Exam.Code:0940
Sub. Code: 7046

2010

B.E. (Mechanical Engineering) Fourth Semester

MEC-401: Applied Thermodynamics – II

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: *Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Unit.*

x-x-x

I. Answers the following:-
   a) What is Prewhirl? Explain with the help of velocity triangles.
   b) How Supercharging effect the efficiency of IC engines? What are superchargers?
   c) How the IC engine fuels are rated?
   d) Write the name of two solid propellants?
   e) Which type of compression process uses minimum work? Sketch PV and TS diagram. (5x2)

UNIT – I

II. a) Explain the stages of combustion in a CI engine.

   b) A four cylinder, four stroke engine is supplied with 15.25 kg of air/kg of octane fuel having heat value 10650 kcal/ kg. Calculate (i) The compression ratio. (ii) Brake specific fuel consumption (iii) bore and stroke; (iv) b.m.e.p. The following data may be assumed:- air standard efficiency: 0.53, relative efficiency: 0.70, mechanical efficiency: 0.8; volumetric efficiency: 0.8; stroke equal 1.25 times the bore; suction conditions are 1 kgf/cm^2 and 60 °C the engine runs at 2400 rev/min and develops 96 brake power.

III. Air is drawn in a gas turbine unit at 15° C, 1.01 bar and pressure ratio is 7:1. The compressor is driven by the HP turbine and LP turbine drives a separate power shaft. The isentropic efficiencies of compressor, HP turbine and LP turbines are 0.82, 0.85 and 0.85 respectively. If the max cycle temperature is 610° C, calculate: pressure and temperature of the gases entering the power turbine, net power developed by the unit per kg/sec mass flow, work ratio and thermal efficiency of the unit. Neglect the mass of fuel and assume: for compression process Cpa = 1.005 KJ/KgK and Y = 1.4, for combustion and expansion process: Cpg = 1.15 KJ/KgK and Y= 1.333. (10)

IV. The following data pertains to a turbojet flying an altitude of 9500 m: speed of turbojet = 800Km/hr, propulsive efficiency = 55%, overall efficiency of turbine plant = 17%, density of air at 9500 m altitude = 0.17 Kg/m^3, drag on the plane 6100 N. Assuming calorific value of the fuels use as 46000 KJ/Kg calculate. Absolute velocity of the jet, volume of air compressed /Min, diameter of the jet, power output of the unit and air fuel ratio. (10)

P.T.O.

UNIT – II

V. a) Explain the phenomenon of 'surging and choking' in a centrifugal compressor.

b) Free air of $30m^3$/min is compressed from 101.3Kpa to 2.23Bar. Determine the power required if

i) if roots blower is used.

ii) if vane blower is used assume there is 25% reduction in volume before back flow occurs. Also find isentropic efficiency in each case. (2x5)

VI. a) Explain the phenomena of slip and drive a relation for the calculation of slip factor using velocity triangles.

b) Drive a relation for Euler's work in case of centrifugal compressor using velocity triangles. (2x5)

VII. An axial flow compressor with an overall isentropic efficiency of 85% draws air at 20° C and compresses it in the pressure ratio of 4:1. The mean blade speed and flow velocity are constant throughout the compressor. Assuming 50% reaction blading and taking blade velocity as 180m/sec and work input factor as 0.82. Calculate: Flow velocity and number of stages. Take $\alpha 1 = 12°$ $\beta 1 = 42°$. (10)

x-x-x