



Paper id: 252780

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Subject Code: BME401

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**BTECH**  
**(SEM IV) THEORY EXAMINATION 2024-25**  
**APPLIED THERMODYNAMICS**

**TIME: 3 HRS****M.MARKS: 70****Note:** Attempt all Sections. Steam table allowed. In case of any missing data; choose suitably.**SECTION A****1. Attempt all questions in brief.****02 x 7 = 14**

Q no.	Question	CO	Level
a.	State the difference between Otto and Diesel cycles.	1	K1
b.	What is the effect of superheating on the efficiency of the Rankine cycle?	3	K2
c.	Define Higher Heating Value (HHV) and Lower Heating Value (LHV).	2	K1
d.	Name two boiler mountings and two accessories.	3	K1
e.	What is choked flow in a nozzle?	4	K1
f.	Differentiate between impulse and reaction turbines.	5	K2
g.	List two advantages of using a regenerator in a gas turbine cycle.	3	K2

**SECTION B****2. Attempt any three of the following:****07 x 3 = 21**

a.	The output of an I.C. engine is measured by a rope brake dynamometer. The diameter of the brake pulley is 750 mm and rope diameter is 50 mm. The deadload on the tight side of the rope is 400 N and the spring balance reading is 50 N. The engine consumes 4.2 kg/h of fuel at rated speed of 1000 r.p.m. The calorific value of fuel is 43900 kJ/kg. Calculate: (i) Brake specific fuel consumption, and (ii) Brake thermal efficiency.	1	K3
b.	In a steam turbine steam at 20 bar, 360°C is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes, find per kg of steam the net work and the cycle efficiency.	3	K3
c.	Explain the working of a surface condenser with a neat sketch. Discuss the impact of air leakage on condenser performance.	3	K3
d.	Derive the expression for maximum mass flow rate per unit area in a convergent nozzle. Define nozzle efficiency.	4	K3
e.	Explain the working of a turbojet engine with a neat diagram.	3	K3

**SECTION C****3. Attempt any one part of the following:****07 x 1 = 07**

a.	In an air standard Diesel cycle, the compression ratio is 16 and cut-off ratio is 2.5. Calculate the thermal efficiency.	1	K3
b.	Explain the working of a turbocharger with a neat diagram. How does it differ from a supercharger?	1	K3

**4. Attempt any one part of the following:****07 x 1 = 07**

a.	The chemical formula for alcohol is $C_2H_6O$ . Calculate the stoichiometric air/fuel ratio by mass and the percentage composition of the products of combustion per kg of $C_2H_6O$ .	2	K3
b.	Derive the expression for adiabatic flame temperature for constant pressure combustion.	2	K3

**5. Attempt any one part of the following:****07 x 1 = 07**

a.	Define boiler draught. A boiler has chimney of 30 m height to produce natural	3	K3
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**TIME: 3 HRS****M.MARKS: 70**

	draught of 12 mm of water column. Ambient air temperature is 27°C and boiler furnace requires 20 kg of air per kg of fuel for complete combustion. Determine minimum temperature of burnt gases leaving chimney.		
b.	Explain working of feed water heater and superheater in a boiler. How do they improve boiler efficiency?	3	K3
<b>6. Attempt any one part of the following:</b>		<b>07 x 1 = 07</b>	
a.	Draw a velocity diagram for a single-stage impulse turbine. Derive expressions for work done and blade efficiency.	5	K3
b.	In a single stage impulse turbine the isentropic enthalpy drop of 200 kJ/kg occurs in the nozzle having efficiency of 96% and nozzle angle of 15°. The blade velocity coefficient is 0.96 and ratio of blade speed to steam velocity is 0.5. The steam mass flow rate is 20 kg/s and velocity of steam entering is 50 m/s. Determine and drawing velocity diagram <ul style="list-style-type: none"> <li>a. the blade angles at inlet and outlet if the steam enters blades smoothly and leaves axially.</li> <li>b. the blade efficiency</li> <li>c. the power developed in kW</li> <li>d. the axial thrust.</li> </ul>	5	K3
<b>7. Attempt any one part of the following:</b>		<b>07 x 1 = 07</b>	
a.	Air enters the compressor of a gas turbine plant operating on Brayton cycle at 101.325 kPa, 27°C. The pressure ratio in the cycle is 6. Calculate the maximum temperature in the cycle and the cycle efficiency. Assume $W_T = 2.5 W_C$ , where $W_T$ and $W_C$ are the turbine and the compressor work respectively. Take $\gamma = 1.4$ .	3	K3
b.	Explain the working of a turboprop engine with a neat diagram. How is it different from a turbojet?	3	K3