

GATE Questions

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Q.1) For an impulse turbine with identical stages, the hot gas exits from the stator blades at the mean blade height at an absolute angle of 70 degrees with the axis of the turbine. If the absolute inlet blade angle with the axis of the turbine at the mean blade height for the rotor blades is 37 degrees, then the absolute exit blade angle with the axis of the turbine at the mean blade height of the rotor blades is

[Q47, 2007]

- A. 33 degrees
- B. 37 degrees
- C. 53 degrees
- D. 53.5 degrees

Q.2) Which one of the following materials should be selected to design an axial flow turbine operating at high temperatures?

[Q48, 2007]

- A. Steel alloy
- B. Titanium alloy
- C. Nickel alloy
- D. Aluminum alloy

Q.3) The degree of reaction of an impulse turbine is

[Q13, 2008]

- A. 1
- B. 0.75
- C. 0.5
- D. 0

Q.4) A 50 percent degree of reaction axial flow turbine operates with a mean blade speed of 180 m/s. The flow leaves the stator and enters the rotor at an angle of 60 degrees to the axial direction. The axial velocity is 150 m/s, and remains constant throughout the stage. The turbine power per unit mass flow is

[Q58, 2008]

- A. 29.76 kJ/kg
- B. 41.12 kJ/kg

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C. 58.33 kJ/kg

D. 61.13 kJ/kg

Q.5) Consider two engines P and Q. In P, the high-pressure turbine blades are cooled with a bleed of 5% from the compressor after the compression process and in Q the turbine blades are not cooled. Comparing engine P with engine Q, which one of the following is NOT TRUE? [Q19, 2013]

- A. Turbine inlet temperature is higher for engine P
- B. Specific thrust is higher for engine P
- C. Compressor work is the same for both P and Q
- D. Fuel flow rate is lower for engine P

Q.6) A gas turbine engine is operating under the following conditions:

Stagnation temperature at turbine inlet	1350 K
Stagnation pressure at the turbine inlet	10 bar
Static temperature at turbine exit	800 K
Velocity at turbine exit	200 m/s
Total-to-total efficiency of turbine	0.96
γ (ratio of specific heats)	1.33
C_p (specific heat at constant pressure)	1.147 kJ/kgK

The stagnation pressure (in bar) in the nozzle (considering isentropic nozzle) is equal to _____ [Q46, 2014]

Q.7) Hot gas (ratio of specific heats, $\gamma = 1.33$) at a temperature of 1450 K enters into an axial turbine and expands isentropically. Assume that the kinetic energy of the gas across the turbine is negligible. If the ratio of inlet to outlet pressures of the turbine is 9.5, then the temperature (in K) of gas exiting the turbine is _____

[Q65, 2015]

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Q.8) A single-stage gas turbine operates with an axial absolute flow at the entry and exit from the stage. The absolute flow angle at the nozzle exit is 70° . The turbine stage generates a specific work of 228 kJ/kg when operating with a mean blade speed of 440 m/s. The absolute velocity at the rotor entry is

[Q27, 2016]

- A. 275.7 m/s
- B. 551.5 m/s
- C. 1103.0 m/s
- D. 1654.5 m/s

Q.9) For a turbine stage, which one of the following losses occurs due to the turning of the wall boundary layer through an angle due to curved surfaces?

[Q18, 2017]

- A. Profile loss
- B. Annulus loss
- C. Tip clearance loss
- D. Secondary flow loss

Q.10) In an ideal gas turbine cycle, the expansion in a turbine is represented by

[Q19, 2018]

- A. an isenthalpic process.
- B. an isentropic process.
- C. an isobaric process.
- D. an isochoric process.

Q.11) The combustion products of a gas turbine engine can be assumed to be a calorically perfect gas with $\gamma = 1.2$. The pressure ratio across the turbine stage is 0.14. The measured turbine inlet and exit stagnation temperatures are 1200 K and 900 K, respectively. The total – to – total turbine efficiency is _____ % (round off to the nearest integer).

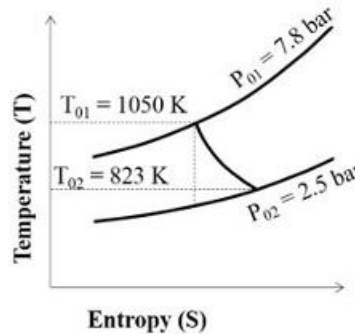
[Q47, 2019]

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Q.12) The figure shows the T-S diagram for an axial turbine stage:



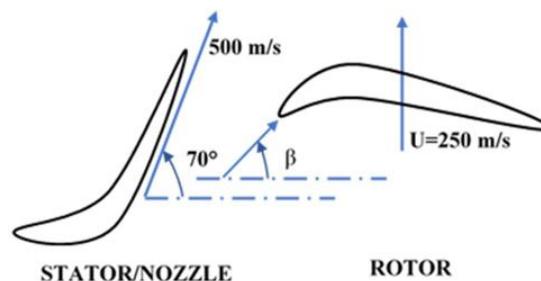
Assuming specific heat ratio of 1.33 for the hot gases, the isentropic efficiency of the turbine stage is _____% (round off to two decimal places) [Q49, 2020]

Q.13) A single stage axial turbine has a mean blade speed of 340 m/s at design condition with blade angles at inlet and exit of the rotor being 21° and 55° respectively. The degree of reaction at the mean radius of the rotor is equal to 0.4. The annulus area at the rotor inlet is 0.08 m^2 and the density of gas at the rotor inlet is 0.9 kg/m^3 . The flow rate through the turbine at these conditions is _____ kg/s (round off to two decimal places).

[Q47, 2021]

Q.14) In a single stage turbine, the hot gases come out of stator/ nozzle at a speed of 500 m/s and at an angle of 70 degrees with the turbine axis as shown. The design speed of the rotor blade is 250 m/s at the mean blade radius. The rotor blade angle, β , at the leading edge is _____ degrees (round off to one decimal place).

[Q35, 2022]



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Q.15) Which of the following statements is/are TRUE for an axial turbine?

[Q49, 2024]

- A. For a fixed rotational speed, the mass flow rate increases with increase in the flow coefficient
- B. The absolute stagnation enthalpy of the flow decreases across the nozzle row
- C. The relative stagnation enthalpy remains unchanged through the rotor
- D. For a fixed rotational speed, the mass flow rate remains unchanged with a change in the flow coefficient

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Answer Keys

Q. No.	Q. Type	Year	Key	Marks
1	MCQ	2007	B	2
2	MCQ	2007	C	2
3	MCQ	2008	D	1
4	MCQ	2008	D	2
5	MCQ	2013	D	1
6	NAT	2014	1.10 to 1.25	2
7	NAT	2015	824.0 to 832.1	2
8	MCQ	2016	B	2
9	MCQ	2017	D	1
10	MCQ	2018	B	1
11	NAT	2019	88 to 90	2
12	NAT	2020	87 to 89	2
13	NAT	2021	18.0 to 19.5	2
14	NAT	2022	51.5 to 52.6	1
15	MSQ	2024	A; C	2