



**UNIVERSITY OF SWAZILAND  
SUPPLEMENTARY EXAMINATION PAPER**

**PROGRAMME: BSC ABE. II**

**COURSE CODE: ABE 203**

**TITLE OF PAPER: FARM POWER**

**TIME ALLOWED: TWO (2) HOURS**

**SPECIAL MATERIAL REQUIRED: NONE**

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO  
OTHER QUESTIONS.**

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GRANTED BY THE CHIEF INVIGILATOR**

## SECTION I COMPULSORY

## QUESTION 1

- a) Tractors have become a dominant energy source in agricultural processes. Classify wheeled tractors by their drive mechanism. [6marks]
- b) Distinguish between two wheel and four wheel drive tractors [8 marks]
- c) What advantages have encouraged the use of chain and sprocket transmission in agricultural machinery? [12 marks]
- d) The power train of a tractor is given below: The engine provides 270 Nm of torque at 2400 rpm.



- i. A transmission of unknown gear ratio and efficiency is to be selected in the gearbox. If the required speed of the wheels is 20 rpm. Calculate the gearbox gear ratio required to achieve this wheel speed. [8 marks]
- ii. Assuming the losses in the transmission is negligible; determine the torque available at each of the rear wheels? [6 marks]

**SECTION II**

**ANSWER ANY TWO QUESTIONS**

**QUESTION 2**

- a) What are benefits and limitations of animal draught power in farming application? [10 marks]
  
- b) A span of draught oxen generates a pull in the trek chain of 1.21 kN when walking steadily in the field at an average speed of 0.9 m/s. Given that the angle of pull is  $16^\circ$ , and the plough width of cut is 200 mm, calculate:
  - i. Draught force; [5 marks]
  - ii. The power generated by the oxen; [5 marks]
  
- c) Why is operation of tractors at smallholder farmer level not as efficient

**QUESTION 3**

- a) Choose the correct answer to the statements below: [10 marks]
  - i. In a two stroke engine, the working cycle is completed in two revolutions of the crankshaft.
    - 1) True
    - 2) False
  
  - ii. A two stroke cycle engine gives ..... the number of power strokes as compared to the four stroke cycle engine, at the same engine speed.
    - 1) half
    - 2) same
    - 3) double
    - 4) four times

- iii. A two stroke engine requires more space than a four stroke engine.
  - 1) True
  - 2) False
  
- iv. A two stroke engine gives ..... mechanical efficiency than a four stroke cycle engine.
  - 1) higher
  - 2) lower
  - 3) equal
  - 4) none of the mentioned
  
- v. The two stroke cycle engine have lighter flywheel.
  - 1) True
  - 2) False
  
- vi. Thermal efficiency of a two stroke engine is ..... a four stroke engine.
  - 1) equal to
  - 2) less than
  - 3) greater than
  - 4) none of the mentioned
  
- vii. In a petrol engine, the mixture has the lowest pressure at the
  - 1) beginning of suction stroke
  - 2) end of suction stroke
  - 3) end of compression stroke
  - 4) none of the mentioned
  
- viii. The injector nozzle of a compression ignition engine is required to inject fuel at a sufficiently high pressure in order to
  - 1) inject fuel in a chamber of high pressure at the end of compression stroke.
  - 2) inject fuel at a high velocity to facilitate atomization.
  - 3) ensure that penetration is not high
  - 4) all of the mentioned.

ix. The following is a Spark Ignition engine

- 1) Petrol engine
- 2) Diesel engine
- 3) Gas engine
- 4) None of the above

x. The following is a Compression Ignition engine

- 1) Petrol engine
- 2) Diesel engine
- 3) Gas engine
- 4) None of the above

b) What are the operational differences between diesel and petrol engines? [10 Marks]

c) Figure 1 above shows a gear train composed of three gears. Gear A revolves at 60 revs/min in a clockwise direction.

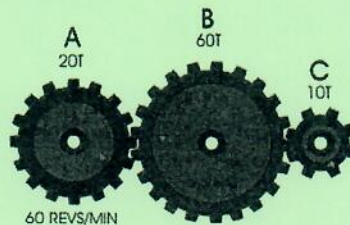


Figure 1 Gear train in transmission of power machines

- i. What is the output in revolutions per minute at Gear C? [5 marks]
- ii. In what direction does Gear C rotate? [2 marks]
- iii. What is function of gear B in the transmission? [3 marks]

**QUESTION 4**

- a) Discuss the recent increase in the use of hydraulic power transmission systems in agricultural machines. [10 marks]
- b) The steering axle of a tractor is mounted with a hydraulic cylinder whose diameter is 50 mm. If a steering load of 20 kN is to be overcome at the wheel, determine the
- i) pressure that the hydraulic pump should provide. [5 marks]
  - ii) hydraulic power of the pump if a discharge of 50 L/min flows to the cylinder. [5 marks]
- c) Distinguish between motion transmission and motion transformation? [10 marks]