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Total No. of Questions: 09 **Total No. of Pages: 02**

B. Tech (Marine Engineering/ME) (Sem. 3)
APPLIED THERMODYNAMICS-I
Subject Code: BTME-304
Paper ID: A1141

Time: 3 Hrs. **Max. Marks: 60**

INSTRUCTIONS TO CANDIDATES:

1. **Section A is COMPULSORY consisting of TEN questions carrying TWO marks each**
2. **Section B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **Section C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION A

1. Write briefly:

a. Why excess air is supplied for combustion?
b. Why S.I. engines are not supercharged?
c. Define dryness fraction of steam?
d. What are the methods by which artificial draught is produced?
e. What are the advantages of Rankine cycle over Carnot cycle?
f. Define nozzle efficiency through (h-s) diagram?
g. Define stage efficiency of an impulse turbine?
h. Define pressure compounding of steam turbine?
i. Define degree of reaction?
j. State various components of a condensing plant?

SECTION B

2. Explain the stages of combustion in C.I. engines.

3. Sketch and describe a Lancashire boiler and indicate the flow path of gases on it.

4. The velocity of steam at inlet to a simple impulse turbine is 1000 m/s and the nozzle angle is 20°.The mean blade speed is 400 m/s and the blades are symmetrical. The mass flow rate of steam is 0.75 kg/s. The friction effects on the blades are negligible. Estimate: (a) the blade angles; (b) the tangential force on the blades; (c) the axial thrust; (d) the diagram power; and (e) the diagram efficiency.

5. Derive an expression for maximum discharge through convergent divergent nozzle for steam.

6. A surface condenser is designed to handle 10000 kg of steam per hour. The steam enters at 0.08 bars and 0.9 dryness and the condensate leaves at the corresponding saturation temperature. The pressure is constant throughout the condenser. Estimate the cooling water flow rate per hour, if the cooling water temperature rise is limited to 10° C.

SECTION C

7. Describe the thermodynamic processes involved in Rankine cycle and sketch them on (T-S) and (h-s) diagram. What are the methods of improving Rankine cycle efficiency? Explain in brief.

8. The following observations were made on a boiler plant during one hour test: Steam pressure = 20 bar; Steam generated= 37500 Kg; Temperature of water entering the economiser = 15°C; Temperature of water leaving the economiser = 90°C; Fuel used = 4400 Kg; Energy of combustion of fuel = 30000 KJ/Kg. Calculate: (a) The equivalent evaporation per kg of fuel; (b) The thermal efficiency of the plant; and (c) The percentage heat energy of the fuel energy utilized by the economiser.

9. A steam power plant uses the following cycle: Steam at boiler = 150 bar, 550° C; Reheat at 40 bar to 550° C; Condenser pressure = 0.1 bar. Using Mollier chart and assuming ideal processes, find: (a) Quality of steam at turbine exhaust; (b) Cycle efficiency; and (c) Steam rate.