Name:

Enrolment No:

UPES
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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Course: Steam, Gas and Hydraulic Turbines **Semester: I**
Program: M Tech RE **Time 03 hrs.**
Course Code: MERE 7004 **Max. Marks: 100**

Instructions: Use Steam Tables, Molier Chart and Graph sheet

SECTION A

ANSWER ALL

S. No.		Marks	CO
Q 1	Explain the super saturated or metastable flow of steam through a nozzle and the significance of Wilson's line.	5	CO4
Q 2	Explain the different losses in turbines.	5	CO3
Q 3	Draw flow duration and mass curve and explicate its merits and demerits.	5	CO2
Q 4	Explain governing of a steam turbine and Describe any one method of governing for turbines.	5	CO1

SECTION B

ANSWER ALL

Q 5	In a gas turbine, plant operating on a Joule cycle maximum and minimum temperature are 825^0 C and 25^0 C. The pressure ratio is 4.5. Calculate the specific work out put, cycle efficiency and work ratio. Assuming isentropic efficiencies of the com pressure and the turbine at 85 and 90 percent respectively. If the rating of the turbine is 1300 k W , what is the mass flow in kg/sec? Neglect the mass flow of fuel. Take C_P = 1.005 k J/kg K.	10	CO3
Q 6	The runoff data of a river at a particular site is tabulated below:	10	CO3

Month	Mean discharge per month (millions of cu.m.)	Month	Mean discharge per month (millions of cu.m.)
January	40	July	75
February	25	August	100
March	20	September	110
April	10	October	60
May	0	November	50
June	50	December	40

(i) Draw a hydrograph and find the mean flow,
(ii) Also draw the flow duration curve,
(iii) Find the power in MW available at mean flow if the head available is 80 m and overall efficiency of generation is 85%.

Take each month of 30 days.

Q 7	Draw layout of hydroelectric power plant and explain the elements of the plant.	**10**	**CO1**
Q 8	Derive the condition for maximum efficiency of an impulse turbine. OR Classify different cooling methods for turbine blades and explain difference between film cooling and transpiration cooling for gas turbine blade cooling.	**10**	**CO2**
SECTION-C **ANSWER ANY TWO**			
Q 9	Air is drawn in a gas turbine unit at 15^0C and 1.01bar, pressure ratio is 7:1 the compressor is driven by the H.P turbine, and L.P turbine drives a separate power shaft. The isentropic efficiency of compressor and the H.P and L.P turbines are 0.82, 0.85 and 0.85 respectively. If the maximum cycle temperature is 610^0C, calculate: The pressure and the temperature of gases entering the power turbine, The net power developed by the unit per kg/s mass flow, The work ratio, Thermal efficiency of the unit, For compression C_{pa}=1.005kJ/kg k and γ=1.4 For combustion and expansion process C_p = 1.15kJ/kg k and γ=1.333	**20**	**CO4**
Q 10	A. The following data is applied for a hydro-electric power station : Catchment area ------ ----------100 sq. km; Annual rain fall ------ ----------1200 mm; Available head ---------- 220 m; Load factor --------- ---------- 45%; Yield factor to allow for run-off and evaporation loss ----- 55%; Power plant efficiency---- ----------72%. Calculate (i) average power produced (ii) Capacity of the power plant. B. Explain compounding of a turbine and describe any one method to reduce the rotor speed of a turbine.	**10** **10**	**CO3/2**
Q 11	In an impulse turbine, mean diameter of blades is 1.05 m and the speed is 3000 rpm. The nozzle angles is 18^0, the ratio of blade speed to steam speed is 0.42 and blade velocity coefficient is 0.85. The outlet blade angle is 3^0 less than that of the inlet blade angle. Steam flow rate is 20 kgs/sec. Obtain: i. Tangential thrust on the blades ii. Axial thrust on the blades iii. Resultant thrust iv. Power developed v. Blade efficiency.	**20**	**CO4**