



**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)

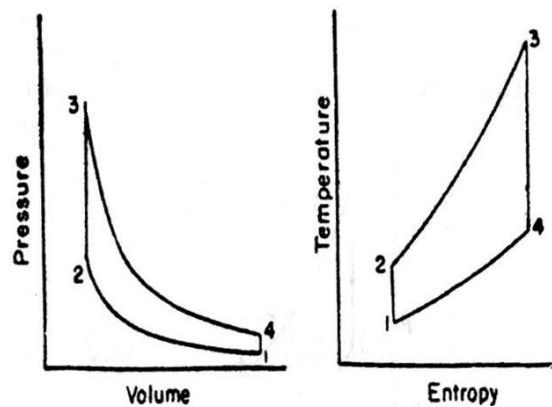
- a. Differentiate between Internal Combustion Engines from External Combustion Engine. (2 marks)
- b. Name three broad categories of Engine Systems. (3marks)
- c. How is the capacity of an engine specified? Give its units (3marks)
- d. Differentiate supercharging from turbocharging, in reference to Internal Combustion engine. (2 marks)
- e. What are the methods that can be used to achieve supercharging (3 marks)
- f. Name the materials used in making a piston and a crank-shaft (2 marks)
- g. State the important factors which affect the process of carburetion. (3 marks)
- h. What is carburetion as used in internal combustion engines (2 marks)
- i. Explain the energy conversion in an Internal Combustion engine, starting from input ingredients all the way to the rotation of the wheels. (3 marks)
- j. The working principle of Combustion engine is based thermal energy conversion, yet the engine need to be cooled. Explain why cooling is necessary. (3 marks)
- k. How many rings does a single piston have? What are the Functions of each ring? (2 +2 marks)

QUESTION TWO (20 Marks)

- a. Give mathematical expressions for: - (5 marks)
 - i) Swept volume
 - ii) Clearance volume
 - iii) Compression ratio
 - iv) Mechanical Efficiency
 - v) Mean Engine speed
- b. With the help of a neat diagram, show the piston and its associated components for an internal combustion engine (6 marks)
- c. i). For a given Engine model, if the cylinder bore is 5 mm, clearance between the bore and the cylinder head is 0.01 mm, calculate the displacement (6 marks)
 - ii) State at least three internal Combustions Engine systems. (3 marks)

QUESTION THREE (20 Marks)

- a. i) Discuss five basic measurements for evaluating the performance of an internal combustion engine. (2.5 marks)
- ii) List two types of conventional ignition systems. (2marks)
- b. i). With the help of sketches, show Air Otto cycles of a 4-cycle 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)



- c. The peak pressure of a SI engine rotating at 1500 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. (5.5 marks)

QUESTION FOUR (20 marks)

- a) Explain the following terms in connection with internal combustion engines.
- i) Mean effective pressure. (1 mark)
 - ii) Indicated power. (1 mark)
 - iii) Brake power. (1 mark)
 - iv) Friction power. (1 mark)
 - v) Mechanical efficiency. (1 mark)
 - vi) Thermal efficiency. (1 mark)
 - vii) Specific fuel consumption. (1 mark)
- b) The diagram below Fig Q 4.1, shows the arrangement of a 4-stroke Internal combustion engine.

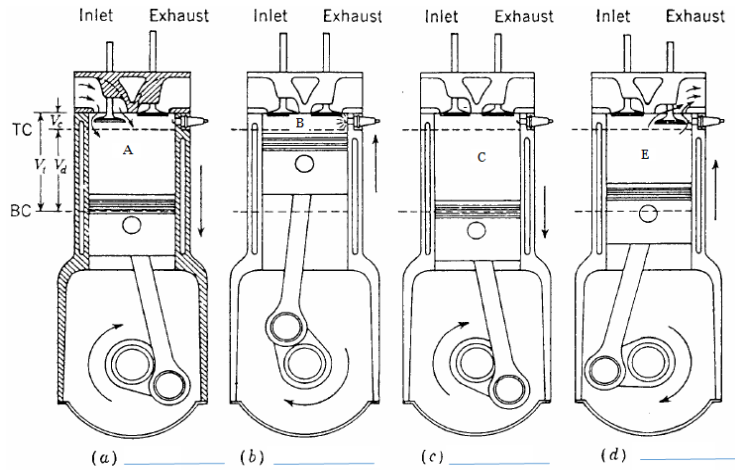


Fig. Q 4.1

From Fig. Q 4.1, name the strokes (a), (b), (c) and (d). (4 marks)

c) State what is happening in the: -

- i. first stroke and give approximate temperatures and pressure.
- ii. second stroke and give approximate temperatures and pressure.
- iii. third stroke and explain why both valves are closed.
- iv. fourth stroke and tell why intake valve, and not outlet valve is closed.
- v. what are the approximate temperatures and pressure of the combustion mixture for each stroke? (5Marks)

d) Fuels have different properties. State and explain at least four general fuel specifications. (4marks)

QUESTION FIVE (20 Marks)

- a. i) Give at least four different classifications of Engines. (2Marks)
- ii) Name three uses of Engine (3 Marks)
- b. The internal Combustion engine losses ('lost work') are mainly attributed to several factors. List and briefly explain them (6 Marks)
- c. Only a fraction of chemical energy is converted into mechanical work, and the rest is 'lost work' which can be attributed to any of the following: -
 - i) What is engine knock, in reference to Internal Combustion Engines? (4Marks)
 - ii) What are the factors affecting knock? (5Marks)