Time:3 Hours **Marks: 80**

Instructions:

- **Question No.1 is compulsory.**
- Solve **ANY THREE** questions from the **remaining FIVE** questions.
- Figure to the right indicates full marks.
- Assume suitable data wherever required, but justify the same.
- Use of steam table is permitted.

			Marks
Q. 1		Solve **ANY FOUR** questions from following. (Each question carries 5 marks)	**(20)**
	a)	Describe construction and working of Economiser with neat sketch.	
	b)	Write short note on compounding of Impulse turbine.	
	c)	Explain the construction and working of double acting reciprocating pump with neat sketch.	
	d)	Illustrate impulse momentum principle and reaction principle in Hydraulic turbines.	
	e)	What is surging and chocking in compressor.	
Q. 2	**a)**	A Pelton wheel is to designed for the following specification: Power (Brake or Shaft) = 9560 kW, Head = 350 m, Speed = 800 RPM, Overall efficiency = 85%, Jet Diameter is limited to $1/6^{th}$ of the wheel diameter. Determine the wheel diameter, diameter of jet and number of jet required. Take C_v=0.985 and speed ratio = 0.45.	**(10)**
	b)	Illustrate working of La-Mont boiler and Once through boiler with the help of neat sketch.	**(10)**
Q. 3	**a)**	In a gas turbine plant , the air enters a compressor from ambient at a pressure of 1 bar and 10°C. The static pressure at the suction of the compressor is 0.9 bar and compresses it to total pressure of 6.0 bar and a total temperature of 230°C. The air expands in the turbine upto a total pressure of 1 bar and total temperature of 460°C. The net output of the turbine is 1930 kW. Calculate: i) Total head isentropic efficiency of the compressor. ii) Velocity at entrance to the compressor iii) Mass flow rate if the area at entry to the compressor is 0.1 m^2. iv) The temperature of gases at the entry to the turbine. Neglect all other losses and the mass of fuel. Assume C_{pa} = 1.05 kJ/kg K for compressor, C_{pg} = 1.13 kJ/kg K for turbine, γ =1.4 throught and R=300 Nm/kg K for air.	**(10)**
	b)	State and derive the expression for equivalent evaporation of boiler and boiler efficiency?	**(10)**

Q. 4 **a)** The following data is recorded during a trial on a boiler: **(10)**
Duration of trial=8 hrs., Pressure of steam leaving the boiler = 14 bar, Condition of steam leaving the boiler = 0.973 dry, Feed water evaporated = 26700 kg, Temperature of feed water at inlet = 50 °C, Mass of coal fired = 4260 kg, Calorific value of coal fired = 28900 kJ/kg, Air supplied per kg of coal fired = 17 kg, Temperature of flue gas leaving boiler = 344 °C, Boiler house temperature = 21 °C, Specific heat of flue gases at constant pressure = 1.1 kJ/kg K. Determine i) Boiler efficiency ii) Equivalent evaporation iii) Heat lost to flue gases.

b) Draw a general layout of a hydroelectric power plant using a Pelton turbine and define the following: (a) Gross head, (b) Net head, (c) Mechanical efficiency (d) Overall efficiency of the Pelton turbine. **(05)**

c) Draw an indicator diagram, considering the effect of acceleration and friction in suction and delivery pipes. **(05)**

Q. 5 **a)** A centrifugal pump having outer diameters equal to two times the inner diameters and running at 1000 rpm works against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm. Determine: **(10)**
(i) Inlet vane angle,
(ii) Work done by the impeller on water per second, and
(iii) Manometric efficiency

b) What is Euler's theory? What is the use of it in pump and turbine **(05)**

c) Illustrate working of Turboprop Engine. **(05)**

Q. 6 **a)** A reaction turbine works at 450 rpm under a head of 120 m. Its diameter at inlet is 1.2 m and the flow area is 0.4 m^2. The angles made by absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Determine the volume flow rate and the power developed by the turbine. **(10)**

b) Derive an expression for condition to get maximum efficiency in De-laval turbine. **(10)**

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