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

Total Number of Pages : 02 **B.Tech.**
PCME4205

4th Semester Back Examination 2017-18
ENGINEERING THERMODYNAMICS
BRANCH : MECH
Time : 3 Hours
Max Marks : 70
Q.CODE : C669

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

Q1 **Answer the following questions :** **(2 x 10)**

a) Why is an isentropic process not necessarily an adiabatic process?

b) What do you understand by exergy and anergy?

c) What are Helmholtz function and Gibbs function?

d) Saturated steam has an entropy of 6.76 kj/kg.K. What are its pressure, temperature, specific volume, an enthalpy?

e) What is metastable equilibrium?

f) What do you understand by steam rate and heat rate? What are their unit?

g) What is a pass-out turbine? When is it used?

h) What is an air standard efficiency?

i) Prove that COP of Heat pump is greater than COP of Refrigerator by unity.

j) What is a Tonne of Refrigeration?

Q2 **a)** Show that S_{gen} is not a thermodynamic property. **(5)**

b) A system has a heat capacity at constant volume; $C_v = AT^2$, where $A=0.042 J/K^3$.The system is originally at 200K, and a thermal reservoir at 100 K is available. What is the maximum amount of work that can be recovered as the system is cooled down to the temperature of the reservoir? **(5)**

Q3 **a)** Derive Maxwell's equations. **(5)**

b) Two kg of air at 500kPa,80^0C expands adiabatically in a closed system until its volume is doubled and its temperature becomes equal to that of the surroundings which is at 100kPa,5^0C.For this process, determine(a)the maximum work,(b)the change in availability, and(c)the irreversibility. For air, take C_v=0.718kJ/kgK ,u = C_vT where C_v is constant, and pV=mRT Where p is pressure in kPa, V volume in m^3,m mass in kg,R is a constant equal to 0.287 kJ/kgK, and T temperature K. **(5)**

Q4 **a)** Explain Binary Vapour Cycle. **(5)**

b) In a reheat cycle, the initial steam pressure and the maximum temperature are 150 bar and 550^0C respectively. If the condenser pressure is 0.1 bar and the moisture at the condenser inlet is 5%,and assuming ideal processes, determine (a) the reheat pressure, (b) the cycle efficiency, and (c) the steam rate. **(5)**

Q5 **a)** For the same compression ratio and heat rejection, which cycle is most efficient: Otto, Diesel or Dual? Explain with p-v and t-s diagrams. **(5)**

b) An engine working on the Otto cycle has an air standard cycle efficiency of 56% and rejects 544 kJ/kg of air. The pressure and temperature of air at the beginning of compression are 0.1MPa and 60^0C respectively. Compute (a) the compression ratio of the engine, (b) the work done per kg of air, (c) the pressure and temperature at the end of compression and (d) The maximum pressure in the cycle. **(5)**

Q6 **a)** Show that the optimum intermediate pressure of a two stage reciprocating compressor for minimum work is the geometric mean of the suction and discharge pressure. **(5)**

b) In an aircraft cooling system, air enters the compressor at 0.1MPa, 4^0C, and is compressed to 0.3MPa with an isentropic efficiency of 72%.After being cooled to 55^0C at constant pressure in a heat exchanger, the air then expands in a turbine to 0.1MPa with an isentropic efficiency of 78%.The low temperature air absorbs a cooling load of 3 tonnes of refrigeration at constant pressure before re-entering the compressor which is driven by the turbine. Assuming air to be an ideal gas, determine the COP of the refrigerator, the driving power required, and the air mass flow rate **(5)**

Q7 A single stage reciprocating air compressor has a swept volume of 2000cm^3 and runs at 800rpm.It operates on a pressure ratio of 8, with a clearance of 5% of the swept volume. Assume NTP room conditions and at inlet(p=101.3kPa,t=15^0C), and polytropic compression and expansion with n=1.25. Calculate (a) indicated power, (b) volumetric efficiency, (c) mass flow rate, (d) isothermal efficiency, (e) the actual power needed to drive the compressor, if mechanical efficiency is 0.85. **(10)**

Q8 **Write short answer on any TWO :** **(5 x 2)**

a) Clausius-Clapeyron equation.

b) Brayton cycle vs Rankine cycle

c) Volumetric efficiency

d) Reheat-Regenerative cycle