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Seventh Semester B.E./B.Tech. Degree Examination, June/July 2026

Thermal Engineering

Time: 3 hrs

Max. Marks: 100

- Note:* 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks, L: Bloom's level, C: Course outcomes.

Module – 1

			M	L	C
Q.1	a.	Explain : i) Path ii) State iii) Process iv) Cyclic process v) Zeroth law of thermodynamics.	10	L2	CO1
	b.	Distinguish between microscopic and macroscopic approaches of thermodynamics.	10	L2	CO1

OR

Q.2	a.	Write thermodynamic definition of work. Explain Shaft work, Electrical work and heat.	10	L2	CO1
	b.	Obtain an expression for displacement work of adiabatic process by writing P – V diagram.	10	L2	CO1

Module – 2

Q.3	a.	Explain : i) First law of thermodynamics ii) Pure substance iii) Two property rule iv) Specific heat v) Enthalpy.	10	L2	CO2
	b.	Derive steady flow energy equation, writing appropriate diagram.	10	L2	CO2

OR

Q.4	a.	Explain : i) Thermal reservoir ii) Heat engine iii) Coefficient of performance iv) Perpetual Motion Machine (PMM)1 v) PMM2.	10	L2	CO2
	b.	Describe Equivalence between Kelvin – Planck statement and Clausius statement of second law of thermodynamics.	10	L2	CO2

Module – 3

Q.5	a.	Derive an expression for efficiency of the air standard Otto cycle.	10	L2	CO3
	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	L3	CO3

OR

Q.6	a.	Explain modes of heat transfer with suitable governing equations.	10	L2	CO3
	b.	A 2m long , 0.3 cm diameter electrical wire extends across a room at 15 °C. Heat is generated in the wire as 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 60V 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	L3	CO3
Module – 4					
Q.7	a.	Derive Fourier - Biot (General three dimensional conduction) equation in Cartesian coordinates.	10	L2	CO4
	b.	Explain the concept of composite wall with suitable diagrams.	10	L2	CO4
OR					
Q.8	a.	Explain the physical significance of following dimensionless numbers : i) Reynolds number ii) Prandtl number iii) Grasshoff number iv) Biot number	8	L2	CO4
	b.	A metal plate 0.609 m in height forms the vertical wall of an oven and is at a temperature of 171 °C, within the oven air is at a temperature of 93.4 °C and atmospheric pressure. Assuming that natural convection conditions holds near the plate and that for this case $Nu = 0.548 (Gr Pr)^{1/4}$. Find the mean heat transfer coefficient and the heat taken up by air per second per meter width. For air at 132.2 °C, take $K = 33.2 \times 10^{-6}$ kW/mK , $\mu = 0.232 \times 10^{-4}$ kg/ms , $C_p = 1.005$ kJ/kg K. Assume air as an ideal gas and $R = 0.287$ kJ/kg K.	12	L3	CO4
Module – 5					
Q.9	a.	Apply dimensional analysis to forced convection heat transfer to obtain a relation $N_u = B R_e^a P_r^b$ (symbols with their usual notation).	11	L2	CO5
	b.	Describe the physical significance of : i) Reynolds number ii) Nusselt number iii) Stanton number.	9	L2	CO5
OR					
Q.10	a.	Explain following radiation laws : i) Plank's Law ii) Wein Displacement Law iii) Stefan Boltzman Law iv) Kirchoff's Law.	8	L2	CO5
	b.	Explain : i) Irradiation ii) Thermal radiation iii) Radiation intensity iv) Radiosity v) Black body radiation and vi) Emissive power.	12	L2	CO5