

	<p>start and stop transients. (At 1000, Pa= 0.0898 MPa and At 25000 m, Pa= 0.00255 MPa)</p> <p style="text-align: center;">OR</p> <p>A rocket has a total mass of 5000 kg, including propellant. Its specific impulse is 300 seconds, and its propellant flow rate is 50 kg/s. The rocket is launched vertically upwards and experiences negligible air resistance.</p> <p>(a) What is the rocket's initial acceleration? (3 marks)</p> <p>(b) What is the maximum velocity the rocket can achieve? (4 marks)</p> <p>(c) What is the total impulse of the rocket motor during its entire burn time? (3 marks)</p>		
Q 3	<p>Let us consider AgniKul Cosmos is developing an advanced solid rocket motor for a new space mission. The motor has a length of 3 meters and a diameter of 1 meter. The company has designed the motor to operate at a chamber pressure of 20 MPa and a nozzle exit pressure of 100 kPa. The motor will use a solid fuel with a density of 1.8 g/cm³ and a burn rate of 5 mm/s.</p> <p>(a) What is the initial mass of the solid fuel required for the motor? (3 marks)</p> <p>(b) What is the total impulse of the rocket motor? (4 marks)</p> <p>(c) What is the average thrust generated by the motor during its burn time? (3 marks)</p>	10	CO1
Q 4	<p>Explain the principles of the thrust vector method used in rockets and discuss its advantages and disadvantages. Then, using appropriate equations, calculate the angle of deflection required for a rocket to change its course by a given angle, and determine the resulting change in velocity.</p>	10	CO3
<p>SECTION-C (2Qx20M=40 Marks)</p>			
Q 1	<p>The Saturn V rocket used by NASA during the Apollo missions was a multistage rocket, consisting of three stages. The first stage used five F-1 engines, the second stage used five J-2 engines, and the third stage used a single J-2 engine. The rocket had a total height of 110 meters and a liftoff mass of 2.8 million kg.</p> <p>(a) Compare and contrast the design of the first, second, and third stages of the Saturn V rocket in terms of their engines, fuel, and performance parameters. (6 marks)</p> <p>(b) The first stage of the Saturn V rocket burned for approximately 2.5 minutes before separating from the rest of the rocket. If the first stage had a thrust of 34 million newtons and a specific impulse of 263 seconds, what was its total impulse? (4 marks)</p> <p>(c) The second stage of the Saturn V rocket burned for approximately 6 minutes before separating from the rest of the rocket. If the second stage had a thrust of 5 million newtons and a specific impulse of 421 seconds, what was its total impulse? (4 marks)</p>	20	CO4

	<p>(d) If the third stage of the Saturn V rocket had a thrust of 1 million newtons and a specific impulse of 421 seconds, what was its maximum velocity? Assume that the third stage burned for 2 minutes. (6 marks)</p> <p style="text-align: center;">OR</p> <p>A private space exploration company is developing a rocket for a mission to Mars. The rocket needs to be capable of carrying a payload of 10,000 kg to Mars and back. The company has selected a liquid rocket engine that has a specific impulse of 320 seconds and a propellant flow rate of 30 kg/s. The rocket is designed to have a total mass of 150,000 kg, including propellant. The mission is planned to launch from Earth and return to Earth after spending 400 days in space.</p> <p>Questions:</p> <ol style="list-style-type: none"> 1. What is the initial acceleration of the rocket? (2 marks) 2. What is the maximum velocity that the rocket can reach assuming no air resistance? (3 marks) 3. What is the total delta-v required for the mission? (3 marks) 4. What is the propellant mass fraction of the rocket? (3 marks) 5. What is the total impulse delivered by the rocket engine over the entire mission? (3 marks) 6. What is the total burn time of the rocket engine? (3 marks) 7. What is the maximum altitude reached by the rocket? (3 marks) 		
Q 2	Can you evaluate and analyze the impact of the successful completion of the crew escape system and Pad Abort Test (L-110-G Vikas engine) on the progress of India's Gaganyaan mission, and the potential significance of the mission for India's position in the global space exploration landscape?	20	CO4