Reg. No. : | | | | | | | | | | |

Question Paper Code: 41744

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Fourth Semester

Mechanical Engineering

01UME404 – THERMAL ENGINEERING

(Regulation 2013)

(Use of Steam table, Refrigration table, Mollier chart, Psychrometric chart are permitted)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. Define effective pressure.
2. Define mean effective pressure of Otto cycle.
3. What is the function of carburetor?
4. Why diesel engines are more efficient than petrol engines?
5. Define supersaturated flow.
6. What is blading efficiency?
7. What does the STP and NTP means?
8. Define clearance ratio of an air compressor.
9. Give the advantages of subcooling and superheating.
10. Define Ton of refrigeration.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) Derive the expression for the air standard efficiency of a diesel cycle. (10)

(ii) Write down the assumptions followed in air standard cycles. (6)

Or

(b) The volume ratios of compression and expansion for a diesel engine as measured from an indicator diagram are 15.3 and 7.5 respectively. The pressure and temperature at the beginning of the compression are 1 *bar* and *27°C*. Assuming an ideal engine,

(i) Determine the mean effective pressure, the ratio of maximum pressure to mean effective pressure and cycle efficiency.

(ii) Also find the fuel consumption per *kWh* if the indicated thermal efficiency is 0.5 of ideal efficiency, mechanical efficiency is 0.8 and the calorific value of oil 42000 *kJ/kg*?

Assume for air: c_p = 1.005 *kJ/kg K*; c_v = 0.718 *kJ/kg K*, γ = 1.4. (16)

12. (a) (i) Explain the working of 4-stroke cycle diesel engine with neat sketch. (10)

(ii) Differentiate between the SI and CI engines. (6)

Or

(b) During a test on a four-stroke cycle diesel engine the following data results were obtained:

Mean height of the indicator diagram = 21 *mm*
Spring index = 27 *kN/m^2/mm*
Swept volume of the cylinder = 14 *liters*
Speed of the engine = 396 *rpm*
Net load on the brake = 0.7554 *kN*
Radius of the brake drum = 0.7 *m*
Fuel consumption = 7.2 *kg/hour*
Calorific value of fuel = 44000 *kJ/kg*
Cooling water circulation = 540 *kg/hr*
Rise in temperature of cooling water = 33*°C*
Specific heat of water = 4.18 *kJ/kg*
Energy to exhaust gases = 33.*6 kJ/s*
Determine,

(i) Mechanical efficiency

(ii) The heat balance sheet expressed as *kJ/s* and as percentage of heat supplied to engine. (16)

13. (a) (i) Explain the types of nozzles and diffusers (6)

(ii) Steam at a pressure of 5 bar and dryness fraction of 0.95 enters the nozzle and expands isentropically till the exit pressure of 1 bar. Determine the change in enthalpy and dryness fraction of steam leaving the nozzle. Also calculate the velocity of steam at the nozzle exit and exit area of the nozzle if the flow rate of steam is 1.1 Kg/s. (10)

Or

(b) Steam at 10.5 *bar* and 0.95 dryness is expanded through a convergent-divergent nozzle. The pressure of steam leaving the nozzle is 0.85 *bar*. Find, (i) velocity of steam at throat for maximum discharge (ii) area at exit (iii) steam discharge if the throat area is 1.2 cm^2. Assume the flow is isentropic and there are no friction losses. Take *n=1.135*. (16)

14. (a) A single stage double acting air compressor is required to deliver 14 m^3 of air per minute measured at 1.013 *bar* and *15°C*. The delivery pressure is 7 *bar* and the speed 300 *rpm*. Take the clearance volume as 5*%* of the swept volume with the compression and expansion index of *n=1.3*, Calculate
(i) Swept volume of the cylinder
(ii) The delivery temperature
(iii) Indicated power (16)

Or

(b) (i) State the advantages and disadvantages of staging of compressors. (8)

(ii) A two stage air compressor compresses air from 1bar 20^{o}C to 42 bar. It follows PV1.35=C. The inter cooling is perfect. Find
(1) WD
(2) mass of cooling water needed in inter cooler if water temperature raise is 25^{o}C. (8)

15. (a) (i) Explain with neat sketch about the Vapour Li-Br vapor absorption Refrigeration system. (10)

(ii) Explain sensible heating and cooling and Tonne of Refrigeration. (6)

Or

(b) It is required to design an air-conditioning plant for a small office room for following winter conditions:
Outdoor conditions - 14*ºC DBT* and 10ºC *WBT*
Required conditions - 20ºC *DBT* and 60% *R.H.*
Amount of air circulation - 0.30 m^3*/min./person.*
Seating capacity of office - 60.
The required condition is achieved first by heating and then by adiabatic humidifying.
Determine the following:
(i) Heating capacity of the coil in *kW* and the surface temperature required if the by-pass factor of coil is 0.4.
(ii) The capacity of the humidifier.
Solve the problem by using psychrometric chart. (16)