TED (15) – 4024

(REVISION — 2015)

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# FOURTH SEMESTER DIPLOMA EXAMINATION IN MECHANICAL ENGINEERING — APRIL, 2017

## THERMAL ENGINEERING

[*Time* : 3 hours

(Maximum marks : 100)

[*Note* :— Use of steam tables and Mollier chart permitted.]

## PART — A

(Maximum marks : 10)

Marks

I Answer the following questions in one or two sentences. Each question carries 2 marks.

1. Define reversible process.
2. Define brake mean effective pressure of an IC engine.
3. State four applications of steam nozzles.
4. Define emissivity of a body.
5. List four positive displacement type rotary compressors. (5×2 = 10)

## PART — B

(Maximum marks : 30)

II Answer *any five* questions from the following. Each question carries 6 marks.

1. State :
   (a) Boyle's law (b) Charle's law (c) Gay-Lussac law
2. List six differences between spark ignition engine and compression ignition engine.
3. Explain Fourier's law of conduction and write the expression to find out thermal conductivity.
4. Define the following efficiencies of a compressor :
   (a) Isothermal efficiency
   (b) Mechanical efficiency
   (c) Overall efficiency
5. Illustrate diesel cycle with P-V and T-S diagram.
6. List three types of steam nozzles and draw the figures.
7. Draw and explain working of Roots blower. (5×6 = 30)

Marks

PART — C

(Maximum marks : 60)

(Answer *one full* question from each unit. Each full question carries 15 marks.)

UNIT — I

III (a) Explain zeroth law, first law and second law of thermodynamics. 7

(b) A quantity of air has a volume of $0.4m^3$ at a pressure of 5 bar and a temperature of 80°C. It is expanded in a cylinder to a pressure of 1 bar. Determine the amount of work done by the air during expansion. 8

OR

IV (a) A closed vessel contains 2kg of $CO_2$ at a temp. 20°C and pressure 0.7 bar. Heat is supplied to the vessel till the pressure become 1.4 bar. Find (i) final temperature (ii) work done (iii) heat added ($C_v$ = 0.657kJ/kgK) 7

(b) A $5m^3$ tank of compressed air at a pressure of 3 bar and 25°C develops a small leak such that the pressure falls to 2.8 bar in 24 hours. How much air has leaked off the tank ? 8

UNIT — II

V (a) Explain the working of 4 stroke petrol engine with schematic diagram. 7

(b) Find the ideal thermal efficiency of a petrol engine working on Otto cycle at a maximum temperature of 2000°C and temperature at the end of expansion is 800°C. Also find the ratio of compression. Take r = 1.4. 8

OR

VI (a) Explain Dual combustion cycle with P-V and T-S diagrams. 7

(b) Estimate the air standard efficiency of a diesel engine, having cylinder diameter 250mm and stroke 400mm, clearance volume 1.5 liters, fuel cut-off at 5% of stroke. 8

UNIT — III

VII (a) State the properties of steam, which made it an excellent working medium in various thermodynamic systems. 7

(b) An IC engine develops a B.P. of 10 kW. Its friction power is 2.3kW. Determine the mechanical efficiency at 0, 5 and 10kW output. If the thermal efficiency is 22%, determine S.F.C/kWh for a fuel of 38000 kJ/kg. 8

OR



Marks

VIII (a) Derive the expression of velocity of steam leaving the nozzle. 7

(b) A four cylinder 4 stroke petrol engine runs at 1200 RPM. Bore diameter of cylinder is 90mm and stroke 120mm. The mean effective pressure in each cylinder is 5 bar. Mechanical efficiency being 75%. Calculate IP and BP of the engine. 8

UNIT — IV

IX (a) Explain parallel flow, counter flow and cross flow type heat exchangers. 7

(b) A wall is made up of two layers of bricks each 150mm thick with a 40mm air space between them. Coefficients of thermal conductivities are : (i) inside brick = 0.69W/mK, (ii) Air = 0.0605 W/mK, (iii) Outside brick = 1.038W/mK. The wall is 6.15m long and 5.5m high. Determine the heat loss/hour through the wall, if inside face temperature is 24°C and outside temperature is 7°C. 8

OR

X (a) Draw and explain radial flow centrifugal air compressor. 7

(b) A single stage single acting air compressor has a cylinder of 200mm diameter and 300mm stroke and runs at 150 RPM. If the suction pressure and temperature are 1 bar absolute and 15°C respectively and the delivery pressure 10 bar absolute. Calculate the power required to drive the compressor. Assume the law of compression to be $pV^{1.2}$ = constant. 8