PAPER ID-311253

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

B TECH
(SEM-III) THEORY EXAMINATION 2020-21
THERMODYNAMICS

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

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

Qno.	Question	Marks
a.	Define system.	2
b.	What do you mean by 'reversible work'?	2
c.	What do you mean by "Perpetual motion machine of first kind-PMM 1"?	2
d.	Define heat engine.	2
e.	What is the perpetual motion machine of the second kind?	2
f.	State the limitations of first law of thermodynamics.	2
g.	Define the term 'availability'.	2
h.	What is the effectiveness of a system?	2
i.	What is the difference between exergy and energy?	2
j.	What is a cycle?	2

SECTION B

2. Attempt any *three* of the following:

Qno.	Question	Marks
a.	0.2 m^3 of air at 4 bar and 130°C is contained in a system. A reversible adiabatic expansion takes place till the pressure falls to 1.02 bar. The gas is then heated at constant pressure till enthalpy increases by 72.5 kJ. Calculate: (i) The work done. (ii) The index of expansion, if the above processes are replaced by a single reversible polytropic process giving the same work between the same initial and final states. Take c_p = 1 kJ/kg K, c_v = 0.714 kJ/kg K.	10
b.	Describe the working of a Carnot cycle.	10
c.	Derive an expression for the change in entropy of the universe.	10
d.	Differentiate between availability function and Gibb's energy function.	10
e.	Derive expressions of efficiency in the following cases: (i) Carnot cycle (ii) Diesel cycle	10

SECTION C

3. Attempt any *one* part of the following:

Qno.	Question	Marks
a.	A cylindrical vessel of 60 cm diameter and 80 cm height contains 3.2 kg of a gas. The pressure measured with manometer indicates 60 cm of Hg above atmosphere when barometer reads 760 mm of Hg. Find: (i) The absolute pressure of the gas in the vessel in bar, and (ii) Specific volume and density of gas.	10
b.	State the First Law of Thermodynamics and prove that for a non-flow process, it leads to the energy equation Q = ΔU + W.	10

4. Attempt any *one* part of the following:

Qno.	Question	Marks
a.	In a gas turbine unit, the gases flow through the turbine is 15 kg/s and the power developed by the turbine is 12000 kW. The enthalpies of gases at the inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively, and the velocity of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate: (i) The rate at which heat is rejected to the turbine, and (ii) The area of the inlet pipe given that the specific volume of the gases at the inlet is 0.45 m3/kg.	10
b.	What do you mean by the term 'Entropy'? What are the characteristics of entropy?	10

5. Attempt any *one* part of the following:

Qno.	Question	Marks
a.	A heat engine is supplied with 278 kJ/s of heat at a constant fixed temperature of 283°C and the heat rejection takes place at 5°C. The following results were reported: (i) 208 kJ/s are rejected, (ii) 139 kJ/s are rejected, (ii) 70 kJ/s are rejected. Classify which of the results report a reversible cycle or irreversible cycle or impossible results.	10
b.	Derive expressions for entropy changes for a closed system in the following cases: (i) General case for change of entropy of a gas (ii) Heating a gas at constant volume	10

6. Attempt any *one* part of the following:

Qno.	Question	Marks
a.	Derive a general expression for irreversibility in (i) non-flow process, (ii) steady flow process.	10
b.	A system receives 10000 kJ of heat at 500 K from a source at 1000 K. The temperature of the surroundings is 300 K. If the temperature of the system and source remains constant during heat transfer, find: (i) The entropy production due to above mentioned heat transfer. (ii) Decrease in available energy.	10

7. Attempt any *one* part of the following:

Qno.	Question	Marks
a.	Briefly explain Brayton cycle. Derive expression for optimum pressure ratio.	10
b.	An engine working on Otto cycle has a volume of 0.5 m3, pressure 1 bar and temperature 27°C at the commencement of compression stroke. At the end of compression stroke, the pressure is 10 bar. Heat added during the constant volume process is 200 kJ. Determine: (i) Percentage clearance (ii) Air standard efficiency (iii) Mean effective pressure. (iv) Ideal power developed by the engine if the engine runs at 400 r.p.m. so that there are 200 complete cycles per minutes.	10