IITians GATE CLASSES
Exclusive GATE Coaching by IIT/IISc Graduates
A division of PhIE Learning Center

GATE

PREVIOUS YEARS QNS & ANSWER KEYS

SPACE DYNAMICS

AEROSPACE ENGINEERING

Subjective Presentation | Thoroughly Revised & Updated

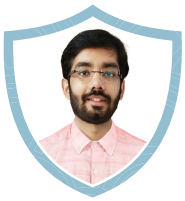
www.iitiansgateclasses.com

SPACE DYNAMICS

CONTENTS

OUR ACHIEVERS

GATE-2024 AE



K SUNIL
IIST TRIVANDRUM
AIR - 2

ASHWIN K
ACHARYA INSTITUTE, B'LORE
AIR - 6

HARIHARAN R
MIT, CHENNAI
AIR - 9

VIGNESH CG
IIST TRIVANDRUM
AIR - 11

ADITYA ANIL KUMAR
IIST TRIVANDRUM
AIR - 17

And Many More .....

GATE-2023 AE

SRIRAM R
SSN COLLEGE CHENNAI
AIR - 2

Akriti
PEC, CHANDIGARH
AIR - 6

SHREYASHI SARKAR
IIEST, SHIBPUR
AIR - 8

YOKESH K
MIT, CHENNAI
AIR - 11

HRITHIK S PATIL
RVCE, BANGALORE
AIR - 14

And Many More .....

GATE-2022 AE

SUBHROJYOTI BISWAS
IIEST, SHIBPUR
AIR - 4

SANJAY. S
AMRITA UNIV, COIMBATORE
AIR - 7

AKILESH . G
HITS, CHENNAI
AIR - 7

D. MANOJ KUMAR
AMRITA UNIV, COIMBATORE
AIR - 10

DIPAYAN PARBAT
IIEST, SHIBPUR
AIR - 14

And Many More .....

OUR PSU JOB ACHIEVERS

HAL DT ENGINEER 2023

S.S Sanjay
Amrita Univ - Coimbatore

Shashi Kanth M
Sastra Univ - Tanjore

Vagicharla Dinesh
Lovely Professional Univ - Punjab

Anantha Krishan A.G
Amrita Univ - Coimbatore

HAL DT ENGINEER 2022

Fathima J
MIT - Chennai

Mohan Kumar H
MVJCE - Bangalore

HAL DT ENGINEER 2021

Arathy Anilkumar Nair
Amrita Univ - Coimbatore

Sadsivuni Tarun
Sastra Univ - Tanjore

DRDO & ADA Scientist B

Job Position for Recruitment (2021-23) Based on GATE AE score

Abhilash K
Amrita Univ - Coimbatore

Ajitha Nishma V
IIST - Trivendrum

Dheeraj Sappa
IIEST - Shibpur

F Jahangir
MIT - Chennai

Goutham
KCG College - Chennai

M Kumar
MVJ College - Bangalore

Mohit Kudal
RTU - Kota

Niladhari Pahari
IIEST - Shibpur

Nitesh Singh
Sandip Univ - Nashik

Ramanathan A
Amrita Univ - Coimbatore

Shruti S Rajpara
IIEST - Shibpur

RAM GOPAL SONI
GVIET - PUNJAB

OUR PSU JOB ACHIEVERS

DGCA Air Safety & Worthiness Officer

Job Position for Recruitment (2023)

Abhishek Shukla
FGIET - Raebareli

Aishwarya PS
BMS College - Bangalore

Anil Kumar Nakkala
Malla Reddy College - Hyderabad

Ayush Boral
KIIT - Bhubaneswar

Dhiraj Rajendra Kapte
Priyadarshini College - Nagpur

Govardhan K
RVCE - Bangalore

R Selvaraj
Sri Ramakrishna College - Coimbatore

Rithik Gowda M
ACS College - Bangalore

Samhit Sumnampa
PEC - Chandigarh

Uttam Kumar Maurya
UPES - Dehradun

Thirthankar Majumdar
Amity University - Noida

GET-ESS-AIESL 2023

S Komesh
Sathyabama University - Chennai

Shrenith Suhas
IIEST - Shibpur

Ankur Vats
School Of Aeronautics - Neemrana

5. Space Dynamics

GATE AE - 2007

One Mark Questions.

1. An artificial satellite remains in orbit and does not fall to the earth because

(A) the centrifugal force acting on it balances the gravitational attraction

(B) the on-board rocket motors provide continuous boost to keep it in orbit

(C) its transverse velocity keeps it from hitting the earth although it falls continuously

(D) due to its high speed it derives sufficient lift from the rarefied atmosphere

Two Marks Questions.

2. Two identical earth satellites A and B are in circular orbits at altitudes h_A and h_B above the earth's surface respectively, with $h_A > h_B$. If E denotes the total mechanical energy, T the kinetic energy and V the gravitational potential energy of a satellite, then:

(A) $E_A > E_B$ and $V_A < V_B$

(B) $E_A > E_B$ and $T_A > T_B$

(C) $E_A < E_B$ and $T_A > T_B$

(D) $E_A > E_B$ and $T_A < T_B$

3. The earth's radius is 6.37×10^6m and the acceleration due to gravity on its surface is 9.81m/s^2. A satellite is in a circular orbit at a height of 6.30×10^5m above the earth's surface. The minimum additional speed it needs to escape from the earth's gravitational field is

(A) 3.66×10^3m/s (C) 3.27×10^3m/s

(B) 3.12×10^3m/s (D) 3.43×10^3m/s

4. The radius of the earth is 6.37×10^6 m and the acceleration due to gravity at its surface is 9.81 m/s^2. A satellite is in circular orbit at a height of 35.9×10^6m above the earth's surface. This orbit is inclined at 10.5 degrees to the equator. The velocity change needed to make the orbit equatorial is:

(A) 561 m/s at 84.75 degrees to the initial direction

(B) 561 m/s at 95.25 degrees to the initial direction

(C) 281 m/s at 84.75 degrees to the initial direction

(D) 281 m/s at 95.25 degrees to the initial direction

GATE AE - 2008

One Mark Questions.

5. To transfer a satellite from an elliptical orbit to a circular orbit having radius equal to the apogee distance of the elliptical orbit, the speed of the satellite should be

(A) increased at the apogee

(B) decreased at the apogee

(C) increased at the perigee

(D) decreased at the perigee

Two Marks Questions.

6. Which of the following quantities remains constant for a satellite in an elliptical orbit around the earth?

(A) Kinetic energy

(B) Product of speed and radial distance from the center of the earth

(C) Rate of area swept by the radial vector from the center of the orbit

(D) Rate of area swept by the radial vector from the center of the earth

7. A planet is observed to be at its slowest when it is at a distance r_1 from the sun and at its fastest when it is at a distance r_2 from the sun. The eccentricity e of the planet's orbit is given by

(A) $e = \frac{r_1}{r_2}$ (C) $e = \frac{r_2}{r_2}$

(B) $e = \frac{r_1 - r_2}{r_1 + r_2}$ (D) $e = \frac{r_1 + r_2}{r_1 - r_2}$

8. The velocity required for a spacecraft to escape earth's gravitational field depends on

(A) the mass of the spacecraft

(B) the distance between earth's center and the spacecraft

(C) the earth's rotational speed about its own axis

(D) the earth's orbital speed

GATE AE - 2009

One Mark Questions.

9. The life of a geo-stationary communications satellite is limited by

(A) the working life of the on-board electronic circuitry

(B) the time it takes for its orbit to decay due to atmospheric drag

(C) the quantity of on-board fuel available for station-keeping

(D) the number of meteorite impacts that the satellite structure can withstand before breaking up

Two Marks Questions.

10. The acceleration due to gravity on the surface of Mars is 0.385 times that on earth, and the diameter of Mars is 0.532 times that of earth. The ratio of the escape velocity from the surface of Mars to the escape velocity from the surface of earth is approximately

(A) 0.453 (C) 0.851

(B) 0.205 (D) 0.724

GATE AE - 2010

One Mark Questions.

11. The angular momentum, about the centre of mass of the earth, of an artificial satellite in a highly elliptical orbit is:

(A) a maximum when the satellite is farthest from the earth

(B) a constant

(C) proportional to the speed of the satellite

(D) proportional to the square of the speed of the satellite

Two Marks Questions.

12. A spacecraft of mass 100 kg, moving at an instantaneous speed of 1.8×10^4 m/s, picks up interstellar dust at the rate of 3.2×10^{-8} kg/s. Assuming that the dust was initially at rest, the instantaneous rate of retardation of the spacecraft is:

(A) 7.9×10^{-8} m/s^2

(B) 2.3×10^{-3} m/s^2

(C) zero

(D) 5.8×10^{-6} m/s^2

GATE AE - 2011

Two Marks Questions.

13. An elliptic orbit has its perigee at 400 km above the Earth's surface and apogee at 3400 km above the Earth's surface. For this orbit, the eccentricity and semi-major axis respectively are (assume radius of Earth = 6400 km)

(A) 0.18 and 8300 km

(B) 0.18 and 1900 km
(C) 0.22 and 8300 km
(D) 0.22 and 1900 km

GATE AE - 2012

One Mark Questions.

14. The Hohmann ellipse used as earth-Mars transfer orbit has
(A) apogee at earth and perigee at Mars.
(B) both apogee and perigee at earth.
(C) apogee at Mars and perigee at earth.
(D) both apogee and perigee at Mars.

GATE AE - 2013

One Mark Questions.

15. Consider the low earth orbit (LEO) and the geo synchronous orbit (GSO). Then
(A) ΔV requirement for launch to LEO is greater than that for GSO, and altitude of LEO is lower than that of GSO
(B) ΔV requirement for launch to LEO is lower than that for GSO, and altitude of LEO is lower than that of GSO
(C) ΔV requirement for launch to LEO is greater than that for GSO, and altitude of LEO is greater than that of GSO
(D) ΔV requirement for launch to LEO is lower than that for GSO, and altitude of LEO is greater than that of GSO

GATE AE - 2014

One Mark Questions.

16. Considering R as the radius of the moon, the ratio of the velocities of two spacecraft orbiting moon in circular orbit at altitudes R and 2R above the surface of the moon is _____.

GATE AE - 2015

Two Marks Questions.

17. A satellite is to be transferred from its geostationary orbit to a circular polar orbit of the same radius through a single impulse out-of-plane maneuver. The magnitude of the change in velocity required is _____ times the magnitude of the escape velocity.

18. A planetary probe is launched at a speed of 200 km/s and at a distance of 71,400 km from the mass center of its nearest planet of mass 1.9×10^{28}kg.. The universal gravitational constant, $G = 6.67 \times 10^{-11}\ m^3/kgs^2$.
The ensuing oath of the probe would be
(A) elliptic (C) parabolic
(B) hyperbolic (D) circular

19. The elliptical area swept by a satellite is $5.6 \times 10^9\ km^2$ in one full orbit. Its angular speed is observed to be 0.00125 rad/s when it is at a distance of 7,200 km from the center of mass of its primary. Its orbital period (in Earth days) is _____.

GATE AE - 2016

Two Marks Questions.

20. A satellite is injected at an altitude of 350 km above the Earth's surface, with a velocity of 8.0 km/s parallel to the local horizon.
(Earth radius = 6378 km, μ_E (GM=Gravitational constant × Earth mass) = $3.986 \times 10^{14}\ m^3s^{-2}$).
The satellite
(A) forms a circular orbit.
(B) forms an elliptic orbit.
(C) escapes from Earth's gravitational field.
(D) falls back to earth.

GATE AE - 2017

One Mark Questions.

21. The period of revolution of earth about the sun is 365.256 days, approximately. The semi-major axis of the earth's orbit is close to 1.4953×10^{11}m. The semi-major axis of the orbit of Mars is 2.2783×10^{11}. The period of revolution of Mars, about the sun, is _____ Earth days (in three decimal place)

GATE AE - 2018

One Mark Questions.

22. The tangential velocity component 'V' of a spacecraft, which is in a circular orbit of radius 'R' around a spherical Earth ($\mu = GM \rightarrow$ gravitational parameter of Earth) is given by the following expression.

(A) $V = \sqrt{\frac{\mu}{2R}}$ (C) $V = \frac{2\pi}{\sqrt{\pi}} R^{3/2}$

(B) $V = \sqrt{\frac{\mu}{R}}$ (D) $V = \frac{2\pi}{\sqrt{\pi}} R^{2/3}$

23. Equation of the trajectory of a typical space object around any planet, in polar coordinates (r, θ) (i.e. a general conic section geometry), is given as follows. (h is angular momentum, μ is gravitational parameter, e is eccentricity, r is radial distance from the planet center, θ, is angle between vectors $\vec{e}$ and $\vec{r}$

(A) $r = \frac{(h^2/\mu)}{1 - e\cos\theta}$ (C) $r = \frac{(h^2/\mu)}{1 + e\cos\theta}$

(B) $r = \frac{(h^2/\mu)}{e - \cos\theta}$ (D) $r = \frac{(h^2/\mu)}{e + \cos\theta}$

24. In an elliptic orbit around any planet, the location at which a spacecraft has the maximum angular velocity is

(A) apoapsis.

(B) periapsis.

(C) a point at $+45°$ from periapsis.

(D) a point at $-90°$ from apoapsis.

Two Marks Questions.

25. A spacecraft forms a circular orbit at an altitude of 150 km above the surface of a spherical Earth. Assuming the gravitational parameter, $\mu = 3.986 \times 10^{14} m^3/s^2$ and radius of earth, $R_E = 6{,}400$ km, the velocity required for the injection of the spacecraft, parallel to the local horizon, is _____ (accurate to two decimal places).

GATE AE - 2019

Two Marks Questions.

26. The product of earth's mass (M) and the universal gravitational constant (G) is GM= 3.986×10^{14} m^3/s^2. The radius of earth is 6371 km. The minimum increment in the velocity to be imparted to a spacecraft flying in a circular orbit around the earth at an altitude of 4000 km to make it exit earth's gravitational field is _____ km/s (round off to 2 decimal places).

GATE AE - 2020

One Mark Questions.

27. For hyperbolic trajectory of a satellite of mass m having velocity V at a distance r from the center of earth (G: gravitational constant, M: mass of earth), which one of the following relations is true?

(A) $\frac{1}{2}mV^2 > \frac{GMm}{r}$ (C) $\frac{1}{2}mV^2 = \frac{GMm}{r}$

(B) $\frac{1}{2}mV^2 < \frac{GMm}{r}$ (D) $\frac{1}{2}mV^2 < \frac{2GMm}{r}$

28. Burnout velocity of a space vehicle in a circular orbit at an angle 5 degree above the local horizon around earth is 13.5 km/s. Tangential velocity of the space vehicle in the orbit is _____ km/s. (round off to two decimal places).

Two Marks Questions.

29. The ratio of tangential velocities of a planet at the perihelion and the aphelion from the sun is 1.0339. Assuming that the planet's orbit around the sun is planar and elliptic, the value of eccentricity of the orbit is _____ (round off to three decimal places).

GATE AE - 2021

One Mark Questions.

30. The velocity required to launch a space shuttle from the surface of the earth to achieve a circular orbit of 250 km altitude is _____(round off to two decimal places)

For earth, $Gm_e = 398{,}600.4\ km^3/s^2$ and surface radius $R_0 = 6378.14$ km.

GATE AE - 2022

Two Marks Questions.

31. Consider a high Earth-orbiting satellite of angular momentum per unit mass $\vec{h}$ and eccentricity e.

The mass of the Earth is M and G is the universal gravitational constant.

The distance between the satellite's center of mass and the Earth's center of mass is r, the true anomaly is θ, and the phase angle is zero.

Which of the following statements is/are true?

(A) The trajectory equation is $r = r(\theta)$

$$= \frac{|\vec{h}|}{GM(1 + e\cos\theta)}$$

(B) The trajectory equation is $r = r(\theta)$

$$= \frac{|\vec{h}|^2}{GM(1 + e\cos\theta)}$$

(C) $\vec{h}$ is conserved

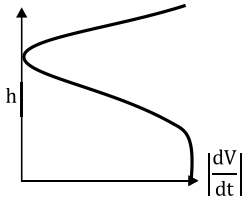
(D) The sum of potential energy and kinetic energy of the satellite is conserved

GATE AE - 2023

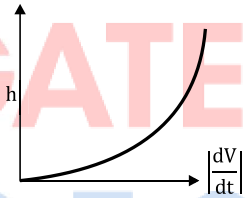
One Mark Questions.

32. Which one of the following figures represents the qualitative variation of absolute deceleration $\left|\frac{dV}{dt}\right|$ with altitude h (measured from the mean sea level) for a space vehicle undergoing a ballistic entry into the Earth's atmosphere?

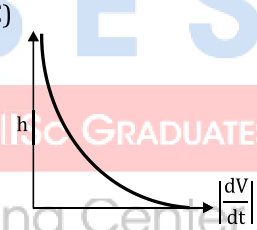
(A)



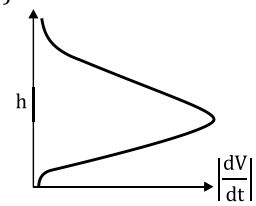
(B)



(C)



(D)



Two Marks Questions.

33. The universal gravitational constant is $6.67 \times 10^{-11}\ Nm^2/kg^2$. For a planet of mass 6.4169×10^{23} kg and radius 3390 km, the escape velocity is ____ km/s. (round off to one decimal place).

34. A satellite is in a circular orbit around Earth with a time period of 90 minutes. The radius of Earth is 6370 km, mass of Earth is 5.98×10^{24} kg and the universal gravitational constant is 6.67×10^{-11} Nm^2/kg^2. The altitude of the satellite above mean sea level is ___ km. (round off to the nearest integer)

GATE AE - 2024

One Mark Questions.

35. Which of the following statements is/are correct about a satellite moving in a geostationary orbit?

(A) The orbit lies in the equatorial plane

(B) The orbit is circular about the center of the Earth

(C) The time period of motion is 90 minutes

(D) The satellite is visible from all parts of the Earth

Two Marks Questions.

36. At a point in the trajectory of an unpowered space vehicle moving about the Earth, the altitude above the mean sea level is 600 km, and the speed with reference to a coordinate system fixed to the center of mass of the Earth is 9 km/s. Assume that the Earth is a sphere with a radius 6400 km and $GM_{Earth} = 3.98 \times 10^{14}$ m^3/s^2, where, G is the universal gravitational constant and M_{Earth} is mass of the Earth. The trajectory is:

(A) Circular (C) Parabolic

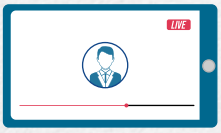
(B) Elliptic (D) Hyperbolic

37. Consider an artificial satellite moving around the Moon in an elliptic orbit. The altitude of the satellite from the Moon's surface at the perigee is 25 km and that at the apogee is 134 km. Assume the Moon to be spherical with a radius of 1737 km. The trajectory is considered with reference to a coordinate system fixed to the center of mass of the Moon. The ratio of the speed of the satellite at the perigee to that at the apogee is _____ (rounded off to 2 decimal places).

OUR COURSES

GATE Online Coaching

Course Features



Live Interactive Classes

E-Study Material

Recordings of Live Classes

Online Mock Tests

TARGET GATE COURSE

Course Features

Recorded Videos Lectures

Online Doubt Support

E-Study Materials

Online Test Series

Distance Learning Program

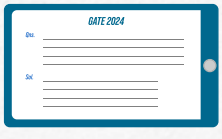
Course Features

E-Study Material

Topic Wise Assignments (e-form)

Online Test Series

Online Doubt Support

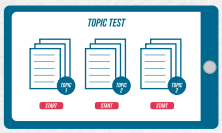


Previous Year Solved Question Papers

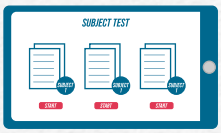
OUR COURSES

Online Test Series

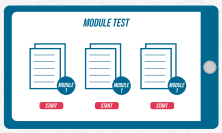
Course Features



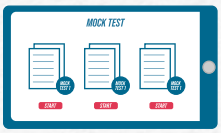
Topic Wise Tests



Subject Wise Tests



Module Wise Tests



Complete Syllabus Tests

More About IGC

SAMPLE STUDY MATERIALS

https://bit.ly/3Wu7lsp

SAMPLE MOCK TESTS

https://bit.ly/3FDyF0f

SAMPLE VIDEO LECTURES

https://bit.ly/3V4xU6j

TEAM IGC GATE

https://bit.ly/3G21khi

OUR TESTIMONIALS

https://bit.ly/3Yp2Hh7

IGC TELEGRAM GROUP

https://bit.ly/3j4koCd

Follow us on:

For more Information Call Us
+91-97405 01604

Visit us
www.iitiansgateclasses.com

Answer Keys SPACE DYNAMICS

1	A	2	D	3	B	4	B	5	A
6	D	7	B	8	B	9	C	10	A
11	B	12	D	13	A	14	C	15	B
16	1.2 to 1.25	17	0.99 to 1.01	18	B	19	1.9 to 2.1	20	B
21	686.5 to 687.5	22	B	23	C	24	B	25	7.80 to 7.80 (or) 7800 to 7802
26	2.54 to 2.62	27	A	28	13.42 to 13.47	29	0.016 to 0.018	30	7.75 to 7.77 or 7750.00 to 7770.00
31	B, C, D	32	D	33	4.9 to 5.1	34	260 to 300	35	A; B
36	B	37	1.05 to 1.07						

IITians GATE CLASSES

Exclusive GATE Coaching by IIT/IISc Graduates

A division of PhIE Learning Center

Admission Open for

GATE 2025/26

Live Interactive Classes

AEROSPACE ENGINEERING

For more Information Call Us

+91-97405 01604

Visit us www.iitiansgateclasses.com