**SIDDHARTH INSTITUTE OF ENGINEERING &TECHNOLOGY**

**(AUTONOMOUS)**

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**QUESTION BANK (DESCRIPTIVE)**

**Subject with Code: Thermodynamics & Heat Engines (18ME0350)** **Branch**: B.Tech - AGRI

**Year & Sem:** II-B. Tech & II-Sem **Regulation:** R18

## UNIT –I

## BASIC CONCEPTS

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| 1 | a) | Show that heat and work is a path function and not a property of the system | L2 | 5M |
| | b) | What is quasi static process? What are its characteristics features? | L1 | 5M |
| 2 | | Explain the following<br>a) Enthalpy b) Internal Energy c) Specific heat d) Thermodynamic cycle | L2 | 10M |
| 3 | | Explain thermodynamics system, surrounding and universal. Distinguish between closed, open, isolated homogenous and heterogeneous systems. Illustrate with examples | L2 | 10M |
| 4 | a) | Explain about Thermodynamic Equilibrium | L2 | 5M |
| | b) | What is the difference between a closed system and an open system? | L1 | 5M |
| 5 | a) | Explain about Quasi Static Process. | L2 | 5M |
| | b) | What do mean by property"? Distinguish between intensive and extensive | L1 | 5M |
| 6 | a) | Differentiate between the cyclic process and non-cyclic process | L4 | 5M |
| | b) | State the following<br>b) Pressure b) Temperature c) volume d) Density | L2 | 5M |
| 7 | a) | What do you understand by path function and point function? What are the exact and inexact differentials? | L4 | 5M |
| | b) | State the thermodynamic system control volume. | L2 | 5M |
| 8 | | What is meant by thermodynamics equilibrium? Explains its types briefly. | L1 | 10M |
| 9 | | State the differences between heat and work. | L2 | 10M |
| 10 | | Explain the following terms | L2 | |
| | | a) State | | 2M |
| | | b) Path | | 2M |
| | | c) Process | | 2M |

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| | | d) Cyclic process | | 2M |
| | | e) System. | | 2M |

## UNIT – II
## ZEROTH LAWS OF THERMODYNAMICS

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| 1 | a) | State first law of thermodynamics. Prove that internal energy is a property of the system. | L2 | 5M |
| | b) | In a cycle which has five processes, the following are the heat transfers at five points. $Q_1$ = +50KJ, $Q_2$ = 85KJ, $Q_3$= -30KJ, $Q_4$=-70KJ and Q5= +135KJ, the work transfers are $W_1$ = +60KJ, $W_2$ = -40KJ, $W_3$= 35KJ, $W_4$=-20KJ and W5= +135KJ, Find out the work transfer at the fifth point. | L3 | 5M |
| 2 | a) | Derive Steady Flow Energy Equation for Turbine | L4 | 5M |
| | b) | A turbine operates under steady flow conditions, receiving the steam having an enthalpy of 2786 KJ/Kg and leaves with an enthalpy of 2513 KJ/Kg. Heat is lost to the surroundings at the rate of 5.30 KJ/sec. If the rate of steam flows though the turbine is 0.40Kg/sec. Find the power output of the turbine. | L3 | 5M |
| 3 | | A system undergoes a cycle composed of four processes and the energy transfers are tabulated below.<br>Process \| Heat transfer in KJ/min \| Work done in KJ/min \| Change in internal energy KJ/min<br>1-2 \| 550 \| 230 \| -<br>2-3 \| 230 \| - \| 380<br>3-4 \| -550 \| - \| -<br>4-1 \| 0 \| 70 \| -<br>a) Complete the table and b) determine rete of work in KW. | L3 | 10M |
| 4 | | The system contains piston and cylinder is subjected to a process, such that its volume increases from 0.004 $m^3$ to 0.034 $m^3$ at constant pressure of 750KN/$m^2$. The heat supplied through the walls of cylinder the process is 8 KJ. Calculate the change in internal energy of the system. | L3 | 10M |
| 5 | a) | The air in a system expands from a temperature of $60^0$C to $300^0$C at a constant pressure of 2 bars. Calculate the heat transfer, work done and change in internal energy. The mass of the air is 0.6 Kg. Assume $C_p$=1.02 KJ/$Kg^K$ and $C_v$= 0.71 KJ/$Kg^K$ for air. | L3 | 5M |
| | b) | State second law of thermodynamics | L2 | 5M |
| 6 | a) | Derive Steady Flow Energy Equation for Nozzle | L4 | 5M |
| | b) | The enthalpy of a steam 3015.6 KJ/Kg enters a nozzle and leaves with an enthalpy of 2819.8 KJ/Kg. Calculate the velocity of steam at the exit, if the velocity of steam at the entry is 50 m/sec | L3 | 5M |
| 7 | a) | What are the different modes in which energy is stored in a system | L1 | 5M |

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| | b) | Derive Steady Flow Energy Equation for compressor | L4 | 5M |
| 8 | a) | During a cycle consisting of four processes, the heat transfer are a s following.<br>Q1 = +60KJ, $Q_2$ = -40KJ, $Q_3$= 15KJ, and $Q_4$=-20KJ, Determine the net work done by the system. | L3 | 5M |
| | b) | Explain the Specific heat capacities ($C_p$ & $C_v$), | L2 | 5M |
| 9 | a) | Define Mass Balance? Derive equation for it. | L1 | 5M |
| | b) | What is Steady Flow Process? Derive SFEE for any one engineering system | L1 | 5M |
| 10 | | Explain the following terms | L2 | |
| | a) | First law Thermodynamic | | 2M |
| | b) | Energy is a Property | | 2M |
| | c) | Zeroth law of thermodynamics | | 2M |
| | d) | Enthalpy | | 2M |
| | e) | Specific heat capacities ($C_p$ & $C_v$) | | 2M |

## UNIT – III
## Law of Perfect Gas

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| 1 | a) | What is Avogadro's law? | L1 | 5M |
| | b) | State Internal Energy and Enthalpy of Gas | L2 | 5M |
| 2 | a) | What is the gas equation of ideal gas? | L1 | 5M |
| | b) | State Dalton's law of partial pressures | L2 | 5M |
| 3 | a) | Explain the differences between isothermal and adiabatic processes. | L2 | 5M |
| | b) | One kg of air in a closed system, initially at 5°C and occupying $0.3m^3$ volume, undergoes a constant pressure heating process to 100°C. There is no work other than *pdv* work. Find (a) the work done during the process, (b) the heat transferred, and (c) the entropy change of the gas. | L3 | 5M |
| 4 | a) | Draw P –V and T-S diagrams on Isochoric process and Isobaric process with derive the (i) work done (ii) heat transfer (iii) internal energy. | L4 | 5M |
| | b) | Air contained in a cylinder fitted with a piston is compressed reversibly according to the law pv1.25 = const. The mass of air in the cylinder is 0.1 kg. The initial pressure is 100 kPa and the initial temperature 20°C. The final volume is 1/ 8 of the initial volume. Determine the work and the heat transfer. | L3 | 5M |
| 5 | a) | 2.5 kg of gas with an initial volume 1.2 $m^3$ is cooled at constant pressure of 799 $KN/m^2$. The temperature at the end of cooling is 287 $^0$ c. determine (i) | L3 | 5M |

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| | | the change in internal energy (ii) work done (iii) heat transfer take R= 0.32 KJ/kg$^k$ and cp=1.16 KJ/kg$^k$. | | |
| | b) | Determine the final temperature, external work done, change in internal energy, in the case of 2 kg of gas at $20^0$ c being heated at constant volume until the pressure is doubled. | L3 | 5M |
| 6 | a) | Sketch the following processes on P-V and T-S diagrams (a) constant volume (b) constant pressure (c) constant temperature (d) isentropic process (e) polytropic process. | L4 | 5M |
| | b) | In a closed vessel a certain quantity of gas is heated from 200 KN/m$^2$ to 500 KN/m$^2$. If the volume of the vessel is 5000 liters find the quantity of i) heat transfer ii) change in internal energy iii) work done. $c_p$= 1.005 KJ/kg$^k$ and $c_v$ =0,715 KJ/kg$^k$ . | L3 | 5M |
| 7 | a) | Derive an expression for work done during isothermal process. | L4 | 5M |
| | b) | 0.2 kg of air at pressure of 1.1 bar and $15^0$c is compressed isothermally to a pressure of 5.5 bar. Calculate (i) final volume (ii) heat rejected (iii) change in internal energy. Assume R= 0.292 KJ/Kg $^K$ | L3 | 5M |
| 8 | a) | Derive an expression for work done during isentropic process. | L4 | 5M |
| | b) | Air in a closed stationary system expands in a reversible adiabatic process from 0.5 MPa, 15°C to 0.2 MPa. Find the final temperature, and per kg of air, the heat transferred, and the work done. | L3 | 5M |
| 9 | a) | Air at 1 bar and 40 0c is compressed to 1/10 th the original volume isentropically. Determine the final pressure and temperature and the workdone on 1 m3 of air. Assume R= 0.287 KJ/Kg $^K$ and $pv^{1.4}$=c. | L3 | 5M |
| | b) | Derive an expression for heat transfer during polytropic process | L4 | 5M |
| 10 | | Explain the following terms | L4 | |
| | a) | Constant pressure process | | 2M |
| | b) | Constant volume process | | 2M |
| | c) | Constant temperature process | | 2M |
| | d) | Non flow process | | 2M |
| | e) | Flow process | | 2M |

## UNIT – IV
## THERMODYNAMIC CYCLES

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| 1 | a) | Find the change in enthalpy steam, initial pressure 10 bar and 0.98 then it will reach 20 bar and 350 temperature. By using steam tables. | L1 | 5M |
| | b) | Explain Limitations of Carnot cycle. | L4 | 5M |
| 2 | | A power plant operating between 30 bars and 0.02 bars. If the steam supplied is 350 $^0$ C and the cycle of operation is Rankine, Find (i) cycle efficiency, (ii) change in enthalpy. | L5 | 10M |

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| 3 | a) | Explain the P-V, P-T, T-S diagrams of Pure Substances | L4 | 5M |
| | b) | Derive an expression for thermal efficiency & mean effective pressure of a dual combustion cycle by drawing PV and TS diagrams. | L4 | 5M |
| 4 | | An engine working on the otto cycle is supplied with air at 0.1 MPa ,350C .the compression ratio is 8.the heat supplied is 2100 kJ/kg .calculate the Maximum pressure and temperature of the cycle ,the cycle efficiency and the mean effective pressure.(for air Cp=1.005kj/kg. k , Cv = 0.717 kJ/kgk, and R=0.287 kJ/kgk) | L3 | 10M |
| 5 | a) | Derive an expression for the thermal efficiency of Sterling cycle and draw P-V & T-S diagrams | L4 | 5M |
| | b) | Find the change in enthalpy steam, initial pressure 15 bar and 0.95 then it will reach 25 bar and 400 temperature. By using mollier diagram. | L3 | 5M |
| 6 | | Derive an expression for the thermal efficiency of Ericson cycle and draw P-V & T-S diagrams | L5 | 10M |
| 7 | a) | Derive an expression for the thermal efficiency of Carnot cycle and draw P-V & T-S diagrams | L5 | 5M |
| | b) | Find the change in enthalpy steam, initial pressure 5 bar and 0.98 then it will reach 10 bar and 250 temperature. | L3 | 5M |
| 8 | | Derive an expression for the thermal efficiency of Diesel cycle and draw P-V & T-S diagrams. | L5 | 10M |
| 9 | a) | Derive an expression for the thermal efficiency and mean effective pressure of an Otto cycle by drawing PV and TS diagrams | L5 | 5M |
| | b) | Find the change in enthalpy steam, initial pressure 5 bar and 200 $^0$c then it will reach 0.95 in isentropic process. | L3 | 5M |
| 10 | | Explain the following terms | L2 | |
| | a) | Dry saturated steam | | 2M |
| | b) | Wet steam | | 2M |
| | c) | Enthalpy of super-heated steam | | 2M |
| | d) | Enthalpy of wet steam | | 2M |
| | e) | Saturated temperature | | 2M |

## UNIT – V
## Steam Boilers

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| 1 | a) | Explain Drum less Boiler, with neat sketch? | L2 | 5M |
| | b) | Explain with neat sketch any one of the fire tube boiler? | L2 | 5M |
| 2 | a) | Explain the following boiler terms:<br>shell, grate, furnace, fire hole, mud hole, ash pit, | L2 | 5M |
| | b) | Give the construction and working principal of la-mount boiler. | L4 | 5M |
| 3 | a) | Write short note on the followings<br>(i) Supercharged boiler (ii) Supercritical boiler | L4 | 5M |

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| | b) | Explain with neat sketch “Bob cock and Wilcox” boiler?. | L2 | 5M |
| 4 | a) | How are boiler classified? | L4 | 5M |
| | b) | Give the Comparison between fire tube and water tube Boiler. | L4 | 5M |
| 5 | a) | Enumerate the factors which should be considered while selecting a boiler. | L5 | 5M |
| | b) | What are the essentials of a good boiler? | L5 | 5M |
| 6 | | Explain the terms with neat sketch.<br>(i) Fusible plug, (ii) feed check valve, (iii) Water level Indicator, | L2 | 10M |
| 7 | | Explain the terms with neat sketch.<br>(i) Economizer, (ii) Air preheater, (iii) Convective super heater | L2 | 10M |
| 8 | a) | What are the advantages of artificial draughts over the natural draught ? | L2 | 5M |
| | b) | Explain with neat sketch of Fire Tube boiler- Cochran boiler | L2 | 5M |
| 9 | | Explain with neat sketch of Water Tube boiler- Babcock and Wilcox Boiler | L4 | 5M |
| | | Explain with neat sketch any one Modern High Pressure Boilers | L4 | 5M |
| 10 | | Explain the following terms | L2 | |
| | a) | Inlet water temperature | | 2M |
| | b) | Boiler pressure | | 2M |
| | c) | Evaporative temperature | | 2M |
| | d) | Pressure gauge | | 2M |
| | e) | Boiler mountings | | 2M |

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