

UNIVERSITY OF FORT HARE

**INTRODUCTION TO
AGRICULTURAL ENGINEERING
AGG221**

DEGREE EXAMINATIONS

NOVEMBER

2018

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Time: 3 HOURS

Subject: AGG221

Marks: 100

This paper consists of 5 pages including the cover page

**Internal Examiners
R MOYO**

External Examiners

INSTRUCTIONS

ANSWER ANY FIVE (5) QUESTION

ANSWER ANY 5 QUESTION

1. a. A lorry is to carry grain. The gross vehicle mass is 16.32 tons and the tare mass is 5.92 kg. The load body of the truck is 2.5 metres wide and 8.4 metres long. The relative density of the grain is 0.75. Calculate the depth of grain in the load body when the lorry is fully loaded if the grain is to be level at the top surface. (10)

b. In order to make the correct pressure a centrifugal pump needs to be driven at 1800 rpm. The pump is driven through a reduction gearbox having 26 teeth on the input shaft to the pump, and 19 teeth on the engine's drive shaft. Calculate the speed that the engine will have to be operated. (10)
2. a. Name 5 systems that a diesel engine needs in order to operate correctly. (5)

b. A hand pump will be used to pump water from the well for a village. The pump has a 45 mm diameter piston. The water level in the well is 5.5 m below the pump delivery sprout. The density of water is 1000 kg/m^3 . The force of gravity can be taken as 9.81 N/kg . Calculate the force required to pull the piston in order to pump water. (15)
3. a. Explain briefly why a tractor needs to be serviced. (5)

b. i. Explain the difference between conservation agriculture compared with plough based crop production. (5)

ii. Give advantages of conservation agriculture. (10)
4. 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 the emergence losses are expected to be 7 %. Fertiliser will also be applied with this machine at the rate of 315 kg/ha. The circumference of the wheel that drives the seeding mechanism is 1750 cm. Calculate the amount fertilizer for 10 turns of the wheel for correct calibration of the fertiliser mechanism. (20)
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 fertilizer 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.
 - a. Decide if the implement and tractor are matched. (5)
 - b. Calculate the calendar days for planting 65 ha of soyabeans. (15)

Table 3: Use of standard concrete mixes (applicable to table 7)

Kind of work	Mix number
General purpose lean mixture for foundations, weirs, thickness over 500mm.	D or E
General reinforced work on buildings, walls, pavements, light floors.	C
Important reinforced work, driveways, garage and workshop floors, heavy precast articles, septic tanks, reservoirs, gate posts.	A or B

Wastage:	Concrete	10%
	Bricks and blocks	5 to 10%
	Mortar	15%
	Plaster	20%

Standard thickness of plaster 15 mm

Table 4: Standard concrete mixes according to volume. (Hand compaction)

1 Mi x No.	Strength MPa	2 Ston e size (mm)	3			4			5		
			Material per bag of cement			Material per m ³ of concrete			Material for mixing in small batches		
			Sand (litre)	Ston e (litre)	Water (litre)	Cemen t (bags)	San d (m ³)	Ston e (m ³)	Cemen t (bags)	San d (m ³)	Ston e (m ³)
A	30	20	80	90	20	8.1	0.65	0.73	1	1.75	2
		40	80	120	20	7.4	0.59	0.89	1	1.75	2.75
B	25	20	90	100	22	7.2	0.65	0.72	1	2	2.25
		40	90	130	22	6.6	0.59	0.86	1	2	3
C	20	20	110	120	25	6.4	0.70	0.77	1	2.5	2.5
		40	110	150	25	5.8	0.64	0.86	1	2.5	3.5
D	15	20	140	140	30	5.5	0.77	0.77	1	3.25	3.25
		40	140	170	30	5.0	0.70	0.85	1	3.25	3.75
E	10	20	170	170	35	4.6	0.80	0.80	1	3.75	3.75
		40	170	200	35	4.2	0.71	0.84	1	3.75	4.25

Table 5: Bricks and mortar required per m² of wall with 10 mm mortar joints.

Size of brick or building block (mm)	Wall thickness	Number of bricks per m ² of wall	Volume of mortar (m ³) per m ² wall
215 x 102.5 x 65mm	102.5mm, half brick	60	0.018
215 x 102.5 x 65mm	215mm, one brick	120	0.043
M4 block 390Lx90Wx190H	90 mm hollow	12.5	0.012
M6 block 390Lx140Wx190H	140 mm hollow	12.5	0.020

$$\text{Length of roof sheets} = \frac{[\text{width of building} + (2 \times \text{overhang})]}{\text{number of rows of sheets}} + 300\text{mm}$$

$$\text{Number of roof sheets} = \frac{[\text{length of building} + (2 \times \text{outside overhang})] \times \text{number of rows}}{\text{Effective covering width of 1 sheet (m)}}$$

Effective covering width of galvanised corrugated iron sheets: 538 mm

Effective covering width of corrugated fibre cement sheets: 875 mm

Standard length of corrugated sheets: 1.5 m plus increments of 0.3 m up to 4.5 m

Table 6: Uses of standard Mortar mixes (Applicable in table 11)

Type of work	Mix number
Fill below machine bases, drain pipe joints	a
Walls above roof level or below floor level, cavity walls load bearing 102mm walls, stone slate or concrete paving blocks.	b
Internal or external walls above floor level and below roof level.	c
Non load bearing internal walls.	d or e

Table 7: Standard mixes for mortars and plasters according to volume

1	2		3		4	
Mix number	Materials for standard batches		Materials per m ³ mortar		Materials for small batches	
	Cement (bags)	Sand (litres)	Cement (bags)	Sand (m ³)	Cement (tins)	Sand (tins)
a	1	100	11.6	1.15	1	2.25
b	1	150	8.5	1.27	1	3.5
c	1	200	6.7	1.34	1	4.5
d	1	250	5.5	1.38	1	5.75
e	1	300	4.7	1.41	1	6.75