

B. E.MECHANICAL ENGINEERING THIRD YEAR SECOND SEMESTER
EXAMINATION, 2023

ENERGY CONVERSION SYSTEM

Time: Three hours

Full Marks:100

(Use of steam table and charts are allowed.)

Question number 1 is compulsory. Answer any three questions from group-A and any one question from group-B

- 1..a) Discuss about the effect of boiler and condenser pressure on Rankine cycle. 6
- b) A steam power plant operates on the ideal reheat Rankine cycle. Steam enters the high pressure turbine at 8 MPa and 500°C and leaves at 3 MPa. Steam is then reheated at constant pressure to 500°C before it expands to 20 kPa in the low-pressure turbine. Draw the cycle on T-s and h-s planes. Determine the turbine work output, in kJ/kg, the thermal efficiency of the cycle and mean temperature of heat addition. 14

Group-A

- 2.a) Classify boilers according to i) circulation, ii) draught, iii) type of furnace. 10
- b) Coal with composition by weight: carbon 75%, hydrogen 5%, oxygen 5%, moisture 8% and ash 7%, is burnt with excess air. The Orsat analysis of the resulting flue gas shows CO₂ 9.09%, O₂ 10.55%, CO nil and the balance nitrogen. Determine the weight of air used per kg of coal and the percentage of carbon which is not burnt. 10
- 3.a) Discuss with suitable plot the effect of load on exit steam temperature of a radiant and convective superheaters. 5
- b) Write down the expression of power consumed by an ID fan. Explain the most suitable location of an ID fan. 4
- c) State the merit and demerits of regenerative type air pre heaters. 3
- d) Explain with sketch individual type pulverization system with an intermediate bunker. State its advantages. 8

- 4.a) Define degree of supercooling and degree of supersaturation for flow through a steam nozzle. Discuss the effect of supersaturated flow on exit steam velocity, dryness fraction and mass flow rate. 8
- b) Steam at 30 bar, 350^o C expands through a convergent-divergent nozzle. The exit plane pressure is 3 bar. The flow rate is 0.5 kg/s and the nozzle efficiency is 0.8. Assuming that the velocity at inlet is negligible, determine the throat and exit areas, steam velocity at the exit, and the quality of steam at the exit plane. 12
- 5.a) Define degree of reaction. Derive the expression of maximum blade efficiency of a reaction turbine with 50% degree of reaction. 10
- b) What is governing? Explain throttle governing. 6
- c) Explain the carryover and partial admission losses in steam turbine. 4

Group-B

- 6.a) Define the following terms: load factor, capacity factor, demand factor, use factor and reserve factor. Establish the relationship between load factor, capacity factor and use factor. 8
- b) The loads on a power plant with respect to time for 24 hours are given as follows:

Time (hours)	0-6	6-8	8-12	12-14	14-18	18-22	22-24
Load (MW)	40	50	60	50	70	80	40

Draw the load curve and find out the load factor of the power plant. If the loads above 60MW is taken by a standby unit of 20MW capacity, find the load factor and use factor of the standby unit. 12

7. a) Explain the need of air removal in a condenser of power plant. 5
- b) Compare between a jet condenser and surface condenser. 5
- c) What do you mean by a moderator? What are the moderators used in BWR and PHWR types of nuclear reactor, respectively? 4
- d) Draw the sketch of a PWR type of a nuclear power plant. 6