

Question 3

A sugar bean farmer intends to apply Dual Magnum a pre-emergence herbicide to his sugar bean crop. The label of on the herbicide states that Dual Magnum has to be applied at a rate of 1.1 litres per ha. The farmer carried out a test on his boom sprayer and got an average nozzle discharge rate of 2 litres per minute. The recommended operating speed for the boom is 8 km/hr. The tank capacity is 400 litres

i. Calculate the boom application rate in litres per ha. **[5 marks]**

ii. Calculate the amount of pesticide required per tank. **[5 marks]**

iii. If the spraying is to be done on a 50 ha field how many tanks of water needs to be field. **[5 marks]**

iv. Calculate the quantity of Dual Magnum required to finish the 50 ha. **[5 marks]**

v. Calculate the theoretical field capacity of carrying out this operation if the boom has 12 nozzles spaced at 0.5 m. **[5 marks]**

Question 4

a) List five mechanical functions performed by a planter. **[5 marks]**
b) Describe the static method of calibrating a planter. **[20 marks]**

Question 5

a) Explain three main functions performed by sprayers. **[6 marks]**
b) A field sprayer having a horizontal boom with 20 nozzles spaced at 46 cm apart is to be designed for a maximum application rate of 750 l/ha at 520 kPa and 6.5 km/hr.
   i. Determine the pump capacity in litres per minute, assuming 10% of the flow is by-passed under the above maximum conditions. **[5 marks]**
   ii. If mechanical agitation requires 375 watts on the input shaft and the efficiency is 50% calculate the engine rating if the engine is to be loaded to not more than 86% of the rated power. **[5 marks]**
   iii. Calculate the discharge rate per nozzle under the above conditions. **[4 marks]**
   iv. If the nozzles have a 70° spray angle and the pattern is such that 50% overlap is needed for uniform coverage, at what height above the top of the plants should the boom be operated. **[5 marks]**

Question 6

a) Describe the adjustments made on a combine harvester. **[10 marks]**
b) Name the parts of a combine that performs the following functions:
   i. Cutting the standing crop, **[2 marks]**
   ii. Conveying and feeding the cut material to the threshing material, **[2 marks]**
   iii. Threshing or removal of seed from the head or pod, **[2 marks]**
   iv. Separating the seed and chaff from straw, **[2 marks]**
   v. Cleaning the chaff and other debris from seed. **[2 marks]**
c) A wheel driven fertilizer distributer with a width of 5 m and a land wheel of one meter diameter is driven to cover an area of $400m^2$
   i. How many times will the wheel rotate to cover the given area? **[3 marks]**
   ii. If 15 kg of fertilizer is applied calculate the application rate per ha. **[2 marks]**