46

UNIVERSITY OF ESWATINI
FINAL EXAMINATION PAPER

PROGRAMME: BSC ABE. II

COURSE CODE: ABE205

TITLE OF PAPER: FARM POWER

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: DRAWING EQUIPMENT

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

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47

SECTION I COMPULSORY

QUESTION 1 [40 marks]

a) Friction has advantages and disadvantages in the functioning of machines.
  (i) Explain the usefulness and disadvantages of friction in a tractor transmission system. [6 marks]
  (ii) Give two examples of how friction is maintained or minimised in each case. [4 marks]

b) Piston displacement is a measure of engine size.
  (i) Define piston displacement? [5 marks]
  (ii) Explain the relationship between piston displacement and engine capacity of a multi-cylinder engine. [5 marks]

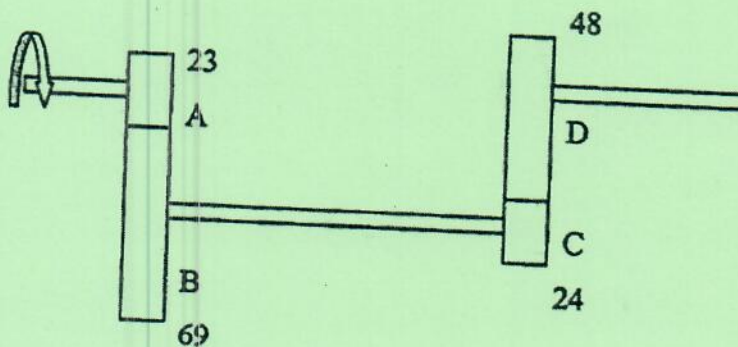c) Figure 1 shows the arrangement of gears in a gearbox for transmission of power in the first gear.

Figure 1 Engaged gears of a gear box when gear selection lever is at 1

Calculate
  i. The Gear ratio of the gearbox in first gear [8 marks]

  ii. The speed of the output shaft when the engine is running at 1800 rpm. [6 marks]

iii. The power supply to the gearbox if the input shaft A has a torque of 250 Nm.

[6 marks]

SECTION II   ANSWER ANY TWO QUESTIONS

QUESTION 2   [30 marks]

a) Distinguish between the operations of two stroke and four stroke internal combustion engines.

[8 marks]

b) Describe the operation of a four stroke internal combustion engine using events that take place as key features.

[12 marks]

c) List five functions of engine oil in an internal combustion engine.

[10 marks]

QUESTION 3   [30 marks]

a) Distinguish between shafts and axles as machinery elements in agricultural tractors.

[4 marks]

b) Discuss the widespread of use gears in tractor gearboxes of tractors.

[10 marks]

c) Figure 2 shows a drive mechanism for a loading auger of a maize harvester. The input pulley at A is driven by a tractor PTO rotating at 540 rpm and the power is transmitted by belts through pulleys B, C, D and by a chain drive at sprockets E and F. The power is turned through 90^0 by bevel gears at G and H. The loading auger is driven by gear H.

Determine

i. Speed of the loading auger.

[10 marks]

ii. The amount of maize (tons) that will be in the tank after one (1) hour of loading if 20.6 g of maize are delivered per revolution.
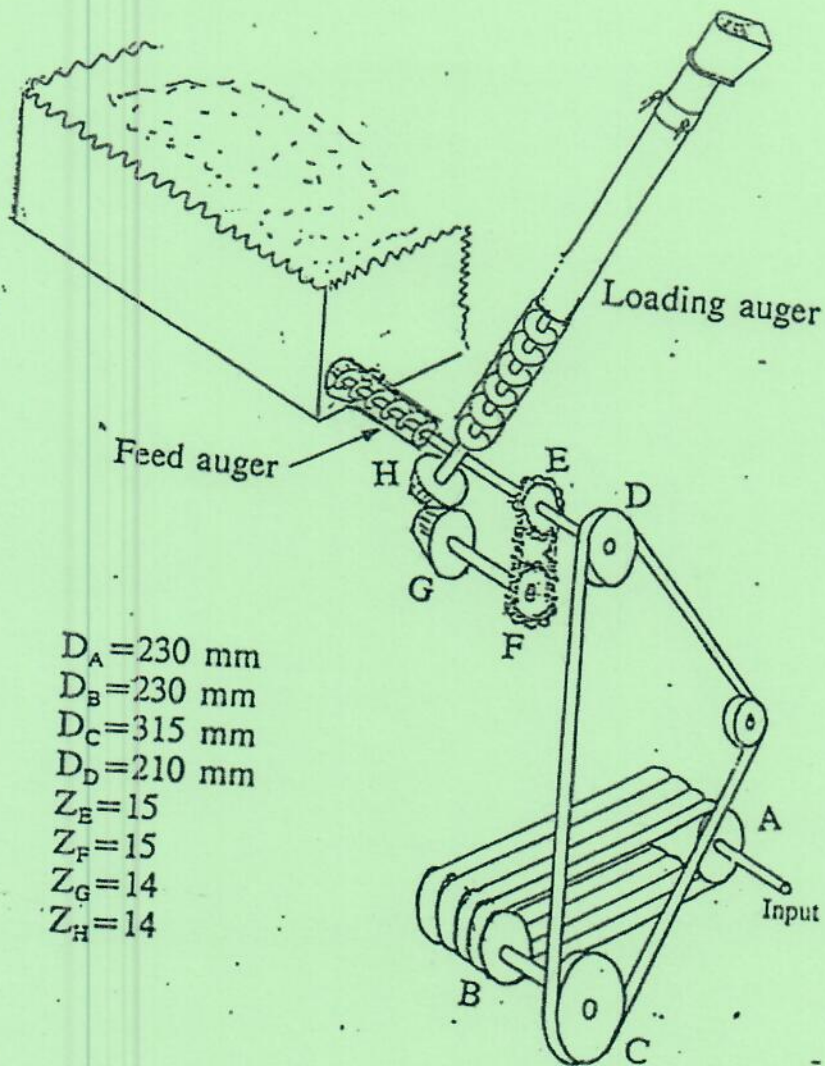
[6 marks]

49

$D_A = 230$ mm
$D_B = 230$ mm
$D_C = 315$ mm
$D_D = 210$ mm
$Z_B = 15$
$Z_F = 15$
$Z_G = 14$
$Z_H = 14$

Figure 2   Power transmission elements for a loading auger of maize harvester

QUESTION 4   [30 marks]

a)   The sidewall of a tyre farm delivery vehicle has the inscription **220/75 R 15 98T**.
Explain the meaning of the following inscriptions.
  i.   220
  ii. 75   [2 marks]
  iii. R   [2 marks]
  iv. 15   [2 marks]
                                                                             [2 marks]

b) Performance of tyres is judged by its ability to rotate while pulling the implements.

    i. What are the practical implications of soft soil on wheel slip and rolling resistance of tyres?

                                      [4 marks]

    ii. How can the performance of a tyre be improved for tractor operation?

                                        [4 marks]

c) A motor vehicle wheel is rotating at 60 rpm during farm operations in a condition where 5% slip is observed. Calculate the forward speed of the vehicle in kph if the tyre markings are **220/75 R 15 98T**

                                        [14 marks]