Indian Institute of Technology Kharagpur

Department of Mechanical Engineering

ATF-1 (Internal Combustion Engine) ME41001

Tutorial 2

Date: January 31, 2018

1. A two liter four-stroke indirect injection diesel engine is designed to run at 4500 rpm with a power output of 45 kW; the volumetric efficiency is found to be 80 per cent. The bsfc is 0.071 kg/MJ and the fuel has a calorific value of 42 MJ/kg. The ambient conditions for the test were 20^0C and 1 bar. Calculate bmep, the thermal efficiency and the air fuel ratio.

    (6 bar, 32% and 22.3)

2. A four-stroke 3 liter V6 spark ignition engine has a maximum power output of 100 kW at 5500 rpm, and a maximum torque of 236 Nm at 3000 rpm. The minimum bsfc is 0.090 kg/MJ at 3000 rpm, and the air flow rate is 0.068 m^3/s. The compression ratio is 8.9:1 and the mechanical efficiency is 90 per cent. The engine was tested under ambient conditions of 20^0C and 1 bar; take the calorific value of the fuel to be 44 MJ/kg.
   a) Calculate the power output at 3000 rpm and the torque output at 5500 rpm. **(74.14 kW, 173.6 Nm)**
   b) Calculate for both speeds the bmep and the imep. **(9.89 bar, 10.98 bar) (7.27 bar, 8.08 bar)**
   c) How does the mechanical efficiency at 3000 rpm compare with the corresponding air standard Otto cycle efficiency, k = 1.4 ? **(25.3 %, 58.3 %)**
   d) What is the volumetric efficiency and the air/fuel ratio at 3000 rpm? **(90.7 %, 12.12)**

3. A four-cylinder, four stroke petrol engine is to develop 40 kW at 40 rev/s when designed for a volumetric compression ratio of 10 to 1. The ambient air conditions are 1 bar and 18^0C, and the calorific value of the fuel is 44 MJ/kg.
   a) Calculate the specific fuel consumption in kg/MJ of brake work if the indicated overall efficiency is 50% of the corresponding air-standard Otto cycle, and the mechanical efficiency is 90%. The specific heat capacity ratio for air is 1.4. **(83.9gm/MJ)**
   b) The required gravimetric air-fuel ratio is 15.4 and the volumetric efficiency is 92%. Estimate the required total swept volume, the cylinder bore if the bore is to be equal to the stroke. Calculate also the brake mean effective pressure. **(2.35 L, 8.51 bar)**