

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-III (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2131905

Date: 05/06/2017

Subject Name: Engineering Thermodynamics

Time: 10:30 AM to 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of steam table is permissible.

Q-1 (a) Answer the following MCQ (7)

i) Which one of the following is a closed system?

- (a) boiler (b) compressor (c) I C Engine (d) Bomb calorimeter.

ii) According to second law of thermodynamics

- (a) Work is completely converted into heat or heat is completely converted to work.
(b) Heat flows, naturally from cold body to hot body.
(c) Naturally, heat flows from cold body to hot body is not possible.
(d) Gas expands naturally from low pressure to high pressure.

iii) The maximum entropy means there is

- (a) Minimum availability for conversion into work.
(b) Minimum unavailability for conversion into work.
(c) Maximum availability for conversion into work.
(d) None of the above.

iv) Efficiency of Rankine cycle increases with

- (a) Superheating of steam (b) increasing boiler pressure
(c) Reducing condenser pressure (d) all of the above.

v) In regenerative feed heating vapour power cycle

- (a) large capacity boiler is required for a given output.
(b) smaller capacity condenser is required for a given output.
(c) turbine output decreases due to extraction of steam.
(d) all of the above.

vi) The compressibility chart gives best results in _____ for all gases.

- (a) Critical point (b) Vicinity of critical point
(c) any point (d) all of the above.

vii) The condition for the reversibility of a cycle is

- (a) The process must be free from internal and mechanical friction.
(b) The process should be quasi-static.

- (c) All the processes taking place in the cycle of operation, must be extremely slow.
(d) All of the above.

Q-1 (b) Fill in the blanks (7)

- i) Second law of thermodynamic defines _____ (Internal Energy/Entropy)
ii) Throttling is an irreversible process during which _____ remains constant of the fluid. (Enthalpy/ Entropy)
iii) Refrigerator and Heat pump works on _____ law of thermodynamics. (Zero/First/Second)
iv) For any irreversible process the net change in entropy is ____ (zero/ >1/ <1)
v) Value of cut-off ratio is always _____ than 1. (>1/ <1)
vi) By reheating final dryness fraction of steam is _____. (increases/decreases)
vii) If the cut-off ratio decreases the efficiency of diesel cycle _____. (increases/decreases)

Q-2 (a) i) State the Steady Flow Energy Equation. Explain the significance of S.F.E.E. in engineering applications. (3)

Q-2 (a) ii) State and explain the Perpetual motion machines of Second Kind (4)

Q-2 (b) Prove that all reversible engines working between the two constant temperatures Reservoirs have the same efficiency. (7)

OR

Q-2 (b) In a gas turbine unit, the gas flow through the turbine is 15 Kg/Sec. and the Power developed by the turbine is 12000 KW. The enthalpies of gases at 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 gases at inlet is 0.45 m³/kg. (7)

Q-3 (a) State the “Principle of increase of entropy”. Explain application of entropy principle with Any two suitable examples. (3)

Q-3 (b) State the comparisons of First law and Second law of thermodynamics. (4)

Q-3 (c) Two Carnot engines work in series between the source and sink temperatures of 550 K and 350 K. If both engines develop equal power determine the intermediate temperature. (7)

OR

Q-3 (a) Define following terms: (3)

- i) Available energy, ii) Unavailable energy, iii) Dead State.

Q-3 (b) Give the comparisons of microscopic and macroscopic point of view of Thermodynamics. (4)

Q-3 (c) What is irreversibility? State various types of irreversibilities and explain them. (7)

Q-4 (a) Define following terms: (3)

- i) Cut-off ratio, ii) Mean effective pressure, iii) Steam rate.

Q-4 (b) Explain in brief the characteristics of entropy. (4)

- Q-4 (c)** A heat engine receives 999KW of heat at constant temperature of 286°C . The heat is rejected at 6°C . The possible heat rejected are: (7)
(a) 850 KW, (b) 490 KW, (c) 400 Kw. State which of the results report a reversible Cycle or irreversible cycle or impossible result.

OR

- Q-4 (a)** Draw the schematic diagram of Simple Gas Turbine cycle with intercooling. Draw also T-S diagram of the cycle. (3)
- Q-4 (b)** State the comparisons of Carnot vapour cycle and Rankine cycle. (4)
- Q-4 (c)** A steam turbine power plant operating on ideal Rankine cycle, receives steam at 30 bar, 350°C at the rate of 2 Kg/S and it exhausts at 0.09 bar. Calculate the followings: (7)
i) Net power output, ii) Steam rate, iii) Heat rejection in condenser in KW,
iv) Rankine Cycle efficiency.

- Q-5 (a)** Draw Rankine cycle on three usual thermodynamic co-ordinates. (3)
- Q-5 (b)** Explain the effect of superheating of steam on the performance of Rankine cycle. (4)
- Q-5 (c)** Write a short note on Vander Waal's equation. (7)

OR

- Q-5 (a)** Compare Otto, Diesel and dual cycle for same compression ratio and heat supplied. (3)
- Q-5 (b)** An engine operating on Diesel cycle has maximum pressure and temperature of 45 bar and 1500°C . Pressure and temperature at the beginning of compression are 1 bar and 27°C . Determine air standard efficiency of the cycle. Take adiabatic index $\gamma = 1.4$. (4)
- Q-5 (c)** Explain adiabatic mixing of perfect gases. (7)