

Printed Pages : 4

EME303

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0430

Roll No.

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B.Tech**(SEM III) ODD SEMESTER THEORY EXAMINATION 2009-10
THERMODYNAMICS**

Time : 2 Hours]

[Total Marks : 50

- Note :**
- (1) Answer **all** questions.
 - (2) Use of steam tables and Mollier chart is permitted.
 - (3) Make **suitable** assumptions in case of missing data, if any and state the assumption made.

1 Answer any **four** of the following : 3.5×4

- (a) Briefly describe the 'principle of corresponding states' and 'quasi static process'.
- (b) State Zeroth law of thermodynamics and its application.

If temperature of a body is 26°C, then find its temperature in °K and °F.

- (c) Steam at 9 MPa and 600°C passes through a throttling process such that the pressure is suddenly dropped to 0.4 MPa. Find the expected temperature after throttling.

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- aktuonline.com (d) Air at 420°C and 7 kPa enters a nozzle aktuonline.com
at 400 m/s velocity and leaves at temperature of 255°C . For specific heat of air ($R=2875/\text{kg.K}$) at constant pressure as 1 kJ/kg.K determine the air velocity and mass per unit area at the exit of nozzle. What is first law of thermodynamics for a closed system?
- (e) Enlist the limitations of First law of thermodynamics.
- (f) Explain the 'free expansion' and 'hyperbolic process.'

2 Answer any **two** of the following : **6×2=12**

- (a) (i) A Carnot engine operates between **4**
temperatures T_1 and T_2 with efficiency η_1
and other Carnot engine operates between
temperatures T_2 and T_3 with efficiency η_2 .
Show that the Carnot engine operating
between temperatures T_1 and T_3 will have
efficiency given as $(\eta_1 + \eta_2 - \eta_1 \cdot \eta_2)$.
- (ii) Explain the perpetual motion machine of **2**
second kind and its relevance.
- (b) Three reversible engines operate in series **6**
between two heat reservoirs of extremities being
at 1000 K and 300 K . Considering the work
produced by each engine to be in the proportion
of $5:4:3$ determine temperature of intermediate
reservoirs.

Explain Carnot theorem and show that no engine working between two fixed temperatures can have efficiency greater than that of a reversible engine working between same temperatures.

3 Answer any **two** of the following : **6×2=12**

(a) Determine the change in entropy in each **6**
 processes for the definite quantity of air
 following three processes in thermodynamic cycle
 and also show them on p-V and T-s diagram.

Process 1-2 : Constant volume heating from
 1 bar, 288 K and 0.02 m³ to
 4.2 bar.

Process 2-3 : Constant pressure cooling.

Process 3-1 : Isothermal heating upto initial
 state.

Take $C_{p, \text{air}} = 1 \text{ kJ/kgK}$.

(b) Show that the change of entropy of a perfect **6**
 gas undergoing change of state from 1 to 2
 can be given as

$$s_2 - s_1 = m \left[c_v \ln \frac{p_2}{p_1} + c_p \ln \frac{v_2}{v_1} \right]$$

(c) (i) Determine the second law efficiency of an **3**
 engine having efficiency of 35% operating
 between reservoirs of 600 K and 300 K.
 (ii) Describe the 'Helmholtz function' and **3**
 'Gibbs function' briefly.



- (a) 2 kg of steam at pressure of 10 bar, 225°C 6
undergoes a reversible polytropic expansion
following index 1.2 upto pressure of 1 bar.
Determine the final temperature, work done and
heat transfer.
- (b) Explain the working of a two stroke SI engine 6
giving neat sketches and differentiate between
two stroke and four stroke spark ignition engine.
- (c) Explain simple Rankine cycle with neat 6
schematic diagram and also show different
processes involved in it on T-s diagram,
h-s diagram and p-v diagram.