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

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

4th Semester Back Examination 2018-19
ENGINEERING THERMODYNAMICS
BRANCH : MECH
Time : 3 Hours
Max Marks : 70
Q.CODE : F902

Answer Question No.1 which is compulsory and any FIVE from the rest.
The figures in the right hand margin indicate marks.

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

a) What do you mean by second law efficiency?
b) What is a dead state? Mention the significance of properties at this state.
c) What is cogeneration? What is its effect on mean temperature of heat addition and cycle efficiency?
d) Differentiate between availability and irreversibility
e) Mention advantage of multistage compression over single stage.
f) Compare Otto and Diesel cycles keeping maximum pressure and temperature fixed.
g) Derive the expression for change in entropy for ideal gas using second law.
h) Why Carnot cycle is not applicable for thermal power plant?
i) What is a tone of refrigeration?
j) Explain the effect of superheat and subcooling on the vapour compression cycle.

Q2 **a)** A two-stage vapour compression refrigeration system with a direct contact heat exchanger (flash chamber) operates with ammonia as the refrigerant. The evaporator and condenser temperatures are -30^0C and 40^0C respectively. If the capacity of the plant is 30 tonnes of refrigeration, estimate the total work of compression and the COP. Had the compression been done in a single stage, what would have been the percentage increase in work of compression? What is the percentage increase in COP owing to the staging of the compression process? **(5)**

b) Explain the working principle of vapour absorption cycle with a neat diagram. **(5)**

Q3 **a)** 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 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)**

b) Compare Brayton cycle with Otto cycle considering their applications in the field of reciprocating engines and turbine plants. **(5)**

Q4 **a)** In a single heater regenerative cycle the steam enters the turbine at 30 bar, 400^0C and the exhaust pressure is 0.10 bar. The feed water heater is a direct contact type which operates at 5 bar. Find (a) the efficiency and the steam rate of the cycle and (b) the increase in the mean temperature of heat addition, efficiency and steam rate, as compared to the Rankine cycle (without generation). Neglect pump work. **(6)**

b) Mention the thermodynamic advantages obtained from (i) Reheat (ii) Regeneration of Rankine cycle. **(4)**

Q5 **a)** Derive the expressions for the reversible of compression if the compression process is (a) adiabatic, (b) polytropic, and (c) isothermal. Show which compression processes need minimum and maximum works. Use common P-v diagram. **(5)**

b) A single stage single-acting air compressor deals with 90 m^3/h of air at 101.325 kPa and 15^0C. The pressure and temperature during the suction stroke remain constant at 98kPa and 40^0C respectively, n=1.22. The air is delivered at 735 kPa, R_a=0.287kJ/kg.K. Find (a) the power needed to drive the compressor if the mechanical efficiency is 0.85, (b) the swept volume if the speed is 120 rpm. Take the volumetric efficiency as 0.78. **(5)**

Q6 **a)** Derive the following : **(5)**

$C_p - C_v = \frac{TV\beta^2}{k_T}$, where β and k_T are volume expansivity and isothermal compressibility respectively.

b) Expain Joule-Kelvin effect. What is inversion temperature? **(5)**

Q7 **a)** Air expands through a turbine from 500kPa, 520^0C to 100 kPa, 300^0C. During expansion 10kJ/kg of heat is lost to the surroundings which is at 98 kPa, 20^0C. Neglecting the K.E. and P.E. changes, determine per kg of air (a) the decrease in availability (b) the maximum work (c) the irreversibility. For air, take C_p=1.005 kJ/kg K, h=C_pT where C_p is constant, and PV=mRT. **(5)**

b) Write the working principle of a single stage reciprocating air compressor and develop the expression for work done per cycle. **(5)**

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

a) Air Motors

b) Maxwell's Equations

c) Entropy Generation