The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mechanical Engineering

Study Programme	:	Bachelor of Science Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**DMX7301 Thermal Power Generation**
Academic Year	:	2024/2025
Date	:	16th February 2026
Time	:	0930-1230hrs
Duration	:	**3 hours**

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of five **(5)** questions. Answer all questions.
3. Answer for each question should commence from a new page.
4. This is a Closed Book Test (**CBT**).
5. Answers should be in clear handwriting.
6. Do not use red colour pen.
7. h-s chart is provided.

Question 1

(i) Classify the thermal power plants in Sri Lanka according to
(a) the type of fuel utilized.
(b) the method of power generation employed. 06 marks

(ii) Briefly explain the two main types of feed water heaters used in steam power plants. 02 marks

(iii) A steam power plant is designed to provide a power output of 200 MW. The boiler generates superheated steam at 600 °C and 170 bar. After expansion through the first stage of the turbine to a pressure of 40 bar, 15% of the steam is extracted for feed heating in an open feed water heater. The remainder is reheated to 600°C and is then expanded through the second turbine stage to a condenser pressure of 0.035 bar. Neglect the feed pump work and assume the generator efficiency as 0.9.

(a) Calculate the continuous steam rating of the boiler in kg per hour. 08 marks

(b) If there is a 15°C rise in the cooling water temperature, what is the rate of flow of the cooling water in the condenser? 04 marks

The enthalpy of saturated liquid water at 0.035 bar is 112 kJ/kg.
Cp for water – 4.187 kJ/kgK. The h-s chart is provided.

Question 2

(i) Distinguish between open and closed cycle gas turbine power plants using schematic layout diagrams and Temperature-Entropy (T–s) plots. Evaluate the advantages and disadvantages of each configuration in the context of industrial power generation. 05 marks

(ii) With the aid of schematic diagrams and Temperature-Entropy (T–s) plots, explain the thermodynamic principles behind Intercooling, Reheating, and Regeneration. Explain how each modification individually affects the cycle's network ratio and overall thermal efficiency. 05 marks

(iii) A gas turbine unit has a pressure ratio of 6:1 and a maximum cycle temperature of 610 °C. The isentropic efficiencies of the compressor and the turbine are 0.80 and 0.82 respectively.

(a) Calculate the power output in kilowatts of an electric generator geared to the turbine when the air enters the compressor at 15°C at the rate of 16kg/s. The efficiency of the electric generator is 60%. 08 marks

Take C_p = 1.005 kJ/kgK and γ = 1.4 for the compression process and take C_p = 1.11 kJ/kgK and γ = 1.333 for the expansion process.

(b) Calculate the thermal efficiency and the work ratio of the plant assuming that C_p for the combustion gas is 1.11 kJ/kgK. 02 marks

Question 3

(i) Describe the function of the rotating regenerative air-heater and the steam drum used in water tube boilers. 05 marks

(ii) Discuss the functions of the safety valve, blowdown valve, and Stream trap used in boilers. 05 marks

(iii) Distinguish between water-tube and fire-tube boilers and state under what circumstances each type would be desirable. 05 marks

(iv) Briefly explain the important factors that must be taken into consideration in designing the combustion chambers of gas turbine plants. 05 marks

Question 4

(i) A city requires 1500 MWh of electric energy per day. It is to be supplied by a reactor that converts nuclear energy into electric energy with an efficiency of 30 percent. If the reactor uses nuclear fuel of U_{235}, calculate the mass of U_{235} needed for one day's operation. (1MW = 36×10^8J) 10 marks

(ii) Explain secular equilibrium in a decay chain. Provide an example from a natural radioactive series. 05 marks

(iii) Evaluate the environmental and health impacts associated with long-term radioactive waste disposal. 05 marks

Question 5

(i) Power generation can be classified into base-load generation, intermediate -load generation and peak-load generation. Briefly describe each type with suitable examples — 06 marks

(ii) Draw a typical synchronous generator's capability curve and clearly label and name its operating limits. — 04 marks

(iii) A 400 V, 50 Hz, Y connected, six-pole synchronous generator is rated at 100 kVA at 0.85 PF lagging. It has a synchronous reactance of 5.0 Ohm per-phase. Assume that this generator is connected to a steam turbine capable of supplying up to 50 kW. The friction and winding losses are 3.0 kW and the core losses are 2.0 kW.

(a) Sketch the capability curve for this generator, including the prime-mover power limit

04 marks

(b) What is the maximum amount of reactive power that this generator can produce?

03 marks

(c) Can this generator supply a line current of 50 A at 0.75 PF lagging? Why or why not?

03 marks

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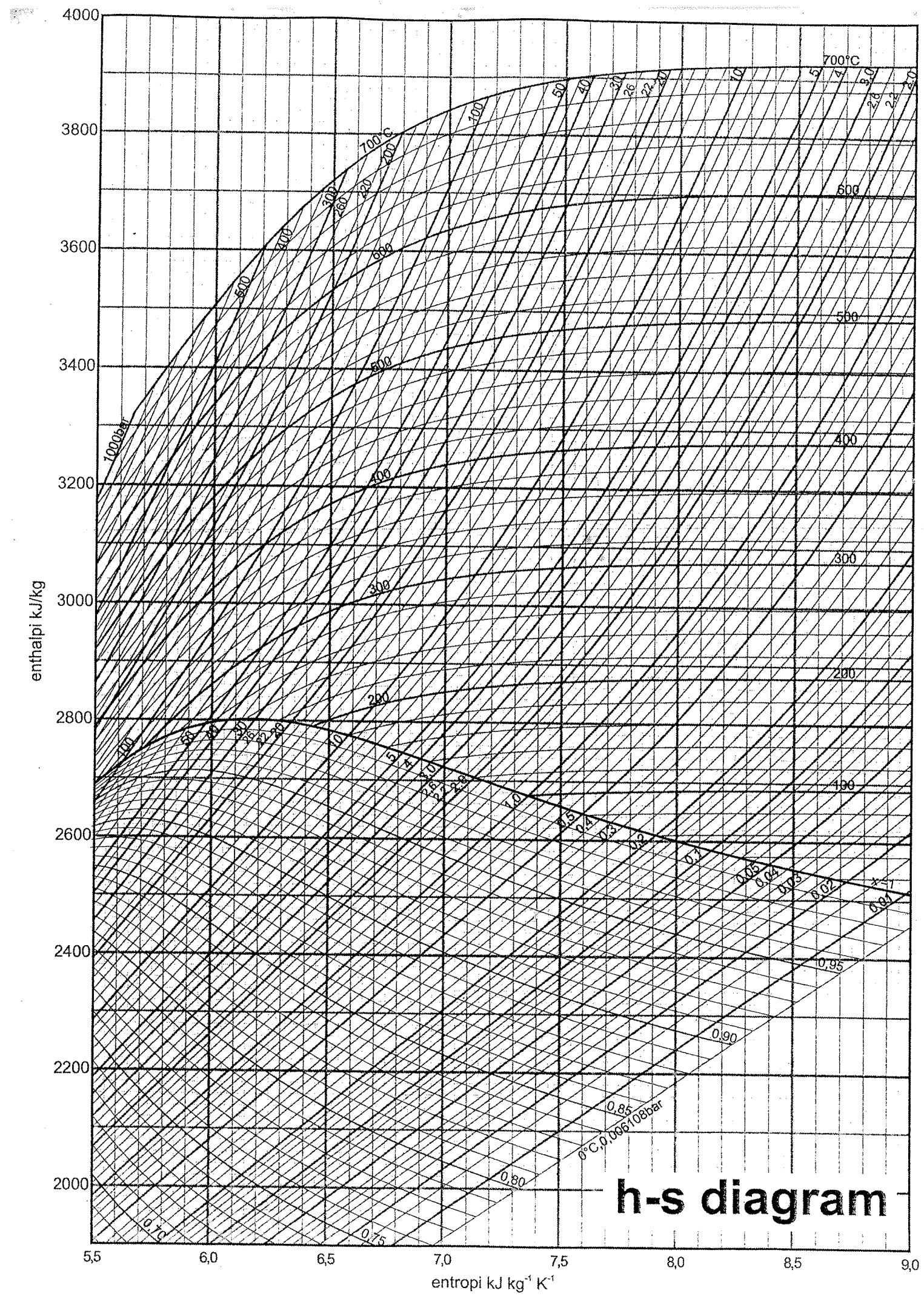
h-s diagram
enthalpi kJ/kg
entropi kJ kg⁻¹ K⁻¹
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
5,5
6,0
6,5
7,0
7,5
8,0
8,5
9,0
700°C
600
500
400
300
200
100
1000bar
0,95
0,90
0,85
0,80
0,75
0,1
0°C,0,006108bar
x=1