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# QUESTION BANK

TLP- 10

**Class:** S.E.M.E
**Semester:** III
**Scheme:** CBCGS
**Academic Year:** 2018-2019
**Curriculum:** 2017 - 2021
**Course:** Thermodynamics
**Course Code:** MEC302

## ***Basic Concepts & definitions and First Law of Thermodynamics***

| Sr No. | Questions |
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| 1 | Define thermodynamic system(D11, M12) |
| 2 | Differentiate between open system, closed system and isolated system (M12) |
| 3 | Define thermodynamic property(D11) |
| 4 | Define intensive & extensive properties.(D12) |
| 5 | Define thermodynamic cycle and process.(D12) |
| 6 | Define the term thermodynamic equilibrium(D11) |
| 7 | Define the term quasistatic process(D12) |
| 8 | Differentiate between point function and path function.(D12) |
| 9 | Define the term thermodynamic work(D8,D11) |
| 10 | Define system, boundary and surrounding with suitable examples and figures. (D17, 5M, CBSGS) |
| 11 | Show that the conversion of work into heat is complete and continuous. (D13, 4M, CBSGS) |
| 12 | Differentiate between non-flow and flow process. What is steady flow process? (M14, 4M, CBSGS) |
| 13 | Explain Joule's experiment. (D13, 5M, CBSGS) |
| 14 | Write a short note on Zeroth law and its significance. (D14, 5M, CBSGS) (M17, 5M, CBSGS)(D12) |
| 15 | Write a short note on Absolute thermodynamic temperature scale (D14, 5M, CBSGS) |
| 16 | Prove that energy is a property of the system (D8) (M9) (M15, 5M, CBSGS) (M16, 5M, CBSGS) (D17, 5M, CBCGS) (M18, 5M, CBSGS) (M18, 5M, CBCGS) |
| 17 | State the first law of thermodynamics for the closed system undergoing a cycle. (D15, 4M, CBSGS) |
| 18 | State and Explain the first law for a closed system(M13) |
| 19 | Explain Zeroth law of thermodynamics. (D15, 4M, CBSGS) |
| 20 | State and derive steady flow energy equation and apply it to a boiler, condenser, nozzle and turbine. (D15, 8M, CBSGS) |
| 21 | State and derive steady flow energy equation and apply it to a boiler, condenser. (M16, 5M, CBSGS) |
| 22 | Explain thermodynamic equilibrium? What is a quasistatic process and quasistatic equilibrium? (D16, 5M, CBSGS) |
| 23 | Apply steady flow equation on boiler, turbine and nozzle. (D16, 5M, CBSGS) |

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| 24 | Explain Zeroth law of thermodynamics with neat sketch. State its significance. (M17, 5M, CBSGS) |
| 25 | Differentiate between (i) Microscopic and Macroscopic point of view (ii) Heat and Work Energy (D17, 8M, CBSGS) |
| 26 | Write down the SFEE on unit mass basis and apply on turbine and nozzle. (D17, 5M, CBSGS) |
| 27 | State the first law for a closed system undergoing a change of state (D17, 5M, CBCGS) |
| 28 | Derive an expression for heat absorbed or rejected during polytropic process for ideal gas (M18, 5M, CBSGS) (D12) |
| 29 | Develop the following expression for the heat transfer from a mass of gas undergoing reversible expansion process obeying the polytropic law, $PV^n$ = constant $Q_{1-2} = \left(\frac{\gamma-n}{\gamma-1}\right) \times W_{1-2}$ (M10) |
| 30 | Explain energy balance for steady flow open system (M18, 5M, CBSGS) |
| 31 | A spherical balloon of 30 cm diameter contains air at a pressure of 1.5 bar. The diameter of the balloon is increased to 40 cm by heating and during the process the pressure is proportional to its diameter. Calculate the work done assuming the process to be quasistatic? (M18, 56, CBSGS) |
| 32 | 0.06 $m^3$ of ait at 5 bar and 200°C expands isentropically until the pressure becomes 2 bar. It is then heated at constant pressure until the enthalpy increase during this process is 80 kJ. Calculate work done in each process and total work done. (M14, 8M, CBSGS) (M18, 8M, CBSGS) (M18, 5M, CBCGS) |
| 33 | 1 kg of Nitrogen gas at 1 bar and 300 K is compressed to 5 bar and 400 K. Find ( i) Index of process (ii) Work transfer (iii) Heat transfer (iv) Change in internal energy (D14, 6M, CBSGS) |
| 34 | A cylinder contains 0.084 $m^3$ of hydrogen at 1.05 bar and 18°C. It is compressed adiabatically to 14 bar and then expanded isothermally to the original volume. The characteristic constant for hydrogen is 4200 J/kg K and its specific heat at constant pressure is 14.29 kJ/kg K. Determine the final pressure of the gas and the amount of heat added during isothermal expansion. Also find the amount of heat which must be extracted from the gas to reduce it to initial state of pressure. (M15, 10M, CBSGS) |
| 35 | A mass of air initially at 206°C is at a pressure of 7 bar and has a volume of 0.03 $m^3$. The air is expanded at constant pressure to 0.09 $m^3$. A polytropic process with n = 1.5 is then carried out, followed by a constant temperature process which completes the cycle. All the processes are reversible. Sketch the cycle on pressure-volume diagram and find the heat received and heat rejected in the cycle. Take R = 0.287 kJ/kg K, $C_v$ = 0.713 kJ/kg K . (D15, 12M, CBSGS) |
| 36 | A mass of air initially at 206°C and 700 kPa and occupies 0.028 $m^3$. The air is expanded at constant pressure to 0.084 $m^3$. A polytropic process with n =1.50 is then carried out, followed by a constant temperature process which completes the cycle. All the processes are reversible. (i) Sketch the cycle on P-V and T-S plane (ii) find the heat received and heat rejected in the cycle. (iii) Find The efficiency of the cycle. (D17, 10M, CBCGS) |
| 37 | A system containing 0.2 $m^3$ of air at a pressure of 4 bar and 160°C expands isentropically to pressure of 1.06 bar and after this 65 kJ of heat is supplied at constant pressure. Calculate combined work done of both processes. Now assuming that these processes are replaced by a single reversible polytropic process producing same amount of work between initial and final state. Find the index of expansion for polytropic process. (M17, 12M, CBSGS) |
| 38 | 60 litres of an ideal gas at 290 K and 1 bar is compressed adiabatically to 10 bar. It is then cooled at constant volume and further expanded isothermally so as to reach condition from where it started. Evaluate (1) Pressure at the end of constant volume cooling (2) Change in internal energy during constant volume process (3) Net work done and heat transfer during cycle. Assume $C_p$=14.25 kJ/kg K, $C_v$ = 10.25 kJ/kg K(D9, 12M) |
| 39 | A gas initially at 14.4 bar and 360°C is expanded isothermally to a pressure of 2.24 bar. It is then cooled at constant volume till the pressure falls to 1.02 bar. Finally an adiabatic compression brings the gas back to initial state. The mass of the gas is 0.23 kg and $C_p$= 1 kJ/kg K. Draw the P-V diagram and determine (1) The value of adiabatic index of compression. (ii) The change in internal energy of gas during adiabatic process. (M11, 10M) |

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| 40 | Steam flow into a turbine at a flow rate of 5000 kg/hr. The turbine develops a power of 550 kW. The heat loss from the casing of the turbine and the bearing is negligible. (i) Find the change in enthalpy across the turbine if the inlet velocity is negligible and exit velocity is 360 m/s and the change in potential energy is negligible.(ii) Find the change in enthalpy across the turbine if the velocity at entry is 66 m/s and the inlet pipe is 3 m above the exit pipe. (D13, 12M, CBSGS) (M16, 12M, CBSGS) |
| 41 | A turbocompressor delivers 2.33 $m^3$/s of air at 0.276 MPa, 43°C which is heated at this pressure to 430°C and finally expended in a turbine which delivers 860 kW. During expansion there is a heat transfer of 0.09 MJ/s to the surroundings. Calculate the turbine exhaust temperature if changes in kinetic and potential energy are negligible. (M14, 10M, CBSGS) |
| 42 | A power washer is being used to clean the walls of house. Water at the rate of 0.1 kg/s enters at 20°C and 1 atm, with the velocity 0.2 m/s. The jet of water exits at 23°C, 1 atm with a velocity 50 m/s at an elevation of 5 m. At steady state, the magnitude of the heat transfer rate from power unit to the surrounding is 10% of the power input. Determine the power input to the motor in kW. (D14, 12M, CBSGS) |
| 43 | A reciprocating air compressor takes in 2 $m^3$/ min at 0.11 MPa, 20°C, which it delivers at 1.5 Mpa, 111°C to an aftercooler where the air is cooled at constant pressure to 25°C. The power absorbed by the compressor is 4.15 kW. Determine the heat transfer in the compressor and the aftercooler. (M15, 10M, CBSGS) (D17, 10M, CBCGS) |
| 44 | The power output of a steam turbine is 5MW. The inlet conditions are 2 MPa of pressure, 400°C of temperature, 50 m/s of velocity and 10 m of elevation. The exit conditions are 15 kPa, 0.9 dry quality, 180 m/s and 6 m elevation. Compute: (i) The magnitude of $\Delta$ h, $\Delta$ ke, $\Delta$ pe (ii) Work done per kg of steam (iii) Mass flow rate of steam. (D16, 10M, CBSGS) |
| 45 | Steam enters a nozzle at a pressure of 7 bar and 20°C with an initial enthalpy of 2850 kJ/kg and leaves at a pressure of 1.5 bar. Initial Velocity of steam at the entrance is 40 m/s and exit velocity from nozzle is 700 m/s. The mass flow rate of steam is 1400 kg/hr. The heat loss from the nozzle is 11705 kJ/hr. Determine the final enthalpy of steam and the nozzle area if the specific volume is 1.24 $m^3$/kg (M17, 8M, CBSGS) (M18, 10M, CBCGS) |
| 46 | In a steam plant 1 kg of water per second is supplied to boiler. The enthalpy and velocity of water entering the boiler are 800 kJ/kg and 5 m/s. The water receives 2200 kJ/kg of heat in the boiler at constant pressure. The steam after passing through the turbine comes out with a velocity of 50 m/s and its enthalpy is 2520 kJ/kg. The inlet is 4 m above the turbine exit. Assuming the heat losses from the boiler and turbine to the surrounding are 20 kJ/s, calculate the power developed by the turbine. Consider the boiler and turbine as single system. (M8, 10M) |
| 47 | A turbine operating on air has inlet conditions as 10 bar, 750 K and 250 m/s. While exit conditions are 1.25 bar and 40 m/s. The mass low rate of air is 1000 kg/hr. The flow of air is assumed to be reversible adiabatic. Calculate (i) The temperature of air at exit (ii) Power output of turbine. (M9, 10M) |
| 48 | In a steady flow system fluid flow at the rate of 5 kg/s. It enters at a pressure 620 kPa, velocity 300 m/s, internal energy 2100 kJ/kg and specific volume 0.37 $m^3$/kg. It leaves the system at a pressure 130 kPa, velocity 150 m/s, internal energy 1500 kJ/kg and specific volume 1.2 $m^3$/kg. During its flow through system there is a heat loss of 30 kJ/kg. Determine the power capacity of the system in kW. State whether it is from or to the system. Neglect change in P.E. (D12, 12M) |
| 49 | In a steady flow process, the fluid flows through a machine at the rate of 15 kg/min. The entrance and exit parameters of the machine are velocity 5 m/s and 8 m/s, Pressure 100 kPa and 700 kPa, Specific volume 0.45 $m^3$/kg and 0.125 $m^3$/kg respectively. The working fluid leaves the machine with internal energy 160 kJ/Kg greater than at entrance and during process 7200 kJ/min of heat is lost to surrounding. Assuming entrance and exit pipe to be at same level, calculate the shaft work and ratio of inlet pipe diameter to outlet pipe diameter. (D9, 12M) |
| 50 | An air compressor takes in air at 1 bar and 20°C and discharge into a pipe having inlet diameter 20 mm. The average velocity of air at a point in the pipe close to discharge is 7.7 m/sec. and the discharge pressure is 3 bar. Neglecting the inlet air velocity and assuming the compression of air as adiabatic. Calculate the power input to compressor. Take $\gamma$ =1.4 and R = 286.7 J/kg K. (D11, 10M) |

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