1st SEM. 2014/2015

UNIVERSITY OF SWAZILAND
MAIN EXAMINATION PAPER

COURSE CODE: ABE 203

TITLE OF PAPER: - FARM POWER

***BSc.* AGRICULTURAL & BIOSYSTEMS ENGINEERING. Year 2.**

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: CALCULATOR

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

1st SEM.2014/2015

SECTION ONE: COMPULSORY

QUESTION ONE

a) A **four**-cylinder, **four**-stroke internal combustion engine, has a bore size of 250 mm and a stroke of 500 mm. the engine runs at 300 revolutions per minute (rpm) giving a compression ratio of 18:1. Determine the following:

i. Piston surface area **(2 Marks)**

ii. Clearance volume **(5 Marks)**

iii. Piston displacement **(3 Marks)**

iv. Displacement volume **(5 Marks)**

v. Piston speed (PS) **(5 Marks)**

b) Why is operation of tractors at smallholder farm level not as efficient as at large-scale commercial farming estates? **(5 Marks)**

c) To predict the power generated by a wind turbine, the following equation is used:

Power in watts (P) = ½ x ρ x A x v^3

Where:

P = power in watts

ρ = air density in kg/m^3.

A = rotor swept area, exposed to the wind in m^2

v = wind speed in m/s

Calculate:

i) The power (in kW) generated by a turbine with a diameter of 1.5 m that is spinning in a steady 23.4 km/h wind of density of about 1.225 kg/m^3. Express your answer in 2 decimal places. **(5 Marks)**

ii) What happens to power if the wind velocity doubles? **(4 Marks)**

iii) What happens to power generated if the turbine diameter is doubled? **(4 Marks)**

iv) Make a comment on the answers you got in ii) and iii) **(2 Marks)**

1st SEM.2014/2015

SECTION II: ANSWER ANY TWO QUESTIONS

QUESTION TWO

a) Describe the step by step procedure for starting a tractor engine and moving the tractor forward in gears 1 and 2 **(15 Marks)**

b) A farmer approaches you for advice on how to select steers for draught work training. Discuss fully the physical features of the animal which the farmer should critically consider in the selection. **(15 Marks)**

QUESTION THREE

a) Describe the procedure for jump starting a **dead** tractor battery **(15 Marks)**

b) If the needle of the engine temperature gauge points to red, which is a sign of engine overheating, discuss five **(5)** fault finding checks that you would carry out on the overheating engine indicating the remedial action that you would take. **(15 Marks)**

QUESTION FOUR

(a) Use of draught animal power in Swaziland has significantly declined whereas in other countries in the region smallholder farmers solely rely on draught animal power for field work. What could be the reasons leading to this state of affairs? Discuss. **(15 marks)**

(b) In Swaziland and some few other countries in the region diesel fuel is supplied in two qualities; (i) 500 ppm and 50 ppm. Explain to someone less knowledgeable the differences between these two types of diesel fuel. **(5 Marks)**

(c) The following data were recorded during field testing of an animal drawn plough;

i) Plough width of cut	=	0.2 metres
ii) Draught force reading from the pulling chain	=	1.2 kN,
iii) Angle of pull	=	34°
iv) Distance walked by animals while ploughing	=	20 metres
v) Time taken by the animals to walk 20 metres	=	22.2 seconds

Using the records given, calculate the following:

i) The forward speed of the animals in kilometres per hour (km/h)
ii) The drawbar power developed by the animals in kilowatts (kW)
iii) The area ploughed by the animals in one hour (ha)
iv) The time required to plough one hectare with the draught animals.

Assume 65% efficiency **(10 Marks)**