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[NPTEL \(https://swayam.gov.in/explorer?ncCode=NPTEL\)](https://swayam.gov.in/explorer?ncCode=NPTEL) » Introduction to Rocket Propulsion (course)

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## Unit 3 - Week 1: Introduction to Rocket Engines & Governing Equations

### Course outline

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#### Week-0

#### Week 1: Introduction to Rocket Engines & Governing Equations

- [Lecture 1: Introduction \(unit?unit=7&lesson=8\)](#)
- [Lecture 2: A Brief History of Rocket Propulsion & ISRO \(unit?unit=7&lesson=9\)](#)
- [Lecture 3: Types of Rocket Engines \(unit?unit=7&lesson=10\)](#)
- [Lecture 4: Fundamentals of Aero-thermodynamics \(unit?unit=7&lesson=11\)](#)
- [Lecture 5: Control Volume Analysis & Governing Equations \(unit?unit=7&lesson=12\)](#)
- [Quiz : Week 1: Assignment \(assessment?name=13\)](#)
- [Week 1: Assignment Solution \(unit?unit=7&lesson=28\)](#)
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#### Week 2: Thermochemistry,Thrust Equation & Performance Parameters of Rocket Engine

#### Week 3: Nozzle Characteristics

#### Week 4: Characteristic Parameters of Rocket Nozzle

#### Week 5: Flight Trajectory & Elements of Orbital Mechanics

#### Week 6: Types of Propellant & its Selection, Multi-staging of rocket and SRPE

#### Week 7: Solid, Liquid & Composite Propellant

## Week 1: Assignment

The due date for submitting this assignment has passed.  
As per our records you have not submitted this assignment.

Due on 2019-08-14, 23:59 IST.

- 1) Turbojet is an example of 1 point
- Air-breathing propulsive engine works on the principle of constant pressure
  - Air-breathing propulsive engine works on the principle of constant volume
  - Non-air-breathing propulsive engine works on the principle of constant pressure
  - Non-air-breathing propulsive engine works on the principle of constant volume
- No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
*Air-breathing propulsive engine works on the principle of constant pressure*
- 2) Which of the following statement is true in reference to the acceleration of rocket 1 point
- Acceleration decreases with increase in exhaust velocity
  - Acceleration increases with increase in fuel burn rate
  - Rocket of mass doesn't affect the acceleration of the rocket
  - None of the above mentioned
- No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
*Acceleration increases with increase in fuel burn rate*
- 3) Identify the correct statement related to air breathing and rocket engine 1 point
- Air-breathing engine cannot operate beyond Mach number 5 and rocket engine cannot operate beyond Mach number 10
  - For air-breathing engine, rate of climb decreases with altitude whereas for rocket engine, it increases
  - Flight speed is always greater than jet velocity for air breathing engine and rocket engine
  - Air-breathing engine operates in both and atmosphere but rocket engine operates only in atmosphere
- No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
*For air-breathing engine, rate of climb decreases with altitude whereas for rocket engine, it increases*
- 4) Consider the following statements regarding the specifications of GSLV and choose the correct one 1 point
- $N_2O_4$ /UDMH propellant system is used for 2nd Stage and strap-on boosters
  - HTPB fuel is used for 3rd Stage
  - 1<sup>st</sup> Stage has the highest value of  $I_{sp}$  among all stages
  - 2<sup>nd</sup> Stage has the highest mass among all stages
- No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
 *$N_2O_4$ /UDMH propellant system is used for 2nd Stage and strap-on boosters*
- 5) Nuclear rocket is an example of non-chemical rocket. This statement is: 1 point
- True
  - False
- No, the answer is incorrect.  
Score: 0

**Rocket Engine, Burning and Flame Structure**
**Week 8: Solid Propellants: Characteristics & Regression Rate Relation**
**Week 9: Evolution of Burning surface, Ignition System of Solid Propellant Grains, Types of Liquid Propellant Rocket Engine and Injection System**
**Week 10: Liquid Propellant Rocket Engines: Injection system, Atomization, Combustion Process and Feed System**
**Week 11: Feed System, Ignition System, Combustion Instability & Cooling System in LPRE**
**Week 12: Hybrid Propellant Rocket Engine and Non-chemical Rocket Engine**

Accepted Answers:  
*True*

6) In rocket engine, viscous forces are negligibly small as compared to inertial or pressure forces in the region away from the combustor wall. This statement is **1 point**

- True  
 False

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*True*

7) Solid propellant rocket engine has higher specific impulse as compared to liquid and hybrid rocket engines. This statement is **1 point**

- True  
 False

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*False*

8) Thrust developed by the rocket engine is dependent of flight velocity. This statement is: **1 point**

- True  
 False

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*False*

9) Consider the problem statement given below to answer the following questions (Q.9-10) **2 points**  
Air at 1300 K and 1.2 atm with velocity of 660 m/s enters into an isentropic nozzle and leaves with the velocity of 1060 m/s  
9. The temperature at the nozzle exit would be: ( $C_p=1005 \text{ J/kgK}$ , specific gas constant= $1.4$ )

- 957.7 K  
 1096.5 K  
 836.3 K  
 1136.6 K

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*957.7 K*

10) The pressure at the nozzle exit would be: **1 point**

- 1.5 atm  
 2.1 atm  
 0.5 atm  
 0.4 atm

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*0.4 atm*

11) Consider the following problem statement to answer the following questions (Q.11-13) **2 points**  
In a gas turbine power plant, turbine is used to run compressor and generate power. Air enters into the compressor at 85 kPa and 300 K at a rate of 12 kg/s and leaves at 1 MPa and 650 K whereas products from the combustor enters the turbine at a rate of 15 kg/s with total enthalpy of 4340 kJ/kg and leaves with total enthalpy of 3290 kJ/kg. ( $C_{p,in}=1005 \text{ J/kgK}$ ,  $C_{p,out}=1150 \text{ J/kgK}$ )

11. The work done by the compressor

- 3.22 MJ/s  
 -5.35 MJ/s  
 8.21 MJ/s  
 3.22 MJ/s

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*-5.35 MJ/s*

12) The work done by the turbine **2 points**

- 23.74 MJ/s  
 10.53 MJ/s  
 15.75 MJ/s  
 27.94 MJ/s

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*15.75 MJ/s*

13) The net power delivered to the generator by the turbine

1 point

- 20.51 MJ/s
- 10.39 MJ/s
- 15.42 MJ/s
- 8.22 MJ/s

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*10.39 MJ/s*

14) In a rocket motor, liquid hydrogen and liquid oxygen enter into combustion chamber at a rate of 1.2 kg/s and 7 kg/s respectively. After combustion, the exhaust gas leaves the nozzle with diameter of 14 cm at 870 K and 1.2 atm. For this condition, the exit velocity of exhaust gases would be: (Assume the exhaust gases are perfect with M.wt of 28 kg/Kmol) **2 points**

- 564 m/s
- 896 m/s
- 1208 m/s
- 1400 m/s

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*1208 m/s*