USN | | | | | | | | | | |

10ME/AU43

Fourth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define:
i) Enthalpy of formation.
ii) Enthalpy of combustion.
iii) Stoichiometric air.
iv) Excess air and
v) Adiabatic flame temperature. **(10 Marks)**

b. The products of combustion of an unknown hydro carbon C_xH_y have the following composition as measured by an orsat apparatus: CO_2 = 8.0%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%.
Determine:
i) The composition of the fuel.
ii) The air/fuel ratio and
iii) The percent excess air used. **(10 Marks)**

2 a. With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of diesel cycle. **(10 Marks)**

b. An ideal diesel cycle running at 2000rpm, has a compression ratio of 20 and uses air as the working fluid. The state of air at the beginning of the compression process is 95kPa and 20°C. If the maximum temperature in the cycle is not to exceed 2200K, Determine: i) Thermal efficiency; ii) Mean effective pressure; iii) Net work output per unit mass of air; iv) Specific air consumption in kg/s and Take density air = 1.225 kg/m^3. **(10 Marks)**

3 a. Explain briefly Morse test. **(06 Marks)**

b. Explain the heat balance sheet. **(04 Marks)**

c. A 4 cylinder gasoline engine operates on a 4 stroke cycle. The base of each cylinder is 70mm and the stroke is 90mm. Clearance volume per cylinder is 70CC. At a speed of 3500 rpm, the fuel consumption is 20 kg/hr and torque developed is 150N-m. Calorific value of fuel is 42000 kJ/kg. IP of the engine is 72 kW. Calculate BP, BMEP, brake thermal efficiency, relative efficiency and ISFC. **(10 Marks)**

4 a. With the help of a schematic diagram and T-S diagram, explain the working of a regenerative vapour power cycle and derive an expression for the overall efficiency. **(08 Marks)**

b. An ideal Rankine cycle with reheat is designed to operate according to the following specification:
Steam at boiler outlet 150bar and 550°C.
Reheat at 40 bar to 550°C.
Condensor pressure -0.100 bar.
Using the Molier chart find:
i) Quality at turbine exit; ii) Cycle efficiency and iii) Steam rate. **(12 Marks)**

PART – B

5 a. Derive an expression for the minimum work input to a two stage compressor with perfect inter cooling between the stages. Also derive an expression for the ideal intermediate pressure for the same. **(10 Marks)**

b. A two stage air compressor with complete intercooling delivers air to the mains at a pressure of 30bar. Suction conditions are 1 bar and 15°C. If both cylinders have same stroke find ratio of cylinder diameter for maximum efficiency. **(10 Marks)**

6 a. Derive an expression for the optimum pressure ratio for the maximum network output in a brayton cycle. **(06 Marks)**

b. With the help of a schematic layout, explain the working of turbo prop jet engine. **(04 Marks)**

c. A gas turbine plant has temperature limit 1000°C and 10°C Compression and expansion process are isentropics. Determine:
   i) Pressure ratio which will give the maximum net workout put.
   ii) Maximum net specific work output.
   iii) Thermal efficiency of maximum work out put.
   iv) Carnot efficiency within the cycle temperature limits take $\gamma = 1.4$, CP = 1.005 kJ/kg K. **(10 Marks)**

7 a. With a neat sketch, explain the working of vapour absorption refrigeration system. **(06 Marks)**

b. Explain the effect of superheating and subcooling on the vapour compression cycle with the help of T-S and P-H diagrams. **(04 Marks)**

c. A R-12 vapour compression refrigeration plant is to develop 5 tonnes of refrigeration. The condensor and evaporator temperatures are to be +40°C and -10°C respectively. Determine: i) The flow rate of refrigerant in kg/s; ii) The volume flow rate handled by the compressor; iii) The compressor discharge temperature; iv) The pressure ratio; v) The heat rejected to the condenser in kW; vi) The flash gas percentage after throttling; vii) COP and viii)The power required to drive the compressor. **(10 Marks)**

8 a. Distinguish between:
   i) Specific humidity and relative humidity.
   ii) Dry bulb temperature and wet bulb temperature.
   iii) Summer air conditioning and winter air conditioning. **(09 Marks)**

b. Atmospheric air at 1.0132 bar has a dbt of 32°C and a wbt of 26°C. Compute:
   i) The partial pressure of water vapour.
   ii) The specific humidity.
   iii) The dew point temperature.
   iv) The relative humidity.
   v) The degree of saturation.
   vi) The density of air in the mixture.
   vii) The density of vapour in the mixture and
   viii) The enthalpy of the mixture. **(11 Marks)**

* * * * *