GATE Aerospace Coaching By IITians GATE CLASSES

First law applied to open

1). Air flows steadily at a rate of 0.25 kg/s through a turbine, entering at 10 m/s velocity, 100 kpa, 0.15 m^3/kg internal energy of out is 100 kJ/kg less than that of entering air. Heat losses are accounted at a rate of 10 KN. Air leaves at 5 m/s, 100 kpa, 0.3 m^3/kg. what is the change in enthalpy of the air,

(a). 50 kJ/kg (b). 60 kJ/kg (c). 55 kJ/kg (d). 0

2). In the above problem, what is the work delivered by the turbine?

(a). 55 KN (b). 45 KN (c). 35 KN (d). 30 KN

3). If the out let diameter in the pipe is 0.3 m, what is the inlet diameter? (consider data in question-1). Close to 4 decimals……(m)

4). Air enters a nozzle at a temperature of 2000 K and leaves at ambient temperature 300 K. Assuming air to follow ideal gas laws, the velocity of air at the exit of nozzle is (in m/s) (assume negligible inlet velocity)

(a). 58.45 m/s (b). 1848.5 m/s (c). 42.25 m/s (d). 100 m/s

5). If a heat loss of 180 kN/kg happens across the nozzle boundaries , then, the velocity of air at the exit will be (in m/s)?. close to (4 decimal places)……..,

6). A stream of methane and air in the ratio 1:10 (by mass) enter together as a mixture into an engine. At 30^0C and leave at 900^0C. the engine has a specific fuel consumption 0.1 kg/kwh. Net heat transfer rate from fuel air stream to the jacket cooling water is 30 KN. The power delivered by the engine is 20 KW.

Fid the mass flow rate of mixture required to deliver the given power.

(a). 0.05 kg/s (b). 0.005 kg/s (c). 0.006 kg/s (d). 0.007 kg/s

7). In the above problem, what is the change in specific enthalpy of the mixture (correct to 2 decimal places)……(kJ/kg mix)

8). A gas turbine takes in air at 1000 kpa and 400^0C and exhausts, to nozzle at 200 kpa, 300^0C. In the nozzle , the air is further expanded to 100kpa into atmosphere and temperature 300 K.

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What is the work delivered by the turbine (assume ideal gas)

(a). 1000 kW (b). 2000 kW (c). 3000 kW (d). 4000kW

9). What is the velocity of air coming out of the nozzle? Close to 2 decimals……..(Assume negligible inlet velocity)

10). What is the area of nozzle required to momentum the 40 kg/s mass flow rete? (Assume ideal gas law $p = \rho RT$ is value)

(a). 0.001 m^2 (b). 0.01 m^2 (c). 0.0564 m^2 (d). 0.08 m^2

11). An adiabatic heat exchange is used to heat cold water at 15^0C entering at a rate of 5 kg/s by hot air 90^0C also entering at rate of 5 kg/s. if the exit temperature of hot air is 20^0C, exit temperature of cold water is.,

(a). 27^0C (b). 32^0C (c). 52^0C (d). 85^0C

12). A thermodynamic process, requires that the working fluid be throttled, from a (higher) pressure 300 kpa to 100 kpa, while specific volume changes from 0.1 m^3/kg to 0.0100 m^3/kg. determine the change in internal energy.

(a). -92 kJ/kg (b). -29 kJ/kg (c). 72 kJ/kg (d). 29 kJ/kg

13). In the above process, if it is a real gad and if it were to be an ideal gas, what would be the expected temperature changes respectively?

(a). Increases, Increases (b). Increases, Decreases (c). Decreases, Increases

(d). Decreases, remains constant

14). An isolated rigid tank of volume 10 m^3 is initially evaluated. A supply line connects it to air at 2 bar, 350 K. after sometime, the tank equalizes is pressure to the supply line. What is the mass temperature of air present inside the tank (take r_{air}=1.4) Assume ideal gas behavior.