PAPER ID-421521

Subject Code: RME403

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

BTECH
(SEM IV) THEORY EXAMINATION 2021-22
APPLIED THERMODYNAMICS

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

Notes:

- *Attempt all Sections and Assume any missing data.*
- *Appropriate marks are allotted to each question, answer accordingly.*

SECTION-A	Attempt **All** of the following Questions in brief	Marks **(7X2=14)**
Q1(a)	What do you mean by air standard cycles? Discuss its significance.	
Q1(b)	State the comparison between Jet and Surface condenser.	
Q1(c)	Write the difference between the Otto cycle and the Diesel cycle.	
Q1(d)	How equivalent evaporation is used for the comparison of boilers?	
Q1(e)	What do you mean by thrust augmentation?	
Q1(f)	What is choked flow?	
Q1(g)	Explain the significance of choked flow in a nozzle.	

SECTION-B	Attempt **ANY THREE** of the following Questions	Marks **(3X7=21)**
Q2(a)	An IC engine working on a diesel cycle has a bore diameter of 150 mm and a stroke length of 260 mm respectively. If clearance volume is 0.0004 m^3 and fuel injection takes place at constant pressure for 5% of the stroke. Determine the thermal efficiency of the engine.	
Q2(b)	In an ideal Rankine cycle, the saturated steam enters the turbine at a pressure of 8 MPa and exits from the condenser as a saturated liquid at a pressure of 0.008 MPa. The net power output of the cycle is 100 MW. Determine: (i) the thermal efficiency of the cycle, (ii) the Work ratio, and (iii) the mass flow rate of the steam in kg/h.	
Q2(c)	What are the essentials of a good boiler? Differentiate between mounting and accessories. Explain the working at least one of each.	
Q2(d)	Explain the principle of working of steam impulse turbine. Explain the need for compounding in a steam turbine. Also, describe the pressure-velocity compounding with a neat diagram.	
Q2(e)	Explain the Brayton cycle with P-V and T-S diagram and obtain an expression for efficiency in terms of pressure and temp ratio.	

SECTION-C	Attempt **ANY ONE** following Question	Marks **(1X7=7)**
Q3(a)	Explain the Otto cycle with P-V and T-S diagram. Derive an expression for air standard efficiency of Otto cycle in terms of compression ratio.	
Q3(b)	A four-cylinder petrol engine working on a two-stroke cycle develops 30 kW at 2600 rpm. The mean effective pressure on each piston is found to be 8 bar. The calorific value of the fuel used is 44000 kJ/kg and brake thermal efficiency is 29%. Calculate the fuel consumption of the engine. Further determine the bore and stroke of each cylinder, If the stroke to bore ratio is 1.5. The mechanical is 80.8%.	

SECTION-C	Attempt **ANY ONE** following Question	Marks **(1X7=7)**
Q4(a)	What is the advantage of the combined cycle? Briefly discuss different types of combined cycles.	
Q4(b)	The volumetric composition of the dry products of combustion of an unknown hydrocarbon fuel C_xH_y gives: CO_2 = 12.1%, O_2 = 3.8%, CO = 0.9%, and N_2 = 83.2%. Determine: (i) the Chemical composition of the fuel, (ii) The air-fuel ratio, and (iii) the Percentage of excess air used.	

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SECTION-C	Attempt **ANY ONE** following Question	Marks **(1X7=7)**
Q5(a)	A boiler generates 7.5 kg of steam per kg of coal burnt at a pressure of 11 bar form of feed water having a temperature of 70°C. The efficiency of the boiler is 75% and the factor of evaporation is 1.15. The specific heat of steam at constant pressure is 2.3 KJ/kgK. Calculate : (D Degree of superheating and temperature of the steam generated (ii) Calorific value of coal in kJ/kg (iii) Equivalent evaporation in kg of steam per kg of coal	
Q5(b)	What is the function of a condenser? Give the classification of the condenser and also explain the Barometric jet condenser with a neat sketch?	

SECTION-C	Attempt **ANY ONE** following Question	Marks **(1X7=7)**
Q6(a)	What is a convergent-divergent nozzle? Derive the condition and expression for maximum discharge through a nozzle.	
Q6(b)	The following data belong to a single stage of Parson's steam turbine consisting of one ring of fixed blade and one ring of moving blades: Average diameter of blade ring = 70cm, Speed of turbine = 3000rpm, the Steam velocity at the exit from blades = 160m/sec, Blade outlet angle = 20°, the Steam flow rate through blades = 7 kg/sec. Draw the velocity diagram and find (i) blade angle at the inlet (ii) tangential force on the moving blades (iii) power developed in a stage.	

SECTION-C	Attempt **ANY ONE** following Question	**(1X7=7)**
Q7(a)	A simple gas turbine admits air at atmospheric pressure (1.013 bar) and 15°C and compresses air in the compressor up to 16 bar. Then, air enters the combustion chamber and is heated to a maximum temperature of 1350°C, further it enters the turbine and expands to the atmospheric pressure. The isentropic efficiency of the compressor and turbine is 85% each. Take combustion efficiency at 98%, drop of the pressure through the combustion chamber is 0.3 bar, specific heat at constant pressure for both air and gases is 1.005 kJ/kgK and the ratio of specific heats is 1.4. Determine the flow rate of air and gases for a net power of 200 MW. Neglect the mass of fuel.	
Q7(b)	Explain the working of the jet propulsion system and compare the working of Ram jet with Pulse jet engines.	