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Enrolment No:			
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES End Semester Examination, May 2023			
Course: Applied Thermodynamics Program: B.Tech Mechanical Course Code: MECH 2044		Semester: IV Time : 03 hrs. Max. Marks: 100	
Instructions: Make suitable assumptions (if any needed)			
SECTION A (5Qx4M=20Marks)			
S. No.	Question	Marks	CO
Q 1	What is Vortex tube refrigeration? Plot the process of expansion in vortex tube on T-s diagram.	4	CO1
Q 2	Explain the following terms (a) Wet compression and (b) Dry Compression.	4	CO1
Q 3	Explain the following (a) Wet Bulb Depression (b) Degree of saturation.	4	CO1
Q 4	What is air conditioning? What factors are required to be controlled by an air-conditioner for human comfort?	4	CO1
Q 5	What do you mean by the term 'Volumetric efficiency' in reference to Engines and compressor.	4	CO1
SECTION B (4Qx10M= 40 Marks)			
Q 6	In a single heater, regenerative cycle the steam enters the turbine at 30 bar, 400 deg Cel. and the exhaust pressure is 0.1 bar. The feed water heater is a direct contact type, which operates at 5 bar. Find the A. The efficiency and B. steam rate of the cycle	10	CO3
Q 7	In a gas turbine plant working on Brayton cycle, the effectiveness of the regenerator is 75%, the air at the inlet to the compressor is at 0.1 MPa and 30 deg. cel. The pressure ratio is 6, and the maximum cycle temperature is 900 deg. cel. If the turbine and compressor has 80% efficiency. Find the percentage increase in the cycle efficiency due to regeneration.	10	CO3
Q 8	A refrigerant-12 VCR plant producing 10 tonnes of refrigeration operates with condensing and evaporating temperatures of 35 °C and -10 °C respectively. A suction line heat exchanger is used to sub-cool the saturated liquid leaving the condenser. Saturated vapor leaving the evaporator is superheated in the suction line heat exchanger to the extent that a discharge temperature of of 60 °C is obtained after isentropic compression. Determine a) The sub-cooling achieved in the heat exchanger in the heat exchanger b) The refrigerant flow rate in kg/s	10	CO3

	<p>c) The cylinder dimension of the two cylinder compressor is the speed is 900 rpm, stroke to bore ratio is 1.1 and the volumetric efficiency is 80%</p> <p>d) The COP of the plant and</p> <p>e) The power required to drive the compressor in kW.</p>		
Q 9	<p>Dry saturated steam at a pressure of 15 bar is expanded isentropically in a nozzle to pressure of 0.5 bar. With the help of Mollier's diagram, find the velocity and dryness fraction of the steam issuing from the nozzle, if the friction is neglected. Also, find the velocity and dryness fraction of the steam if 15% of the heat drop is lost in friction.</p> <p style="text-align: center;">OR</p> <p>An engine working on the Otto cycle is supplied with air at 1 atmospheric pressure, 25 degree Celsius and the compression ratio is 8. Heat supplied is 3000 kJ/kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and the mean effective pressure (for air $C_p=1.005$, $C_v=0.718$, and $R=0.287$ KJ/Kg K)</p>	10	CO4
<p>SECTION-C (2Qx20M=40 Marks)</p>			
Q 10	<p>(a) Two streams of air 30 deg. Celsius, 60% RH and 35 deg. Celsius, 70% RH are mixed adiabatically to obtain 0.4 kg/s of dry air at 33 deg Celsius. Calculate the amount of air drawn from both the streams and the humidity ratio of the mixed air.</p> <p>(b) Air-water vapour mixture at 0.1 MPa, 30 deg cel, 80% RH has a volume of 100 m³. Calculate the specific humidity, dew point, WBT, mass of dry air and mass of water vapour. If the mixture is cooled at constant pressure at 5 deg Celsius. Calculate the amount of water vapour condensed.</p>	20	CO4
Q 11	<p>(a) Explain the following in reference to expansion through the nozzle, also plot it on the h-s axes.</p> <ol style="list-style-type: none"> 1. Super saturation 2. Degree of undercooling 3. Degree of super saturation 4. Nozzle efficiency <p>(b) The dry saturated steam is expanded in a nozzle from 15 bar to a pressure of 8 bar. If the expansion is supersaturated, find the degree of undercooling and the degree of super saturation.</p> <p style="text-align: center;">OR</p> <p>(a) Plot the following processes on the Psychrometric chart and Analyse the state of the air after,</p> <ol style="list-style-type: none"> a. Sensible Heating and cooling b. Heating and dehumidification c. Adiabatic saturation process d. Mixing of Air streams 	20	CO2

	<p>(b) With the help of a neat line and T-s diagram, derive the relation for the following in a multistage vapour compression refrigeration cycle with flash intercooling.</p> <ol style="list-style-type: none">a. Refrigeration effectb. Work of compression andc. Coefficient of performance of the cycle.		
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