# B. Tech - 3rd (PE)

## Thermal And Fluids Engineering

*Full Marks* : 50

*Time* : 2.5 hours

Answer **all** questions.

*The figures in the right-hand margin indicate marks.*

*Symbols carry usual meaning.*

**1.** Answer *all* questions. $2 \times 5$

(*a*) What is PMM-II ? And mention which statement of 2nd law of thermodynamics it gives ?

(*b*) Define enthalpy. Why does the enthalpy of an ideal gas depend only on temperature ?

(*c*) Differentiate between intensive and extensive properties.

( *Turn Over* )

(*d*) Define Reynold's Number. How its helpful to determine the flow of the fluid ?

(*e*) Mention various types of non-Newtonian fluid with example.

2. (*a*) State 2nd law of thermodynamics. And define Carnot cycle with all the processes it involves. 4

(*b*) A cyclic heat engine operates between a source temperature of 900°C and sink temperature of 35°C. What is the least rate of heat rejection ($Q_2$) per kW net out of the engine ? 4

*Or*

(*a*) What is Clausius statement ? How it is helpful for working of refrigerator and heat pump. 4

(*b*) A heat of 20 kJ is added when a closed system undergoes a process 1-2 and it produces 50 kJ of work. Now the





system is returned from state 2 to state 1 and a heat of 10 kJ is taken out of it. What will be the amount of work done during process 2-1 ? 4

3. A piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfers is -170kJ. The system completes 100 cycles per min. Complete the following table showing the method of each item, and compute the net rate of work output in kW. 8

| Process | Q (kJ/min) | W(kJ/min) | Δ E(kJ/min) |
|---|---|---|---|
| *a* – *b* | 0 | 2,170 | – |
| *b* – *c* | 21,000 | 0 | – |
| *c* – *d* | – 2,100 | – | – 36,600 |
| *d* – *a* | – | – | – |

*Or*

The isobaric expansion of air takes place in a piston cylinder system and gives 45 kJ of work. Air was at 500 kPa, 25°C with 0.015 $m^3$ of volume at the start of the

expansion process. Determine the final temperature and volume of the air. Also, calculate the amount of heat transfer involved in the process. 8

4. A piston cylinder device contains $0.05m^3$ of a gas initially at 200 Kpa. At this state a linear spring which has spring constant of 150 KN/m is just touching the piston but exerting no force on it. Now, heat is transferred to the gas causing the piston to rise and to compress the spring until the volume inside the cylinder doubles. If the cross-sectional area of the piston is $0.25m^2$. Find: - 8

(*i*) Find pressure inside the cylinder

(*ii*) Work done by the gas

*Or*

A fluid system contained in a piston cylinder machine passes through a complete cycle of four processes. The summation of heat transfer is - 340 KJ/cycle. The system completes 250 cycle per minute. Complete





the following table and find the network transfer in K watt. 8

| Process | Q (KJ/min) | W (KJ/min) | du (KJ/min) |
|---|---|---|---|
| 1 – 2 | 0 | 4,340 | – |
| 2 – 3 | 42000 | 0 | ? |
| 3 – 4 | – 4200 | ? | – 73,200 |
| 4 – 1 | ? | ? | ? |

5. (*a*) Write short notes on : 4

(*i*) Relative Density

(*ii*) Bulk Modulus

(*b*) An increase of pressure 2 bar decreases the volume of a liquid by 0.01%. Find the bulk modulus in $N/m^2$. 4

*Or*

(*a*) Define : 4

(*i*) Viscosity

(*ii*) Kinematic Viscosity

(*b*) When the pressure on a given mass of liquid it increases from 3MPa to 3.5 MPa. The density increases from 500 kg/m$^3$ to 501 kg/m$^3$ . Then find the bulk modulus of liquid over given pressure range. 4

6. (*a*) Define : 4

(*i*) Hydrostatic law

(*ii*) Absolute pressure of a fluid

(*b*) The velocity distribution over a flat plate is given by $u = 3/4y - y^2$. The shear stress at a location 0.3m above the plate is $K$ times shear stress at a location 0.2m above the plate then find the value of $K$. 4

*Or*

(*a*) Define : 4

(*i*) Pascal Law of static fluid

(*ii*) Archimedes principle





(*b*) A piston of 800 mm dia & 200 mm long works inside a cylinder of 804 mm dia. If the annular space is filled with a lubricating oil of viscosity 5 centipoise. Find the speed of piston in vertically direction, take weight of the piston action load equal to 9.42 N. 4

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