TECHNICAL UNIVERSITY OF MOMBASA

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

THIRD YEAR SECOND SEMESTER UNIVERSITY EXAMINATION FOR THE DEGREE IN BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (BSME)

EMG 2308
ENGINEERING THERMODYNAMICS III

END OF SEMESTER EXAMINATIONS

SERIES: DECEMBER, 2013

TIME: 2 HOURS

INSTRUCTION TO CANDIDATES

1. You should have the following for this examination:-
   - Answer Booklet
   - Scientific Calculator
2. This paper consists of **FIVE** questions.
3. Answer **ANY THREE** Questions.
4. Maximum marks for each part of Question are as shown.
5. This paper consists of **FOUR** printed pages.

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 talles air at a pressure of $9.7 \times 10^4 N/m^2$ and temperature 20ºC. It has runs at a speed of 500 rev/min. The clearance volume is 5% of the swept volume and the polytrophic index is 1.3 thought. If the compression pressure is 5.5 x 10^5N/m^2. Calculate:

(i) The free air delivered in m^3/min (FAD conditions 1.01325 x 10^5N/m^2 and 15^{o}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^{o}C. The cut-off is 8% of the stroke. Calculate:

(i) Pressure and temperatures at all salient points
(ii) theoretical air standard efficiency
(iii) mean effective pressure
(iv) power of the engine if the working cycles per minutes are 380

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 furnance gas has the following volumetric composition:

$$CO_2 = 11\%, \quad CO = 27\%, \quad H_2 = 2\% \ \ and \ \ N_2 = 60\%$$

Calculate:

(i) The theoretical volume of air required for the complete combustion of $1m^3$ of the gas

(ii) The percentage composition of dry flue gases by volume
(Assume that air contains 21% of O_2 and 79% of N_2 by volume)

(10 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	=	$420mm^2$
Length of indicator diagram	=	60mm
Spring scale	=	1.1 bar per mm
Diameter of cylinder	=	0.815kg/h

Calorific value of oil = 42 000 kJ/kg

Calculate:

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

(10 marks)