



# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

**DIPLOMA YEAR I SEMESTER II**

**EPL 2101 : MECHANICAL PLANT THEORY**

**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.**

**Assume: 1 bar =  $10^5$  N/m<sup>2</sup>, 1 atm = 101.3 kN/m<sup>2</sup>, 1 hp = 0.7457kW**

## **Question ONE**

- Define the term fuel. (2 marks)
- Differentiate between “proximate analysis” and “ultimate analysis” and state their relevance. (4 marks)
- List **THREE** types of fuel. (3 marks)
- Determine the percentage excess air supplied to boiler for burning the coal having the following composition on mass basis. C=0.82, H<sub>2</sub>=0.05, O<sub>2</sub>=0.08, N<sub>2</sub>=0.03, S=0.005 and moisture = 0.018. Volumetric analysis of dry flue gases shows the following composition: CO<sub>2</sub>=10%, CO=1%, N<sub>2</sub>=82% and O<sub>2</sub>=7%. (11 marks)

## **Question TWO**

- Define the term “Compressor” (2 marks)
- State and explain **THREE** classification of compressors. (3 marks)
- Describe the working of a single stage reciprocating compressors. (4 marks)

- d. A single stage, single acting reciprocating air compressor has air entering at 1bar, 20°C and compression occurs following polytropic process with index of 1.2 up to the delivery pressure of 12bar. The compressor runs at the speed of 1240rpm and has L/D ratio of 1.8. The compressor has mechanical efficiency of 0.88. Calculate the:
- isothermal efficiency
  - cylinder dimensions
  - rating of drive required to run the compressor which admits 1m<sup>3</sup> of air per minute (11 marks)

### Question THREE

- Define the term “Internal Combustion Engine”. (2 marks)
- Briefly explain the operation of a four stroke diesel engine. (8 marks)
- State TWO advantages of 2-stroke engines. (2 marks)
- State FOUR differences between diesel engine and petrol engine. (4 marks)
- Explain the difference between Otto Cycle and Diesel Cycle in I.C. engines. (4 marks)

### Question FOUR

- Differentiate between pumps and compressors. (4 marks)
- State FOUR ways of increasing pressure of fluids by pumps. (4 marks)
- List FOUR losses in rotodynamic pumps. (4 marks)
- Differentiate between reciprocating pumps and rotary pumps. (4 marks)
- List FOUR characteristics of positive displacement pumps. (4 marks)

### Question FIVE

- Define the following terms with reference to fuels and combustion. (4 marks)
  - Air-fuel ratio
  - Volumetric analysis
- Describe THREE types of fuels giving relevant examples. (6 marks)
- A hydro-carbon fuel when burned with air gave the following Orsat analysis; CO<sub>2</sub>=11.94%, O<sub>2</sub>=2.26%, CO=0.41% and N<sub>2</sub>=83.39%. Calculate:- (10 marks)
  - Air- fuel ratio
  - The percent carbon and hydrogen in the fuel on mass basis
  - Percentage theoretical air supplied. Assume air to have 21% oxygen.