Assignment Problem

ME 3302: IC Engines and Gas Turbines

Section: S2

Due Date: 21/4/2025 No. of page: 01

Course Instructor: Prof. Saroj Ray

1. A 4-cylinder, 4-stroke petrol engine is tested using the Morse test at full throttle and a constant speed of 2000 rpm. During the test, the brake power with all cylinders firing is measured to be 60 kW. When each cylinder is cut off one at a time, the corresponding brake power readings are recorded as follows: 45.5 kW with cylinder 1 cut off, 46.0 kW with cylinder 2 cut off, 45.0 kW with cylinder 3 cut off, and 46.5 kW with cylinder 4 cut off. The engine consumes fuel at a rate of 15 kg per hour, and the calorific value of the fuel is 44,000 kJ/kg. Calculate (a) the Indicated Power (IP) of each cylinder using Morse test data, (b) the total indicated power, (c) the friction power, (d) the mechanical efficiency, and (e) the brake specific fuel consumption.
2. Determine the air-fuel ratio of a four-stroke, single-cylinder, air-cooled engine with fuel consumption time for 10 cc is 20.4 s and air consumption time for 0.1 m^3 is 16.3 s. The load is 17 kg at the speed of 3000 rpm. Find also brake specific fuel consumption in g/kW.h and brake thermal efficiency. Assume the density of air as 1.175 kg/m^3 and specific gravity of fuel to be 0.7. The lower heating value of fuel is 43 MJ/kg and the dynamometer constant is 5000.
3. A gas-turbine power plant operates on the simple Brayton cycle between the pressure limits of 100 and 1600 kPa. The working fluid is air, which enters the compressor at 40°C at a rate of 850 m^3/min and leaves the turbine at 650°C. Assuming a compressor isentropic efficiency of 85 percent and a turbine isentropic efficiency of 88 percent. Determine (a) the compressor work, (b) the turbine work, (c) the net power output, and (d) the thermal efficiency. Use constant specific heats with C_v = 0.821 kJ/kg·K, and C_p = 1.108 kJ/kg·K.
4. A gas turbine unit works on an air-standard Brayton cycle. The pressure ratio across the compression is 6. Air enters the compressor at 1 bar and 27^{o}C. The maximum temperature of the cycle is 850^{o}C. Both the compressor and turbine isentropic efficiency of 85 percent. Calculate (a) the compressor work, (b) the turbine work, (c) the specific output of the cycle, and (d) the power developed by the unit for a mass flow rate of 10 kg/s. Would you recommend this cycle for a reciprocating engine? For air γ = 1.4 and C_p = 1.005 kJ/kg K. Also draw the T-S and P-V diagram.