Mid-Semester Examination

First Semester 2022-2023

Name: Id:

Birla Institute of Technology and Science, Pilani
ME F317: Engines, Motors, and Mobility

Close Book 60 Marks 02:00-03:30 PM, 04/11/2022

Instructions: *1. Please write concisely and legibly. Final answers should be clearly marked.*
2. Draw neat labelled diagrams wherever necessary.
3. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
4. Assumptions made if any, should be stated clearly at the beginning of your answer.

Q1. Please answer the following questions briefly.

a) What do you understand by *valve overlap*? Why is it there and how does it impact the engine performance? Represent valve overlap by drawing a valve timing diagram. **[4]**
b) An automobile has a 3.2-liter, five-cylinder, four-stroke diesel engine operating at 2400 rpm. Fuel injection occurs from 20° BTDC to 5° ATDC. The engine has a volumetric efficiency of 0.95 and operates with fuel equivalence ratio of 0.8. Calculate:
    1. Time for one injection
    2. Fuel flow rate through an injector
    Hint – take Stoichiometric A/F ratio – 14.5 **[4]**
c) What do you understand by *Cetane number*? How is it defined and how is it used to compare different fuels? Compare it with biodiesel as the fuel in diesel engine. **[4]**
d) Why are there *piston rings* in the engine piston-cylinder arrangement? Explain different piston rings with the help of suitable diagram. **[4]**
e) What do you understand by *alternative fuels*? How renewable fuels are different from alternative fuels? Name three alternative fuels to gasoline. **[4]**

Q2. An engine working on the dual combustion cycle has a compression ratio of 15:1. The air-fuel ratio of the engine is 29:1, and calorific value of the fuel is 42000 kJ/kg. The heat is supplied half at constant volume and the other half at constant pressure. Assume $\gamma = 1.4$ (for compression and expansion), $R = 0.287$ kJ/kg K and $C_v = 0.709 + 0.000028T$ kJ/kg K. If the temperature and pressure at the beginning of compression are 35 ˚C and 1 bar respectively,

a) Write down the major differences in assumptions between an air standard cycle and fuel-air cycle. **[3]**
b) Calculate all the state points (pressure and temperature), and present them in a tabulated form. **[10]**

c) Calculate all the state points if it is assumed an air standard cycle and present them in a tabulated form. Compare your results that with point (b) and present explanations. Take C_p = 1.005 kJ/kg K. **[7]**
d) Draw a P-V diagram for both fuel-air and air-standard dual cycles for the above cases. **[5]**

Q3. Eight-cylinder four-stroke SI engine of 80 mm bore and 100 mm stroke is tested at 4500 rpm on a dynamometer which has 55 cm arm. The dynamometer scale reading is 40 kg. The time for 100 cc of fuel consumption is recorded as 9.5 seconds and the calorific value of fuel is 44,000 kJ/kg. Air at 1 bar and 27°C is supplied to the carburettor at the rate of 6 kg/minute. Assume specific gravity of fuel to be 0.7. Clearance volume of each cylinder is 65 cc. Determine the following:

a) Brake power, **[2]**
b) Brake mean effective pressure (bmep), **[2]**
c) Brake specific fuel consumption (bsfc), **[2]**
d) Air/fuel ratio, **[2]**
e) Brake thermal efficiency, **[2]**
f) Volumetric efficiency **[2]**
g) Relative efficiency **[3]**