Paper id: 252780

Roll No: | | | | | | | | | | | | | |

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 measuredby a rope brake dynamometer. The diameter of the brakepulley is 750 mm and rope diameter is 50 mm. The deadload on the tight side of the rope is 400 N and the springbalance reading is 50 N. The engine consumes 4.2 kg/hof fuel at rated speed of 1000 r.p.m. The calorific value offuel 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°Cis expanded to 0.08 bar. It then enters a condenser, where itis condensed to saturated liquid water. The pump feeds backthe water into the boiler. Assume ideal processes, find perkg 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 thepercentage composition of the products of combustion perkg 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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	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 completecombustion. 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
6.	**Attempt any *one* part of the following:**	**07 x 1 = 07**	
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 nozzlehaving efficiency of 96% and nozzle angle of 15°. The blade velocity coefficient is 0.96 and ratio ofblade speed to steam velocity is 0.5. The steam mass flow rate is 20 kg/s and velocity of steam enteringis 50 m/s. Determineand drawing velocity diagram a. the blade angles at inlet and outlet if the steam enters blades smoothly and leaves axially. b. the blade efficiency c. the power developed in kW d. the axial thrust.	5	K3
7.	**Attempt any *one* part of the following:**	**07 x 1 = 07**	
a.	Air enters the compressor of a gas turbineplant operating on Brayton cycle at 101.325 kPa, 27°C. Thepressure ratio in the cycle is 6. Calculate the maximumtemperature in the cycle and the cycle efficiency. Assume $W_T = 2.5 W_C$, where W_T and W_C are the turbine and thecompressor 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