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

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

PAU3I103

3rd Semester Regular / Back Examination 2017-18

AUTOMOTIVE THERMODYNAMICS

BRANCH: Auto

Time: 3 Hours

Max Marks: 100

Q.CODE: B854

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) Second law of thermodynamics defines
(a) heat (b) work (c) enthalpy
(d) entropy (e) internal energy.

b) A process, in which the temperature of the working substance remains constant during its expansion or compression, is called……process.

c) For a reversible adiabatic process, the change in entropy is
(a) zero (b) minimum (c) maximum
(d) infinite (e) unity.

d) The C.O.P. for a Carnot heat pump is equal to .....

e) Most of the commercial refrigeration is produced by the evaporation of a liquid .....

f) 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.

g) Thermal efficiency of closed cycle gas turbine plant increases by
(a) reheating (b) intercooling
(c) regenerator (d) all of the above.

h) If the temperature of the source is increased, the efficiency of the Carnot engine
(a) decreases (b) increases
(c) does not change (d) will be equal to the efficiency of a practical engine
(e) depends on other factors.

i) In a reversible cycle, the entropy of the system
(a) increases (b) decreases
(c) does not change (d) first increases and then decreases
(e) depends on the properties of working substance.

j) Kelvin-Planck's law deals with
(a) conservation of energy (b) conservation of heat (c) conservation of mass
(d) Conversion of heat into work (e) conversion of work into heat.

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

a) State the limitations of first law of thermodynamics.
b) Define heat engine, refrigerator and heat pump.
c) Distinguish between higher calorific value and lower calorific value.
d) What is volumetric efficiency of IC engine?
e) Define entropy?
f) What is an air-standard efficiency?
g) State elements of refrigeration systems.
h) Describe a simple vapour compression cycle giving clearly its flow diagram
i) What is relative COP?
j) What do you mean by 'Clausius inequality'?

Part – B (Answer any four questions)

Q3 a) An iron cube at a temperature of 400°C is dropped into an insulated bath containing 10 kg water at 25°C. The water finally reaches a temperature of 50°C at steady state. Given that the specific heat of water is equal to 4186 J/kg K. Find the entropy changes for the iron cube and the water. Is the process reversible? If so why? **(10)**

b) Describe the working of a Carnot cycle. **(5)**

Q4 a) With help of P-V and T-s diagram, derive the expression for air standard efficiency of Diesel cycle. **(10)**

b) Calculate the air standard efficiency of a four stroke Otto cycle engine with the following data : **(5)**
Piston diameter (bore) = 137 mm ; Length of stroke = 130 mm ;
Clearance volume 0.00028 m^3.
Express clearance as a percentage of swept volume.

Q5 a) A perfect gas undergoes a cycle which consists of the following processes taken in order : **(10)**
(a) Heat rejection at constant pressure.
(b) Adiabatic compression from 1 bar and 27°C to 4 bar.
(c) Heat addition at constant volume to a final pressure of 16 bar.
(d) Adiabatic expansion to 1 bar.
Calculate: (i) Work done/kg of gas.
(ii) Efficiency of the cycle.

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)**

Q6 a) A two stage, single acting reciprocating air compressor, with complete inter cooling atmospheric air at 1 bar and 15^0C, compresses it polytropically (n=1.3) to 30 bar. If both the cylinder have same stoke, calculate the diameter of HP cylinder. The diameter of LP cylinder is 300 mm. **(10)**

b) Derive the expression for the condition for the minimum work input, required for a two stage compressor, with perfect inter cooling. **(5)**

Q7 a) Explain the vapour absorption refrigeration system. **(10)**

b) State merits and demerits of 'Vapour compression system' over 'Air refrigeration system' **(5)**

Q8 **a)** In a gas turbine the compressor is driven by the high pressure turbine. The exhaust from the high pressure turbine goes to a free low pressure turbine which runs the load. The air flow rate is 20 kg/s and the minimum and maximum temperatures are respectively 300 K and 1000 K. The compressor pressure ratio is 4. Calculate the pressure ratio of the low pressure turbine and the temperature of exhaust gases from the unit. The compressor and turbine
are isentropic. Cp of air and exhaust gases = 1 kJ/kg K and $\gamma = 1.4$. **(10)**

b) Describe with neat diagram a closed cycle gas turbine. State also its merits and demerits **(5)**

Q9 **a)** A simple vapour compression plant produces 5 tonnes of refrigeration. The enthalpy values at inlet to compressor, at exit from the compressor, and at exit from the condenser are 183.19, 209.41 and 74.59 kJ/kg respectively. **(10)**
Estimate :
(i) The refrigerant flow rate, (ii) The C.O.P.,
(iii) The power required to drive the compressor, and
(iv) The rate of heat rejection to the condenser.

b) Describe the alternative fuels for automobiles. **(5)**