Seat No. | | | | | | |

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Applied Thermodynamics
(1050)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory.
5. Attempt **any two** sub questions from each unit.
6. Use of steam Table, Mollier Chart, Non Programmable calculator is allowed.
7. Neat diagrams must be drawn wherever necessary.
8. Assume suitable data, if necessary.

UNIT - I

1. a) Discuss the following terms with reference to fuel and combustion. **10**

i) Enthalpy of Formation ii) Standard Reference state

iii) Theoretical Air iv) HCV

v) LCV.

b) Describe Boy's Gas calorimeter with neat sketch. **10**

c) A fuel having chemical formula $C_{12}H_{26}$ is burnt with 50%. excess air. Calculate the stoichiometric Air required and percentage analysis of products of combustion including water vapour. **10**

UNIT - II

2. a) Discuss the characteristics of a Good Boiler. Also list the factors affecting the selection of a Boiler. **10**

b) Explain with neat sketch : 10

i) Induced Draught ii) Forced Draught

iii) Balanced Draught

Discuss the advantages of Artificial Draught over Natural Draught.

c) Calculate the Equivalent Evaporation from and at 100 °C for a boiler, which receives water at 60 °C and produces steam at 1.5MPa and 300 °C. The steam generation rate is 16000 Kg/hr. Coal is burnt at the rate of 1800 Kg/hr. The calorific value of coal is 34750 KJ/kg. Also calculate the thermal efficiency of boiler.

If the thermal efficiency of boiler increased by 5% due to use of economiser, find the saving in coal consumption per hour. 10

UNIT - III

3. a) List various types of surface condensers. Discuss the reasons for in efficiency in surface condensers. 10

b) A steam power plant operates on a theoretical reheat cycle. The steam from boiler at 150 bar and 550 °C expands through the high pressure turbine. It is reheated at constant pressure of 40bar to 550 °C and expands through the low pressure turbine to a condenser pressure of 0.1 bar. Draw T - S and h - s diagrams find.

a) Quality of steam of turbine exhaust

b) Thermal efficiency of the cycle.

c) Steam rate in Kg/kwh. 10

c) A vacuum of 710 mm of Mercury was recorded in a condenser when the barometer reads 755 mm of mercury. The temperature of the condensate was 25 °C. Calculate the pressure of steam and air in condenser and mass of air per kg of steam. Also calculate the vacuum efficiency. 10

UNIT - IV

4. a) What do you mean by metastable expansion of steam in a nozzle ? Discuss the effects of supersaturation. 10

b) Define and explain : **10**

i) Mach Number ii) Critical pressure

iii) Sonic velocity iv) Nozzle Efficiency

v) Super saturated Flow.

c) In a convergent divergent nozzle, the steam enters at 15 bar and 300 °C and leaves at a pressure of 2 bar. The inlet velocity to the nozzle is 150 m/s. Find the required throat and exit areas for mass flow rate of 1 Kg/s.
Assume nozzle efficiency to be 90 percent and Cps = 2.4 KJ/kgK. **10**

UNIT - V

5. a) What is the necessity of multi - stage compression ? Explain with neat diagram, the working of multi - stage reciprocating compressors. Also list the advantages and disadvantages. **10**

b) Discuss the methods for improving Isothermal Efficiency of compressor. **10**

c) A two cylinder single acting air compressor is to deliver 16kg of air per minute at 7 bar from suction conditions 1bar and 15 °C. Clearance may be taken as 4% of Stroke volume and the index for both compression and re - expansion as 1.3. Compressor is directly coupled to a four cylinder four stroke patrol engine which runs at 2000 rpm with a brake mean effective pressure of 5.5 bar. Assuming a stroke - bore ratio of 1.2 for both engine and compressor and a mechanical efficiency of 82% for compressor, calculate the required cylinder dimensions. **10**

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