Code No: 07A3EC08 **R07** **Set No. 2**

II B.Tech I Semester Examinations,November 2010
THERMODYNAMICS
Common to Mechanical Engineering, Aeronautical Engineering, Automobile Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Two reversible heat engines operate on Carnot cycle. They work in series between a maximum and minimum temperature of 750^0C and 30^0C. If the engines have equal thermal efficiencies and the first rejects 456 kJ to the second, calculate:

   (a) The temperature at which heat is supplied to the second engine

   (b) The heat taken from the source: and the work done by each engine. [16]

2. (a) Derive an expression for the displacement work done during any arbitrary process.

   (b) A fluid at a pressure of 3 bar with a specific volume of $0.2m^3/kg$ is contained in a cylinder behind a piston. The fluid expands reversibly to a pressure of 0.6 bar according to the Law $PV^2 = C$ Where C is constant. Calculate the work done by the fluid on the piston. [8+8]

3. (a) What is the compressibility factor?

   (b) A cylinder contains 0.5 m^3 of gas at 1 bar and 100^0C. The gas is compressed to a volume of 0.2 m^3, the final pressure being 5 bar. Determine

      i. The value for index 'n' for compression

      ii. The increase in inernal energy and

      iii. The heat received or rejected by the gas during compression. Take $\gamma =$ 1.4 , R = 0.286 k J/kg C. [6+10]

4. (a) Explain how actual vapour compression refrigeration cycle differs from an ideal vapour compression refrigeration cycle.

   (b) An ammonia vapour compression refrigerator operates with evaporator pressure of 3.5 bar and condenser pressure of 15 bar. Calculate ideal and actual COP also calculate the mass flow rate per kW of refrigeration assuming that dry saturated vapour is delivered by the compressor and liquid after condensation is sub cooled to 20^0C. [8+8]

5. A rigid and insulated tank is divided into two compartments. One compartment of volume 1 m^3 contains (C_p =29. 1 j /mol k;C_v=20.786 j /mol k)at 300 K and 1 bar while second compartment of volume 2 m^3 contains helium (C_p=20.786 j/mol j ; C_v=12.4717 j/mol k) at 100 k and 5 bar. The gases are allowed to mix by removing the partition. determine

   (a) Molar composition of mixture

(b) Final temperature and pressure of the mixture

(c) Change in entropy of helium and air

(d) Net entropy change. [16]

6. A 250 mm diameter cylinder fitted with a frictionless leak proof piston contains 0.02 kg of steam at a pressure of 0.5 Mpa and a temperature of 200^0C.As the piston moves slowly outwards through a distance of 300 mm, the steam under goes a fully resisted expansion during which the steam pressure p and the steam volume V are related by
pV^n = constant, where n isa constant. The final pressure of the steam is 0.1 Mpa. Determine

   (a) The value of n

   (b) The network done by the steam

   (c) Magnitude and sign of heat transfer.

[16]

7. (a) Derive an expression for the mean effective pressure of an otto cycle.

   (b) A petrol engine with compression ratio of 5 develops 24 kW indicated power and consumes 8 litres of fuel per hour. The specific gravity of fuel is 0.78 and its calorific value is 45 MJ/kg. Calculate the indicated thermal efficiency and relative efficiency. Take $\gamma = 1.4$. [8+8]

8. A fluid is confined in a cylinder by a spring loaded friction less piston so that the pressure in the fluid is a linear function of the volume (p=a + b V). The internal energy of the fluid is given by the following equation U = 32 + 3.15 pV .where U is in kj , p in kpa and V in cubic meter. If the fluid changes from an initial state of 120kpa, 0.025 m^3 to a final state of 300 kpa,0.056 m^3, with no work other than that done on the piston, find the direction and magnitude of the work and heat transfer. [16]

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Code No: 07A3EC08 **R07** **Set No. 4**

II B.Tech I Semester Examinations,November 2010
THERMODYNAMICS
Common to Mechanical Engineering, Aeronautical Engineering, Automobile Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. A rigid and insulated tank is divided into two compartments. One compartment of volume 1 m^3 contains (C_p =29. 1 j /mol k;C_v=20.786 j /mol k)at 300 K and 1 bar while second compartment of volume 2 m^3 contains helium (C_p=20.786 j/mol j ; C_v=12.4717 j/mol k) at 100 k and 5 bar. The gases are allowed to mix by removing the partition. determine
   (a) Molar composition of mixture
   (b) Final temperature and pressure of the mixture
   (c) Change in entropy of helium and air
   (d) Net entropy change. [16]
2. Two reversible heat engines operate on Carnot cycle. They work in series between a maximum and minimum temperature of 750^{0}C and 30^{0}C. If the engines have equal thermal efficiencies and the first rejects 456 kJ to the second, calculate:
   (a) The temperature at which heat is supplied to the second engine
   (b) The heat taken from the source: and the work done by each engine. [16]
3. (a) Explain how actual vapour compression refrigeration cycle differs from an ideal vapour compression refrigeration cycle.
   (b) An ammonia vapour compression refrigerator operates with evaporator pressure of 3.5 bar and condenser pressure of 15 bar. Calculate ideal and actual COP also calculate the mass flow rate per kW of refrigeration assuming that dry saturated vapour is delivered by the compressor and liquid after condensation is sub cooled to 20^{0}C. [8+8]
4. A 250 mm diameter cylinder fitted with a frictionless leak proof piston contains 0.02 kg of steam at a pressure of 0.5 Mpa and a temperature of 200^{0}C.As the piston moves slowly outwards through a distance of 300 mm, the steam under goes a fully resisted expansion during which the steam pressure p and the steam volume V are related by
   pV^n = constant, where n isa constant. The final pressure of the steam is 0.1 Mpa. Determine
   (a) The value of n
   (b) The network done by the steam

(c) Magnitude and sign of heat transfer.

[16]

5. (a) Derive an expression for the displacement work done during any arbitrary process.

   (b) A fluid at a pressure of 3 bar with a specific volume of $0.2m^3/kg$ is contained in a cylinder behind a piston. The fluid expands reversibly to a pressure of 0.6 bar according to the Law $PV^2 = C$ Where C is constant. Calculate the work done by the fluid on the piston. [8+8]

6. (a) Derive an expression for the mean effective pressure of an otto cycle.

   (b) A petrol engine with compression ratio of 5 develops 24 kW indicated power and consumes 8 litres of fuel per hour. The specific gravity of fuel is 0.78 and its calorific value is 45 MJ/kg. Calculate the indicated thermal efficiency and relative efficiency. Take $\gamma = 1.4$. [8+8]

7. (a) What is the compressibility factor?

   (b) A cylinder contains 0.5 m^3 of gas at 1 bar and 100^0C. The gas is compressed to a volume of 0.2 m^3, the final pressure being 5 bar. Determine

      i. The value for index 'n' for compression

      ii. The increase in inernal energy and

      iii. The heat received or rejected by the gas during compression. Take $\gamma =$ 1.4 , R = 0.286 k J/kg C. [6+10]

8. A fluid is confined in a cylinder by a spring loaded friction less piston so that the pressure in the fluid is a linear function of the volume (p=a + b V). The internal energy of the fluid is given by the following equation U = 32 + 3.15 pV .where U is in kj , p in kpa and V in cubic meter. If the fluid changes from an initial state of 120kpa, 0.025 m^3 to a final state of 300 kpa,0.056 m^3, with no work other than that done on the piston, find the direction and magnitude of the work and heat transfer. [16]

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Code No: 07A3EC08 **R07** **Set No. 1**

II B.Tech I Semester Examinations,November 2010
THERMODYNAMICS
Common to Mechanical Engineering, Aeronautical Engineering, Automobile Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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   (a) Molar composition of mixture
   (b) Final temperature and pressure of the mixture
   (c) Change in entropy of helium and air
   (d) Net entropy change. [16]

2. (a) Derive an expression for the mean effective pressure of an otto cycle.
   (b) A petrol engine with compression ratio of 5 develops 24 kW indicated power and consumes 8 litres of fuel per hour. The specific gravity of fuel is 0.78 and its calorific value is 45 MJ/kg. Calculate the indicated thermal efficiency and relative efficiency. Take γ = 1.4. [8+8]

3. A fluid is confined in a cylinder by a spring loaded friction less piston so that the pressure in the fluid is a linear function of the volume (p=a + b V). The internal energy of the fluid is given by the following equation U = 32 + 3.15 pV .where U is in kj , p in kpa and V in cubic meter. If the fluid changes from an initial state of 120kpa, 0.025 m^3 to a final state of 300 kpa,0.056 m^3, with no work other than that done on the piston, find the direction and magnitude of the work and heat transfer. [16]

4. (a) What is the compressibility factor?
   (b) A cylinder contains 0.5 m^3 of gas at 1 bar and 100^{0}C. The gas is compressed to a volume of 0.2 m^3, the final pressure being 5 bar. Determine
      i. The value for index 'n' for compression
      ii. The increase in inernal energy and
      iii. The heat received or rejected by the gas during compression. Take γ = 1.4 , R = 0.286 k J/kg C. [6+10]

5. (a) Derive an expression for the displacement work done during any arbitrary process.

(b) A fluid at a pressure of 3 bar with a specific volume of $0.2m^3/kg$ is contained in a cylinder behind a piston. The fluid expands reversibly to a pressure of 0.6 bar according to the Law $PV^2 = C$ Where C is constant. Calculate the work done by the fluid on the piston. [8+8]

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7. (a) Explain how actual vapour compression refrigeration cycle differs from an ideal vapour compression refrigeration cycle.

   (b) An ammonia vapour compression refrigerator operates with evaporator pressure of 3.5 bar and condenser pressure of 15 bar. Calculate ideal and actual COP also calculate the mass flow rate per kW of refrigeration assuming that dry saturated vapour is delivered by the compressor and liquid after condensation is sub cooled to 20^0C. [8+8]

8. A 250 mm diameter cylinder fitted with a frictionless leak proof piston contains 0.02 kg of steam at a pressure of 0.5 Mpa and a temperature of 200^0C.As the piston moves slowly outwards through a distance of 300 mm, the steam under goes a fully resisted expansion during which the steam pressure p and the steam volume V are related by
   pV^n = constant, where n isa constant. The final pressure of the steam is 0.1 Mpa. Determine

   (a) The value of n

   (b) The network done by the steam

   (c) Magnitude and sign of heat transfer.

   [16]

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Code No: 07A3EC08 **R07** **Set No. 3**

II B.Tech I Semester Examinations,November 2010
THERMODYNAMICS
Common to Mechanical Engineering, Aeronautical Engineering, Automobile Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is the compressibility factor?
   (b) A cylinder contains 0.5 m^3 of gas at 1 bar and 100^0C. The gas is compressed to a volume of 0.2 m^3, the final pressure being 5 bar. Determine
      i. The value for index 'n' for compression
      ii. The increase in inernal energy and
      iii. The heat received or rejected by the gas during compression. Take γ = 1.4 , R = 0.286 k J/kg C. [6+10]

2. Two reversible heat engines operate on Carnot cycle. They work in series between a maximum and minimum temperature of 750^0C and 30^0C. If the engines have equal thermal efficiencies and the first rejects 456 kJ to the second, calculate:
   (a) The temperature at which heat is supplied to the second engine
   (b) The heat taken from the source: and the work done by each engine. [16]

3. A rigid and insulated tank is divided into two compartments. One compartment of volume 1 m^3 contains (C_p =29. 1 j /mol k;C_v=20.786 j /mol k)at 300 K and 1 bar while second compartment of volume 2 m^3 contains helium (C_p=20.786 j/mol j ; C_v=12.4717 j/mol k) at 100 k and 5 bar. The gases are allowed to mix by removing the partition. determine
   (a) Molar composition of mixture
   (b) Final temperature and pressure of the mixture
   (c) Change in entropy of helium and air
   (d) Net entropy change. [16]

4. (a) Derive an expression for the mean effective pressure of an otto cycle.
   (b) A petrol engine with compression ratio of 5 develops 24 kW indicated power and consumes 8 litres of fuel per hour. The specific gravity of fuel is 0.78 and its calorific value is 45 MJ/kg. Calculate the indicated thermal efficiency and relative efficiency. Take γ = 1.4. [8+8]

5. (a) Derive an expression for the displacement work done during any arbitrary process.

(b) A fluid at a pressure of 3 bar with a specific volume of $0.2m^3/kg$ is contained in a cylinder behind a piston. The fluid expands reversibly to a pressure of 0.6 bar according to the Law $PV^2 = C$ Where C is constant. Calculate the work done by the fluid on the piston. [8+8]

6. A fluid is confined in a cylinder by a spring loaded friction less piston so that the pressure in the fluid is a linear function of the volume (p=a + b V). The internal energy of the fluid is given by the following equation U = 32 + 3.15 pV .where U is in kj , p in kpa and V in cubic meter. If the fluid changes from an initial state of 120kpa, 0.025 m^3 to a final state of 300 kpa,0.056 m^3, with no work other than that done on the piston, find the direction and magnitude of the work and heat transfer. [16]

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pV^n = constant, where n isa constant. The final pressure of the steam is 0.1 Mpa. Determine

   (a) The value of n
   (b) The network done by the steam
   (c) Magnitude and sign of heat transfer.

[16]

8. (a) Explain how actual vapour compression refrigeration cycle differs from an ideal vapour compression refrigeration cycle.
   (b) An ammonia vapour compression refrigerator operates with evaporator pressure of 3.5 bar and condenser pressure of 15 bar. Calculate ideal and actual COP also calculate the mass flow rate per kW of refrigeration assuming that dry saturated vapour is delivered by the compressor and liquid after condensation is sub cooled to 20^0C. [8+8]

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