Reg. No. :

Question Paper Code : X 60848

B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020

Fifth Semester

Mechanical Engineering

ME 2301/ME 1351 A/10122 ME 402/ME 51 – THERMAL ENGINEERING

(Common to Mechanical Engineering (Sandwich))

(Regulations 2008/2010)

(Also common to PTME 2301 – Thermal Engineering for BE (Part-Time) Fourth Semester – Mechanical Engineering – Regulations 2009)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. For a given compression ratio the Otto cycle is more efficient than Diesel cycle. Justify.
2. What is meant by mean effective pressure ?
3. Define Scavenging.
4. What is the use of a catalytic converter ?
5. Define critical pressure ratio. Calculate the value of critical pressure ratio for saturated and supersaturated steam.
6. What is the effect of supersaturated flow in steam nozzle ?
7. In reciprocating compressors, why the free air delivered volume is lesser than compressor displacement volume ?
8. Define compressor efficiency.
9. List out the alternate refrigerants used in vapour-compression systems.
10. Define the terms : wet bulb temperature, relative humidity, specific humidity and dew point temperature.

PART – B **(5×16=80 Marks)**

11. a) A spark ignition engine working on ideal Otto cycle has the compression ratio 6. The initial pressure and temperature of air are 1 bar and 37°C. The maximum pressure in the cycle is 30 bar. For unit mass flow, calculate

    i) P, V and T at various salient points of the cycle and

    ii) The ratio of heat supplied to the heat rejected. Assume $\gamma = 1.4$ and $R = 8.314$ kJ/kmol K. **(16)**

    (OR)

    b) An air standard dual cycle has a compression ratio of 18, and compression begins at 1 bar, 40°C. The maximum pressure is 85 bar. The heat transferred to air at constant pressure is equal to that at constant volume. Estimate :

    i) The pressures and temperatures at the cardinal points of the cycle.

    ii) The cycle efficiency and

    iii) The mean effective pressure of the cycle. **(16)**

12. a) With a neat sketch explain the working principle of a simple carburettor.

    (OR)

    b) Explain the battery ignition system with a suitable diagram.

13. a) i) What are the effects of friction in a nozzle ? Explain. **(8)**

    ii) A convergent – divergent nozzle is required to discharge 2kg of steam per second. The nozzle is supplied with steam at 7 bar and 180°C and discharge takes place against a back pressure of 1 bar. The expansion up to throat is isentropic and the frictional resistance between the throat and exit is equivalent to 63kJ/kg of steam. Taking approach velocity of 75 m/s and throat pressure of 4 bar, estimate :

    1) Suitable areas for the throat and exit and

    2) Overall efficiency of the nozzle based on the enthalpy drop between the actual inlet pressure and temperature and the exit pressure. **(8)**

    (OR)

    b) i) The velocity of steam, leaving the nozzle of an impulse turbine is 1000 m/s and the nozzle angle is 20°. The blade velocity is 350 m/s and the blade velocity of coefficient is 0.85. Assuming no losses due to shock at inlet, calculate for a mass flow of 1.5 kg/s and symmetrical blading.

    1) Blade inlet angle. **(3)**

    2) Driving force on the wheel. **(3)**

    3) Axial thrust on the wheel and **(3)**

    4) Power developed by the turbine. **(3)**

    ii) Differentiate between impulse and reaction turbine. **(4)**

14. a) In a two stage compressor in which inter-cooling is perfect, prove that work done in the compressor is minimum when the pressure in the inter cooler is geometric mean between the initial and final pressure. Draw the P-V&T-S diagram for Two Stage Compression. **(16)**

(OR)

b) Explain the construction and working principles of Multi stage compressor and discuss the perfect and im-perfect intercooling with neat sketch. **(16)**

15. a) The sling psycrometer in a laboratory test recorded the following readings. DBT = 35°C and WBT = 25°C. Calculate

i) Specific humidity.

ii) Relative humidity.

iii) Vapour density in air.

iv) Dew point temperature.

v) Enthalpy of mixture per kg of dry air.

Take atm. Pressure as = 1.0132 bar. **(16)**

(OR)

b) A Freon-12 refrigerator producing a cooling effect of 20 kJ/s operates on a simple cycle with pressure limits of 1.509 and 9.607 bar. The vapour leaves the evaporator dry saturated and there is no under cooling. Determine the power required by the machine. If the compressor operates at 300 rpm and has a clearance volume of 3% of stroke volume, determine the piston displacement of the compressor. For compressor assume that the expansion follows $pV^{1.3}$ = constant. Given :

Temperature °C	P_s bar	V_g m^3/kg	Enthalpy kJ/kg h_f	h_g	Entropy kJ/kgK s_f	s_g	Specific heat kJ/kgK
–20	1.509	0.1088	17.8	178.61	0.073	0.7082	–
40	9.607	–	74.53	203.05	0.2716	0.682	0.747

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