



**JOMO KENYATTA UNIVERSITY  
OF  
AGRICULTURE AND TECHNOLOGY**

**University Examinations 2015/2016**

**FOURTH YEAR EXAMINATION FOR THE DEGREE OF  
BACHELOR OF SCIENCE IN AGRICULTURAL & BIOSYSTEMS ENGINEERING**

**ABE 2404: ENGINE & TRACTOR TECHNOLOGY**

**DATE: December 2016**

**TIME: 2 HRS**

**INSTRUCTIONS**

Attempt Question one and ANY other TWO Questions.

**Question One (Compulsory)**

- (a) Explain the operational differences between:
  - (i) An SI and a CI engine (4 Marks)
  - (ii) A FOUR stroke and a TWO stroke cycle engine (4 Marks)
- (b) Outline THREE reasons that make it desirable to have multi cylinder operation as opposed to single cylinder operation (3 Marks)
- (c) Name and briefly discuss FOUR types of tractor based on utility classification (6 Marks)
- (d) Explain the purpose of a tractor power train and give the relationship that governs the power transmitted (6 Marks)
- (e) Explain how a synchronizer unit of a manual gearbox operates (2 Marks)
- (f) A 2.5 litre 4-stroke diesel engine is designed to run at 4200 rpm with a power output of 52kW. The volumetric efficiency is found to be 80% and the sfc is 0.076 kg/MJ. The fuel has a calorific value of 42MJ/kg. Calculate
  - (i) The brake mean effective pressure
  - (ii) The thermal efficiency (5 Marks)

**Question Two**

- (a) Explain how the various speeds of a single planetary gear system are attained. (8 Marks)

$$P_{output} = T \times \omega$$

brief 3 pt

P. 13, 14

Indicate FOUR possible locations where clutches can be used within a tractor power train and give the reasons for their use. (6 Marks)

Define flashpoint as used in fuels (1 Mark)

Determine the stoichiometric gravimetric air/fuel ratio for petrol that can be approximated as  $C_{12}H_{26}$ . Assume that air contains 23% oxygen by weight (21% molar) and the products of combustion are carbon dioxide and water. Clearly show the combustion equation (5 Marks)

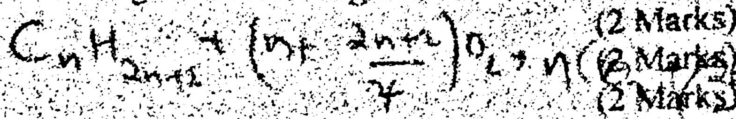


Question Three

Explain how fuel metering is achieved in an in-line injection pump (4 Marks)

What is your understanding of the following for a diesel engine

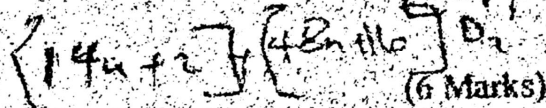
- (i) Indirect injection
- (ii) Turbocharging
- (iii) Governing



List the objectives of engine lubrication. (2 Marks)

Explain what is meant by the following in hydraulic control systems

- (i) Nudging system
- (ii) Automatic draft control system



Explain the importance of having a differential mechanism lock on a tractor (2 Marks)

Question Four

Explain the advantages of using fluid power in tractors (2 Marks)

A hydraulic piston pump has a displacement of  $10.50 \text{ cm}^3/\text{rev}$  at rated speed of 1820 rpm and  $10.3 \text{ MPa}$  pressure. If  $\eta_{vp}$  is 0.95 and  $\eta_{mp}$  is 0.85, calculate

- (i) Pump delivery, L/min (2 Marks)
- (ii) Required torque to drive the pump (2 Marks)
- (iii) Shaft power (2 Marks)

Define "Tractive efficiency" of a tractor and explain THREE factors that may affect it (4 Marks)

Using examples, explain the methods used to classify oils for lubrication purposes (5 Marks)

Identify and explain TWO likely problems that may lead to overheating in a pressurized liquid engine cooling system (3 Marks)