Assignment No.1

BASIC MECHANICAL ENGINEERING (PART-A)

First Semester, Batch A-6 (Session: Aug-Dec.,2019)

(To be submitted in last class before Mid- sem exam. positively)

Q1(i) Distinguish between the following with examples:

a) Reversible and irreversible processes

b) Intensive and extensive property

c) System, boundary, surrounding and universe

d) Path function and point function

e) Macroscopic and microscopic viewpoint

(ii) A gas flows steadily through a rotary compressor. The gas enters the compressor at a temperature of 16º C , a pressure of 100KPa and an enthalpy of 391.2 KJ/Kg. The gas leaves the compressor at a temperature of 245º C , a pressure of 0.6 MPa and an enthalpy of 534.5 KJ/Kg. Heat transfer is negligible.

Evaluate (i) the external work done per unit mass of gas assuming the gas velocities at entry and exit to be negligible. (ii) the external work done per unit mass of the gas when the gas velocities at entry is 80 m/s and that at exit is 160m/s.

Q.2 (i) Explain the following:

a) Quasi-static process

b) Thermodynamic equilibrium

c) Zeroth law of thermodynamics and temperature

d) Cause of irreversibility

e) Adiabatic processes

(ii)A fluid at a pressure of 3 bar with sp. Volume of 0.18 m^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 a constant. Calculate the work done by the fluid on the piston.

Q.3 (i) Show that internal energy and enthalpy are properties of a thermodynamic system.

(II) A closed rigid vessel containing 10 Kg of Oxygen at 290 K is supplied heat until its pressure becomes two fold that of initial value . Identify the process and calculate the final temperature , change in internal energy , change in enthalpy and heat interaction across the

boundary. Take C_v = 0.65 KJ/Kg-K.

Q.4(i) Show the reversible adiabatic process, pv^{γ}= a constant in p-v and T-s diagrams. Also establish the relation between T & p and T & v for the process. Show that the work done in the process $W_{1-2} = (p_1v_1 - p_2v_2)/\gamma - 1$.

(II) A perfect gas undergoes the following three separate and distinct processes to execute a cycle. (i) Constant volume during which 80 KJ of heat is supplied to the gas (ii) Constant pressure during which 85 KJ of heat is lost to the surroundings and 20 KJ of work done on it (III) Adiabatic process which restores the gas back to the initial state . Evaluate the work done.

Q.5(i) Explain the concept of flow work. What is steady flow process? State the assumptions made for steady flow process. Derive energy and mass balance equations for a steady flow single fluid in the system.

(ii) A fluid is confined in a cylinder by a spring loaded , frictionless piston so that the pressure in the fluid is a linear function of the volume , p= a+bv. The internal energy of the fluid is given by the equation U=34+3.15 pv where U is in KJ , p is in KPa and v is in m^3 . If the fluid changes from the initial state of 170KPa , 0.03 m^3 , to the final state of 400 KPa,0.06 m^3 , with no work other than that done by the piston, find the direction and magnitude of the work and heat transfer.

Q.6(a) Explain the processes involved in Diesel cycle with p-v and T-s diagrams and find out the air standard thermal efficiency of the cycle.

(b)An ideal Diesel cycle with air as the working fluid has a compression ratio of 18 and a cut-off ratio of 2 . At the beginning of the compression, the air is at 100kPa, 27^0C and 1917cm^3. Determine (a) the pressure and temperature of air at each point (b) the net work and the thermal efficiency and (c) the mean effective pressure. Draw p-v and T-s diagrams of the cycle.

7(a) What is a Carnot cycle? What are the four processes which constitute the cycle. Show that the efficiency of a reversible engine operating between two given constant temperatures is the maximum.

(b) A reversible heat engine operates between two reservoirs at temperature of 600 ^{0} C and 40^0 C. The heat transfer to the heat engine is 2000kJ. Find the heat rejected, the work done by the engine and the thermal efficiency of the Carnot's engine.

(c) Determine the air standard thermal efficiency of Otto cycle and show the p-v and T-s diagrams of the cycle.. An engine working on Otto cycle has a compression ratio of 8. Find its' thermal efficiency. Take γ=1.414

Q.8(i) Write short notes on :

a) PMM-1 & PMM-2.

b) Control volume and control surfaces

c) Change of state

d) Universal gas constant and Characteristic gas constant

e) Work transfer and Heat transfer

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Assignment No. 2

Basic Mechanical Engineering , Part –A

First Semester, Batch A-6 (Session: Aug-Dec.,2019)

(To be submitted in last class before End- sem exam positively)

Q.1(a) Discuss the necessity of power generation and mention some of the conventional methods of power generation in our country.

(b)What are the renewable and non-renewable sources of energy used for power generation?

Q.2(a) What are the four important factors to be considered for selecting hydel power plant?

(b)Draw the layout of thermal power plant and explain the various circuits.

Q.3(a) Sate the advantages and disadvantages of setting up of steam power plants.

(b) Explain the working of hydel power plant.

Q.4(a) What is the purpose of Dam in hydel power plant ?.

(b) Explain the working of nuclear power plant with a layout.

Q.5(a) State the characteristics of fluid and its relevant properties. How will you differentiate ideal and real fluid?

(b)The dynamic viscosity of oil used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 metre and rotates at 190 rpm. . Calculate the shear stress and the shear force. The sleeve length is 90 mm and the thickness of the oil film is 1.5 mm.

(c) An oil film of thickness 1.5mm is used for lubrication between a square plate of size 0.9 m X0.9m and an inclined plane having an angle of inclination 20^0 . The weight of the square

plate is 392.4 N and it slides down the plane with a uniform velocity of 0.2 m/s. Find the dynamic viscosity of the oil in Poise.

Q.6(a) Explain Newton's law of viscosity. and derive the expression for shear force in fluid.

(b)The velocity distribution for fluid flow over a flat plate is given by $u=3/4y-y^2$ where u is the velocity in m/sec and y is the distance above the plate in m. Determine the shear stress at y=1.5m.

(c) Explain the difference between Newtonian and non-Newtonian fluids.

Q.7(a) Derive an expression showing that the intensity of pressure at a point in a static fluid is equal in all directions.

(b)A 30 cm. Diameter pipe, conveying water, branches into two pipes of 20 cm and 15 cm diameters respectively. If average velocity in 30 cm diameter pipe is 2.5 m/s , find discharge in this pipe.. Also determine the velocity in 15 cm pipe, if average velocity in 20 cm diameter pipe is 2 m/s.

(c) Derive a general expression for the pressure variation in a fluid at rest .

Q.8 (a) Derive an expression for Bernoulli's theory for steady stream of fluid flow, mentioning the details of the notations used and their units.

(b)Determine the absolute pressure in Pa at a depth of 6m below the free surface of a tank of water,

where gauge pressure is 58.85KPa. The barometer reads 760 mm of Hg.

(c)Water is flowing through a pipe of 100mm diameter under a pressure of 19.62 N/cm^2 and with mean velocity of 3 m/s. Find the total head of water of a cross section which is 8 m above the datum line.

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