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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:
- Enthalpy of formation.
 - Enthalpy of combustion.
 - Stoichiometric air.
 - Excess air and
 - 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:
- The composition of the fuel.
 - The air/fuel ratio and
 - 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:
- Thermal efficiency;
 - Mean effective pressure;
 - Net work output per unit mass of air;
 - Specific air consumption in kg/s and Take density air = 1.225 kg/m³. (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 bore 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:
- Quality at turbine exit;
 - Cycle efficiency and
 - 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:
- Pressure ratio which will give the maximum net work out.
 - Maximum net specific work output.
 - Thermal efficiency of maximum work out put.
 - Carnot efficiency within the cycle temperature limits take $\gamma = 1.4$, $C_p = 1.005$ 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 condenser and evaporator temperatures are to be +40°C and -10°C respectively. Determine:
- The flow rate of refrigerant in kg/s;
 - The volume flow rate handled by the compressor;
 - The compressor discharge temperature;
 - The pressure ratio;
 - The heat rejected to the condenser in kW;
 - The flash gas percentage after throttling;
 - COP and
 - The power required to drive the compressor. (10 Marks)
- 8 a. Distinguish between:
- Specific humidity and relative humidity.
 - Dry bulb temperature and wet bulb temperature.
 - 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:
- The partial pressure of water vapour.
 - The specific humidity.
 - The dew point temperature.
 - The relative humidity.
 - The degree of saturation.
 - The density of air in the mixture.
 - The density of vapour in the mixture and
 - The enthalpy of the mixture. (11 Marks)
