Paper Code: ME-309	**Roll No.**									

B.Tech.
THIRD SEMESTER EXAMINATION, 2016-17
THERMAL AND HYDRAULIC MACHINE

[Time: 3 hrs.] [Max. Marks: 100]

Note- Attempt All Questions. Assume missing data suitably. Use of steam table is permitted.

1. Attempt any **four** parts of the following:- **(5x4=20)**

(a) What are the limitations of first law of thermodynamics? Write down the statements of second law of thermodynamics.
(b) A gas is compressed in a quasi-static process from 80 kPA, 0.1 m^3 to 400 kPa, 0.03 m^3 following the law Pv^n = const. Find the work done by the gas.
(c) What is concept of continuum? Define Intensive and Extensive properties with examples.
(d) 2 kg/sec of fluid is expanding from the nozzle. The velocity & enthalpy of a fluid at the inlet of the nozzle are 50 m/s and 2800 kJ/Kg respectively. The enthalpy of fluid at the exit of nozzle is 2600kJ/Kg. Heat loss from the nozzle is 30 kW. Find velocity of fluid at the exit of the nozzle.
(e) The velocity & enthalpy of a fluid at the inlet of a certain nozzle are 50 m/s and 2800KJ/Kg respectively. The enthalpy at the exit of nozzle is 2600KJ/Kg. The nozzle is insulated. Find, velocity of fluid at exit.
(f) For a non-flow quasi-static process the pressure depends on volume as follows:
$P=V^2+\frac{8}{V}$ Determine the work done if volume changes from 2 to 3 m^3

2. Attempt any **four** parts of the following:- **(5x4=20)**

(a) A cyclic heat engine operates between a source temperature of 800^0C and sink temperature of 30^0C. What is least rate of heat rejection per kW net output of the engine?
(b) Derive the expression for maximum work output:
Maximum work output (W_{net}) =$C_p[\sqrt{T_{max}}-\sqrt{T_{min}}]$
(c) Make comparison between 2-stroke and 4-stroke engine.
(d) Draw the Otto cycle on p-v and T-s entropy chart and drive the expression of efficiency of otto cycle in terms of compression ratio.
(e) A diesel engine having clearance volume 6% of swept volume and cut off ratio is 1.8. Find the air standard thermal efficiency of the diesel cycle.
(f) A reversible heat engine operates between 600 °C and 37 °C and drives a reversible refrigerator operating between 310 K and 255 K. the engine receives 2000 kJ of heat and the net work output from the arrangement is 350 kJ find the heat removed by the refrigerator from 255 K reservoir.

3. Attempt any two parts of the following:- **(10x2=20)**

(a) Draw the simple rankine cycle on P-v, T-s and h-s diagram. Discuss how boiler pressure and condenser pressure affect the cycle efficiency.

(b) Define Critical point and triple point. In a steam turbine installation running on simple rankine cycle steam leaves the boiler at 10 MPa and 700 °C and leaves the turbine at 5 kPa. For the 100 MW output of the plant find heat added in the boiler in kW and efficiency of the cycle. Neglect pump work.

(c) Answer the following

(i) With the help of steam table find the value of enthalpy, entropy and specific volume of steam at 44 bar pressure and 280 °C.

(ii) Steam is flowing in a pipeline at a pressure of 20 bar is throttled to a pressure of 1 bar and 115 °C. Find the dryness fraction, temperature and enthalpy of steam in the pipeline.

4. Attempt any two parts of the following:- **(10x2=20)**

(a) A jet of water having a velocity of 20m/s strikes a curved vane which is moving with a velocity of 10 m/s. The jet makes an angle of 20^0 with the direction of motion of vane at inlet and leaves at an angle of 130^0 to the direction of motion of vane at outlet. Calculate:

(i) Vane angles, so that the water enters and leaves the vane without shock.

(ii) Work done per sec per unit weight of water striking (or work done per unit weight of water striking) the vanes per sec.

(b) Discuss the working of gas turbine with neat schematic and draw the cycle on p-v and T-s chart. A gas turbine power plant operates on the brayton cycle between minimum and maximum temperature of 20^0C and 800^0C. Air enters the turbine at 1bar and leaves the compresses at 8 bar. It produces 800 kW of power. Calculate the mass flow rate of air in the cycle.

(c) Answer the following

(i) What is Draft tube? Why it is used in reaction turbine.

(ii) Make comparison between impulse and reaction turbine.

5. Attempt any two parts of the following:- **(10x2=20)**

(a) What is Net Positive Suction Head (NPSH) Explain by giving its expression?
A Centrifugal pump rotating at 1000rpm delivers 160 litres/s of water against a head of 30m. The pump is installed at a place where atmospheric pressure is $1x10^5$Pa (abs) and vapour pressure of water is 3kPa (abs). The head lost in suction pipe is equivalent to 0.2 m of water. Calculate minimum NPSH.

(b) A single acting reciprocating pump running at 40 rpm delivers 200 litres of water per minute. The diameter of the piston is 150 mm. and stroke lenth 300 mm. The suction and delivery heads are 3.5m and 11.5m respectively. Frictional losses in suction pipe is 1.5 m and and delivery pipe is 2 m. Determine

(i) theoretical discharge
(ii) coefficient of discharge
(iii) percentage of slip of the pump
(iv) power required to run the pump.

(c) Write short notes on the following.

(i) Air Vessel

(ii) Cavitation & priming