

B.E. Power Engineering 3rd Year, 2nd Semester, Examination (Old), 2017**Steam Turbine and Condenser (Old)****Time : 3 Hours****Full Marks: 100**
(50 marks for each half)**Use Separate Answer Scripts for each part.****Part – I**Answer any **three** questions. Two marks are kept for neatness and to the point answer.

1. a) What do you mean by choked flow through a nozzle? Under what condition such flow is achieved? (4)
- b) For a compressible fluid expanding isentropically ($pv^k = \text{const.}$) through a nozzle deduce the relation

$$\frac{dA}{A} = \frac{1}{k} \frac{dp}{p} \left[\frac{1}{M^2} - 1 \right]$$

where, the symbols have their usual meaning. (12)

2. Steam enters the nozzle of a turbine at 20 bar and 360°C and leaves at 1 bar. The steam flow rate is 2.5 kg/s and the velocity of steam at the entry to the turbine is 24 m/s. If friction loss is assumed only in the divergent part of the nozzle and the velocity coefficient of the nozzle is 0.94, find (i) the condition of steam at the nozzle exit, (ii) the velocity of steam at the exit, (iii) the maximum and minimum cross-sectional areas of the nozzle. (16)

3. In a single-stage impulse turbine, the steam velocity at nozzle exit is 295 m/s and the nozzle angle is 18°. The mean blade velocity is 150 m/s. The outlet blade angle is 2° less than the inlet blade angle and the blade velocity coefficient is 0.85. If the turbine has to develop 0.6 MW power, calculate the mass flow rate of steam through the turbine. Also calculate the axial thrust on the turbine. (16)

4.a) With a neat sketch explain the constructional and operational features of a surface condenser. Which materials can be used for the condenser tubes? (8)

b) Why air ingress is undesirable in a condenser? With a neat sketch explain how the main ejector removes air from the condenser. (8)

5. A surface condenser receives 320 t/h of steam at 40°C with 12% moisture. The cooling water enters at 26°C and has a temperature rise of 8°C across the condenser. The pressure inside the condenser is 0.078 bar. The velocity of circulating water is 1.8 m/s. The condenser tubes have 25.4 mm outer diameter and 1.2 mm thickness. The overall heat transfer coefficient across the condenser tubes based on outer surface is 2500 W/m²K. Determine (a) the rate of flow of cooling water, (b) the number of cooling water tubes, (c) the total heat transfer surface area. (16)

**B.E. Power Engineering 3rd Year 2nd Semester Supplementary
Examination, 2017 (Old)**

Steam Turbine and Condenser

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Full Marks: 100

Use separate Answer Scripts for each part

Part-II (Marks:50)

Answer Q. No. 1 and any three from the rest

1. Answer the following questions briefly (Any four). Marks: 4 X 5
- i) Make a comparison between Impulse turbine and Reaction turbine and discuss the efficiency aspects of both the turbines.
 - ii) Describe the merits and demerits of the 'Nozzle governing' and Throttle governing' in steam turbine.
 - iii) What is the difference between the shape of blades of impulse turbine and reaction turbine? Explain the reason.
 - iv) Why the blades of the last stage of turbine are twisted?
 - v) What is the function of shrouding and lacing wire in turbine blade?
 - vi) What are the different turbo supervisory instruments provided for the safe and effective operation of turbine indicating the parameter it measures?
2. a) What is the purpose of governing system in steam turbine?
b) What is frequency regulation?
c) Write down the various methods of governing based on the methods of varying steam flow rate. Marks: 2+2+6
3. a) What is the reason for compounding of impulse steam turbine?
b) Make a comparative analysis of velocity compounding and pressure compounding impulse turbine, describing their merits and demerits. Marks: 4+6
4. a) Write down the different losses involved in the moving blades of steam turbine.
b) Describe the disc friction loss and partial admission loss in steam turbine Marks 2+8
5. a) Write down the different blade attachments used in the steam turbine.
b) Discuss the 'Inverted T attachment' and 'serrated blade root attachment'. Marks 4+6
6. a) Why the Curtis stage turbine is used in conjunction with reaction turbine?
b) Find the power output ratio in different rows in 3 row Curtis stage and prove that it is not justified to use more than 2 rows Curtis stage? Marks 3+7
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