

FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI  
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY  
DEPARTMENT OF AGRICULTURAL AND BIORESOURCES ENGINEERING  
2019/2020 HARMATTAN SEMESTER EXAMINATIONS

COURSE: PME 405 – HEAT AND POWER MACHINERY. TIME: 3 HOURS. DATE: 15/02/2021

Instructions: Answer question 1 and any other four questions

- ✓ 1(a) Briefly discuss the various ways of classifying internal combustion engines  
 (b) With the aid of illustrations, describe the principle of operation of 4-stroke cycle engine.  
 ✓ (c) A diesel engine uses 54.5 kg of fuel oil/hr of calorific value 45 MJ/kg. The thermal efficiency of the engine is 25%. Determine the power output of the engine in kilowatts.
- ✓ 2(a) Describe the principle of operation of an engine drive mechanical fuel system.  
 ✓ (b) Determine the volume of fuel to be injected/cylinder/cycle in a 6 cylinder 4-stroke cycle engine delivering 765kW at 200rpm, with fuel rate of 0.26kg/kWh. Assume the fuel specific gravity to be 0.71.  $\frac{200}{2} = 100$
- ✓ 3(a) What are indicator diagrams? Discuss the indicator diagrams for S.I and C.I engines.  
 (b) An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263 m<sup>3</sup>. Determine the thermal efficiency of this engine if the adiabatic exponent (k) is 1.4.  $\eta_t = 1 - \frac{1}{\gamma^{k-1}}$
- 4(a) Briefly discuss the stages of combustion in S.I engines  
 (b) Calculate the amount of air required for complete combustion of 9.5 kg of octane in an I.C engine with 0% of excess air. Determine the air/fuel ratio, classify the fuel mixture and calculate the amount of water discharged at the exhaust.
- ✓ A 4-cylinder, 4-stroke cycle engine has cylinder bore of 240 mm, stroke bore ratio of 1.25, compression ratio of 10:1, engine speed of 340 rpm, and indicated mean effective pressure of  $7.35 \times 10^5$  N/m<sup>2</sup>. If the number of misfires is 8/min, and the mechanical efficiency is 65%. Determine these parameters of the engine: (i) the indicated horsepower (ii) brake horsepower (iii) clearance volume.
- 6(a) With the aid of illustrations, discuss the principle of operation of a simple carburetor.  
 (b) Define the term Ignition delay and enumerate the factors affecting it  
 (c) Write short notes on these terms (i) Calorific value of fuel (ii) Mechanical efficiency (iii) Volumetric efficiency (iv) Indicated thermal efficiency

value: This is the quantity of energy required per unit mass of the fuel.

This is the ratio of BHP to IHP.

$$\eta = \frac{V_1 - V_2}{V_1}$$

This is the ratio of the total vol of the piston to

$$V = \frac{\pi D^2 \times L}{4}$$