

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

Online End Semester Examination, June 2021

Programme Name: M.Tech –Energy Systems

Course Name : Thermal Utilities

Course Code : EPEC 7027

Nos. of page(s) : 2

Semester : II

Time : 03 hrs

Max. Marks : 100

Instructions: Steam table are allowed, Assume suitable data if required.

SECTION A

1. Each Question will carry 5 Marks

2. Instruction: Complete the statement / Select the correct answer(s)

S. No.	Question	Marks	
Q 1	(a) Give two examples of non-combustible substances. (b) List some important primary fuels and secondary fuels. (c) Define calorific value. Explain higher & lower calorific value.	5	CO1
Q 2	Distinguish between Fire-tube and Water-tube boiler.	5	CO2
Q 3	Explain the following boiler mountings (a) Water level indicator (b) Feed check valve (c) Blow-off cock (d) Fusible plug	5	CO2
Q 4	Explain the difference between impulse and reaction turbine.	5	CO3
Q 5	Define the following as related to steam turbines (a) Blade velocity co-efficient (b) Diagram efficiency (c) Stage efficiency	5	CO3
Q 6	Define the following terms. (a) Compressor isentropic efficiency (b) Turbine isentropic efficiency (c) Work ratio	5	CO4

SECTION B

1. Each question will carry 10 marks

2. Instruction: Write short / brief notes

Q 1	Explain the following boiler accessories with neat sketches. (a) Economizer (b) Air pre-heater (c) Super heater	10	CO1
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Q 2	The percentage composition by mass of a crude oil is given as follows: C=90%; H ₂ = 3.3% ; O ₂ = 3%; N ₂ = 0.8% ; S = 0.9% and remaining incombustible. If 50% excess air is supplied, find the percentage of dry exhaust gases found by volume.	10	CO2
Q 3	In a regenerative cycle the inlet conditions are 40 bar and 400°C. Steam is bled at 10 bar in regenerative heating. The exit pressure is 0.5 bar. Neglecting pump work determine the efficiency of the cycle.	10	CO3
Q 4	5400 kg of steam is produced per hour at a pressure of 7.8 bar in a boiler with feed water at 41.5°C. The dryness fraction of steam at exit is 0.98. The amount of coal burnt per hour is 670 kg of calorific value 31000 kJ/kg. Determine: (a) The boiler efficiency (b) Equivalent evaporation.	10	CO3
Q5	In a single row impulse turbine the nozzle angle is 30° and the blade speed is 215 m/s. The steam speed is 550 m/s. The blade friction co-efficient is 0.85. Assuming axial exit and a flow rate of 700 kg/h, Determine: (a) Blade angles. (b) Absolute velocity of steam at exit. (c) The power output of the turbine.	10	CO3

SECTION-C

1. Each Question carries 20 Marks.

2. Instruction: Write long answer.

Q 1	<p>At a particular stage of reaction turbine, The mean blade speed is 60 m/s and the stream pressure is 3.5 bar with a temperature of 175°C. The identical fixed and moving blades have inlet angles of 30° and outlet angle of 20°. Determine:</p> <p>(a) The blade height, if it is 1/10th of the blade ring diameter, for flow rate of 13.5 kg/s. (b) The power developed by a pair. (c) Specific enthalpy drop if the stage efficiency is 85%.</p> <p style="text-align: center;">(OR)</p> <p>Air is drawn in a gas turbine unit at 17°C and 1.01 bar and the pressure ratio is 8:1. The compressor driven by the H.P. turbine and the L.P. turbine drives a separate power shaft. The isentropic efficiencies of the compressor, and the H.P. and L.P. turbines are 0.8, 0.85 and 0.83, respectively. Calculate the pressure and temperature of the gasses entering the power turbine, the net power developed by the unit per kg/s of mass flow, the work ratio and the thermal efficiency of the unit. The maximum cycle temperature is 650°C. For the compression process take $c_p = 1.005$ kJ/kg K and $\gamma = 1.4$ For the combustion process and expansion process, take $c_p = 1.15$ kJ/kg K and $\gamma = 1.33$ Neglect the mass of fuel</p>	20	CO4
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