Ref. No.: Ex/ME(M2)/PC/B/T/321/2025

B.E. MECHANICAL ENGINEERING THIRD YEAR SECOND SEMESTER - 2025
Subject: ENERGY CONVERSION SYSTEM

Time: Three hours | Full marks: 100

Answer any five questions

1 (a)	Draw a block diagram to show the energy conversion from fuel to electricity in a steam power plant.	7
(b)	In a steam power plant, the electric generator efficiency, turbine mechanical efficiency, boiler efficiency, cycle efficiency, and overall plant efficiency are 0.98, 0.95, 0.92, 0.4, and 0.35, respectively. Evaluate the percentage of total electricity consumed by the auxiliaries that run them.	5
(c)	Why is the de-Laval or convergent-divergent nozzle commonly used in single-stage impulse turbines?	3
(d)	Why stator and rotor blades are made identical in Parson's steam turbines?	2
(e)	What is specific steam consumption? Is higher or lower value of it desired?	3
2 (a)	Show that a convergent-divergent passage with a section of minimum area is required to accelerate from subsonic to supersonic speed. State assumptions for this derivation.	12+4=16
(b)	Write down advantages to use Parson's turbine in comparison to the simple impulse turbines.	4
3 (a)	Why is the pressure compounding done for a simple impulse turbine? Show the variations of absolute velocity and pressure in the axial direction in a two-row pressure compounded impulse turbine. Define the term 'degree of reaction' of an impulse-reaction turbine. Explain its significance.	2+4+4=10
(b)	Following are the data for a stage of an impulse-reaction turbine: Blade velocity = 150 m/s. Fixed blade outlet steam velocity = 350 m/s Nozzle angle = 20^0 The relative velocity of steam at the moving blade outlet = 1.5 times that of at moving blade inlet. Moving blade outlet angle = 65^0 Neglect any carry over loss Find out the degree of reaction assuming expansion efficiency = 0.85 for both the fixed and moving blades.	10
4 (a)	What are the functions of a condenser in a steam power plant? What is TTD? Why is TTD so important?	4+2+2=8
(b)	In a simple impulse turbine provided with a single row of wheel, the mean diameter of the blade ring is 800mm and the speed of rotation is 3000 rpm. The steam exits from the nozzle with a velocity of 300m/s and the nozzle angle is 20^0.	12

[Turn over

	The rotor blades are equiangular and the blade friction factor is 0.86. What is the power developed when the axial thrust on these blades is 140 Newton	
5 (a)	What is the lower heating value of a coal? What information is obtained from the ultimate analysis of a coal? What is proximate analysis? Why is it required in addition to ultimate analysis?	3+3+4 =10
(b)	A bituminous coal has the following composition: C 0.716, H 0.048, O 0.063, N 0.013, S 0.034, moisture 0.035, and ash 0.091. Determine (i) the theoretical weight of air per kg of coal, (ii) The actual weight of air necessary having 60% excess air, (iii) The actual volume of air at 1.013 bar and 25-degree centigrade, A complete combustion may be assumed. Also, write the complete combustion equations and evaluate the dew point temperature.	10
6 (a)	Explain different losses in a steam turbine.	10
(b)	With neat sketches, show different types of pulverized fuel firing to the furnace in power station boilers.	5
(c)	How many types of superheaters are there in a power plant boiler? Where are these located in the boiler and why ?	5
7	Write short notes on: i) Why excess air is required in coal combustion? ii) Mountings of a boiler, iii) Critical pressure ratio of a nozzle, iv) Parson's turbine	4x5 = 20