GOVERNMENT POLYTECHNIC JAJPUR

A/ P: Ragadi, Block: Korei, Dist.: Jajpur, Odisha- 755019

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QUESTION BANKS

THERMAL ENGG-I

1^{st} Chapter: (Thermodynamic concept and terminology)

2 marks questions:

1. What do you mean by macroscopic and microscopic approach in thermodynamics?
2. What do you mean by a path function?
3. Define thermodynamic state and process.
4. Define thermodynamic properties with example.
5. Define temperature and its unit.
6. Define entropy.
7. Define intensive and extensive properties with example.
8. Define heat and its units.
9. Differentiate between path and process.
10. Define thermodynamic systems
11. Define heat and work.
12. Define mechanical equivalent of heat.
13. Define thermodynamic system and property.
14. Define thermodynamic equilibrium.
15. What do you mean by macroscopic and microscopic approach in thermodynamics?
16. What is the relation between Celsius scale and Fahrenheit scale?
17. Define Quasi-static process

5 marks questions:

1. What do you mean by thermodynamic property of a system? How will you classify it?
2. A vacuum recorded in the condenser of a steam power plant is 740 mm of Hg. Find the absolute pressure in the condenser in Pascal. The barometric reading is 760 mm of Hg.
3. Differentiate homogeneous and heterogeneous systems.
4. Differentiate between extensive and intensive properties.
5. Define Quasi-static process. State its salient features.
6. Define thermodynamics and write its importance and application.
7. Explain concept of macroscopic and microscopic viewpoints applied to the study of thermodynamics.
8. Differentiate between closed system and open system.
9. Give comparison between work and heat.
10. What are the salient features of work transfer.
11. In a reversible non-flow process, the work is done by a substance in accordance with V=2.80/p m^3, where p is the pressure in bar. Find the work done on or by system as pressure increases 0.7 bar to 7 bar.
12. A gas is compressed from an initial volume of $0.38m^3$. During the quasistatic-equillibruium process, the pressure changes with volume according to the relation, p=aV+b, where a= -1200kPa/m^3 and b=600kPa. Calculate the work done during this process

10 marks questions:

1. What is thermodynamic system? Explain briefly different types of thermodynamic system.
2. Define energy and explain its sources.
3. Define thermodynamic equilibrium. What are the conditions necessary to establish thermodynamic equilibrium to a system?
4. A system of 1 kg of gas expands from an initial state at pressure of P_1 bar and a volume of V_1 $m^{3/}$kg to a volume of V_2 $m^{3/}$kg. Calculate the work done by the gas, when expansion is (a) isobaric

   (b) isothermal

   (c) polytropic with the law pv^n= constant

5. In a non-flow process, a gas expands from volume 1 m^3 to a volume of 2 m^3 according

   to the law P=2/V+1.5

   Where P= the pressure at any points in its path in bar and V is the volume at the same

   point in m^3. Determine:

   (i) Pressure at the end of expansion in KN/m^2
   (ii) Work done by the gas doing expansion in KJ.

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2nd Chapter: (Laws of Thermodynamics)

2 marks questions:

1. State Zeroth law of thermodynamics.
2. State 1st law and Second law of thermodynamics.
3. What is heat engine?
4. Define co-efficient of performance of a heat pump.
5. Define co-efficient of performance of a heat engine.
6. Define co-efficient of performance of a refrigerator.
7. Define steady flow energy equation with its example.
8. State Clausius's statement of 2nd law of thermodynamics.

5 marks questions:

1. State & explain First law of thermodynamics.
2. What are the limitations of 1st law of thermodynamics?
3. Write down the applications of 1st law of thermodynamics.
4. What is the steady flow energy equation and explain its application to turbine and compressor.
5. A Carnot cycle operates between temperature of 727 degree celsius and 227 degree celsius. Calculate the efficiency of the engine.
6. A refrigerator transfers 120KJ of heat from a cold space and needs 40KJ of works input. Calculate its co-efficient of performance.
7. Determine the minimum heat input to a heat engine that operates between 350 degree celsius and 25 degree celsius and produces 100KJ of work.
8. State and explain Zeroth law of thermodynamics.
9. State and explain 2nd law of thermodynamics.
10. Write down the applications of 2nd law of thermodynamics.

10 marks questions:

1. A reversible heat engine operates between two reservoirs at temperature of 800 degree Celsius and 40 degree Celsius. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40 degree Celsius and -20 degree Celsius. The heat transfer to the engine is 2 MJ and the network output of the combined engine and refrigerator plant is 360KJ. Find the heat transfer to the refrigerant and the net heat transfer to the refrigerant and the net heat transfer to the reservoir at 40 degree Celsius and also find these values if the efficiency of the heat engine and COP of the refrigerator are each 40% of their maximum values

2. An ideal heat engine works on Carnot cycle between the temperature limits of 327 degree Celsius and 77 degree Celsius. If 550 KJ of heat is supplied to the working medium during a cycle of operation. Then, Find
   (i) thermal efficiency of the cycle
   (ii) quantity of heat rejected.
3. A cyclic heat engine operates between a source temperature of 800 degree Celsius and a sink temperature of 30 degree Celsius. What is the least rate of heat rejection per KW net output of the engine.
4. A heat pump delivers 2KW of heat to a room maintained at 25 degree celsius and receives heat from a reservoir at -10 degree Celsius. If the actual co-efficient of performance is 50% of heat of an ideal heat pump operating between the same temperature limits, what is the actual power required in kw to run the heat pump.
5. A heat pump is absorbing heat from a cold outdoor at 5 degree celsius and supplying heat to a house at 22 degree celsius at a rate of 18000 KJ/h. The power consumed by the heat pump is 2.5 KW. Calculate the co-efficient of performance of heat pump.
6. A heat engine receives heat from a source at 1000 degree celsius and rejects the waste heat to a sink at 50degree celsius. If the heat is supplied to the engine at the rate of 100KW. Calculate the maximum power output of this engine.

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3^{rd} Chapter: (Properties processes of perfect gas)

2 marks questions:

1. State Law's of perfect gas:
   (i) Boyle's law.
   (ii) Charle's law
   (iii) Avogadro's law
   (iv) Dalton's law of partial pressure
   (v) Guy lussac law,
2. Define specific heat of gas
3. Define throttling process.
4. Define non-flow process.
5. Define ideal gas.
6. What is isentropic process?
7. What is universal gas constant?
8. In which process heat transfer is equal to work transfer and how?
9. Define dryness fraction.

5 marks questions:

1. Derive the relation between C_p and C_v .
2. Derive work done during polytropic process.
3. Prove that $P_1V_1/T_{1=} P_2V_2/T_2$
4. Derive work done during isentropic process.
5. A quantity of air has a volume of $0.4m^3$ at a pressure of 5 bar and a temperature of 80 degree Celsius. It is expanded in a cylinder at a constant temperature to a p pressure of 1 bar. Determine the amount of work done by the air during expansion

10 marks questions:

1. A system contains $0.20m^3$ of a gas at a pressure of 4.8bar and 180 degree celsius. It is expanded adiabatically till the pressure fails to 1 bar. The gas is then heated at a constant pressure till its enthalpy increases by 70KJ. Determine the total work done Take C_p=1 KJ/kgK and C_v= 0.714 kj/kgK
2. Calculate the enthalpy of 1 kg of steam at a pressure of 8 bar and dryness fraction of 0.8. How much heat would be required to produce 2kg of steam at 8 bar with 0.8 dryness fraction from water at 20 degree celsius.
3. $0.4m^3$ of a gas at a pressure of 10 bar and temperature of 535 degree celsius expands at constant pressure to volume of $0.5m^3$. Find the change in entropy per kg of gas if R=0.287kj/kgK and C_v=0.714 kj/kgK

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4. A certain gas occupies a space of $0.3m^3$ at a pressure of 2 bar and a temperature of 77 degree Celsius. It is heated at a constant volume, until the pressure is 7 bar. Determine:
   (a) temperature at the end of the process
   (b) mass of the gas
   (c) change in internal energy
   (d) change in enthalpy during the process
5. $0.1m^3$ of air at a pressure of 1.5 bar is expanded isothermally to 0.5 m^3. Calculate the final pressure of the gas and heat supplied during the process.
6. The initial volume of 0.18kg of a certain gas was $0.15m^3$ at a temperature of 15 degree Celsius and a pressure of 1 bar. After adiabatic compression to $0.056m^3$, the pressure was found to be 4 bar. Find:
   (a) Gas constant
   (b) Molecular mass of the gas
   (c) Ratio of specific heats
   (d) Two specific heats at constant pressure and other at constant volume
7. A system contains 0.15 m^3 of a gas at a pressure of 3.8 bar and 150 degree celsius. It is expanded adiabatically till the pressure falls to 1 bar. The gas is then heated at a constant pressure till its enthalpy increases by 70Kj. Determine the total work done. C_p=1 KJ/kgK and C_v= 0.714 kj/kgK
8. $0.336m^3$ of a gas at a pressure of 10 bar and temperature of 150 degree celsius expands adiabatically until the pressure is 4 bar. It is compressed isothermally, to its original volume . Find the final temperature and pressure of the gas. Also determine the change in internal energy. Take C_p=0.996 KJ/kgK and C_v= 0.703 kj/kgK
9. A certain quantity of air has a volume of $0.028m^3$ at a pressure of 1.25 bar and 25 degree celsius. It is compressed to a volume of $0.0042m^3$ according to the law $pv^{1.3}$= constant. Find the final temperature and work done during compression. Also determine the reduction in pressure at a constant volume required to bring the air back to its original temperature.

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4th Chapter: (Internal Combustion engine)

2 marks questions:

1. What is an internal combustion engine?
2. Write the classification of internal combustion engines.
3. Define brake-specific fuel consumption.
4. Define Terminology of I.C Engine such as bore, dead centres, stroke volume, piston speed &RPM.
5. List the parts of an IC engine.
6. What is scavenging?
7. What is an IC engine and mention its parts?
8. List the parameters by which performance of an engine is evaluated.

5 marks questions:

1. Why are four-stroke engines preferred over twostroke engines?
2. Compare petrol (SI)and Diesel engines(CI).
3. Compare two-stroke and four-stroke engines.
4. What are the terminology used in IC engine and explain each one of them?

10 marks questions:

1. Explain the construction, working and applications of a two-stroke petrol engine.
2. Explain construction, and working of a twostroke Diesel engine.
3. Explain the working of a four-stroke petrol engine.
4. Explain the working of a four-stroke Diesel engine.
5. Discuss the construction of a four-stroke petrol engine.
6. Explain the classification of internal combustion engines.
7. Explain with the help of suitable sketches the working of a 4-stroke cycle and 2-strole cycle.

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5th Chapter: (Gas power cycle)

2 marks questions:

1. Define compression ratio.
2. What is mean effective pressure? and its significance?
3. Define (a) work ratio (b) swept volume, (c) charge, (d) thermal efficiency
4. Define the term of gas power cycle:
   (a) Carnot cycle
   (b) Otto cycle
   (c) Diesel cycle
   (d) Dual cycle

5 marks questions:

1. Compare Otto, Diesel and Dual cycles for given compression ratio.
2. Write the drawback of Carnot cycle.
3. Why are engines not operated on Carnot cycle? Explain.
4. Explain the various stages involved in Carnot cycle along with PV and TS diagram.
5. Find out the efficiency of Carnot cycle with p-v and t-s diagram.
6. Calculate the ideal air-standard cycle efficiency of a petrol engine operating on Otto cycle. The cylinder bore is 50 mm, a stroke is of 75 mm and the clearance volume is of 21.3 cm^3 .
7. In an engine working on an ideal Otto cycle, the temperatures at the beginning and at the end of compression are 27°C and 327°C. Find the compression ratio and air-standard efficiency of the engine.
8. A Diesel engine has a compression ratio of 18 and cut off takes place at 5% of the stroke. Calculate the air-standard efficiency. Take y = 1.4.

10 marks questions:

1. The pressure and temperature of air at the beginning of compression in an Otto cycle is 103 kPa and 27°C, respectively. The heat added per kg of air is 1850 kl. The compression ratio is 8. Determine maximum temperature, maximum pressure, thermal efficiency.

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2. A four-stroke, four-cylinder petrol engine of 250-mm bore and 375-mm stroke works on Otto cycle. The clearance volume is 0.01052 m^3 . The initial pressure and temperature are 1 bar and 47°C. If the maximum pressure is limited to 2 5 bar, find the following: (a) The air standard efficiency of the cycle, (b) The mean effective pressure.
3. In an air-standard Otto cycle the pressure ratio during the compression is 15. The temperature of air at the beginning of compression is 37°C and maximum temperature attained in the cycle is 1950°C. Determine (a) Compression ratio, (b) Thermal efficiency of the cycle. (c) Work done. Take y= 1.4, Cv = 0.717 kl/kg·K.
4. An air-standard Diesel cycle has a compression ratio of 14. The pressure at the beginning of the compression stroke is 1 bar and the temperature is 300 K. The maximum cycle temperature is 2500 K. Determine the cut-off ratio and thermal efficiency.
5. An engine works on a Diesel cycle with an inlet pressure and temperature of 1 bar and l 7°C. The pressure at the end of the adiabatic compression is 35 bar. The ratio of expansion, i.e., after constantpressure heat addition is 5. Calculate the heat addition, heat rejection and efficiency of the cycle. Assume y = 1.4 Solution CP = 1.004 kJ/kg · K Cv =0.717 kJ/kg·K .
6. A Diesel engine has a compression ratio of 18 and cut off takes place at 5% of the the stroke. Calculate the air-standard efficiency. Take y = 1.4.
7. An engine operates on air standard Diesel cycle. The pressure and temperatures at the beginning of compression are 100 k.Pa and 27°C. The compression ratio is 18. The heat added per kg of air is 1850 kj. Determine maximum pressure, maximum temperature, thermal efficiency, network done and mean effective pressure of the cycle. Assume y = 1.4 and CP = 1.005 kj/ kg·K.
8. In an air standard dual cycle, the pressure and temperature are 0.1 MPa and 27°C. The compression ratio is 18. The pressure ratio for the constant volume part of heating process is 1.5 and the volume ratio for the constant pressure part of heating is 1.2, determine, (a) thermal efficiency b) mean effective pressure in MPa.
9. In an air standard dual cycle, the pressure and temperature at the beginning of compression are 1 bar and 57°C, respectively. The heat supplied in the cycle is 12 50 kl/kg, two third of this being added at constant volume and rest at constant pressure. If the compression ratio is 16. Determine the maximum pressure, temperature in the cycle, thermal efficiency and mean effective pressure.
10. Explain briefly Otto cycle with the help of PV and TS diagram and derive an expression for air standard efficiency of Otto cycle.
11. Derive an expression for thermal efficiency of Diesel cycle.

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6th Chapter: (Fuel and combustion)

2 marks questions:

1. Define fuels and classify their various types.
2. What do you understand by higher and lower calorific values of fuels?
3. Define (a) reactants, (b) products, (c) combustion, and (d) ignition temperature.
4. Define (a) stoichiometric air-fuel ratio (b) Excess air (c) and equivalence ratio.
5. Define enthalpy of formation and enthalpy of combustion.
6. Define calorific values of fuels.
7. Define air-fuel ratio.
8. Define Octane number.
9. Define Cetane number.
10. What are secondary fuels? List some examples.

5 marks questions:

1. Write the characteristic of an ideal fuel.
2. Write the advantages of liquid and gaseous fuels over solid fuels.
3. Write the applications of different types of fuel.
4. What are the advantages and disadvantages of using liquid fuels.

10 marks questions:

1. What do you mean by Calorific value of a fuel? Explain about the different types of soild fuel available for combustion purposes.
2. Explain about the different types of fuels available for combustion purposes.

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