



# TECHNICAL UNIVERSITY OF MOMBASA

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FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

THE DEGREE IN BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2308 : ENGINEERING THERMODYNAMICS III

END OF SEMESTER EXAMINATION

**SERIES: APRIL 2016**

TIME: 2 HOURS

DATE: Pick Date May 2016

## Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt any **THREE** questions.

**Do not write on the question paper.**

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## Question ONE

- a) Explain the following terms as applied to internal combustion engines.
- Bore
  - Stroke
  - Clearance volume.
  - Swept volume (4 marks)
- b) Explain with suitable sketches the working of a four-stroke otto engine. ( 4 marks)
- c) Explain the fundamental differences between combustion Ignition and spark ignition engines. (8 marks)
- d) State four purposes of lubrication of an engine (4 marks)

## Question TWO

- a) Describe a hypothetical indicator diagram and derive the equation to determine the mean effective pressure with clearance. (6 marks)
- b) Explain adiabatic flame temperature (3 marks)
- c) Explain the stoichiometric air-fuel ratio(A/F) (3 marks)
- d) A steam boiler uses pulverised coal in the furnace. The ultimate analysis of coal by mass is C =78%, H<sub>2</sub>=3% ,O<sub>2</sub>=3%,S=1%,ash 10% and 5% moisture. Excess air supplied is 30%.Calculate the mass of air to be supplied and mass of gaseous product formed per kg of coal burnt. (8 marks)

## Question THREE

- a) Describe otto cycle using appropriate diagrams and derive it's efficiency. (10 marks)
- b) In an air standard Otto cycle,the compression ratio is 7 and the compression begins at 1 bar and 313k.The heat added is 2510 Kj/kg. Calculate
- Maximum temperature and pressure of the cycle.
  - Work done per kg of air
  - Cycle efficiency
  - Mean effective pressure
- Take for air  $C_v=0.713\text{kJ/kg K}$  and  $R=287\text{j/kg K}$  (10 marks)

## Question FOUR

- a) Define the following engine performance parameters of internal combustion engines.
- Specific output
  - Specific fuel consumption
  - Volumetric efficiency
  - Specific weight
- (4 marks)
- b) With appropriate sketches describe the following designs of combustion chambers
- Turbulent chamber
  - Pre combustion chamber
  - Energy cell
- (6 marks)
- c) The following particulars were obtained in a trial on a 4-stroke gas engine
- |                         |          |
|-------------------------|----------|
| Duration of trial       | = 1 hour |
| Revolutions             | =14000   |
| Number of missed cycles | = 500    |

Net brake load	=1470 N
Mean effective pressure	=7.5 bar
Gas consumption	=20000 litres
Calorific value of gas	=21kJ/litre
Cylinder diameter	= 250 mm
Stroke	=400 mm
Effective brake circumference	=4 m
Compression ratio	=6.5 : 1

Calculate

- i. Indicated power
- ii. Brake power
- iii. Mechanical efficiency
- iv. Indicated thermal efficiency (10 marks)

### Question FIVE

- a) Explain the difference between theoretical and actual value timing diagrams of a petrol engine (4 marks)
- b) Explain the following methods of cooling I.C engines
  - i. Air cooling
  - ii. Liquid cooling (6 marks)
- c) Describe a rope brake dynamometer and derive the brake power equation. ( 7 marks)
- d) The following data were recorded in MPUC laboratory experiment with the rope brake.
 

Diameter of the fly wheel	=1.2 m
Diameter of the rope	= 12.5 mm
Engine speed	=200 r.p.m
Dead load on the brake	=600 N
Spring balance reading	=150 N

Calculate the brake power of the engine. (3 marks)