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B.TECH
(SEM IV) THEORY EXAMINATION 2022-23
APPLIED THERMODYNAMICS

Time: 3 Hours ***Total Marks: 70***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2x7=14

(a) What do you mean by brake power and indicated power?
(b) Sketch and discuss the pV and Ts diagram of dual cycle..
(c) Discuss the effect of pressure and temperature on Rankine cycle.
(d) Explain Equivalent evaporation of the boiler from and at 100^{o} C. What is its importance?
(e) State the comparison between Jet and Surface condenser.
(f) State the comparison of Rankine and Carnot cycle.
(g) State the classification of propulsion device.

SECTION B

2. Attempt any *three* of the following: 7x3=21

(a) Derive an expression of efficiency of Diesel cycle.
(b) Explain the sequence of operations of Rankine cycle with the help of P-V, T-S and H-S diagrams. Also discuss the effect of pressure of steam at inlet to turbine, temperature at inlet to turbine upon Rankine cycle performance.
(c) The following data were taken during the test on a boiler for a period of one hour: Steam generated =5000 kg, coal burnt =700kg, calorific value of coal =31402kJ/kg dryness fraction =0.92. If the boiler pressure is 1.2MPa and the feed water temperature is 45^{0}C, find the boiler equivalent evaporation and the thermal efficiency of the boiler.
(d) Prove that the maximum discharge of fluid per unit area through a nozzle shell occur when the ratio of fluid pressure at throat to the inlet pressure is $(2/n+1)^{n/n-1}$, where n is the index of adiabatic expansion.
(e) Describe the principle of jet propulsion. Discuss the working of Turbojet and Turboprop engines.

SECTION C

3. Attempt any *one* part of the following: 7x1=7

(a) A large four-stroke cycle diesel engine runs at 2000 r.p.m. The engine has a displacement of 25 litres and a brake mean effective pressure of 0.6 MN/m^2. It consumes 0.018 kg/s of fuel (calorific value =42000kJ/kg).Determine the brake power and brake thermal efficiency.
(b) Explain the following:
(i) Morse Test (ii) Willian's line method.

4. Attempt any *one* part of the following: 7x1=7

(a) What is meant by heat of reaction? In what way it differs from enthalpy of formation?

(b) A reheat cycle has steam generated at 40 bar, 500ºC for being sent to high pressure turbine and expanded upto 5 bar before supplied to low pressure turbine. Steam enters at 5 bar, 400ºC into low pressure turbine after being reheated in boiler. Steam finally enters condenser at 0.05 bar and subsequently feed water is sent to boiler. Determine cycle efficiency, specific steam consumption and work ratio.

5. Attempt any *one* part of the following: 7x1=7

(a) Sketch and completely label a fire tube boiler and explain its working. Also differentiate between mountings and accessories.

(b) Determine the temperature of hot flue gases, natural draught produced and efficiency of chimney for maximum discharge through chimney having height of 80 m. Boiler furnace is supplied with 20 kg air per kg of fuel. The minimum temperature of hot gases with artificial draught is 110°C.Temperature of surroundings is 27°C and specific heat of flue gases is 1.0032 kJ/kg K.

6. Attempt any *one* part of the following: 7x1=7

(a) Explain with the help of neat sketch a single-stage impulse turbine. Also explain the pressure and velocity variations along the axial direction.

(b) A single stage steam turbine is supplied with steam at 6 bar , 250^0C at the rate of 50 kg/min. It expands into a condenser at a pressure of 0.4 bar. The blade speed is 450m/s. The nozzle is inclined at an angle of 25^0 to the plane of the wheel and the outlet blade angle is 32^0. Neglecting friction losses, determine the power developed, blade efficiency and stage efficiency.

7. Attempt any *one* part of the following: 7x1=7

(a) Describe with the neat sketches the working of a simple constant pressure open cycle gas turbine. How does the actual cycle differ from the theoretical cycle?

(b) In a gas turbine installation air is supplied at 1 bar, 27ºC into compressor having compression ratio of 8. The air leaving combustion chamber is heated upto 1100 K and expanded upto 1 bar. A heat exchanger having effectiveness of 0.8 is fitted at exit of turbine for heating the air before its inlet into combustion chamber. Assuming polytropic efficiency of the compressor and turbine as 0.85 and 0.90 determine cycle efficiency, work ratio and specific work output of plant. Take c_p = 1.0032 kJ/kg ·K for air.