JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMINATIONS FOR THE DEGREE IN SCIENCE IN RENEWABLE ENERGY TECHNOLOGY AND MANAGMENT

SECOND YEAR RESIT EXAMINATION 2020/21 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TET 3226

COURSE TITLE: INTERNAL COMBUSTION ENGINES

EXAM VENUE: **STREAM: BSc REN TECH & MGT**

DATE: ../11/2020 EXAM **SESSION:**

DURATION: 2 HOURS

Instructions

1. **Answer question 1 (Compulsory) and ANY other two questions**
2. **Candidates are advised not to write on question paper**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

QUESTION ONE (COMPULSORY) (30 Marks)

a. What is the working principle of an Internal Combustion Engine? (3marks)
b. Why is cooling is required in internal combustion engines (2marks)
c. Differentiate carburation from turbocharging, in reference to Internal combustion engine. (4marks)
d. State the important factors which affect the process of carburetion. (2marks)
e. List three methods used to achieve supercharging (3Marks)
f. Give four major classifications of internal combustion engines. (4marks)
g. State and explain the performance Characteristics of an Internal Combustion Engine (3marks)
h. Outline three basic testing ways for internal combustion engines (3marks)
i. How many rings does a common piston have? Give Functions of each. (3marks)
j. Name three uses of Engine (3marks)

QUESTION TWO (20 Marks)

a. i) Discuss four basic measurements for evaluating the performance of an internal combustion engine. (2 marks)
   ii) List two types of conventional ignition systems. (2 marks)
b. i). With the help of clearly labeled sketches, draw a piston of an internal combustion engine (5 Marks)
   ii) Describe the functioning of a typical spark ignition piston engine, when fuel is subjected to changes of pressure, temperature, volume, addition of heat, and removal of heat. (5 Marks)
   iii). The peak pressure of a SI engine rotating at 1800 rpm occurs 0.003S after the spark, what will be the spark timing when peak pressure is at TDC. If the inlet valve opens at 10 degrees bTDC and closes at 45 degrees aBDC, how long the inlet valve opening period is in seconds. (6marks)

QUESTION (20 Marks)

a) With the help of a neat diagram of a standard air-cycle, explain the four combustion Otto –air cycles for a 4-stroke Internal combustion engine. (6 marks)

b) At which cycle - (from (a) above) - do we have:-

i. intake valve and outlet valve is closed. (1 Marks)

ii. atmospheric temperatures and pressure. (2 Marks)

iii. the highest temperatures and pressure. (1 Marks)

iv. Power cycle. (1 Marks)

c) State and explain at least four different properties of general fuel specifications. (4 marks)

d) Explain the following terms in connection with internal combustion engines.

i. Mechanical efficiency. (1 mark)

ii. Thermal efficiency (1 mark)

iii. Mean effective pressure. (1 mark)

iv. Indicated power. (1 mark)

v. Brake power. (1 mark)

QUESTION FOUR (20 Marks)

a. With the help of a neat diagram, show the piston and its associated components for an internal combustion engine (4 marks)

b. Give mathematical expressions for: -

i. Displacement (1 marks)

ii. Clearance volume (1 marks)

iii. Compression ratio (1 marks)

iv. Efficiency (1 marks)

v. Mean Engine speed (1 marks)

c. i) State at least three internal Combustions Engine systems. (3 marks)

ii)In a four stroke single cylinder gas engine the indicated mean effective pressure is 0.46 MN/m^2, the brake power 9 kW, speed 250 rpm, mechanical efficiency, $\eta_m = 0.8$, and bore to stroke ratio = 0.66. Calculate cylinder diameter and mean piston speed. (8 marks)

QUESTION FIVE (20 Marks)

a. i) Give at least four different classifications of Engines. (2 Marks)
   ii) List two methods of cooling an Internal Combustion Engine (2Marks)
b. List and briefly explain factors attributing to internal Combustion engine losses (i.e. 'lost work') (6 Marks)
c. Engine knock is one of the major problems encountered in Internal Combustion Engines.
   i) What is meant by engine knock (2 Marks)
   ii) Enumerate and briefly explain factors affecting knock? (5 Marks)
   iii) List three ways that can be used to avert engine knock (3 marks)