



PAPER ID-411542

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Subject Code: KME401

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BTECH
(SEM IV) THEORY EXAMINATION 2023-24
APPLIED THERMODYNAMICS

TIME: 3 HRS**M.MARKS: 100**

- Note:** 1. Attempt all Sections. In case of any missing data, choose suitably.
 2. Use of steam tables and mollier chart is allowed.

SECTION A**1. Attempt all questions in brief.****2 x 10 = 20**

Q no.	Question	Marks	CO
a.	Differentiate between stoichiometric, lean and rich A/F mixtures.	02	1
b.	Define adiabatic flame temperature.	02	1
c.	Draw the T-s diagram of a Binary Vapour cycle.	02	2
d.	Differentiate between LCV and HCV.	02	2
e.	Explain the performance parameters of a condenser.	02	3
f.	Differentiate between mountings and accessories.	02	3
g.	Explain the terms bleeding of turbines.	02	4
h.	Compare steam turbines and steam engines.	02	4
i.	Enlist the requirements of a good boiler?	02	3
j.	Define the stage efficiency of a gas turbine.	02	5

SECTION B**2. Attempt any three of the following:****3 x 10 = 30**

a.	A furnace burns fuel oil with the following composition by mass: Carbon (C): 86% and Hydrogen (H ₂): 14%. Calculate the following: a) The theoretical air required for complete combustion of 1 kg of fuel oil. b) The composition of the flue gases on a dry basis assuming complete combustion.	10	1
b.	Define boiler draught. Obtain the expression for the natural draught in terms of the height of water column.	10	3
c.	Explain the Regeneration cycle in detail with the help of T-s and p-v diagrams. Also, Give the expression of efficiency of the cycle.	10	2
d.	A convergent divergent nozzle expands air at 7 bar and 427°C into space at 1 bar. The throat area is 650mm ² and the exit area is 975mm ² . The exit velocity is found to be 680 m/s when the inlet velocity is negligible. Assuming negligible friction. Calculate a) Mass flow through the nozzle. b) Nozzle efficiency and coefficient of velocity.	10	4
e.	Describe the Brayton cycle. Explain how the actual Brayton cycle deviates from the ideal cycle due to practical considerations.	10	5

SECTION C**3. Attempt any one part of the following:****1 x 10 = 10**

a.	Derive the expression for efficiency of Otto cycle.	10	1
b.	A sample fuel has the percentage composition by weight as Carbon = 85%, Hydrogen = 12%, Oxygen = 1.5%, Nitrogen = 0.5% and Ash = 1%. Determine: (i) The stoichiometric air fuel ratio by mass, (ii) If 20% excess air is supplied, find percentage composition of dry flue gas by volume.	10	1

4. Attempt any one part of the following:**1 x 10 = 10**

a.	A boiler generates 7.5 kg of steam per kg of coal burnt at a pressure of 11 bar from feed water having a temperature of 70°C. The efficiency of boiler is 75%	10	3
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	and factor of evaporation 1.15. Specific heat of superheated steam at constant pressure is 2.3. Calculate: (i) Degree of superheat and temperature of steam generated (ii) Calorific value of coal in kJ/kg (iii) Equivalent evaporation in kg of steam per kg of coal.		
b.	Explain the construction and working of a Babcock and Wilcox boiler.	10	3

5. Attempt any one part of the following: 1 x 10 = 10

a.	Explain the following in detail: a) Cogeneration b) Combined Cycle	10	2
b.	A reheat Rankine cycle using water as the working fluid operates between 7.5 kPa and 17.0 MPa pressure limits. Steam is superheated to 550°C before it is expanded to the reheat pressure of 4.0 MPa. Steam is reheated to a final temperature of 550°C. Determine (a) the cycle thermal efficiency; (b) the specific steam consumption.	10	2

6. Attempt any one part of the following: 1 x 10 = 10

a.	Explain the supersaturated flow through nozzles. Also, explain Wilson's line.	10	4
b.	A single-stage impulse steam turbine operates with steam entering at a velocity of 600 m/s. The steam flows through nozzles and strikes the turbine blades at an angle of 20 degrees to the plane of the wheel. The blades are symmetrical and have a blade velocity of 250 m/s. Assume that the velocity of steam relative to the blades at exit is equal to the velocity of steam relative to the blades at inlet, and that the steam leaves the blades without any whirl component. 1. Calculate the absolute velocity of steam at exit. 2. Determine the inlet and outlet angles of the blades. 3. Calculate the power developed by the turbine if the mass flow rate of steam is 1.2 kg/s. 4. Determine the efficiency of the turbine.	10	4

7. Attempt any one part of the following: 1 x 10 = 10

a.	Explain the methods to improve the efficiency of a gas turbine cycle with the help of appropriate diagrams to illustrate the processes.	10	5
b.	Explain the principles of jet propulsion. Describe the working of a turbojet engine.	10	5