



يسمح باستخدام جداول و خرائط البخار

Assume any missing data, use schematic diagrams in your answer

Question (1) (25 marks)

1-a) choose the correct answer :

(15 marks)

1. The degree of reaction is defined as the ratio
A. heat drop in the fixed blades to the heat drop in the moving blades
B. heat drop in the moving blades to the heat drop in the fixed blades
C. heat drop in the moving blades to the total heat drop in the fixed blades
D. heat drop in the fixed blades to the total heat drop in the moving blades
2. Da-Laval turbines are mostly used
A. where low speeds are required
B. for small power purposes and low speeds
C. for small power purposes and high speeds
D. for large power purposes
3. There is enthalpy drop only in blades in case of an impulse steam turbine
A. fixed
B. rotating
C. moving
D. all of the mentioned
4. The efficiency of steam turbine may be improved by
A. reheating of steam
B. regenerative feed heating
C. binary vapour plants
D. any of the previous
5. The ratio of work done on the blades per kg of steam to the energy supplied to the blades is called:
A. gross or stage efficiency
B. diagram or blading efficiency
C. nozzle efficiency
D. mechanical efficiency
6. The action of steam in a steam turbine is
A. static
B. dynamic
C. static and dynamic
D. neither static nor dynamic
7. In an impulse turbine
A. the steam is expanded in nozzles only and there is a pressure drop and heat drop
B. the steam is expanded both in fixed and moving blades continuously
C. the steam is expanded in moving blades only
D. the pressure and temperature of steam remains constant
8. The person's reaction turbine has
A. only moving blades
B. only fixed blades
C. identical moving and fixed blades,
D. fixed and moving blades of different shape
9. The Person's reaction turbine, the degree of reaction is
A. 20%
B. 30%
C. 40%
D. 50%
10. The blade friction in the impulse turbine reduces the velocity of steam by while it passes over the blades
A. 10% to 15%
B. 15% to 20%
C. 20% to 30%
D. 30% to 40%
11. In a turbine, when the degree of reaction is zero, then there is
A. no heat drop in the moving blades
B. no heat drop in the fixed blades
C. maximum heat drop in the moving blades
D. maximum heat drop in the fixed blades

12. Nozzle efficiency is described as
- A. isentropic heat drop/useful heat drop B. saturation temperature/super saturation temperature
 C. useful heat drop/isentropic heat drop D. super saturation temperature/saturation temperature
13. The steam leaves the nozzle at a
- A. high pressure and low velocity B. high-pressure and high velocity
 C. low pressure and low velocity D. low pressure and high velocity
14. The effect of friction in nozzle is to
- A. keep dryness fraction constant B. increase dryness fraction
 C. decrease dryness fraction D. first increase dryness fraction up to certain limit and then decreases it
15. The Da-Laval impulse turbine is a
- A. velocity compounded impulse turbine B. simple single wheel impulse turbine
 C. pressure compounded impulse turbine D. simple single wheel reaction turbine
16. A steam power station requires space
- A. equal to diesel power station B. more than diesel power station
 C. more than diesel power station D. none of the above
17. The function of a governor is to
- A. store energy and give up whenever required B. decrease variation of speed
 C. increase variation of speed D. adjust variation of speed by varying the input to the engine
18. The maximum delivery pressure in a rotary air compression is
- A. 10 bar B. 20 bar C. 30 bar D. 40 bar
19. When steam reaches turbine blades the type of force responsible for moving turbine blades are
- A. axial force B. shear force C. longitudinal force D. none of the mentioned
20. Reaction turbine works with the force obtained from change in pressure energy.
- A. True B. False
21. A turbine having alternate blades and nozzles is called as
- A. impulse turbine B. reaction turbine C. impulse & reaction turbine D. none of the mentioned
22. Multi stage arrangement of turbines is called as
- A. impulse turbine B. reaction turbine
 C. compounding D. none of the mentioned
23. In pressure compounded turbines flow passage is from
- A. moving nozzles to fixed blades B. fixed nozzles to moving blades
 C. fixed blades to moving nozzles D. none of the mentioned
24. In velocity compounded turbines flow passage is from
- A. moving blades to fixed nozzles B. fixed nozzles to moving blades
 C. fixed blades to moving nozzles D. none of the mentioned
25. Reaction turbine is also called as
- A. impulse turbine B. Curtis wheel C. Parsons turbine D. none of the mentioned
26. Compounding is used for power applications.
- A. low B. high C. medium D. none of the mentioned
27. The blade speed ratio of impulse turbine is given as
- A. (Blade velocity) / (Steam velocity at inlet) B. (Blade velocity) / (Steam velocity at exit)
 C. (Steam velocity at inlet) / (Blade velocity) D. (Steam velocity at exit) / (Blade velocity)
28. A pair of fixed blade and rotor blade in axial flow compressor is called as
- A. step B. pair C. stage D. state
29. turbines are also called as parallel flow turbine.
- A. Radial flow B. Axial flow C. Both radial flow and axial flow D. none of the mentioned
30. components of fluid velocity have the responsibility of the transportation of fluid through the machine.
- A. Radial and tangential B. Tangential and axial C. Radial and axial D. None of the existing

1-b) A steam turbine is governed by throttling, and the no-load steam consumption is found to be 10% of the full load consumption. The nozzle box pressure at full load is 18 bars and the initial degree of superheat equals $83\text{ }^{\circ}\text{C}$. The exhaust pressure is 0.05 bars. If the steam consumption at full load is 6 kg/kw.hr, calculate the following in case of 1/4, 1/2, and 3/4 of the full loads:

- steam consumption,
 - nozzle box pressure,
 - turbine internal efficiencies, and cycle efficiency
- (10 marks)

Question (2) (20 marks)

2-a) Describe and Draw the velocity compound and pressure compound multi-stages impulse turbine
(5marks)

2-b) Calculates the average stages turbine efficiency and with the aid of it deduces the values of reheats factor and internal or isentropic turbine efficiency.
(5marks)

2-c) A single stage impulse turbine, arranged for maximum power, receives dry and saturated steam at a pressure of 10 bars and exhausts it at 1 bar. There 4 nozzles each of which are oriented at 20° to the plane of the wheel. Assuming no friction in the stage and a final axial discharge, find:

- The total mass flow rate of steam, if the throat of each nozzle is 2cm^2 .
 - Blade angles.
 - Diagram and stage efficiencies.
- (10 marks)

Question (3) (15 marks)

3-a) Draw and describes the velocity triangles and (T-S) diagram for the axial flow turbine indicating the values of pressure and velocity at all points.
(5 marks)

3-b) The following data refer to a single-stage axial flow gas turbine with convergent nozzle:

Inlet stagnation temperature, T_{01}	1100K
Inlet stagnation pressure, p_{01}	4 bar
Pressure ratio, p_{01}/p_{03}	1.9
Stagnation temperature drop	145K
Mean blade speed	345m/s
Mass flow rate	24 kg/s
Rotational speed	14500 rpm
Flow coefficient, Φ	0.75
Angle of gas leaving the stage	12°

$C_{pg} = 1147\text{ J/kg}\cdot\text{K}$, $\gamma = 1.333$, $\lambda_N = 0.05$

Assuming the axial velocity remains constant and the gas velocity at inlet and outlet are the same, determine the following quantities at the mean radius:

- The blade loading coefficient and degree of reaction
 - The gas angles
 - The nozzle throat area
- (10 marks)

Question (4) (15 marks)

4-a) Derive an expression for calculating the degree of reaction as a function of inlet and outlet blade angles for axial flow gas turbines (5 marks)

4-b) The nozzle angle of a single stage impulse turbine is 20° and the blade efficiency is to be 90% of the maximum possible value. Blade speed is 200 m/s. Tip blade angles 35° . Draw the velocity diagram for the stage and calculate:

- a) Blade velocity coefficient
- b) Kinetic energy lost in friction over the blades,
- c) Axial thrust on the bearings,
- d) Specific power developed and adiabatic enthalpy drops in the stage. (10 marks)

With Best Wishes