Registration No: | | | | | | | | | | |

Total Number of Pages: 03 **B.TECH**
PME3I103

3rd Semester Regular / Back Examination 2017-18
ENGINEERING THERMODYNAMICS
BRANCH: Mech,PT
Time: 3 Hours
Max Marks: 100
Q.CODE: B861

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1 Answer the following questions: multiple type or dash fill up type (2 x 10)

a) Which of the following is the extensive property of a thermodynamic system?
(a) Pressure (b) Volume
(c) Temperature (d) Density.

b) Absolute zero temperature is taken as……

c) In an irreversible process, there is a
(a) loss of heat (b) no loss of heat
(c) gain of heat (d) no gain of heat.

d) The absolute zero pressure will be
(a) when molecular momentum of the system becomes zero
(b) at sea level (c) at the temperature of – 273 K
(d) under vacuum conditions (e) at the centre of the earth.

e) Thermal efficiency of a gas turbine plant as compared to Diesel engine plant is
(a) higher (b) lower
(c) same (d) may be higher or lower.

f) The air standard Otto cycle comprises
(a) two constant pressure processes and two constant volume processes
(b) two constant pressure and two constant entropy processes
(c) two constant volume processes and two constant entropy processes
(d) none of the above.

g) Rankine cycle comprises of
(a) two isentropic processes and two constant volume processes
(b) two isentropic processes and two constant pressure processes
(c) two isothermal processes and two constant pressure processes
(d) none of the above.

h) In a refrigeration system the heat rejected at higher temperature = ... + ...

i) The C.O.P. for a Carnot refrigerator is ..... than that of Carnot heat pump.

j) Rankine cycle efficiency of a good steam power plant may be in the range of
(a) 15 to 20% (b) 35 to 45%
(c) 70 to 80% (d) 90 to 95% .

Q2 **Answer the following questions: Short answer type** **(2 x 10)**

a) Differentiate between open system, closed system and an isolated system.
b) Explain briefly zeroth law of thermodynamics.
c) Explain the quasi-static process.
d) What is an air-standard efficiency ?
e) What is a cycle ? What is the difference between an ideal and actual cycle ?
f) What are the basic component of steam power plant?
g) Describe the different operations of Rankine cycle
h) Define COP.
i) State merits and demerits of an air refrigeration system.
j) Explain the various operation of a Carnot cycle. Also represent it on a T-s and p-V diagrams.

Part – B (Answer any four questions)

Q3 **a)** A cylinder contains 1 kg of a certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to a law $PV^{1.2}$ = constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position; heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the net work done by the fluid, for an initial volume of 0.05 m^3 **(10)**

b) A gas having a volume of 0.05 m^3 and pressure of 6.9 bar expands reversibly in a cylinder behind a piston according to law $pv^{1.2}$ = constant until the volume is 0.08 m^3. Calculate the work done by the gas. Also sketch the process on a p-v diagram. **(5)**

Q4 **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 m^3/kg. **(10)**

b) Derive an expression for change in efficiency for a change in compression ratio. If the compression ratio is increased from 6 to 8, what will be the percentage increase in efficiency? **(5)**

Q5 **a)** Air enters the compressor of a gas turbine plant operating on Brayton cycle at 101.325 kPa, 27°C. The pressure ratio in the cycle is 6. Calculate the maximum temperature in the cycle and the cycle efficiency. Assume WT = 2.5 WC , where WT and WC are the turbine and the compressor work respectively. Take $\gamma = 1.4$. **(10)**

b) Explain “Air standard analysis” which has been adopted for I.C. engine cycles. State the assumptions made for air standard cycles. **(5)**

Q6 **a)** The atmospheric air at pressure 1 bar and temperature -5°C is drawn in the cylinder of the compressor of a Bell-Coleman refrigerating machine. It is compressed isentropically to a pressure of 5 bar. In the cooler, the compressed air is cooled to 15°C, pressure remaining the same. It is then expanded to a pressure of 1 bar in an expansion cylinder, from where it is **(10)**

passed to the cold chamber. Find: (i) the work done per kg of air.
(ii) C.O.P of the plant.

For air assume law for expansion $pv^{1.2} = C$, law for compression $pv^{1.4} = C$ and specific heat of air at constant pressure is 1kJ/kgK..

b) Explain the vapor absorption cycle refrigeration system. **(5)**

Q7 **a)** A engine uses 6.5 kg of oil per hour of calorific value 7160 kcal/kg. The BHP of engine is 30 HP and mechanical efficiency is 85%. Calculate the brake thermal efficiency and specific fuel consumption. **(10)**

b) Differentiate between 4-stroke engine and 2-stroke engine? **(5)**

Q8 **a)** A turbine is supplied with steam at a pressure of 32 bar and a temperature of 410°C. The steam then expands isentropically to a pressure of 0.08 bar. Find the dryness fraction at the end of expansion and thermal efficiency of the cycle. If the steam is reheated at 5.5 bar to a temperature of 395°C and then expanded isentropically to a pressure of 0.08 bar, what will be the dryness fraction and thermal efficiency of the cycle? **(10)**

b) Explain the Joule-Thomson coefficient **(5)**

Q9 **a)** Steam at a pressure of 15 bar and 250°C is expanded through a turbine at first to a pressure of 4 bar. It is then reheated at constant pressure to the initial temperature of 250°C and is finally expanded to 0.1 bar. Using Mollier chart, estimate the work done per kg of steam flowing through the turbine and amount of heat supplied during the process of reheat. Compare the work output when the expansion is direct from 15 bar to 0.1 bar without any reheat. **(10)**
Assume all expansion processes to be isentropic

b) Explain the Maxwell relations **(5)**