Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

END Semester Examination, May 2019

Programme Name: B.Tech- Mechanical **Semester : IV**
Course Name : Thermal Engineering **Time : 03 hrs**
Course Code : GNEG292 **Max. Marks : 100**
Nos. of page(s) : 2

Instructions:

i. *There are three sections viz. Section A, Section B and Section C. Section A carries 20 marks, Section B carries 40 marks and Section C carries 40 marks*
ii. *Attempt all the questions in Section A, B and C*
iii. *Make appropriate assumptions wherever required*

SECTION A – 20 Marks

S. No.		Marks	CO
Q 1	Identify factor contributing to loss of efficiency in a surface condenser?	**5**	**CO4**
Q 2	Explain compounding of steam turbine?	**5**	**CO1**
Q 3	How is degree of reaction defined? Explain 50% reaction turbine?	**5**	**CO1**
Q 4	Explain draught? Describe the various methods for producing draught?	**5**	**CO1**

SECTION B-40 Marks

Q 5	In a reaction, stage of a steam turbine the nozzle angle is 20^0 and the absolute velocity of steam at inlet to the moving blade is 240 m/s. If the blading is designed for 50% reaction, determine (a) the blade height at inlet and exit, (b) the enthalpy drop per kg of steam in the moving blade and in the complete stage, (c) the diagram power for a steam flow of 1 kg/s.	**10**	**CO2**
Q 6	A coal analysis by mass is 73% C, 12% ash, 15% H_2O. When burned in a boiler the residue contains 18% C by mass. The analysis of the dry flue gas, by volume, is CO_2 11.8%, CO 1.3%, O_2 5.5 %. Calculate the % C in the coal, which undergoes combustion and the actual air used.	**10**	**CO3**
Q 7	Steam at 7 bar, 200 ^{0}C expands isentropically in convergent-divergent nozzle into a space at 3 bar. Neglecting the inlet velocity, estimate the exit area required for a mass flow rate of 0.1 kg/s when (a) the flow is in equilibrium throughout, (b) the flow is supersaturated with $pv^{1.2}$ = constant Find (b) the degree of supercooling and the degree of supersaturation.	**10**	**CO2**
Q 8	Assess the effect of air leakage in steam condenser (surface type)? Explain the method by which air can be removed from the steam condenser?	**10**	**CO4**

SECTION C- 40 Marks			
Q 9	The following particulars relate to a two-row velocity compounded impulse wheel, which forms a first stage of a combination turbine. Steam velocity at nozzle outlet = 579.12m/s Mean blade velocity = 115.82m/s Nozzle outlet angle = 16^0 Outlet angle first row of moving blades = 18^0 Outlet angle fixed guide blades = $22^{0\backslash}$ Outlet angle, second row of moving blades = 36^0 Steam flow rate = 2.4 kg/s The ratio of the relative velocity at outlet to that at inlet is 0.84 for all blades. Determine for each row of moving blades the following 1. The velocity of whirl 2. The tangential thrust on blades 3. The axial thrust on the blades 4. The power developed What is the efficiency of the wheel as a whole?	**20**	**CO3**
Q 10	A combined power plant consisting of a closed cycle GT unit (Brayton cycle) using air as the working fluid and a ST unit (Rankine Cycle) is to be designed such that the heat rejected at the GT unit is to be utilized to produce steam at the generator for the ST. The air leaving the generator is at 200 ^{0}C and it is cooled to the compressor inlet temperature by a second cooler, which rejects the heat to waste. Draw the flow and T-S diagram of the plant and calculate on the basis of ideal cycle, neglecting the feed pump work of Rankine cycle, (a) mass flow rate (b) Total power output ***OR*** The cylinder of steam engine is 30 cm in diameter and piston stroke is 58 cm. The steam at admission is at 10 bar and 30 ^{0}C. It expands adiabatically to 0.7 bar and is then released at constant volume to a condenser at 0.3 bar. Determine, (a) Modified Rankine efficiency (b) new stroke	**20**	**CO2**