Total No. of printed pages = 3

ME 181501

Roll No. of candidate | | | | | | | | | | |

17/12/22 **2021**

B.Tech. 5th Semester End-Term Examination

ME

APPLIED THERMODYNAMICS - I

(New Regulation & New Syllabus)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

1. Answer any four questions from the followings: $(4 \times 2\frac{1}{2} = 10)$

   (a) Define four thermodynamic properties of steam with their SI units for solving engineering problem.

   (b) Differentiate between adiabatic process and isothermal process.

   (c) Draw the P-V and T-S diagram of a basic steam power plant cycle.

   (d) Draw T-S diagram of two improved methods of basic steam power plant cycle.

   (e) State two laws of thermodynamics that are applied in a steam power plant.

   (f) Construct a rough sketch of Mollier diagram and show important lines in it.

2. Answer any four questions from the followings: $(4 \times 5 = 20)$

   (a) Draw a suitable sketch of Cochran boiler and label the various components.

   (b) Express the various methods to measure the evaporating capacity of a steam generator.

   (c) Describe in brief the influence of convergent and divergent part of a nozzle on steam velocity.

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(d) Deduce the expression of critical pressure ratio in terms of index of expansion for maximum discharge condition of steam flow through a nozzle.

(e) Classify steam turbine on the basis of (i) action of steam and (ii) direction of steam flow.

(f) Illustrate the working of steam condenser with suitable diagram.

3. Answer any four questions from the followings: $(4 \times 5 = 20)$

(a) A steam generator evaporates 18200 kg/hr of steam at 14 bar and a quality of 0.98 from feed water at 102°C when coal is burned at the rate of 2050 kg /hr. If the efficiency of the boiler is 63% then evaluate the caloric value of coal in kJ/kg used for steam generation.

(b) Steam is expanded frictionless adiabatically in a steam nozzle from 5 bar and 400°C to 1 bar. If the initial velocity of steam entering the nozzle is 90 m/sec then evaluate the exit velocity of steam.

(c) In a steam turbine, steam is supplied at 12 bar and dry-saturated. The condenser pressure is 0.8 bar. Determine the efficiency of the steam power cycle.

(d) Estimate the flow rate of cooling water in kg per hour in a condenser which takes 12,500 kg of steam per hour. The steam enters at 0.08 bar with dryness fraction 0.94. The condensate leaves at 38°C. The inlet temperature and outlet temperature of water flowing through the condenser are 12°C and 22°C respectively.

(e) Evaluate the value of blade efficiency of the impulse turbine from following data available.

Mean diameter of blade=1.2 m

Turbine speed=3000 RPM

Nozzle angle=20°

Inlet blade angle=25°

Outlet blade angle=18°

Blade velocity coefficient=0.92

(f) Determine the height of the chimney of a boiler based on the following data:

Equivalent draught produced=18 mm of water

Flue gas temperature=278°C

Ambient temperature=25°C

Minimum amount of air per kg of fuel=17230 gm

4. Answer any four questions from the followings: $(4 \times 2\frac{1}{2} = 10)$

(a) Distinguish between fire tube boiler and water tube boiler.

(b) Differentiate between boiler mountings and boiler accessories.

(c) Distinguish between the working of impulse turbine and reaction turbine.

(d) Distinguish between Jet condenser and surface condenser.

(e) Compare the relative advantages between different methods of steam turbine governing.

(f) Compare the working performance between Back pressure turbine and pass-out turbine.

5. Answer any TWO questions from the followings: $(2 \times 5 = 10)$

(a) Deduce that unavailable energy is the product of lowest temperature of heat rejection and the change of entropy during the process.

(b) Illustrate Keenan function and Gibb's function with their mathematical expressions.

(c) Explain the terms Irreversibility and Effectiveness.

(d) Differentiate between available energy and unavailable energy