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Courses » IC Engines and Gas Turbines

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## Unit 14 - Week 11: Components of Brayton Cycle Based Power Plant

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### Course outline

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### Assignment 11

The due date for submitting this assignment has passed.

As per our records you have not submitted this **Due on 2019-04-17, 23:59 IST.**  
assignment.

1) Degree of reaction for axial compressor is defined as the ratio of **1 point**

- (a) Total temperature rise in stage / Total temperature rise in rotor
- (b) Total temperature rise in rotor / static temperature rise in stage
- (c) Static temperature rise in stage / Total temperature rise in rotor
- (d) Static temperature rise in rotor / Total temperature rise in stage

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

*(d) Static temperature rise in rotor / Total temperature rise in stage*

2) Each Stage of axial compressor experiences a **1 point**

- (a) Favorable pressure gradient
- (b) Adverse pressure gradient
- (c) Constant Pressure
- (d) Can't comment

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

*(b) Adverse pressure gradient*

3) In a stage, Static enthalpy drop takes place in the rotor of **1 point**

- (a) Impulse turbine
- (b) 100% Reaction turbine
- (c) 50% Reaction turbine

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**Analysis of Brayton Cycle**

**Week 9: Introduction to Various Aircraft Engine and Performance Parameters**

**Week 10: Components of Brayton Cycle Based Power Plant**

**Week 11: Components of Brayton Cycle Based Power Plant**

- Lec 1: Axial Compressor: Basics, Velocity triangles, T-S diagram and Work Interaction
- Lec 2: Axial Compressor: Different factors, Degree of Reaction and Free Vortex Condition
- Lec 3: Complete Analysis of Axial Flow Gas Turbine
- Lec 4: Solved Examples for Axial Compressors, Centrifugal Compressors and Turbine
- Quiz : Assignment 11
- Assignment 11 Solutions

**Week 12: Components of Brayton Cycle Based Power Plant**

4) Numbers of the stages in axial flow gas turbine are always less than axial flow compressor **1 point**  
because turbine experiences a

- (a) Favorable pressure gradient
- (b) Adverse pressure gradient
- (c) Constant Pressure
- (d) Can't comment

**No, the answer is incorrect.**  
**Score: 0**

**Accepted Answers:**  
*(a) Favorable pressure gradient*

5) Assuming, negligible change in total enthalpy and axial velocity in radial direction of an impeller, free vortex condition for compressor is: **1 point**

Where  $C_w$  = Whirl velocity component

- $C_a$  = Axial velocity
- $C_r$  = Relative velocity
- $r$  = Radius of impeller

- (a)  $C_r \cdot r = \text{Constant}$
- (b)  $C_a \cdot r = \text{Constant}$
- (c)  $C_w / r = \text{Constant}$
- (d)  $C_w \cdot r = \text{Constant}$

**No, the answer is incorrect.**  
**Score: 0**

**Accepted Answers:**  
*(d)  $C_w \cdot r = \text{Constant}$*

6) As the number of stages of an axial compressor increases, the value of mean work done factor: **1 point**

- (a) Does not depend on number of stages
- (b) Increases
- (c) Decreases
- (d) Can't comment

**No, the answer is incorrect.**  
**Score: 0**

**Accepted Answers:**  
*(c) Decreases*

7) For increase in the pressure ratio of a compressor, there are some limitations on governing parameters. Match correct limitation with the respective factor. **1 point**

<b>Factors</b>	<b>Cause of limitations</b>
<b>P.</b> Axial velocity	1. Centrifugal stress increases.
<b>Q.</b> Blade speed	2. Relative Mach number becomes supersonic.
<b>R.</b> Deflection of flow	3. Flow separation due to adverse pressure gradient.

- (a) P-2, Q-1, R-3
- (b) P-1, Q-1, R-3
- (c) P-2, Q-3, R-1
- (d) P-3, Q-1, R-1

**No, the answer is incorrect.**  
**Score: 0**

**Accepted Answers:**

(a) P-2,Q-1,R-3

**Common Data for Questions Q08 to Q11**

The first stage of an axial compressor is designed with no inlet guide vanes. The rotational speed of the compressor is 6000 rev/ min and the stage stagnation temperature rise is 20 K. The hub- tip ratio is 0.60, the work done factor is 0.93 and the isentropic efficiency of the stage is 0.89. Inlet Mach number related to tip, based on relative velocity, is 0.95. Assuming an inlet velocity of 140 m/s and ambient conditions of 1.01bar and 15 degree Celsius, find out the following. Consider, specific heat at constant pressure as 1.005kJ/kgK and specific heat ratio for air as 1.4

8) Rotor blade angles at tip section for inlet and outlet respectively are

1 point

- (a) 50.85 and 60.23 degree
- (b) 63.80 and 56.23 degree
- (c) 72.42 and 60.52 degree
- (d) 48.26 and 50.23 degree

No, the answer is incorrect.

Score: 0

**Accepted Answers:**

(b) 63.80 and 56.23 degree

9) Stage stagnation pressure ratio for axial compressor is

1 point

- (a) 2.126
- (b) 1.826
- (c) 3.456
- (d) 1.234

No, the answer is incorrect.

Score: 0

**Accepted Answers:**

(d) 1.234

10) Radius at the tip and at the root, in meters, respectively is

1 point

- (a) 0.30 and 0.20
- (b) 0.35 and 0.23
- (c) 0.45 and 0.27
- (d) 0.51 and 0.24

No, the answer is incorrect.

Score: 0

**Accepted Answers:**

(c) 0.45 and 0.27

11) Power required to run compressor in kW is

1 point

- (a) 1306
- (b) 1450
- (c) 1538
- (d) 1190

No, the answer is incorrect.







Score: 0

**Accepted Answers:**

(a) 1306

**Common data for questions Q12 to Q15**

Consider the following data:

Speed (N)	:	14000 rev/min	
Mass flow rate ( $\dot{m}$ )	:	20 kg/s	
Pressure ratio (r)	:	4:1	
Isentropic efficiency	:	80%	
Slip factor ( $\mu$ )	:	0.9	
Flow coefficient at impeller exit ( $\phi$ )	:	0.3	
Hub diameter of the eye	:	15 cm	
Axial velocity of air at entry to and exit from the impeller	:	150 m/s	
Stagnation temperature at inlet	:	295 K	
Stagnation pressure at inlet	:	1 bar	

Assume equal pressure ratio in the impeller and diffuser. Consider, specific heat of air at constant pressure as 1.005kJ/kgK and specific heat ratio for air as 1.4.

12) Impeller diameter of centrifugal compressor in mm is

**1 point**

- (a) 457
- (b) 780
- (c) 682
- (d) 363

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

(c) 682

13) Power required to run the compressor in kW is

**1 point**

- (a) 4000
- (b) 4500
- (c) 6800
- (d) 7500

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

(b) 4500

14) Actual exit temperature of the impeller exit in K is

**1 point**

- (a) 346
- (b) 426
- (c) 745
- (d) 256

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

(a) 346

15 Width of the impeller exit in mm is

**1 point**

- (a) 33
- (b) 48
- (c) 52
- (d) 26

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

(a) 33



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