

UNIVERSITY OF FORT HARE

AGG 221 INTRODUCTION TO  
AGRICULTURAL ENGINEERING

DEGREE EXAMINATIONS

NOVEMBER 2016

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Time: 3 hours

Subject: AGG 221

Marks: 100

This paper consists of 3 pages including the cover page

Internal Examiners

R Moyo

INSTRUCTIONS  
Answer any 5 Questions

1. a. A hand pump will be used to pump water from a well for a village. The pump has a 40 mm diameter piston. The water level in the well is 4.7 m below the pump delivery spout. Calculate the force required to pull the piston up in order to pump water. Density of water is  $1000\text{kg/m}^3$  and gravity is  $9.81\text{m/s}^2$  (10)
- b. A van will be used to transport flowers to market. The volume of the load space of the van is  $7.3\text{ m}^3$ . If the relative density of the flowers packed in boxes is 0.37, calculate the mass of flowers that the van will be able carry per load. Density of water is  $1000\text{ kg/m}^3$ . (10)
2. a. A team 2 oxen is supposed provide a draft force of 1.12 kN to pull an implement at speed of 3.6 km/h. Determine if the oxen would be adequate for this particular task if each oxen is expected to provide 500W of power. (10)
- b. The pump for a small scale irrigation scheme is going to be powered by the engine on a single axle (2 wheel) tractor. The tractor engine comes with a 'vee' belt pulley which is 275 mm in diameter. The engine produces maximum power speed of 1800 rpm. The pump is required to be rotated at 2400 rpm in order to produce the required pressure. Calculate what diameter of the 'vee' belt pulley which will have to be purchased for the pump. (10)
3. a. What type of fuel injection system gives the lowest fuel consumption on a diesel engine? (3)
- b. List the items on a tractor that must be checked every morning (7)
- c. Give 3 reasons why a smallholder farmer would use animal traction for crop production. (6)
- d. What two actions are needed to make an ox-drawn plough plough deeper? (4)
4. a. Explain the importance of calibrating a planter (5)
- b. A small grain drill (planting machine) will be used to plant soyabeans. The spacing between rows is 178 mm. The planter has 14 rows. The final population of soyabeans is 165 000 plants per hectare. Germination of the seeds is 94 % and emergence losses are expected to be 7 %. Fertiliser will also be applied with his machine at the rate of 315 kg/ha. The circumference of the wheel that drives the seed mechanism is 1750 cm. Calculate the amount fertiliser for 10 turns of wheel for correct calibration of the fertiliser mechanism (15)

65ha field of

5. A small grain drill (planting machine) will be used to plant soyabeans without ploughing or any other tillage in a loam soil. The spacing between rows is 178 mm. The planter has 14 rows. The planter applies fertiliser at the same time as planting seeds. The planter will be used with a 55 Kw tractor. The operator and assistant together cost R38.50 per hour. Using Table 1 & 2;

- a. Decide if the implement and tractor are matched  
*and they work a 9 hours day for 6 days a week*
- b. Calculate when planting will be completed if planting was started on the 20<sup>th</sup> of November.  
*20 (15)*

**Table 1: Typical soil drafts when soil is easily workable (speeds for tractors)**

Implement	Power rating	Draft (kN/m effective width)			Typical Speed (km/h)
		Sandy soil	Loam soil	Clay soil	
Plough (173mm depth)	High	8.7	12.4	15	3-4
Chisel plough	High	1.1kN/tine	1.2kN/tine	1.3kN/tine	4-6
Planter, tilled	Low	0.7kN/row	0.8kN/row	0.9kN/row	5-7
Planter, CA	Low	1.2kN/row	1.3kN/row	1.4kN/row	5-7
Boom sprayer	Low				6-8

**Table 2. Field Efficiencies for different machinery activities (tractor operated)**

Activity	Field Efficiency (%)
Primary and secondary tillage	80
Planting of row crops (seed only)	60
Planting and fertilising row crops	50
Spraying with boom sprayer	55

Implement power requirement (Pd) = 0.45 x D x S x W (kW)

6. a. With aid of diagram, explain how a VIP toilet is different to a normal toilet. Explain why this type of toilet should be encouraged. (10)
- b. You measure the distance between two points X and Y on a map with a ruler and the distance 43 mm. The map scale is 1: 25 000. What distance is there between X and Y on the ground? (4)
- c. Calculate the % slope from point A to B which are 74 mm apart on a map with a scale of 1: 20000. Point A is on contour level 1694 above sea level. Point B is midway between contours 1708 and 1709 (6)

