CBCS Scheme

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10MR43

Fourth Semester B.E. Degree Examination, June/July 2017
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Explain the following terms with reference to a combustion process.
i) Percent excess air ii) Enthalpy of formation
iii) Adiabatic flame temperature iv) Enthalpy of combustion. **(08 Marks)**

b. The products of combustion of an unknown hydrocarbon 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 percentage excess air used. **(08 Marks)**

OR

2 a. Distinguish between : i) Theoretical air and excess air
ii) Higher calorific values and lower calorific values. **(06 Marks)**

b. Propane (C_3H_8) is burnt in atmospheric air and the mass analysis of the dry products of combustion is as follows: CO_2 = 12.19%, CO = 1.23%, O_2 = 7.57 and the balance N_2. Determine: i) The volumetric analysis of the dry products ii) Percent theoretical air. **(10 Marks)**

Module-2

3 a. Explain briefly about Morse test. **(04 Marks)**

b. Explain the heat balance sheet. **(03 Marks)**

c. The following observations were recorded in a test of one hour duration on a single cylinder oil engine working on four stroke cycle Bore = 300mm, Stroke = 450mm, Fuel used = 8.8 kg, Calorific value of fuel = 41800 kJ/kg, Average speed = 200rpm, Mean effective pressure = 5.8bar, Brake friction load = 1860N, Quality of Cooling water = 650kg, Temperature rise = 22°C, Diameter of the brake wheel = 1.22m.
Calculate: i) Mechanical efficiency ii) Brake thermal efficiency.
Draw the heat balance sheet. **(09 Marks)**

OR

4 a. Obtain an expression for the volumetric efficiency of single stage air compressor in terms of pressure ratio, clearance volume and 'n' the polytropic index. **(08 Marks)**

b. An air compressor takes in air at 1br and 20°C and compressor the same according to the law $PV^{1.2}$ = constant. It is then delivered to a receiver at a constant pressure of 10 bar. If R for air = 0.287 kH/kg K. determine :
i) Temperature at the end of compression
ii) Workdone and heat transferred during compression per kg of air. **(08 Marks)**

Module-3

5 a. With the help of a schematic diagram and T-S diagram, explain the working of regenerative vapour power cycle and derive an expression for the overall efficiency. **(07 Marks)**

b. A cycle steam powerplant is to be design for a steam temperature at turbine inlet of 360°C and an exhaust pressure of 0.08 bars. After isentropic expansion of steam in the turbines, the moisture content at the turbine exhaust is not to exceed 15%. Determine the greatest allowable steam pressure at the turbine inlet, and calculate the Rankine cycle efficiency for these steam conditions. Estimate also the mean temperature of heat addition. **(09 Marks)**

OR

6 a. Derive an expression for efficiency of diesel cycle in terms of compression ratio, cut off ration and specific heats ratio. **(08 Marks)**

b. The minimum pressure and temperature in an Otto cycle are 100KPa and 27°C. The amount of heat added to the air per cycle 1500 kJ/kg.

i) Determine the pressures and temperatures at all points of the air standard otto cycles.

ii) Also calculate the specific work and thermal efficiency of the cycle for a compression ration 8:1.

Take for air: $C_v = 0.75$ kJ/kg K, and $\gamma = 1.4$. **(08 Marks)**

Module-4

7 a. Explain the working of a ramjet engine with the help of sketch. **(04 Marks)**

b. Write the advantages and disadvantages of a gas turbine plant. **(05 Marks)**

c. In a gas turbine, the compressor is driven by the high pressure turbine. The exhaust from the high pressure turbine gas to a free low pressure turbine which runs the load. the air flow rate is 20kg/s and the minimum and maximum temperatures are respectively 300K and 1000K. The compressor pressure ratio is 4. Calculate the pressure ratio of the low pressure turbine and the temperature of exhaust gases from the unit. The compressor and turbine are isentropic. C_p of air and exhaust gases = 1kJ/kg K and $\gamma = 1.4$. **(07 Marks)**

OR

8 a. Discuss with the help of t-s diagrams the three methods of improving the thermal efficiency of an open cycle gas power plant. **(07 Marks)**

b. Find the required air fuel ration in a gas turbine whose turbine and compressor efficiencies 85% and 80% respectively. Maximum cycle temperature is 875°C. The working fluid can be taken as air ($C_p = 1.0$ kJ/kg K, $\gamma = 1.4$) which enter's the compressor at 1 bar and 27°C. The pressure ratio is 4. The fuel used has calorific value of 42000 kJ/kg. There is a loss of 10% of calorific value in the combustion chamber. **(09 Marks)**

Module-5

9 a. With neat sketch, explain the working of vapour absorption refrigeration system. **(05 Marks)**

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

c. A vapour compression heat pump system uses R – 12 as the working fluid. The refrigerant enters the compressor at 2.4 bar, 0°C with a volumetric flow rate of $0.6 m^3$/min. compression is adiabatic to 9 bar, 60°C and the saturated liquid exits the condenser of 9 bar. Determine : i) the power input to the compressor ii) the heating capacity of the system iii) the co-efficient of performance iv) the isentropic compressor efficiency. **(07 Marks)**

OR

10 a. Define the following terms :

i) Dry bulb temperature (DBT) ii) Wet bulb temperature (WBT)

iii) Specific Humidity (SH) iv) Relative humidity (RH). **(08 Marks)**

b. The dry and wet bulb temperature of atmosphere air at 1atm (101.325 KPa) pressure are measured with a sling psychomotor and determined to be 25 and 15°C respectively. Determine : i) specific humidity ii) relative humidity iii) the enthalpy of air.

Use properties of tables only, without using psychrometic chart. **(08 Marks)**

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