(15%)1.A water pump is operating at a volume flow rate of $0.005 m^3/s$.   The water is delivered from the ground to a height of 5m through a pipe of diameter 0.1m. Please calculate the required power to the water.

(15%)2. Derive the differential entropy change of an ideal gas

$$dS = C_v \frac{dT}{T} + R \frac{dV}{V}$$ where C_v = specific heat at constant volume, R = gas constant

(20%)3.A 10kg block of iron casting at 350K is thrown into a large lake which is at a temperature of 300 K. For iron, Cv=0.45 kJ/kg-K, determine
(a) The entropy change of the iron block.
(b) The entropy change of the lake water.
(c) The total entropy change for this process.
(d) Is this process irreversible?

20% 1.Explain
(i)   Reversible work, Useful work, Surrounding work, Irreversibility.
(ii) 2nd Law Efficiency
(iii)   Isentropic process
(iv)   Availability
(v)   Entropy

(30%) 4. Explain
(i) Otto cycle
(ii) Carnot cycle
(iii) Diesel cycle
Plot the temperature-entropy diagram for these 3 cycles and explain their four process