COSMOS 360 PROBLEM STATEMENTS

1) **Solar Sails. d**
   Solar Sails (also called light sails or photon sails) are a method of spacecraft propulsion that uses radiation pressure exerted by sunlight on large mirrors for long distance space travel. A typical Solar Sail uses expansive sheets of photosensitive material to capture energy from high velocity photons being emitted by nearby stars. Since the energy of a single photon is miniscule, the solar sail needs to be adequately stable and large enough to harness the energy from a large number of photons. Moreover such structures cannot be directly deployed into outer space because of shape, size and material constraints. Design a Solar Sail that can be compactly stored in a deployment structure, which self assembles upon reaching outer space and also a space vehicle that is compatible with the said solar sail which can accomodate space travel and energy harnessing simultaneously.

2) **Lunar / Martian / Space Housing. d**
   Space pioneers all over the world having achieved a sensible degree of confidence in their capability of space travel and are now shifting their focus on to the fact of settling on extraterrestrial bodies. Scientists have theorised and formulated habitation on planets such as Mars and Venus where as colonising the Moon has been a space frontier dream of the ages. Space homes of Earth-size asteroids is theory in contemplation. Space colonies are soon going to be “a thing of the present” as mankind makes progress in the field of space discovery. Design a Space Home / Colony / Station that can indefinitely sustain and support human life on an extraterrestrial space body.

3) **Rover Landing System. d**
   The VIKRAM lander carrying the PRAGYAN rover for ISRO’s CHANDRAYAAN 2 mission has been the topic of discussion in every space and non-space related avenue as India grab its spot in space and lunar exploration having shown sheer quantities of technical skills, tenacity, perseverance and a vast reserve of intellectual human potential. Even though the lander failed to land successfully on the lunar surface, the mission was a huge step forward for the Indian space program and the space community as a whole. Design a Lander module to be inserted in either a martian or lunar orbit that will safely deploy a rover on either a martian or lunar surface respectively. After landing the said module should be capable of opening up and deploy the said rover in an upright orientation.

4) **Manned Rover. d**

Once humankind establishes a foothold on an extraterrestrial heavenly body it would just be a matter of time until they find themselves in the need of locomotive sources. Design a Rover capable of carrying 2-4 humans at a time and of traversing lunar, martian or other extraterrestrial surfaces. This Manned Rover must have suitable load carrying capacities for carrying around research and exploration equipment used by astronauts. The Rover should be designed keeping in mind the rough and treacherous terrain of extraterrestrial bodies as well as an appropriate way to incorporate a life support system for the said astronauts. The uniqueness and quality features of the Rover should play a major role in the design process.

5) **Docking and Berthing Systems. d**

Docking and berthing of spacecraft is the joining of two space vehicles. This connection can be temporary, or semipermanent such as for space station modules. Docking specifically refers to joining of two separate free-flying space vehicles whereas Berthing refers to mating operations where an inactive module/vehicle is placed into the mating interface of another space vehicle by using a robotic arm. Design a multifaceted system for the docking or berting of various space modules to a space station or a spacecraft.

6) **Space Transportation System. d**

Space Transportation is a major factor in play when you theorize about space colonisation and space exploration. Conceptual space transportation systems such as O'Neill Cylinders, Bernard Spheres, Earth-Mars Cyclers etc are just a few of the ideas put forth by scientists for interplanetary transportation and housing. Transportation systems capable of moving resources and facilitating mass human travel are also needed for traversing the lengths of a particular planet such as internal transportation on mars, a hyperloop etc. Design an effective and efficient interplanetary or subplanteray space mass transportation system capable of providing human travel facilities and moving light or heavy cargo.

7) **Space Robotics. d**

Basic human industrial processes are highly difficult when they need to be carried out in space. When space colonies get established humans would feel the need to start production of basic amenities on the planet or heavenly body they settle on. The successful setup of such production lines in extraterrestrial conditions can be achieved with the help of extremely optimised robotics solutions. Design a completely robotic assembly line that is fully operational in an extraterrestrial setting. Assume the necessary conditions and scenarios accordingly.

8) **Extraterrestrial Copter / Space Glider / Space Drone.**

Design an extraterrestrial aerial exploration vehicle capable of powered flight in the atmosphere of an extraterrestrial heavenly body say moon, mars, venus etc.
The size of the aerial vehicle should not exceed that of a conventional military surveillance drone. The vehicle should be able to achieve powered flight with high efficiency and should carry a scientific experiment payload of 20 kilograms.

9) **In-flight Spacecraft Launch Systems. d**

On ground spacecraft launch pads are very common in the space industry. Spacecrafts can also be launched from in flight aerial vehicles. “Air launch to orbit” is the method of launching rockets at altitude from a conventional horizontal-takeoff aircraft, to carry satellites to low Earth orbit. It is a follow-on development of air launches of experimental aircraft that began in the late 1940s. This method, when employed for orbital payload insertion, presents significant advantages over conventional vertical rocket launches, particularly because of the reduced mass, thrust and cost of the rocket. Air launching is also being developed for sub-orbital spaceflight. Design an “In-flight” or “Air launch to orbit” spacecraft launch system suitable for launching conventional spacecrafts into orbit and interplanetary trajectories.

10) **Space Telescope. d**

A space telescope or space observatory is an instrument located in outer space to observe distant planets, galaxies and other astronomical objects. Space telescopes avoid the filtering of ultraviolet frequencies, X-rays and gamma rays (the distortion (scintillation) of electromagnetic radiation) as well as light pollution which are encountered by ground-based observatories. Design a Space telescope with suitable features for deep space exploration or studying the solar corona.

11) **Self Assembling Spacecraft. d**

The distance between any given heavenly body is extremely large and even the fastest of spacecrafts will take months to cover the said distance. For humans to travel such long distances its highly essential to provide adequate life support systems for the entirety of the journey which cannot be achieved by conventional spacecrafts because of size constraints. Here arises a need for considerably bigger spacecraft that is highly stable in space. Such a space vehicle cannot be launched by traditional means. Therefore, design a set of spacecrafts or spacecraft modules that can be launched separately and that have the ability to self-assemble in space to form a single spaceship for long distance space travel and/or exploration.