CBCS SCHEME

USN | | | | | | | | | |

18MT72

Seventh Semester B.E. Degree Examination, June/July 2025
Thermal Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Thermodynamic data handbook is permitted to use.

Module-1

1 a. Define in the context of thermodynamics :
i) Isolated system
ii) Environment
iii) Adiabatic wall
iv) Property and
v) Energy **(10 Marks)**

b. Distinguish between microscopic and macroscopic approaches of thermodynamics. **(10 Marks)**

OR

2 a. Define Thermodynamic work and explain displacement work. **(10 Marks)**

b. Write a note on:
i) Shaft work
ii) Electrical work
iii) Heat **(10 Marks)**

Module-2

3 a. Define:
i) First law of thermodynamics
ii) Pure substance
iii) Two property rule
iv) Specific heat at constant volume
v) Enthalpy. **(10 Marks)**

b. Prove that energy a property of a system. **(10 Marks)**

OR

4 a. Define:
i) Thermal reservoir
ii) Heat engine
iii) Coefficient of performance
iv) PMM 1 and
v) PMM 2 **(10 Marks)**

b. Explain equivalence between Kelvin-Planck statement and clausius statement of second law of thermodynamics. **(10 Marks)**

Module-3

5 a. Derive an expression for efficiency of the air standard Otto cycle. **(10 Marks)**

b. A diesel engine has a compression ratio of 14 and cut off takes place at 6% of the stroke. Find the air standard efficiency. **(10 Marks)**

OR

6 a. Explain modes of heat transfer with suitable governing equations. **(10 Marks)**

b. A 2 m long, 0.3 cm diameter electrical wire extends across a room at 15°C. Heat is generated in the wire of a result of resistance heating and the surface temperature of the wire is measured to be 152°C in steady operation. Also the voltage drop and electric current through the wire are measured to be 60 V and 1.5A, respectively. Disregarding any heat transfer by radiation, determine the convection heat transfer coefficient for heat transfer between the outer surface of the wire and the air in the room. **(10 Marks)**

Module-4

7 a. Derive general three dimensional conduction equations in Cartesian coordinate. **(10 Marks)**

b. Explain the concept of thermal contact resistance. **(10 Marks)**

OR

8 a. Explain the physical significance of following dimensionless numbers:

i) Reynolds number
ii) Prandtl no.
iii) Grashof no.
iv) Biot number. **(10 Marks)**

b. The maximum allowable surface temperature of an electrically heated vertical plate 15 cm high and 10 cm wide is 140°C. Estimate the maximum rate of heat dissipation from both sides of the plate in an atmosphere at 20°C. The radiation heat transfer coefficient is 8.72 W/m^2K. For air at 80°C, take $\gamma = 21.09 \times 10^{-4}$ m^2/s, $P_r = 0.692$ and K = 0.03 W/mK. **(10 Marks)**

Module-5

9 Apply dimensional analysis to forced convection heat transfer to obtain a relation $N_u = Bh_e^a \times P_r^b$ (symbols with their usual notation). **(20 Marks)**

OR

10 State and explain:

i) Plank's law
ii) Wien's displacement law
iii) Stefan-Boltzmann law
iv) Kirchhoff's law. **(20 Marks)**

* * * * *