



# TECHNICAL UNIVERSITY OF MOMBASA

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.**

## Question ONE

- (a) Explain the following terms of a reciprocating air compressor.
- (i) Free air delivery
  - (ii) Swept volume
  - (iii) Compressor capacity (3 marks)
- (b) Sketch the theoretical indicator diagram for a single stage, single cylinder reciprocating compressor with clearance volume showing the various processes. (5 marks)
- (c) A reciprocating air compressor which is single stage, single acting takes air at a pressure of  $9.7 \times 10^4 \text{N/m}^2$  and temperature  $20^\circ\text{C}$ . It has runs at a speed of 500 rev/min. The clearance volume is 5% of the swept volume and the polytropic index is 1.3 thought. If the compression pressure is  $5.5 \times 10^5 \text{N/m}^2$ . Calculate:
- (i) The free air delivered in  $\text{m}^3/\text{min}$  (FAD conditions  $1.01325 \times 10^5 \text{N/m}^2$  and  $15^\circ\text{C}$ )
  - (ii) Volume efficiency

- (iii) Air delivery temperature
- (iv) The cycle power
- (v) The isothermal efficiency, neglecting clearance (12 marks)

### Question TWO

- (a) Describe a diesel cycle and derive its efficiency. (10 marks)
- (b) An engine with 200mm cylinder diameter and 300mm stroke works on theoretical Diesel cycle. The initial pressure and temperature of air used are 1 bar and 27<sup>0</sup>C. The cut-off is 8% of the stroke. Calculate:
  - (i) Pressure and temperatures at all salient points
  - (ii) Theoretical air standard efficiency

Assume that compression ratio is 15 and working fluid is air. Consider all conditions to be ideal (10 marks)

### Question THREE

- (a) Define the term fuel. (1 mark)
- (b) Explain the advantages and disadvantages of liquid fuels over solid fuels. (5 marks)
- (c) A sample of coal has the following composition by mass.

Carbon 75%; Hydrogen 6%; Oxygen 8%, Nitrogen 2.5%; Sulphur 1.5% and ash %

Calculate the higher and lower calorific values per kg of coal (4 marks)

- (d) A blast furnace gas has the following volumetric composition:

CO<sub>2</sub>=11%, CO = 27%, H<sub>2</sub> = 2% and N<sub>2</sub> = 60%

Calculate:

- (i) The theoretical volume of air required for the complete combustion of 1m<sup>3</sup> of the gas
- (ii) The percentage composition of dry flue gasses by volume  
(Assume that air contains 21% of O<sub>2</sub> and 79% of N<sub>2</sub> by volume) (0 marks)

#### Question FOUR

- (a) State the advantages of lubrication of I.C. engines (5 marks)
- (b) Describe the following lubrication systems in I.C. engines
- (i) Splash lubrication
  - (ii) Forced lubrication (6 marks)
- (c) Explain the purpose of governing of an I.C. engine (1 mark)
- (d) Explain the following methods of governing I.C. engines:
- (i) Hit and miss governing
  - (ii) Qualitative governing
  - (iii) Quantitative governing
  - (iv) Combination system of governing (8 marks)

#### Question FIVE

- (a) Describe briefly and with appropriate sketches the actual sequence of events in the cylinder of a petrol engine working on the four stroke cycle. (6 marks)
- (b) Describe the different methods of cooling and give specific examples where each method is employed. (4 marks)
- (c) During the test on single cylinder oil engine the working of the four stroke cycle and fitted with a rope brake. The following readings are taken:

Effective diameter of brake wheel	=	630mm
Dead load on brake	=	200N
Spring balance leading	=	30N
Speed	=	450r.p.m
Area of indicator diagram	=	420mm <sup>2</sup>
Length of indicator diagram	=	60mm
Spring scale	=	1.1 bar per mm
Diameter of cylinder	=	0.815kg/h

Calorific value of oil = 42 000kJ/kg

Calculate:

- (i) Brake power
- (ii) Indicated power
- (iii) Mechanical efficiency
- (iv) Brake thermal efficiency
- (v) Brake specific fuel consumption ( 10 marks)