LNMIIT
The LNM Institute of Information Technology

The LNM Institute of Information Technology

Mechanical - Mechatronics Engineering

ENGINEERING THERMODYNAMICS

End Term Examination

Time : 180 minutes **Date:**04/12/2017 **Max. Marks: 50**

Instruction: *i) All questions are compulsory, ii) Write all steps while answering the problems, iii) No data book is allowed, iv) Assume suitable data whenever necessary.*

Q.1 What is an absorption refrigeration cycle? How does it differ from a vapour compression cycle? [5]

Q.2 Explain with neat diagram the principle of Linde-Hampson system for liquefaction of air? [5]

Q.3 In a gas turbine plant the ratio of T_{max}/T_{min} is fixed. Two arrangements of components are to be investigated: (a) Single- stage compression followed by expansion in two turbines of equal pressure ratios with reheat to the maximum cycle temperature, and (b) compression in two compressors of equal pressure ratios, with intercooling to the minimum cycle temperature, followed by single stage expansion. If η_c and η_t are the compressor and turbine efficiencies, show that the optimum specific output is obtained at same overall pressure ratio for each arrangement. [5] [10]

If η_c is 0.85 and η_t is 0.9 and T_{max}/T_{min} is 3.5, determine the above pressure ratio for optimum specific output and show that with arrangement (a) the optimum output exceeds that of arrangement (b) by about 11%.

Q.4 In an air standard diesel cycle, the compression ratio is 16, and at the beginning of isentropic compression, the temperature is 15° C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of the constant pressure process is 1480° C. Calculate (a) the cut-off ratio, (b) the heat supplied per kg of air, (c) the cycle efficiency, and (d) the m.e.p. [5]

Q.5 A certain factory has an average electrical load of 1500 kW and requires 3.5 MJ/s for heating purposes. It is proposed to install a single extraction passout steam turbine to operate under the following conditions: [5]

Initital pressure 15 bar
Initial temperature 300° C
Condenser pressure 0.1 bar
Steam is extracted between the two turbine sections at 3 bar, 0.96 dry, and is isobarically cooled without subcooling in heaters to supply the heating load. The

internal efficiency of the turbine (in the L.P. section) is 0.80 and the efficiency of boiler is 0.85 when using oil of calorific value 44 MJ/Kg.
If 10% of boiler steam is used for auxiliaries calculate the oil consumption per day. Assume that the condensate from the heaters (at 3 bar) and that from the condenser (at 0.1 bar) mix freely in a separate vessel (hot well) before being pumped to the boiler. Neglect extraneous losses.

Q.6 Dry saturated steam at 40 bar expands in a turbine isentropically to the condenser pressure of 0.075 bar. Hot gasses available at 2000 K, and at 1 atm pressure are used for steam generation and then exhausted at 450 K to the ambient temperature which is at 300K and 1 atm. The heating rate provided by the gas stream is 100 MW. Assuming c_p of hot gasses as 1.1 kJ/Kg K, give an exergy balance of the plant and compare it with the energy balance, and find the second law efficiency. [5]

Q.7 What is metallurgical limit? [5]

Q.8 How boilers are classified? Explain with neat sketch water tube boiler(any one). [5]

Q.9 What is the effect of reheat on (a) the specific output, (b) the cycle efficiency, (c) steam rate, and (d) heat rate, of steam power plant? [5]