* IT & Computers :-

* [Net Neutrality] :

- In Recent times, there have been some instances like - zero rating plan of airtel, free basics.org floated by mark zukerberg, which have raised the question of Net Neutrality violation.

- The principles of Net Neutrality are :-
  ① Same speed.
  ② Same cost
  ③ Equal access

In the debate on Net Neutrality, there are 4 stakeholders.
  ① govt.
  ② Subscribers.
  ③ Mobile / Internet Service Providers.
  ④ OTT.

- The argument of telecom (internet) service providers was, that they invest in infra, pay for the spectrum & the profits are earned by OTT companies. ∴ They should be allowed to share the profit, which was ruled out by the govt as it would have increased the digital divide. Govt. told the telecom companies, that they should reduce the price through other means.

- The supporters of freebasics.org argues that → some internet is better that no internet, The plan was the subscribers of a particular telecom company will have free access to 17 infotainment sites. If the

subscribers will visit the other infotainment sites, then they're to pay for it.
- The opponents of freebasics argued that → it will lead to splintered (split + internet).
• Then the advocates of feu basics org countered it that it will not be always like this. Gradually the users will move towards paid internet. Then same the internet society said, "It will hurt the startup culture" & sometime later, "Cambridge Analytica scandal" came to light → In that the data of FB users was sold in some cases to the pol. parties. That raises the question of possible impact on the electoral process.
        ↓
   (data-feudairary to Facebook)

- TRAI, then asked the users about their choices & overwhelming majority of those respondents said no the Zukerbergs plan. & after that it has issued the guidlines which has banned "paid prioritization", data throttling, Data Blocking. The exceptions are - emergeny services, closed electronic comm" groups. In case of violation, there can be a penalty of ₹50,000 per day, which should not exceed ₹50 lakh in total.

- There is no consistency in international benchmark as in USA & UK, paid prioritization is legal. As far as India is concerned, the use of Universal service obligation fund → 5% of the total is taken by govt for rural telecom infra, BHARATNet (optic fibre project, CSR should be used for increased digitization.

- Another emerging option is, satellite based internet services.

* <u>Artificial Intelligence</u> :
- Intelligence is our ability to adjust in env. The env. could be physical, social, cychological. Intelligence is measured with IQ, through the formulae,

$$IQ = \frac{mental\ age}{chronological\ age} \times 100.$$

- There are 2 major issues, with the concept of IQ.
   i) It is not a true reflector of the potential.
   ii) The IQ score declines with age. ∴. It has been replaced by emotional intelligence.

- Allen Turing, a British mathematician, said that computers are the only m/c capable of demonstrating human behaviour. AI includes voice recognition, speech recognition, pattern recognition, game playing, etc.
- There are two streams -
   ① <u>Narrow AI</u> :- When the AI system is able to perform better than human beings in one or two domains.
   eg : Bluegene of IBM.

   ② <u>Generalised AI</u> :- Also known as singularity.
   - When the AI systems are able to perform better than human beings in all the domains.
   - The obj. of generalised AI is to realise the ultimate goal of robotics . i.e., Artificial person in the form of Humanoid robots.
   - The other obj. are -

i) **Transhumanism** : Taking humanity to next level, a society where routine activities are outsourced to the m/c's & the people are following their passion.

But in a country like India with the poor skilled of the people, there is a possibility of polarization of the wealth, because in 4th industrial revol^n, low skills will result in low pay & high skill will result in high pay. In that scenario, mid-level jobs will be gone... Before pushing for AI in labour intensive industries, the skills should be upgraded.

ii) The AI systems should be able to understand the non verbal comm^n.

iii) They should use the same tools as used by the human beings.

Under digital India. AI is promoted through multiple routes → " Cyberphysical system "
                              * Robot using AI.

→ **obstacles in the emergence of generalized AI :**

① lack of natural language ability, which is responsible for decision making, judgements, critical analysis.

② These systems have not yet passed Turing test. i.e., when Human beings will fail to distinguish b/w work of men & robot.

③ They cannot move from one architecture to another.

⑨ The Info. processing ability is very high.

⇒ Evolution of AI:

① Artificial Neural N/w:
- These structures resembles the working of Neuron.
They have an I/P & o/P layer with multiple processing layers in b/w.

② m/c learning:
. It is the ability to learn from data or making m/c's to perform the tasks which comes naturally to human beings. In recent time, m/c learning has gain lot of currency (usage), due to increased data generation, better computing. Today, m/L learning has plethora of applications, right from e-commerce, social media, medicine discovery, health-care, agriculture, transportation, FINtech, education, (PhonePay, BHIM)

⇒ m/c learning & Agriculture:-
- Use of m/c learning will be one of dimension of smart agriculture. for eg! Using drones for crop monitoring that req. the processing of the info. to be communicated to the farmers, There is a proposal to have blockchain used in the digitization of soil health card. m/c learning tools will communicate the data to & fro to have optimum utilization of the land resource. If done comprehensively, it can be a path for adapting agriculture. au. to climate change.

→ **m/c Learning & Healthcare!**

- NITI Aayog has started a project called "Imaging Biobank", to have a repository of the scanned images of the cancer patients uploaded on the cloud. When the new scanned image of a new patient is uploaded, the m/c Learning tool will overlap it with the existing image in the database.

→ **m/c Learning is of various types**

① Supervised m/c learning:
   - Uses labelled data.

② Unsupervised m/c learning:
   - Uses unlabelled data

③ Semisupervised:
   - Uses both labelled & unlabelled data.

④ Reinforcement:
   - Used in game playing.

* **Deep Learning:**

- It is based on deep Neural N/w, which involves more processing layers B/w I/P & O/P. The obj. is to develop the AI system, showing the same capabilities as the human beings. In deep learning, the performance keeps on improving with the increase in quantity of data. Whereas in m/c learning, it plateaues after some time.

Performance ↑ ⎫— Deep Learning
            ⎬— m/c Learning
         data→
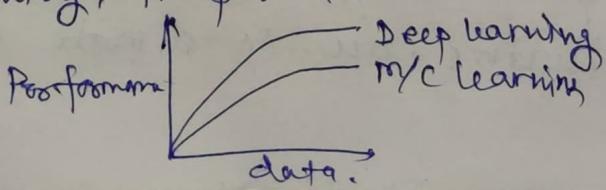
- To further deep learning, the focus has shifted towards Neuromorphic computing. 1st computer of this type - spiking Neural N/w Architature - Spinnaker.

- The deep learning will shift computing power towards the user in form of Edge computing.

*. Kamakoti Panel on AI :

- Min. of commerce appointed a panel under V. Kamakoti under IIT Madras. The mandate was in the form of 3 questions.
  ① what should be the role of govt in AI?
  ② How the jobs can be created through AI?
  ③ How quality of life of the people can be improved by using AI?

- The recc. made are -
  ① There should be an interministerial national AI mission. for 5 years with the corpus of 1200 crores.
  ② Establish center of excellence to reskill & upskill the people.
  ③ they have identified multiple sectors to create jobs like healthcare, education, agriculture, food processing, manufacturing, FINTech, env., people with disability freiendly devices, etc.

→ NITI aayog has also presented a paper for the strategy of AI. They have suggested a citizen centric approach for using AI :-

1] CORE & ICTAI. - Centre for Research excellence & Int. center for transformational AI.

2] scholarships.

3] IPR

4] Protection of IPR { → laws
                       → courts

5] Assess the changing nature of jobs.

6] Reskill & Upskill the human resource.

* [Data Localization]:

- In 4th Industrial Revol^n, data will play the same role as played by electricity in the 3rd Ind. Revol^n. Data is defined as a new oil. Globally all the major economies have started measures for localization like cloud act of USA (Clarifying lawful Oversees Use of Data). Similarly UK has also passed a law. In china, data has to pass the security test. whereas Russia dont allow any data to be moved out. EU has formulated GDPR (General data Prot^n Regulation).

- The domestic initiatives for data localization are:
① Personal data protⁿ bill : drafted by Justice B.N.Srikrishna
② DISHA (dig. info security in thealthcare) Act :
③ Drugs & Cosmetic Act Amendment : to mandate that
e-pharmacies have to keep their portal in India.
④ RBI circular to MNCs (banking companies) : to keep
one copy of financial transaction within the boundries
of the country.
⑤ The new e-commerce policy : It has incentivised data storage
in the country.

- Data localization is keeping the data of the residents
of a country within the boundries → to creation of
digital infrastructure , next generation jobs in IT sector.
It will have other benefits as well . like -
i) Lesser probability of foreign surnellance.
ii) Law enforcement will be easy .
iii) The cost of law enforcement will reduce .
iv) Evidence based policy making .
   ↳ using genomic sequencing for pandemic preparedness
v) Improvement in the quality of research
vi) Better targetted marketting.

- The possible negative outcomes are -
① data localization is against spirit of globalisation.
② Internet speed & cost should determine the flow
of data rather than national boundries.

④ If data is stored in India, but the encryption key is may be abroad with the CEO.

⑤ If implemented stringently, data localization will hurt ease of doing business & investor might stay away.

⑥ It will go against Indian companies going global. In the competitive markets, if they are asked to take up data localization, their chances of survival will reduce.

→ **Personel data protⁿ Bill :**

- The bill presented in the parliament is diff. from the one drafted by Justice B.N. Srikrishna comm. One notable change is the dilution of data localization.

- Personel Data has been categorised into 3 types.

  Ⓐ general.   Ⓑ Sensitive personel
                    ↓
             - Haalth info,
             - financial details
             - Religious belives.
             - pol. idiologies.
             - sexual orientation.
                   ↓

- In the bill drafted by Justice B.N. srikrishna comm, this data was not supposed to be movd out, but now it can be transferred abroad with the consent of the individual.

Ⓒ Critical personel data : It is imp. from the semity pt. of view to be defind by gavt from time to time. It can never be transfered outside the country.

- This bill has a provision for __Data protⁿ Authority__ to address the grievances of the individual. It has the powers to penalise the companies upto 4% of their global turnover.

- It has introduced the concept of "Right to be forgotten", that goes against investigative journalism, as it will allow individuals to stop the publication of incriminating material.

- There is a provision that social N/w sites can conduct user identification & KYC.

- It has introduced the concept like - "Data Principle", "Data fiduciary", "right to erase", "right to correction".

*. Computing :-

QUANTUM COMPUTING :

- It is based on quantum mechanical model of the atom. The obj. is to use supercooled atoms, ions, photons to store & retrieve the info.

- The quantum computers are looking to replace supercomputers with desktop size computers. They will be known for data crunching. Recently google demonstrated - "Quantum Supremacy", by performing a calculation that'll req. 10,000 years to be performed by a supercomputer of IBM.

- Quantum computing is based on following principles :-

① <u>Entanglement</u> : When two quantum entities are brought closed, so that w/o knowing the details of the one, the other cannot be defined, that is called entanglement

- One of the noble prize in physics was awarded to Serge Haroge & David Wineland for demonstrating quantum entanglement b/w a led ion & an a photon oscillating b/w super conducting mirrors.

- Entanglement has multiple applications like -
i> <u>quantum commⁿ</u>: China launched a statellite - QUESS, MICIUS using quantum entanglement.

ii> <u>quantum clock</u> : They will replace atomic clocks. If such a clock would be switched on at the time of Big Bang, then till today, then it might have shown error of only 5 seconds.

iii> <u>Encryption using quantum key distribution</u>: It will enhance data security. Quantum key distribution also employs <u>Hasenburg's uncertainity principle</u> & <u>No clowing thuorem</u> → which says it is impossible to create a copy of entangled particle.

② <u>Superposition</u> : The possibility of a particle existing in 2 <u>states simultaneously</u>. To explain this phenomena, Schrodinger used the analogy of <u>"CAT in the BOX"</u> paradox.

③ <u>QUBID</u> : QUBITS / Quantum Bits. The capacity of quantum computers is expressed in qubits, i.e, also all the possible combinations of 0 & 1 can exists simultaneously. i.e, the computing power increases exponentially.

- Recently, QUTRIT was also demonstrated → Three states combining to give multiple possibilities.

→ **Quantum Computing Related Initiatives in India**:

① Dept. of S&T has started QuEST (Quantum Enabled S&T). Besides that, National mission on Quantum Computing has also announced with corpus of ₹1200 crore.

② Tata Inst. of fundamental Research has started QuMAC (Quantum measurement & Control). Raman Research Inst. has developed QKDsim (Quantum Key distributor simulator).

③ IIT Rurkee & C-DAC has also developed Quantum Simulator for the testing of Quantum devices.

④ ISRO is also working on Quantum Key Distribution.

⑤ MeiTy has tied up with Amazon web services (cloud) to use their cloud computing facility for Quantum Research by the govt Institutes. ~~They are~~

⑥ There have been Int. collaborations as well :- for eg! with Italy, USA.

→ **STARTUPS in Quantum**:

① QUNU LABS.

② Entanglement Partners.

③ Y2Q.

④ Automatski

⑤ IBM has also started its quantum facility in Bengaluru

→ Challenges :

i) 95% of the patents are with China. They've allocated $10 Billion, whereas India & USA have allocated around $1.2 Billion

ii) lack of put. sector participation.

iii) lack of quantum roadmap & coordination.

iv) Insufficient Hardware manufacturing -

v) Duplication of Research. (focus on only one aspect).

vi) There is a need for an org. like ISRO or BARC to coordinate the activities & have the better utilization of men & material resources.

* Neuromorphic Computing :-

- They are modelled on the working of human brain. The underlying principle is - "Spiking Neural N/w". i.e, the potential difference in the neuron must reach a certain level, then only a nerve impulse will be generated.

- Human brain is event driven, i.e, motivated by outcomes of its action. It is known for working within the constraints known as constraint satisfaction.

- In 2005, A blueprint Project was started to have a simulation model of the working of Rat's Brain, which was later followed by Human Brain project to develop the virtual model of the working of human brain. It was supported by EU. This project is the basis of development of the 1st Neuromorphic computer - Spinnaker. i.e, "Spiking Neural N/w Architecture". It has been used in a robot called - SPOMINI BOT

- IBM & DARPA started SyNAPSE (Systems Neuromorphic adaptive Plastic Scalable Electronics). IBM & USA airforce are having a BLUE RAVEN project. Besides them, there is Brainscales. IBM developed the 1st Neuromorphic cheap → TRUENORTH. The multifold obj. behind Neuro-morphic computing are :-

i) To further evolve AI (deep learning).
ii) To develop new types of computing languages.
iii) To develop new types of storage system.
iv) To push the broadbasing of Edge computing.

- AI specially m/c learning, deep learning, virtual Reality, Augmentative Reality, all will benefit from this approach.

* DNA Computing :- Biological computing / Organic computing / liquid computing.

- The concept was given by Leonard Adlemen. The benefits of DNA computing are :

i) Enormous data storage capacity : 1gm can store 10^{14} MB of data.

ii) Inbuilt parallel processing.

iii) Energy efficiency.

- DNA computing has been used as a proof of concept in the following instances :-
i) To calculate squareroot of some no.s.
ii) To identify prime no.s in the range 1 to 63.
iii) To elect a leader.
iv) To solve Hamiltonian path problem or Travelling salesman problem

↓ To diagnose the infection and prescribe the treatment.

- DNA computing operates on the principle of complementarity,
  i.e., Adenine combining with Thymine
      & Cytosine with Guonine.

- The electrons are replaced by the chemical bonds, whereas
  semiconductors are replaced by Nitrogenous basis.

- multiple half strands in the DNA are released in the
  sol^n along with the enzyme DNA polymerase. Each
  half strand is acting as I/P, when they combine to give
  a DNA molecule, that is o/P, which are seperated
  by using GEL ELECTRO PHORASIS.

• The long term perspective is to bring convergence of
  Biology, chemistry & information Tech^n (4th Ind. Revol^n eg.)
  to develop the systems capable of identifying the target
  & interacting with thuir surroundings. They will be self
  replicating, self repairing, responsive & Evohing.

- In an experiment, Atic Winfree & Seemen prepared
  2D squares from DNA → when put in sol^n, they demonstrated
  self assembly.

→ <u>challange</u> :

- How to demonstrate the use of DNA in conventional
  desktop type computing. & at a large scale.

As of Now, it is confined only to labs & only domain
specialists have used it.

. **OPTICAL COMPUTING** :-

- It is based on __Photonics__ . i.e., using light → to store & retrive the information. The use of light offers the following advantages :-

i) It is faster than current.
   ∴ systems will be much better.

ii) It does not req. any medium to travel . ∴ systems will be compact.

iii) There is no heating effect . ∴ efficiency ↑ .

- Optical computers will be Binary using 0 & 1 . The state of constructive interference will give 1 , wherease destructive interferce gives 0 . There is no pure optical device . As of now there are only thybrid device using light + current.

＊ **CLOUD COMPUTING** :-

- Cloud mean internet . It is one of the imp. pillars of the
- current eco^n system, which has moved considerably towards digitization . The eg. are - Amazon web services,
  Azure of Microsoft , etc.

- cloud computing is cost effective, scalable & secured. The GoI has __Meghdut Project__ for cloud computing implemented by __C-DAC (Pune)__ .

- Cloud computing includes - software as a service .
  __For eg!- ①Drop Box__ , i.e., the indv./organisations getting the softwares all-to pay per use .

③ Platform as a service !

for eg ! Redhat open shift.

Those who are developing the apps, requires multiple software to test their product. This option under cloud computing offer them this service. It allows them flexibility at lower cost, they can release their product early as they do not have to purchase software stacks.

④ Infra. as a service !

It is about providing computing resources like servers to the organizations to fulfill their requirement. It includes serverless computing. In that, all the computing requirements are outsourced. ~~There is fun~~.

⑤ fun^n as a service !

In this approach, the service provider executes the functions if the mutual consent was their b/w the service provider & the client.

- The clouds could be public, pvt or hybrid. There are 2 Big challanges emerging in cloud computing !-

A] Req. of Bandwidth, because of data which is flowing.

B] Latency Issues.

If the Bandwidth is less, the services get hampered, which may lead to outages.

* . FOG COMPUTING :-

- It is an interface B/w edge computing & cloud computing.
The unnecessary data generated by the edge devices is
filtered & only relevant info. is passed to the cloud.

* DEW COMPUTING :-

- It offers the option of accessing the data stored on the
cloud to be accessed in the absence of internet.
<u>For eg</u> : DROPBOX.

* SKY COMPUTING :-

- It is the next stage of cloud computing based on the
integration of various cloud service providers to harness
their potential by allowing users to have seemless
transition from one service provider to another.

* EDGE COMPUTING :-

- It is an extention of cloud computing.
<u>For eg</u> : Drones used in crop monitoring,
wearable digital devices   - ONEPLUS
Oil rigs , smartgrid , Driverless car.

- In cloud computing there are bandwidth issues, latency
problem & too much of data flow . that is why,
the edge computing is looking to shift info. processing
ability towards the end user.

- It offers data sovereignity . data security & autonomy.
- The emergence of AI, Virtual Reality, augmented Reality,
IoT have fuelled the growth of edge computing.

* GRID COMPUTING :- Research oriented.

- It involves specialized organisation to join a N/w for solving a common problem.

Foreg: GARUDA Project: It connected IITs, Ind. Inst. of G., AIIms to solve diff. scientific problems.

The International eg. are: LHC Grid & SETI (search for extra terrestial Intelligence)

MOBILE TECHNOLOGY:

① Freqⁿ Division multiple Axis :- FDMA

- The spectrum alloted to the operator is divided into freqⁿ slots which are then given to the users. It is not a very effective mode as the no. of users that can accomodated is less.

② Time Division multiple Axis :- TDMA

- The spectrum is divided into freqⁿ slots, which is subdivided into time slots. These time slots are then assigned to the users. In the process of making the call, the users are moved from one time slot to another w/o disturbing.

③ Code Division Multiple Axis: CDMA

- It is the most efficient way of freqⁿ utilisation, which allows all users to use the entire spectrum simultaneously.

→ Terminologies related to Mobile spectrum :

i> Unified licensing Regime :

- India has 22 Telecom circles. Under 1 licence, an operator can provide all types of telecom services in all the circles.

ii> Administratively Allocated spectrum !

- When the mobile services started, the use of particular band of spectrum was linked with a particular technology.

  for eg !   CDMA & 800 MHz were tied up
             900 & 1800 MHz were used for GSM.
                                              ↳(FDMA+TDMA)

→ Liberlization of spectrum :

- The operator is free to use/provide any spectrum to provide any generation of mobile services. It was introduced by the National Telecom Policy of 2012. But, the spectrum sharing was intro.

→ Spectrum sharing !

Spectrum sharing was introduced in 2015 to address the fragmentation of the spectrum & also to provide an exit route to loss making telecom companies. Because of this mechanism, telecom operators do not have to wait for spectrum auction by govt. They can merge their alloted bands with the other operators in the same circle, provided that they have same type of spectrum (Administrative or Liberalised).

→ Spectrum Refarming /Reframing :

- In the initial phase, telecom licenses were allocated for 2G services. In 800 & 900 band ∧ when these licenses started expiring, govt told 2G service provider that

they will be shifted to 1800 Bands. & the vacated bands
will be used for 3G & 4G services.

→ <u>Delinking of licensing from Spectrum allocⁿ</u> :
- In 2012, SC cancelled 122 Telecom licences & asked
that the future allocation of spectrum should be
through open auction. Telecom companies have to pay
a fee to get the license & participate in open auction
to get the spectrum. Once they get the spectrum,
they've to share the revenue - 8% in high revenue
generating area & 6.5% in low revenue generating area.

→ <u>Generations of mobile Techⁿ</u> :

① <u>1G</u> :   - Not launched in India.
              - It was based on <u>FDMA</u>

② <u>2G</u> :   - Allowed voi & non voice data.

③ <u>2.5G</u> :- - Started the era of digital convergence
                i.e., mobile become a multimedia platform
                because of the availability of internet.
               -The techⁿ used was <u>GPRS</u> (general packet radio
                                                        service)

④ <u>2.75G</u> :- It has faster internet speed.
                - The techⁿ was Edge <u>EDGE</u> (Enhanced data rate
                 for GSM evolⁿ).

⑤ <u>3G</u> :- - Internet speed was more faster.
             - Distinguishing feature was video calling.

⑥ <u>4G</u> : Long Term Evolⁿ (LTE)
             - It has 2 technologies →① FDD (freqⁿ Division Duplex)
                                       ② TDD (Time /÷)

- In freq^n div. duplex, the operator uses pair spectrum. One for uplinking, another for downlinking.
- In TDD, unpaired spectrum is used, i.e., same band is used for uplinking & downlinking.
- To avoid the interference, the operator has to keep a time gap.

① <u>5G</u> :- It is a general purpose Technology like electricity.
    - It will be the basis of 4th Industrial Revol^n. The characteristics are -

   i) Enhanced mobile Broadband : In urban areas, the internet speed will be 10 GBps whereas in rural areas, it will be 1 GBps.

   ii) <u>Latency will be less than 1 milisec</u>.

   iii) 80% internet through optic fibre.

   iv) 99.9% of the area to be covered.

Open Radio Access N/W : The equipment manufactures are free to use any freq^n of any operator for their services.

- The world radio conf. organised by ITU on 5G, identified 2 freq^n Bands, i.e., upto 5 GHz & from 24 GHz in the milimeter wave Band (30 GHz to 300 GHz).

- The spectrum for 5G is classified in three freq^n categories.

Ⓐ <u>Low Band</u> : The freq^n used is <1 GHz. & the internet speed is around 100 mBps.

Ⓑ <u>mid Band</u> : freq^n ! 2.5 to 3.5 GHz.
             speed : can reach 1 GBPs.

Ⓒ <u>High Band</u> : from 24 GHz onwards.
        - It provides Highest speed, but min. coverage.

- TRAI, has identified 2 freq slots for 5G trial.

  A] 3.3 to 3.67 GHz

  B] 24.25 to 28.5 GHz

The base price for 1MHz is 492 crore. & the operator will req. 100 mHz to provide this type of service. The low & mid bands are already crowded. ∴ spectrum availability is a challenge.

- In High Band, attenuation of the freq will be more

→ Security concerns:

- Initially Huawei was invited to participate in the trial, but later it was excluded, 'cause the proximity of this company with Chinese govt. The counter Espionage law & National Intelligence law of China has mandated the sharing of the data with the govt.

→ Indeginization of Tech:

- At IIT madras, Dept. of Telecomm, funded a 5G tech demonstration project, which was successful. There was participation of IIT Hyderabad as well. Later the project was stopped.

→ Societal Applications & governance through 5G:

- Dept. of Telecom has constituted diff. working group for the use of 5G tech in the areas like - SMART GRID, TRANSPORT, HEALTH CARE, EDUCATION, WASTE WATER TREATMENT, INDUSTRY 4.0, AGRICULTURE, FINTECH.

- 5G has also been identified as a tool for improving the ranking of country in the ITU index of innovation, increasing the share of digital services in the GDP to further the concept of dig. eco^n through dig. India.

* Internet Governance :-
- In 1980's "dept of def^n", USA developed ARPA net which later evolved into Internet. In 1997, ICANN was created (Internet corp. of assigned names &nos). It had a contractual relationship with USA dept-of commerce.
- ICANN is managed by a board governance, elected au. to the principle of multistakeholderism.

Below ICANN, there is IANA. (Internet Assigned No. Authority), which operates through Regional Internet Registries to allocate domain name.

- After the revellation of NSA PRISM, a prog. of USA for the electronic surveillance of other leaders in diff. countries ;there was a demand to struck down the contract B/W ICANN & USA dept-of commerce.
To evolve the future architecture, 2models were discussed-.
ⓐ multistakeholder model of governance. (MMG)
- ⓑ multilateral model of governance. (multi stated)

A] multistate model :
- UNGA created world summit on info. society, which adopted TUNIS agenda & created IGF (Internet governance forum) representing, multistakeholderism. It is an open system. works through consensus, the structure is horizontal. Adopted tool Box approach for problem solving

Internet was projected as a tool for socio-econ trans-formation. It was supported by the majority of the countries. Finally, ICANN was brought under - IGF.

B) multilateral model :-

- It has proposed that ICANN to be brought under - ITU. The structure was Hierarchical, closed, decisions through agreement & treaties. Internet was mostly seen as a tool for cyber security.

* Blockchain Tech & Crypto currency :

- Blockchain is one of the emerging technology. It will have an impact on financial institution, society, governance, data security & above all - economy.
- In blockchain tech, the data is encrypted through the process called HASHING. In this technology, data of variable lengths will always produce similar HASH (in terms of data quantity). Thus, it will be impossible to reverse the HASH into information through hacking.
- Blockchain is a distributed LEDGER tech. The participants called NODES verify the information through MINING. In put setup, the MINERS are rewarded for their efforts in the form of cryptocurrency.
- The blockchain tech runs on the principle of distributed consensus. i.e., the participants have to agree, then only info. can be altered.

- The characteristics are (blockchain tech) :-

① Programmable.
② Decentralised.
③ Destributed.
④ Secured.
⑤ Immutable (cant be unilaterally changed)
⑥ Transperent.
⑦ Time stamped.
⑧ Auditable.
⑨ Accountable.
⑩ verifiy able.

- The Blockchain tech works in the fallowing manner :-

Transaction is Requested & Authinticated.	→	Block Representing that transaction is created.	→	Nodes Receive the Block

↓ (to Nodes Validate)

Block is added to the chain	←	Node is Rewarded	←	Nodes Validate the transaction

↓

Updated information sent to all the nodes.
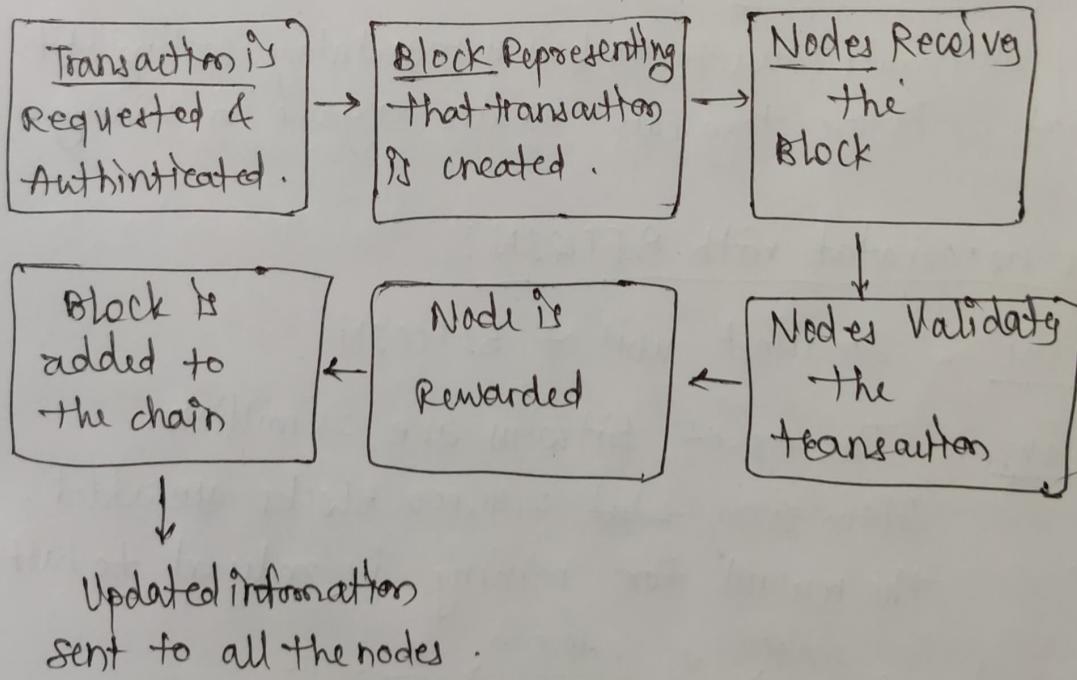
- There are multiple principles of issuing cryptocurreny -

① Proof of work : i.e., miner has to validate a transaction
to get the reward.
It leads to too much consumption of power.
If Blockchain tech is taken as a country, then it will be

ranked 40th in the world in terms of power consumption.
∴ there is definite echological footprint.

- BITCOIN is based on this approach.

⊕ **Proof of Burn** :
- In this system, the participants have to permenantly forgo some cryptocurrenies. Then only they can engage in mining.

⑧ **Proof of Stake** :
- The participants must own the cryptocurrenies to engage in mining.
  for eg ! Etherum, smart contracts.

④ **Rule of Elapsed Time** :
- The participants have to follow a mandatory cooling off period ., before they can again engage in mining.

⟹ **Terms associated with BITCOIN** !

① satoshi ! smallest unit of BITCOIN.

② Halving : The no. of Bitcoins are 21 million.
After every ~~slot~~ 2,10,000 Blocks are added, the reward for mining is reduced to half.

for eg ! $x \xrightarrow{2,10,000} \frac{x}{2} \xrightarrow{2,10,000} \frac{x}{4} \cdots$

∴ The graph for distribution of Bitcoin is -

21 mn
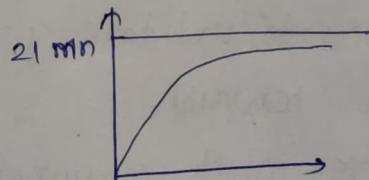
Cryptocurrency :-

- Acc. to "Committee for Banks of Int. Settlements". there are 3 characteristics of virtual currencies :-

i> They are electronic.

ii> They are peer to peer exchange (decentralised).

iii> They are liability of none.

- The Bank for Int. Settlement has also noted that 14% of Central Banks have already adopted the tech" & 60% are in the process of doing so.

- Acc. to **Ishwar S Prasad**, in his book "future money", countries can be classified into 3 types (categories):-

A) **Outright Ban** .→ China.

B) **passive Intolerance** → They have not declared it illegal, but there is an attempt to discourage the adoption of cryptocurrency.

c) **3rd countries** : CANADA, JAPAN, USA permitted the use & simultaneously evolving the regulation.

- **El-Salvador** has become the 1st country to declare Bitcoin as legal tender & they are building Bitcoin City.

- USA, Canada, Japan, Thailand have permitted the selutive use of cryptocurrencies.

- Pm modi at Sydney dialouge exaulted that all the democratic nations should come together to prevent the misuse of cryptocurrencies. The motive of the Crypto developers have been to create a parallel eco" system, that will be quiet disturbing as the situational will be chaotic, there will be no regulation & no accountability.

- The issues involved in virtual currencies are :-
  i) Their price is highly volatile.
  ii) They can be used for financing terror or other illegal activities.
  iii) The cyber crimes committed are transnational in nature.
      ∴ tracking the theft of crypto currencies will be challenging
  iv) The FIAT currencies issued by central bank is against the assets. While in virtual currency, that asset is missing
      ∴ the question is what is the basis of valuation, other than demand & supply.

- RBI issued a circular to ~~banks~~ BAN that transaction arising from the trading of cryptocurrencies. It was challenged in SC & 3 questions were raised :-

  Ⓐ Is crypto currency a money?
  Ⓑ Whether RBI has power to regulate it?
  Ⓒ Whether RBI has exercised the proportionate use of its authority?

  SC Answered 'yes' for first 2 questions. But replied in 'negative' to third. Since then, there is a boom in crypto trading in India. Almost 90,000 crores have been invested by millions. The other issues are :-

o Regul" of crypto exchanges.
o How to tax the I/C.
o Proot" of interest of the investors.
o A lack of financial literacy among the investors.

* CBDC :-

- China has adopted digital _Renminbi_, which is govt-sponsored. RBI has also initiated the process of adopting its digital currency based on Blockchain Technology. It will be _one-to-one exchangable_ with the FIAT currency. The users will have to get an electronic wallet to receive & transfer the CBDC. It has been port forced by the circumstances - domestic & international as most of the countries are moving in that direction. ∴ To keep pace it has to be adopted. At the same time, domestically, new technologies are being adopted by the people to ensure that they are not left behind such a step is necessary.

- CBDC will result in _less transaction cost_. There will be greater security, the chances of missed transaction are less. The charges incurred for carrying out digital transaction is less. But, in country like in India - where there is huge digital divide, the actual beneficiaries of crypto will be very less.

* NFT :

- They are unique digital course based on _blockchain tech"_. They are used for establishing the ownership of the digital copies of the original art. In online world, there are multiple copies of an art copies. These tokens are used for identifying the original one. They are also used for _offline to online integration_.

  foreg! Amitabh Bacchan has used NFT for securing the digital copy of _MADHUSHALA_.

*. Purvasive Computing:

- It is also known as __Ubiquitous computing__. It will take computing to every day objects in the form of __IOT__. There are 3 factors responsible for the increased application /use of it :-

(A) Standardization of Internet.

(B) Micro Electronics have made it possible to embedd them in small devices.

(C) Digital communication. → World wide Roaming, Increased Bandwidth

- It will be use in Aviation, Healthcare, Wearable devices, Retail.

$$\boxed{\text{MODULE - 2}}$$
$$\text{SPACE}$$

BASICS

→ **ROCKET** → Has its own **fuel and oxidiser**
   → Non-Air Breathing b/c does not take up atmospheric oxygen.
→ for e.g. SLV, PSLV, GSLV, AGNI, PRITHVI → anti ballistic missiles

→ **JET** → Has **fuel** but **not the oxidiser** → depend upon atmospheric oxygen.
   → Air-Breathing
   → e.g. Cruise Missiles (Brahmose, Nirbhaya); scramjet engine.

→ **TYPES OF FUELS**
                                                                b/c
(a) **Solid fuel** → Prefered for Iˢᵗ stage of launch vehicle. → **easy to handle.**
         → Provide **neccessary thrust** for the take off.
only **Disadvantage** → Engines using solid fuel cannot be switched on and
         off frequently. → **will go on until fuel completely exhausted.**
         → Does not facilititate the manuvering the vehicle.
   → **b/c fuel and oxidiser is in same chamber for combustion** b/c
      they cannot flow. — **first choice for missiles.**
   e.g. AL-Powder (Binded by Hydroxyl Terminated Poly Butadiene)
      → Agni → based on solid fuel. | notpossible | vehicle must be
      → Pruthvi → shift is towerds solid fuel. { | in SF | above ocean
                                                              | change direction

[note → **Expandable Vehicle** → cannot be come back after first use.
                        → can only be used once.
      Liquid Apogee Motor → Satellite has this motor → uses liquid fuel.
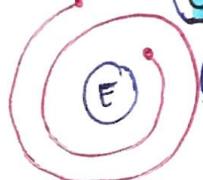
      International Telecommunication Union (ITU) → Every vehicle has to be registered here
                        → they give a specific degree called
                        Orbital Slot (LV will travel through such slot)
                        → To avoid collision with other satellites)

(b) **Liquid Fuel** → Difficult to handle, highly corrasive
                → But facilitate the manuvering of vehicle.
      e.g. **UDMH** → Unsymmetrical Dimethyl Hydrazene

(c) **Cryogenic fuel**
                                          | fuel and oxidiser → flow can
                                          | in same chamber. be controlled
                                          | can flow
   → Application of temperature lower than
      minus 153°C. (−153°c)
   → Cryogenic Engines used **Liquid Hydrogen as fuel** (minus 253°c)
   →   "   "   "   "   **Oxygen u oxidiser** (minus 183°c)
   → Provides maximum thrust, forms the most vital part of GSLV.
   → minimum fuel
   → Satellite > 2 tonne   GSLV used **cryogenic engine**

 # 1984 - 85 | AGREEMENT B/W INDIA & SOVIET UNION

→ USSR started training Indian Scientist how to handle liquid hydrogen and oxygen. (Cryogenic Technology)

1991 | IND - USSR

- USSR Agreed to provide India Cryogenic Engine and Technology Transfer

But USSR disintegrated ✓

1993 Russian President Boris Yeltzin cancelled the deal under the influence of Bill Clinton on the ground of veilation of MTCR [Missile Technology Control Regime]

MTCR | Controls technology transfer | International organisation which says you cannot transfer the technology related to ~~space Reg~~ space.

India's → But 1991 USSR was not part of MTCR, hence they could not Argument cancel deal. ~~retrospective~~ ~~natur~~ "International agreements do not have retrospective application.

Russia eventually ~~~~~~~~ gave 7 Cryogenic Engines but no TOT.

CRYOGENIC UPPER STAGE PROGRAM | - CUSP [1993]

→ Started by ISRO, to develop cryogenic engines indigenously.
→ Initial launches were successful using USSR cryogenic engine — later started failing.
→ ISRO → Reverse Engineering and learned to develop cryogenic engines

2014 JAN ONWARDS

All the launches of GSLV are using indigenous cryogenic technology.

→ GSLV MK I (Russian)
→ GSLV MK II
→ GSLV MK III } Indigenous

GSLV - MK - II
⤷ CE 7·5 and CUS 12
⤷ Thrust is 75 KN and 12 tonne (cryogenic upper stage)

GSLV - MKB - III
⤷ CE 20 and CUS 25
⤷ Thrust 200 KN and 25 tonne (cus)

LAUNCH VEHICLE PROGRAMS

- **SOUNDING ROCKETS** → designed for studying upper atmosphere. [b/w 40-160 km]

  b/c meteorological baloons can go upto → (40 km)

  ~~sattett~~ satelites can come & → (160 km)

  → 2 STAGES → [Solid fuel]

  → India currently has **ROHINI SERIES** Sounding Rocket

  → launched from .Thumba Equitorial Rocket launch station [TERLS]. prefered b/c magnetic equator lies here.

  → Can also be launched from Balasore, Odisha and Satish Dhawan space centre. → Preference TERLS

- **SATRELLITE LAUNCH VEHICLE** (SLV)

  1969 - ISRO was created

  1994 - Nuclear Test conducted → [Need for missile.]

  1979-80 SLV-3 was started (purpose being development of IRBM)

  → **SLV-3** → [4 stages], all using solid fuel.

  → **ASLV** → **Augumented SLV**

  > **1983**
  > Integrated Guided Missile Development Program based on SLV-3

  → [5 stages], all using solid fuel.

  → Results not very encouraging.

  → **PSLV** → **Polar SLV** → most successful launch of ISRO

  → [4 stages] → SLSL (solid - liquid - solid - liquid)

  originally made for Polar regions but used for others as GSLV delayed.

  → 6 Boosters [for extra thrust]

  → Payload → 1600 kg

  → Revolves → N-S Pole

  → Liquid fuel engine → VIKAS

  > Record of carrying 104 satellites in single flight
  > → launch cost → low

  → **VARIENTS OF PSLV**

  ① **PSLV** → 4S + 6B, 1600 Payload

  ② **PSLV- CA** (core alone) → 4S + 0B, payload 1100 kg

  ③ **PSLVXL** (Extended length) → 4S + 6B (XL), payload 1800 kg. used for Chandrayaan 1, MOM, ASTROSAT and all 7 satellites of IRNSS

  ④ **PSLV HP** (High performance) → 4S + 6B, payload 2000 kg

⑤ PSLV-DL → 4S + 2B → was used for India's lightest telecom
   ↳ Satellite → KAMLASAT (2 month life)
   → 4th stage Remained attached to provide a platform.

⑥ PSLV 3S → Solid-Solid-Liquid, No Booster, Payload 500 kg.
   ↳ AKA SSLV (Small satellite launch vehicle)
   → ISRO will handover SSLV to a private consortium to manage
     their launches.

* more Vehicles in single flight.

Space Tech + Defence

ToT will enable DRDO to develop Next Generation Ballistic Missile.

MIRV → Multiple Independently Targetable Reentry Vehicle)
   ↳ can carry 3-10 Nuclear warheads → Capable of striking
     different locations. → guarantee SECOND STRIKE CAPABILITY.

→ GSLV - Geostationary SLV   Stages → Solid - Liquid - Cryogenic
   → 3S + 4B   [SLC]

① GSLV-MK 1 Russian Cryogenic Engine, Payload 2500 kg

② GSLV-MK2   3S + 4B, Payload 2500 kg
             (Cryogenic Engine indigenous → 7.5)
                          (Thrust → 75 KN)

③ GSLV-MK 3 AKA LVM3 (Launch Vehicle Mark 3) 3S + 4B
   CE 20 (Thrust 200 KN)
   Payload ┬ Remote sensing Sat. - 10 Tonne
           └ Communication Sat. - 4 Tonne.
   → will be used in Gaganyan; space Station.
   → already used in Chandrayan 2.

→ RLV → Reusable LV → Can come back from space.
   AKA - 2 stage to orbit
   → ToT for Gaganyan
   STAGE 1 SEMI CRYOGENIC ISROSENE → ISRO used Kerosene in place
                                      of LH₂ b/c LH₂ couldn't be
                                      handled.
   → will go upto a little height
     then detach and glide back like
     an aeroplane and lands over a temporary Air strip over
     Bay of Bengal.

==STAGE 2 CRYOGENIC== (comes down by balloon)

- Will push the satellite to orbit and then deorbit itself with help of balloon have a safe landing.

* ISRO planning to put together a | Re-Entry Technology |

St-1 and st-2 Engines can be put together and reused.

- | EXPERIMENTS PLANNED BY ISRO for RLV |

① HEX — Hyper Sonic Flight Experiment (5-8 mach)   { 1 mach = speed of   speed   sound }
② REX — Reusable   "   "
③ LEX — Landing   "   "
④ SPEX — Scramjet Propulsion Flight Experiment (Tested)

• | SCRAMJET | — ==Supersonic Combustible Ramjet==
→ ==Filters the oxygen and stores it.==

* ISRO has ==successfully== tested the prototype of RLV by ==using==
again | ROHINI Sounding Rocket. | → went up " , Autopilot RLV came back ①
tatti   but crashed in Bay of Bengal.
→ ② Experim -ment { → carried the prototype upto 70 Km height. (scramjet storing O_2)
↳ scramjet seperated and switched on for 6 seconds and acheived speed of 5 Mach.

ISRO Became 4th space Agency to test/develop Scramjet Engines after US, RUS (FR-ESA), IND

- | SIGNIFICANCE OF RLV |
→ will provide Re-entry ==technology== for Human space Flight. (Gaganyaan)
→ Payload - 20,000 Kg (20 Tonne) → help ISRO to provide commercial service in cost competetive Manner.
→ Cut down Cost by ≈90%.
→ Help avoiding creation of ==space Debris==
→ Will be used for Hyper sonic version of Brahmos.
→ Hyperplane program.
→ spacestation → China also
In future A country who control space will control every realm.

→ | SSLV | — | Small satellite Launch Vehicle | 3S (solid fuel) SSS
→ Payload 500 Kg   (PSLV- 3S (SSL) engine)
→ Vehicle on demand for industry   ↳ mind er   diff-b/w
→ Can carry multiple satellites   PSLV-3S
→ Can be alingned horizontally and vertically.   & SSLV

AVATAR — **Airborne/Aerobic Vehicle for Trans Atmospheric Research**
- Single stage vehicle AKA → single state to orbit
- Hyperplane → fusion of Rocket and Jet.
- Joint Initiative of DRDO and ISRO
- Acc to DRDO → 1 AVATAR Can do 100 flights

| Take off (speed 5-8 mach) | → | Push satellite in orbit | → | glide back like a Jet |
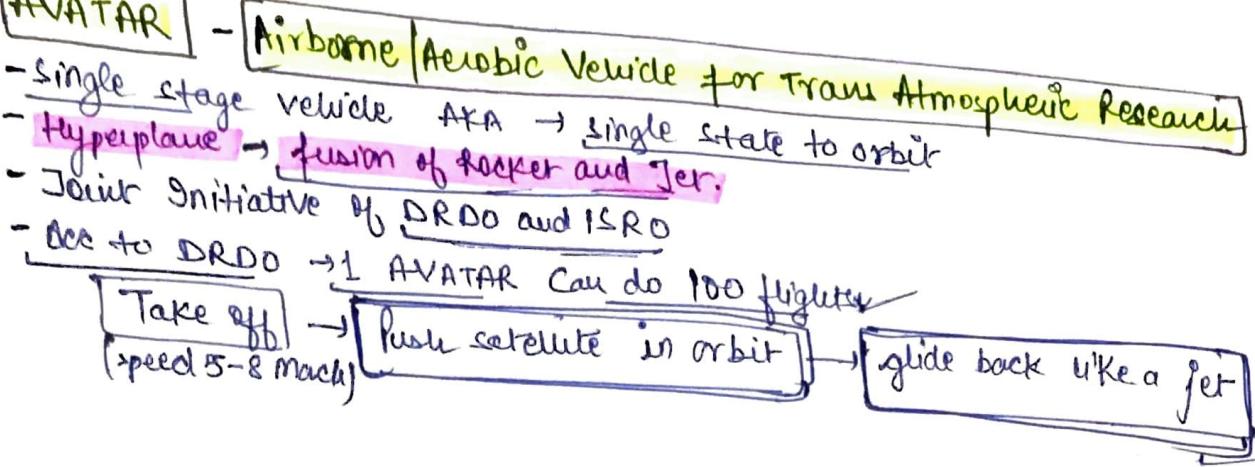
SATELLITE PROGRAM → ISRO pursuing 3 types of programs for commercial and military purposes

- Remote Sensing Satellite
- Telecommunication Satellite
- Navigation Satellite

→ **REMOTE SENSING SATELLITE**

→ Placed in polar orbit at a height of 600-900 Km, one revolution in 1½ hour. 16 Revolutions - 24 hours.

→ Can cover entire surface of earth b/c everytime pass through a diff. location b/c earth is also revolving. ∴ [Earth observation Satellite]
   rotating

→ Used for :- Cartography, Resource monitoring, weather prediction, Identification of agroclimatic zones, Intelligence gathering and military Ressonance.

*Note → space upto 160 Km is subject to national appropriation.
         " after " " is for Global Commons.
      Every satellite can pass over/above any nation, diff. being of image resolution.
      → when India carried surgical strikes, the data had come from satellite CARTOSAT-2

→ **TYPES OF REMOTE SENSING SATELLITES**

① Optical Remote Sensing Satellite
   → Rely on reflected sunlight.
   → Problem → works only during day time
   → further grouped into two :-
      * General Purpose → IRS, IRNSS
      * Dedicated → Oceansat, Resourcesat, Cartosat

for military purposes

55 color combinations → HYSIS (Hyper Spectral Imaging satellite) contrast best → b/c uses much more frequency than used by other satellites

② Microwave Satellite. AKA Active Remote sensing satellite
→ Do not require reflected sunlight → own mechanism for Radiation.
→ Capable of working in all weather conditions.

eg RISAT (Radar Imaging Satellite)

currently have {
 - RISAT 1
 - RISAT 2
 - RISAT 2B
 - RISAT 2 BRI
}

ISRO planning to have constellation of more satellites.
why → so we can observe Activity in border, sea, ocean mountain area.] Security, Defence

SAR → Like Eyes/Brain
Radio wave travels straight, Reflect back; or computer uses reflected wave and create Image.

Planning NISAR (NASA ISRO Synthetic Aperture Radar)

microwave satellites use SAR technology to generate high resolution images which are transmitted in real time.
 * Intelligence Gathering
 * Maritime Domain Awareness → Locate objects in Indian Ocean Region (Arabian sea etc)

→ TELECOMMUNICATION SATELLITES
 → Initially → INSAT, then → GSAT → Geostationary Satellite
→ GSAT → placed in geostationary earth orbit (Clarke's Orbit), at height of 36000 Km, time period 24 hours, moves in same direction as earth is moving.
→ Always above equator. why? (orbital and Equitorial → coplaner) so that this satellite can cover both hemispheres.
 * Geostationary? → Remains fixed above a particular place, as earth is moving, satellite is also moving (relative speed zero)
   ↓
   Stationary w.r.t. Earth.

• TRANSPONDER (Transmitter + Responder) most vital part of Telecom satellites.
 ↳ Classified on the basis of frequency used:-
   (a) S Band Transponder → 2-4 GHz
   (b) C " " → 4 - 6/7 GHz
   (c) Ku " " → 11·2 GHz (DTH services)
   { frequency is lost in bad weather.

 → Isro has also placed one more satellite (Telecom) called
   HTS (High Throughput Satellites)
   → Use multiple frequency beams to transmit data, ∴ Data Transmission capacity is very high (upto 100 GBPS)
   → ISRO has planned → 4HTS, → GISAT 11, 19, (20) 29
     Except G20 all 3 have been successfully placed in their orbit
     SAT

[NOTE]

SPACE DIPLOMACY → use of space capabilities to further the strategic interests.
→ using space tech. to influence other countries by providing services from space industry.

China has emerged as a pioneer in this field by launching satellites for Venezuela, Srilanka (India worried), Srilankan space academy.
Pakistan
India didn't bother.   (Asia Pacific Space Co-operation Organisation)

→ China has evolved well crafted space diplomacy to lure neighbours by using — soft-loans, executing the process by turn key process, govt. to govt. cooperation.

→ China wants to breach the curtain of policy of India in IOR.
    ↳ Breach the string
    ↳ BRI
    ↳ Space Diplomacy.

1998 SAARC - SATELLTE → concept was mooted but after Kargil was → not followed.

" India will launch satellites for all SAARC Nations, free of cost" But beneficiaries have ↓ to est. ground stations

2014 SAARC - SAT. PROJECT [India promised that it will launch telecom sat with 12 Transponders in Ku Band]
                            [one transponder reserved for each of the SAARC countries (for civilian purposes)]

* Some Hiccups
    ① SL → delayed consent process
    ② PAK → withdrew from project
        ↳ [PANAMA PAPER LEAK]
    ③ AF → Reluctant to join b/c taken European satellite on lease.
    ④ BD → Genuinely Agreed → plan to provide commercial services for Bhutan and Nepal → but now they have a free transponder.

2016 URI TERROR ATTACK → SURGICAL STRIKE
    → India gave up hope regarding future of SAARC (No SAARC summit since then)

∴ launch was delayed → MAY 2017 → GSAT 9 launched
        digital connectivity   (AKA South Asian satellite)
(coordination) hotline commun" → disaster management.

**SAG** → providing services to all immediate neighbours except Pakistan.

→ Plan is to engage these countries with us so that they dont look towards china ———→ In future may not be free.

→ Dedicated satellites should be launced for them

WAY FORWARD

- ① Commercialise GSLVMK3
- ② Greater Autonomy to **ANTRIX**
- ③ Private sector participation

→. NAVIGATION SATELLITE

→ Constellation of Satellites ~~works~~, placed in geosynchronous orbits and works on **triangulation principle** i.e, receiver must be in contact with atleast **3** satellites for **2D info**.

for 3D info → R in contact with 4 satellites.
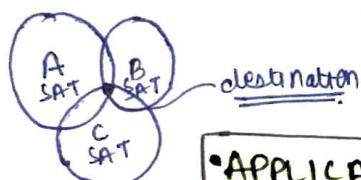
→ Information provided → on real time basis by calculating time lag.

A SAT, B SAT — destination, C SAT

•APPLICATION OF NAV. SAT.

→ Initially navigation system was only for military purpose.

→ Now they are used for:—
- ✳ Tele communication
- ✳ Metrological service
- ✳ Navigation
- ✳ Search and Rescue

•NAVIGATION SYSTEMS OF THE WORLD ARE—

① IRNSS | NAVIC → 7 satellites — INDIA

② GLONAS (Global Navigation Satellite System) → 21 satellites + 3 in standby
— RUSSIA

③ GPS → 24 satellites → USA

④ Galileo → 30 satellites → EUROPE

⑤ Quasi-Zenith → 4 satellites → JAPAN

⑥ COMPASS| BEIDOU → 35 satellites → CHINA

- INDIAN REGIONAL NAVIGATION SATELLITE SYSTEM [IRNSS] / NAVIGATION WITH INDIAN CONSTELLATION [NAVIC]

2006 → Official announcement was made in 2006.

2013 → launch of satellites started

2016 → last satellite was put in orbit

TOTAL SATELLITES → 7

* 3 Geostationary satellites → Height 36000 km, time period 24hrs, moves along equator in same direction of earth. Geostationary is a special case

* 4 Geosynchronus satellites → of geosynchrous, each forming figure of 8

Longitudinal expanse → 34° - 132° E (Indo pacific)
Lattitudinal expanse → 30°S - 50°N

(E. Africa)
34°

55° (Arabian) 83° (near meridian)

111° (B. a.s.)

Geostationary
geosynchronus
132°   50°N

Equator

Indo-Pacific, IRNSS   30°S
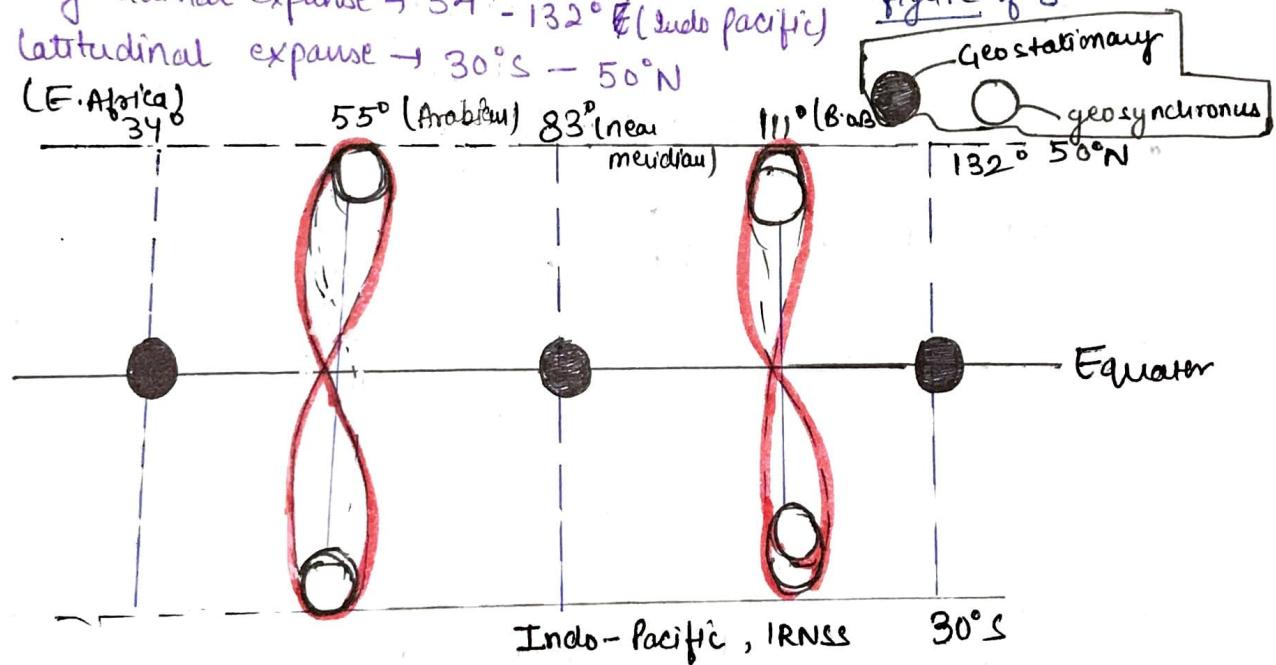
→ Over Indian landmass → Accuracy of services is 10 meter
→ In Adjoining area → 20 meter
→ In future can be increased to 5 meter

India wants to play the role of net security advisor that would be fulfilled by concept of Maritime Domain Awareness

* PURPOSE
  → Two types of purposes
    * General Purpose for civilian
    * Restricted services for military use.

⇒ It is only navigation system which is using 2 Bands i.e., L and S Bands (avoid disruptions during extreme weather acuts.

→ NAVIC provides imaging not only to on Indian sides but 1500 km to both sides.

→ Accuracy on the 83° Geostationary → 10m but on two sides one will be 20m → b/c we want lesser margin of error on Indian side land.

→ It is quite possible it could be transformed into a global system but for that no. of satellites to be increased, India and Japan have concluded the first ever SPACE DIALOGUE. Theme was to put in place a global navigation system so as to reduce dependence on China and USA.

SIGNIFICANCE OF IRNSS → Restricted purpose as well as General purpose.

① Border Management — for e.g. INDO-PAK BORDER we're working on comprehensive Border Mgmt system → CCTV, lasers, underground sensors, thermal imaging devices [info. collect]

{ bought through satellite ← or optical fibre cable at a centralised location. }

② Disaster Management

③ Search and Rescue

④ Enhancing presence of Indian Navy so that it can Emerge as blue water navy.

⑤ Space Diplomacy   ⑥ Navigation and guidance of Missile.   for [Brahmos]

⑦ [Act East Policy] South China Sea (132° longitude) [we have to keep track geostationary sat]
→ focal point of AEP → Freedom of Navigation in South China sea and [west pacific].   ⓟ   ⓢ   ⓢ

* China has territorial disputes with [Parcels, Spratleys and Scarborough islands] ⓟ ⓢ ⓢ in south china sea. Even if they all come together, they can't bear China as it has great military might. This has created a situation of safety vaccuum. (Nine-Dash-Line)

* P and S and s are looking for someone to fill this security vaccuum. For this India came up with 'Act East Policy'.
        e.g. Indi selling "Brahmos" to Vietnam.

⑧ Free open and secure Indo-Pacific. ——→ QUAD

EXPLORATION

→ LARGE HADRON COLLIDER (LHC)

→ **HADRON** → Term collectively used for Proton and Neutron.
→ Biggest experiment in fundamental Physics.
→ On the border of France and Switzerland
   * 27 km long tunnel, 100 m below the surface of the Earth.
→ In this tunnel → extremely powerful superconducting magnet and particle accelerators have been used.
→ LHC is world's largest and most powerful particle accelerator.
→ Two beams of proton released in opposite direction and gradually accelerated almost to the speed of light (99.99991% of light) and then they were crashed into each other ⟶ to recreate the conditions which existed 10^{-25} seconds after **BIG BANG**

• LHC IS LOOKING TO ANSWER FOLLOWING QUESTIONS

① How the origin of Mass took place?
② What is Dark Matter and Dark Energy?
③ Why don't we find Anti-matter in Universe? — when universe formed antimatter and matter were in equal proportion.

• Acc to science, universe came into existence after Big Bang explosion.
   → Big Bang Resulted in formation of matter → matter is formed of particles ⟶ Particles have mass ⟶ Hence ①
   To understand origin of Mass → Concept of HIGGS BOSON (God's particle) is used.

• Dark matter + Dark Energy = 95% of the universe. ②

• Anti-matter is formed of anti-particles. Anti-Particle have same mass as matter but opposite charge.
   → Electron⁻ – Positron⁺
   → proton⁺ – Anti-Proton⁻
→ Neutron — Anti-Neutron (neutron having opposite momentum)
   → Neutron has feeble magnetic field that is a vector quantity (qty with magnitude and direction)
   → Anti-neutron means → same mass but diff. direction

• LHC will provide the basis for completion of standard model of Physics (most successful theory of origin of the universe)

STANDARD MODEL OF PHYSICS (SMP)

→ Has tried to explain the composition of universe.
→ Has defined 12 fundamental Particles and 4 fundamental forces.

SMP

→ 12 FUNDAMENATAL PARTICLES

→ 4 FUNDAMENTAL FORCES
- Gravitational force
- Electro magnetic force
- weak ⎤→ Nuclear forces
- strong ⎦

Order of strength

$G < W < E < S$

QUARKS ⑥
✓ - up and down (most stable)
✓ - Charm and strange
✓ - Top and Bottom (least stable)

LEPTONS ⑥
- −ve lightest
  Electron (e⁻),
  muon (μ),
  τ (Tau)
  ⌣ heaviest
- Neutral
  Neutrinons
→ (Small neutral one)
→ (second most abundant particle in universe)

3 types ⌐ e⁻ neutrino
       ⌡ μ   "
         τ   "

→ Fundamental Particles

Baryon → 3 Quarks   Masons → one quark, one antiquark

• Quarks → Proton = 2 up + 1 down   ⟹ $2 \times \frac{2}{3} - \frac{1}{3} = \frac{4}{3} - \frac{1}{3} = \frac{3}{3} = 1$
for every Quark,   up charge = $+2/3$
there is an antiquark   down " = $-1/3$
to form
antiparticle → Neutron = 1 up + 2 down ⟹ $1 \times \frac{2}{3} - 2 \times \frac{1}{3} = \frac{2}{3} = \frac{2}{3} = 0$

• Leptons → Neutrinos → (after Photon) second most abundant are neutrinos → also
for each lepton   called ghost particles b/c they do not interact with
there is one   matter.
anti lepton   → Neutrions are emitted by sun, stars and anything which is
to form   having radio isotopes (including living organisms)
antiparticle   → formed due to radio active decay.

Change flavour while travelling
$e^{\nu} ⥋$ J. Kajita & A. Macdo
$τ μ$ (Nobel Prize Physic

→ INDIAN NEUTRINO OBSERVATORY
→ Theni Distt, Tamil Nadu will probably the be the biggest experimental
  setup. → But has faced opposition by locals.

Pre-fact → Neutrinos are chargeless, mass less than electrons (but very very less)
          Chargeless but not mass less. Some properties as dark matter

→ **Positive Implications of IND**

① **Cyber security** → Neutrino based on Quantum encryption technology will definitely address the cyber security concerns.

* ISRO has demonstrated Quantum key distribution, It is the most evolved form of cyber security security.
* Research will help in developing Quantum Encryption.

② **Inter planetary Communication** → Neutrinos can be used b/c they are neutral particles they will not be affected by magnetic f fields (as charged particles do).

* FERMI LAB in USA has already tested communication device called Neutrinophone.

③ X Ray of Earth (crust) → With the help of neutrinos.
  → Scan the crust of earth by using { resources hidden, nuclear sites }
  EARTH TOMOGRAPH

④ **Geoneutrinos** Acc to some hypothesis, at the time of seismic activity, Geoneutrinos are emitted → if they can be detected then it will be possible to predict earthquakes and Tsunami

⑤ **Nuclear Proliferation** → with the help of Neutrinos we can find out hidden nuclear technology facilities for weap weapon purpose.

⑥ **Global communication**

⑦ **Dark matter** → Neutrino share property of DM → if connection established we will be able to find out mystry of dark matter which will many Q. associated with origin of universe.

→ | OTHER PROJECTS RELATED TO NEUTRINO RESEARCH |

① **ICE cube Experiment** → Conducted in Antarctica, looking for sterile neutrinos → linked with dark matter

② **OPERA** → Gran Sessa, Italy

③ **DUNE** → Deep underground Neutrino experiment → USA

④ **JUNO** → Jiangmen Underground Neutrino experiment → China

⑤ Sadbury Neutrino Experiment → Canada

⑥ Super Kamio Konde / Hyper Kamio Konde → Japan

→ Fundmental forces

→ In order of strength   Gravitational (G), Weak (W), Electromagnetic (E),
 (weakest → strongest)   strong (S)

$$G < W < E < S$$
2013 (P.U)

→ To explain the origin of force, the concept of BOSON has been used.

BOSON → Named after Satyendra Nath Bose. He had drafted some rules to explain the behaviour of photon.
→ These rules are also followed by matter also, that form of matter which follows the rules of photons laid by Bose and later modified by Einstein are called Bose-Einstein condensate (fifth state of matter)

→ Boson particles are responsible for Origin of force.

→ for each force there is a different Boson

~~Gravity~~   GRAVITATION → for gravitational force
Whino & Zwino → for weak force
Photon → for Electromagnetic force
GLUON → for strong force

→ Except gravitation all have been detected till date.

→ Criticism of SMP
① Failed to even explain dark matter and Dark energy.
② It has not able to give the reason why antimatter is not found.
③ Not been able to give reason why gravitation has not been detected.

THEORY OF SUPER-SYMMETRY → LHC summ 2012 → Restarted to work on this theory.
→ for every particle there is super-partner Particle.

PARTICLES

Fermions super partner (B)	Bosons – super partner (F)
1. – e⁻, proton, neutrons	– Gravitation, Gluon, W&2, Photon
– Quarks, Antiquarks	Higgs Boson
– Lepton, Anti lepton	
2. Value of spin → fraction	integer
3. form universe by forming matter	sustain the universe
4. form → Fermionic condensate (6ᵗʰ state of matter)	form Bose Einstein condensate (5ᵗʰ state of matter)

(left margin, vertical text)
– Simplest super symmetry particle is changeless with some mass.
– Characteristic of Dark matter and neutrons

STRING THEORY | PHYSICS OF EVERYTHING

→ Universe is formed of matter
→ matter is made of particles [e⁻, p, n]
→ Particles are different manifestation of a string particle

No research on this theory is going on in any lab — b/c they can't produce required energy.

DARK MATTER AND DARK ENERGY → 95% of Universe
     25% of universe   70% of universe

• Dark Matter → Invisible b/c does not reflect light. Chargeless, not massless

→ Albert Einstein → "Empty space is not nothing."

→ Those regions which seem to be devoid of matter are actually having a form of invisible matter, this is known as Dark matter.

→ It can't be seen but exerts gravitational pull and is responsible for Gravitational lensing. → [General Theory of Relativity] Einstein (deals with force of gravity)

→ Gravitational lensing → is bending of light by the matter that seems to be vaccuum.

* Target areas to study Dark matter

1. MACHOs → (Massive Compact Halo Objects)
        e.g. Black hole, binary star, neutron star] Real)

2. WIMPs → (Weakly Interacting Massive particles)
        → Constituents of MACHOs] (Hypothetical)

→ To study WIMPs → China launched a mission
        DAMPE → Dark matter Particle Explorer

→ USA, → LUX → Large Underground Xenon
  Australia

→ Europe → EUCLID → Spacecraft of Europe to study dark matter.

• Dark Energy 70% of universe → responsible for expansion of universe.
→ Expansion → movement of galaxies away from each other.
→ For long time there was presumption that expansion of universe was started with big bang will gradually slow down and ultimately will stop.

→ But, In 1990s when data from space probes was stu. like hubble telescope, was studied, it was found that there expansion of is acceleration in the expansion of universe.

→ To explain this phenomenon, concept of Dark energy has been used.

Acceleration in expansion of universe → It is defined as the property of space which responsible for its expansion b/c of expansion there is extra space which further increases the quantity of dark energy and in turn the rate of expansion increases further.

Expansion → extra space → dark energy ↑ → more expansion.

→ Dark matter and Dark energy are antagonistic.

[Brings object close] < [takes objects away]

25%   70%

If dark energy would've been less than dark matter → everything would have crashed.

→ ∴ universe is surviving.

ANTI MATTER

→ when universe came into being, matter and anti-matter was in equal proportions but today anti matter is not found in nature.

→ formed by Anti-particles (same mass but opposite charge)

$e^- =$ Positron⁺ ; $p =$ Antiproton ; $n =$ anti-neutron.

→ Antimatter have th th theoretical and practical applications.

• Practical Application

⊛ Anti Hydrogen → synthesized by LHC → but failed to sustain
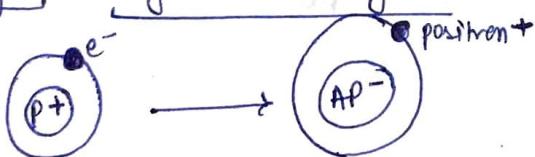
nuclei of
Anti - Helium → synthesized by Brook Haven lab, USA
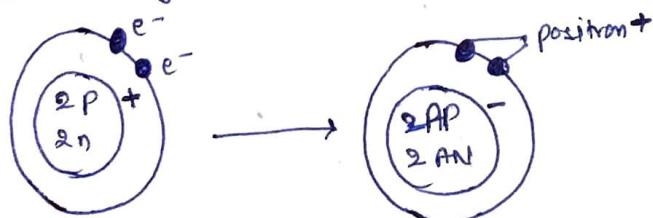
This is done b/c Researchers want to use anti-matter get as the fuel for [Interplanetary Mission] (manned space figur)

Matter	Anti-Matter
1 : 1	

→ Matter and antimatter will attract each other → as soon as they will come in contact with each other → they will annihilate each other and convert into energy by the equation of $E = mc^2$.

② PETSCAN → already used antimatter in medical imaging technique.

③ Tumour Tissue(Kill) → LHC performed an experiment called ACE (Anti-proton Cell Experiment). Took a test tube and placed a piece of tumour and antiparticle there, (anti proton) → Tumour was destroyed.

Tumour — AP

AP and Tumour → annihilated to form energy by $E = mc^2$ → it was enough to destroy tumour

• <mark>Theoretical Application</mark>

②⃝ unrevealing the mysteries of the universe

① PAMELA, NASA → Detected sheet of anti protons trapped in probe of earth's magnetic field.

② Positrons were found by AMS (Alpha Magnetic Spectrometer), it is a device on International space station.

\# HIGGS - BOSON (aka God's Particle) (Derived from God's Damn Particle)

→ Responsible for acquisition of mass by particles during formation of universe

→ origin of mass → Explain

→ Immediately after Big Bang, there was an energy field called Higg's field. → here some virtual particles were in state of flux.

→ Appearing and disappearing → started interacting and due to this [mass formed]. (higher the interaction higher the mass.

→ HIGGS BOSON → has been defined as the smallest possible excitation of Higgs field which led to the interaction of particles with environment.

→ At LHC → when 2 beams of protons were collided /smashed into each other, higgs boson came into existence for a fraction of a second and then disintegrated. After studying and calculating energy and disintegration pattern → discovery was given 6 Σ (sigma) rating. Higgs and Engler (2013) [nobel]

→ India → Raja Ramana Centre for Advanced technology (RRCAT) and Saha Institute of Nuclear Physics → Major role in hunt of Higgs Boson

GRAVITATIONAL WAVES & LIGO

→ Theory of relativity is the basis of GW, this theory established the space continuum.

→ GW are distortions/vibrations in space and time b/c of some cataclysmic event. e.g. supernova

→ They continually wash our universe

→ Produced by movement of neutron stars around each other, or
     "   "   collission of black holes or, Binary stars (event must be
     "   "   Pulsars (light emitting Binary stars).   big)

→ 1.3 Billion Light years ago → two black holes were moving around each other with half speed of light.

$$\left[\begin{array}{l} \text{one with mass} \to 36 \times \text{of sun} \\ \text{"} \quad \text{"} \quad \text{"} \to 29 \times \text{of sun} \end{array} \right]$$

→ These two collided with each other to form a new black hole which had mass 62× of sun

→ within second, energy equivalent to 3 solar masses were released which resulted in vibrations → detected by LIGO in Sep 2015.

→ As time goes by and distance increases → gravitation waves decrease in intensity ∴ not felt so much on earth.

→ SIGNIFICANCE OF GW

✱ GW are much weaker than Electromagnetic waves but GW are most reliable source of (understanding black hole) B/c EW are not allowed to escape from BH but GW are just waves (they wash the universe and aren't trapped in black hole).

✱ GW will make us understand that how was the universe created and will also explain state of universe during formation of GW.

elongation in direction of GW

compression in direction of GW

GW

BH collided

EARTH
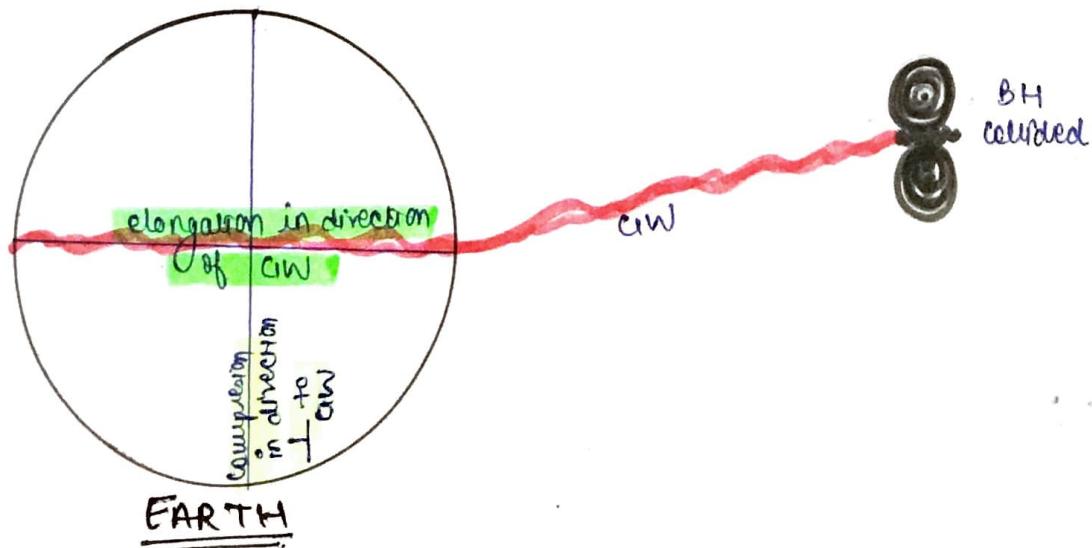
→ LASER INTERFEROMETER GW OBSERVATORY (LIGO)

→ **1970s** → Taylor and Hulls indirectly infered the GW when they were studying Pulsars.

2015 → Recent detection done with help of LIGO

→ Ligo is always 'L' shaped b/c ⊥ dirⁿ length elongates and same dirⁿ length compresses. Each **Arm having length of 4km**

→ Elongation and compression due to GW is denoted by LIGO machine.

→ at the end of each arm **mirror** are placed

→ " convergence of each arm **beam splitter** installed

→ Also a source of **laser** which was emitting them as per principle of

Destructive Interference

overlap — crest —— Trough
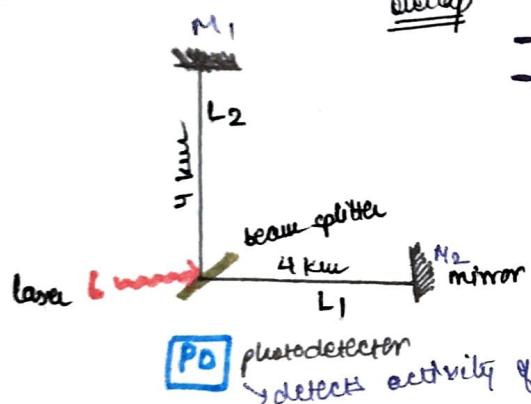
→ The arms are underground
→ Beam splitter divides laser towards
M₁ and M₂ → mirrors

L_1 and L_2 → lengths

T_1 and T_2 → Time taken

S → speed

D → Distance.

(Diagram: M₁, L₂, 4 km, beam splitter, laser, 4 km, L₁, M₂ mirror, PD photodetecter → detects activity of laser)

CASE 1 → **NO GW**
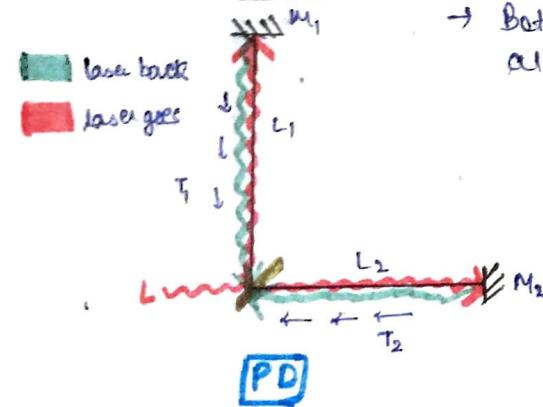
→ No change in length of laser arm
→ Both lasers come back at same time and meet at convergence point → destructive interference at Beam splitter.

$L_1 = L_2$
$T_1 = T_2$ → No activity at photo detector.
S = same for both
Distance = same "

(Diagram: M₁, L₁, T₁, L₂, M₂, T₂, PD; legend: laser back, laser goes)

CASE 2 → **GW**
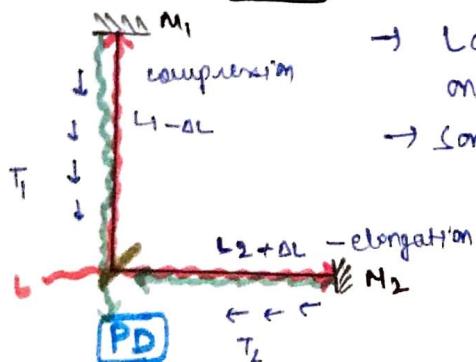
→ change in length L₂ elongated, L₁ is compressed
→ Laser beams come back at convergence point on diff. intervals
→ some able to escape → strike the Photo detector
↓
generates current
↓
GW detected.

$L_2 > L_1$
$T_2 > T_1$
speed → same

(Diagram: M₁, compression, $L_1 - \Delta L$, T₁, $L_2 + \Delta L$ — elongation, M₂, PD, T₂)

→ US → two LIGO ⟶ Hanford, near washington
                   Livingstone, Lubiana

→ INDIA → 1 LIGO → Hingole, MH → will be built by IND & USA

→ JAPAN → ~~XXXX~~ TAMA

→ GERMANY → GIO

[Dept. of Atomic Energy & Dept. of
  Sci. and Tech
         +
  National Sci. foundation (USA)]

INDIA

→ IUCAA, Pune (Inter University Centre for Astronomy & Astrophysics)
→ IPR, Ahemdabad (Institute of Plasma Research)
→ RRCAT, Indore (Raja Ramanna Centre for Advanced Technology)
→ A consortium was created with name [INDIGO] by Indian
  Researchers working on LIGO.
→ Here they used to present their research.
  ✦ Indigo Is the Indian initiative for gravitational observations.
→ Later it became a part of Gravitational wave International
  committee (GWIG)

Note:- 2017 Nobel Prize in Physics was awarded to Barry C. Barish,
   Kip S. Thorne, Reiner S. Weiss ⟶ for their work on LIGO

\# [LUNAR MISSION] ⟶ IND. → Chandrayaan 1, 2, 3
                   → USA → Artemis
                   → CHIN → Chang'e
                   → RUS → LUNA

⟹ [LUNAR MISSION OF INDIA]

→ [CHANDRAYAN - I]
  → Launched on Oct 2008 by PSLV-XL
  → Planned to be an orbiter and Impact Probe

  → was bought eventually in
    lunar orbit by way of
    'LOW ENERGY TRANSFER.'
  → Moon Impact probe of
    Chandrayan - I detached on south
    Pole and where it landed (S. Pole
    of moon) is called Jawaharsthal.
  → Chandrayan I carried 11 payloads;-
       5 of ISRO, 6 other (including NASA)

  → Biggest contribution is discovery of water (on moon) in the form
    of [Hydroxyl ion]. After that NASA discovered frozen water (L Cross)

Terminology
[Orbiter] → orbits a planet like satellite
[Lander] → lands on moon, remains immobile
[Rover] → Movable
[Flyby] → ⊙→ fly by
[Impact probe] →
  comes down from orbiter and lands with crash on surface.
  Orbiter ↓ get data from IP, do calculations and send to us
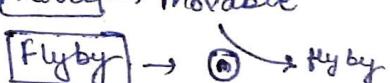
→ It was supposed to orbit for two years but we lost contact after 10 months (IRSO believed it crashed ; NASA - told it's _still there_)

→ But it had completed _95%_ of assigned task in 10 months.

→ **CHANDRAYAN - 2** → launched in 2019 from _Satish Dhawan Space Centre_.

→ It was an orbiter, lander, Rover → launched by GSLV MK III

→ Earlier, plan was that Russia will provide the lander and it will carry two Rovers, one each from India and Russia.

Orbiter - India
lander - Russia
Rover — 1 India, 1 Russia

2011 Lander of Russian mission _PHOBOS GRUNT_ failed.
Russia asked India to wait or Proceed at its own.

→ ISRO decided to do the mission independently; having only 1 rover.

orbiter - India
(vikram) lander - " } Became an indegerous project
(Pragyan) Rover - "

→ Like Chandrayan 1, it was also based on principle of low energy transfer.

→ Vikram and Pragyan were supposed to operate for 1 Lunar day (i.e. 14 days).

→ ISRO planned to land Vikram on south pole of moon b/c this is where _frozen water_ was detected by LCROSS of NASA and at poles there are (4 peaks of eternal light) i.e. _peaks_ of mountains receiving continuous sunlight.

NOTE (some points operated in detail)

MOON

SUN

Receive sunlight throughout the year

Craters where frozen water is found

Peaks of eternal light

b/c sunlight do not reach poles of moon b/c of
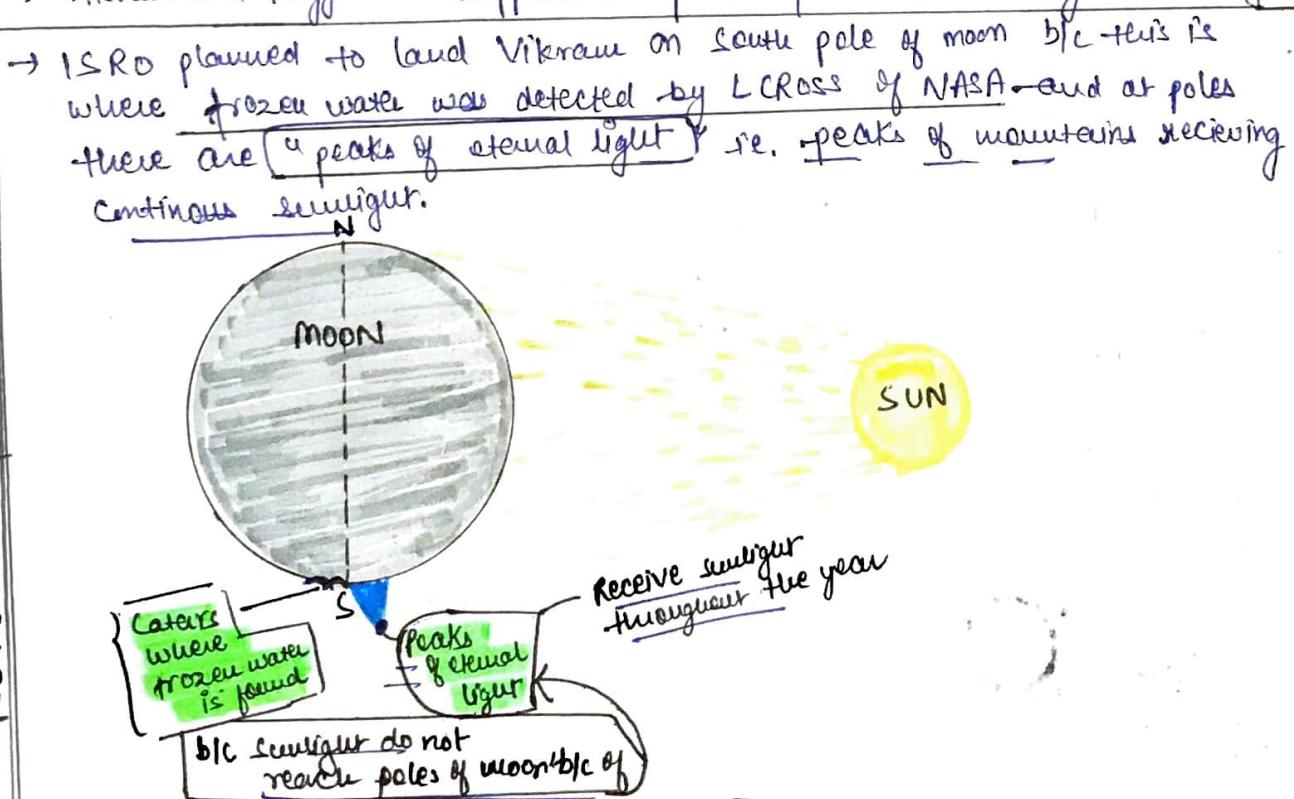
[Why has moon become so Important?]

→ B/c frozen water would become the source of Hydrogen as fuel.

→ 4 peaks of eternal light would allow putting of solar panels to produce electricity to function the instruments.

→ Various Countries planning to establish stations at south pole of moon.

→ Moon will become gas station for future interplanetary missions. (H) fuel.

→ Most critical part of this mission of landing of Vikram, it was supposed to have descent rate of 1 m/s.
→ To do so, boosters were fired in opposite direction.
→ Everything was going good till 2.1 km distance was left.
→ Before landing the lander has to rotate itself so as to position its cameras to find suitable spot for touch down.
→ At this point, for some reason the lander did a summersault (turned upside down) and suddenly boosters increased speed and instead of soft landing, it crashed. (Boosters + gravitation).
→ But main part of this mission was operator which is still functioning properly.
→ It has multiple instruments and some of them were improvised person version of probe carried by Chandrayaan 1.

→ SOME FACTS → LUNAR MISSIONS

→ LCROSS discovered frozen water on moon (NASA) ✓
→ China also planning a mission for lunar south pole (Chang'e) ✓
→ US announced Artemis mission 2024 → Gateway to the moon.
→ Also planning space station to orbit moon (USA)
→ Elon Musk of spaceX has his own mission and Blue origin Jeff Bezoz
→ Jeff Bezoz Russia planing lunar mission − LUNA
→ In future moon will become launchpad of interplanetry mission as gravity is less, fuel consumption will be lower and mission will be refuelled by using hydrogen produced will also from frozen water from poles.
→ Some critics have raised certain questions → all these are violation of the [1979 MOON TREATY] → which says that space moon is a global commons, where all countries have equal rights and it is not subject to national appropriation.
   → when all countries will have their station and missions it will not lead to creation of territories belonging to diff. countries where principle of non interference will be observed.
→ countries have violated this.
→ No dispute Resolution mechanism ←
→ "Pursuit of science becoming political"   [1967 Outer space treaty]
∴ Outer space Treaty and Moon treaty need   "space is province of
   ammendmeut to reflect the present reality.   man kind."

→ CHANDRAYAN - 3

→ announced by ISRO
→ will address the issues of Chandrayan II

LUNAR MISSION OF USA

→ **ARTEMIS** → Acceleration, Reconnection, Turbulence and electrodynamics of Moon's Interaction with the sun.

→ objective → to help establish new station of NASA on south pole of moon.
  → Demonstrate new technology and capability for need of future mars exploration.

→ Program is divided into 3 parts

- **ARTEMIS I** → uncrewed / unmanned space flight to test SLS and orion spacecraft.
- **ARTEMIS II** → First crewed flight test and targeted for 2023
- **ARTEMIS III** → land astronauts on moon's south pole in 2024

→ **SYSTEM DEVELOPED**

(a) **Exploration ground system** (structure on ground that are required to support the launch)

(b) **Space launch system [SLS]**
(c) **Orion spacecraft** (for lunar missions)
  → **Crew module**
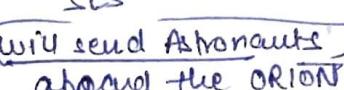
SLS → **will send Astronauts aboard the ORION**

(d) **Gateway** :- lunar outpost around the moon.
(e) **Lunar landers** — modern human landing system

(f) Astronauts going for Artemis program will send wear newly designed space suit, called —
  Exploration Extravehicular Mobility Unit
  [XEMU]
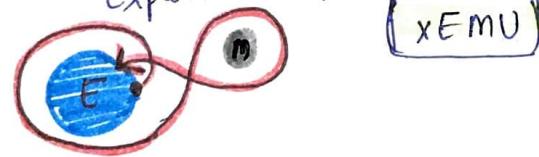
LUNAR MISSION OF CHINA

→ china has planned multiple missions to moon

→ **CHANG'E** → "Goddess of moon"

- **Chang'e 1 and 2** → Orbiters and moon Impact probe
- **Chang'e 3 and 4** → Orbiters and Rover
  → Name of Rover → **YUTU**   **YUTU-2** has become first man-made project to reach far side of moon.
- **Chang'e 5 and 6** → Sample Return mission
  → Chang'e 5 took samples from moon → collected them and came back)
  → was looking for Helium 3 a non radio active isotope found on moon.

→ to check composition of moon.
→ adjust age of lunar solar system

→ He -3 will be used in Nuclear Fusion.

e.g of → space mining, space Race. (Judia aims to space mining one day)

→ Change 5 → a multicomponent mission, there was a Lander, Rover, Ascent vehicle and orbiter and Earth Return module.

→ landed on surface of moon at a place called Mons-Rumker, collected sample of its crust, ascended to orbiter and sample brought to earth return module.

→ material that it bought back will help find inner composition of moon and human being will adjust the age of material found in inner solar system.

1970, Apollo of NASA and Luna of Russia also had bought samples (3-4 Bn yrs old)

CHANG'E 7 & 8 → will be done to establish station on south pole of moon.

⇒ LUNAR MISSION OF RUSSIA

LUNA

GAGANYAN & INDIA'S SPACE STATION

→ By 2030 → India, planning to carryout its human space flight.

→ will make India, 4th Nation to have manned mission.

→ There will be 3 members in crew, placed in space (low Earth orbit) for 7 days.   ↳ 325 km height.

→ Crew members will be called 'VYOMNAUTS'

→ To conduct this we need following:—   →[originally designed for satellites]

→ ROCKET → GSLVMK-3 will be used, but before actual flight it must accomplish 10 successful launches

→ RE-ENTRY TECHNOLOGY → most challenging task in any human space mission
   → Most vital requirement.
   → India has done 3 experiments for this.
   → All were successful

① 2007 → SRE1 (SPACE CAPSULE RECOVERY)1
   → capsule was placed in an orbit at 600 km and from there it was instructed to return.
   → splashed into Bay of Bengal after Return.

② 2014 → CARE (CREW MODULE ATMOSPHERIC RE-ENTRY EXPERIMENT)
   → GSLVMK 3, with a passive cryogenic engine carried the capsule (designed by HAL), at 126 km the capsule detached and returned following a parabolic path.

③ 2016 → RLV - PROTOTYPE
   → ROHINI sounding rocket → placed on RLV prototype
   → At 70 km -detached and came back

→ CREW ESCAPE SYSTEM → or PAD Abort Test.
   → Emergency measure for evacuating the crew members to save them.
   → All those who attempted manned space mission have experienced technological glitches.

→ HUMAN RATING OF CREW MODULE → GSLVMK3 was originally designed for satellites → recalibrated for manned space missions.
   → Capsules tested without human beings.
   → [Vyom-mitra] → Half Humanoid Robot was fixed developed by ISRO → sensors on Robot that will give us information.

→ ENVIRONMENT CONTROL LIFE SUPPORT SYSTEM (ECLSS) → maintain temp., oxygen, remove CO_2, Control humidity, block radiations.

→ **ASTRONAUT TRAINING**

→ from 100 fighter pilots of IAF, 4 will be chosen. Will be made to undergo training at Airforce Institute, Bangalore ; France; Russia.

→ 3 will be selected for Gaganyan.

⇒ **IMPLICATIONS OF GAGANYAN**   [Russia - planning → Orbital for Jupiter]

① Beginning of manned **interplanetary missions** like moon, mars etc.

② India's own **space station** (probably by 2024 work will start) space station will be put in low earth orbit.
- International space station is; size of a football field
- Members have spent 7.5 lakh crore
- China reduced the size of TIANGONG to that of a Bus

→ for space station; launch vehicle required have to be more powerful, otherwise the cost will increase further.

→ In future space station will turn out to be strategic asset; ~~anymore~~ anyone controlling the space will control air, land and water.

③ Gaganyan and space station will have the **relevance for space-mining** — to bring the energy resources from outer space.

④ Generate employment → Push to Domestic Industry   **challenges**
- Re-entry module
⑤ Increase India's Prestige ; International collaboration   - Life supporting environment control.
⑥ Research and development

→

MARS MISSION

→ **WHY MARS?** → Geographical features like Earth.
  → 3-4 Bn years ago → Mars was warm and wet b/c of thick atmosphere. → Maintained water in liq. form → shifted to cold & dusty.
  → Atmosphere became thin → became cold dry & dusty.
  → Mass → temperature moderate.
  → Mercury and Venus → temp around 400°C → human life won't sustain.
 → Mars is last terrestial planet.

→ **WHAT ARE THE CHALLENGES?**
① Round trip will take 18 months → long journey → more fuel needed, more food
② ⌇⌇⌇⌇⌇⌇⌇⌇ we'll have to developed temperature controlled crew module.
③ **Cost Factor** → 250 Bn - 1 Trillion USD
  That's why SPACEX has to come up with "Starship", it will bring out the cost by 95-99%.
      But how? → Elon Musk - "we will not carry anything from Earth"
          (→mission → lighter, cost ↓)

MARS MISSIONS (INDIA & WORLD)

| MOM | | MAVEN | | CURIOSITY | | INSIGHT | | PERSEVERANCE |

ISRO

UAE **HOPE**   **CHINA**   **EXOMARS** EU

NASA
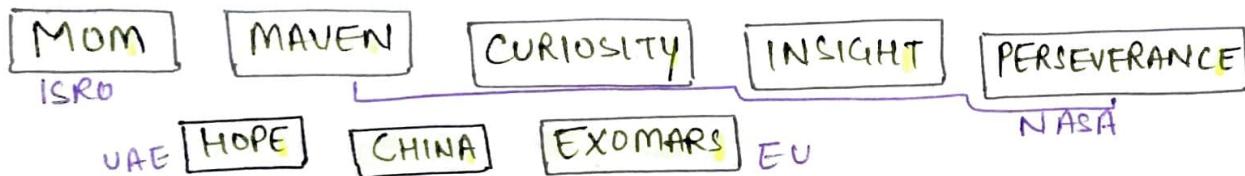
→ **MARS ORBITER MISSION** — ISRO

→ Launched by PSLV on 5ᵗʰ Nov. 2013 → put in geocentric orbit; Reached mars on 24ᵗʰ Sep. 2014.
→ We used Low Energy Transfer → proper configuration of Earth, Sun & Mars that comes in 26 months once. — need —
→ MOM → finished in 3 phases.

First Phase → Geocentric when the orbiter completed multiple revolution and each time and height of orbit was raised by using the Boosters.

Second Phase → It was bought into sun centric orbit.

Third Phase → Into martian orbit
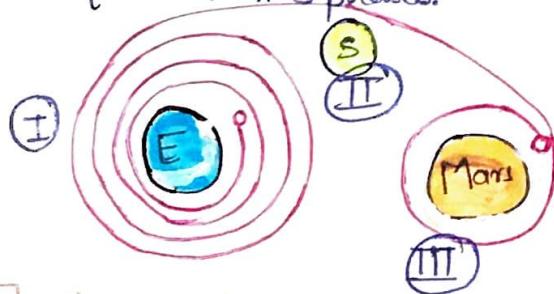
India → 1ˢᵗ to reach Mars in first Attempt
→ 1ˢᵗ to reach Mars from India

→ we spent 450 crore on this mission → most economical

≠ We had lost contact during last phase.

→ ISRO → AI in mom → Electronic Brain or Autonomy
orbiter ISRO used to send messages 10 days in advance
so that the orbiter can deal with critical situation

[24/sep/2014]

Orbiter went to far side of Mars → contact lost — electronic brain reoriented the orbiter so that contact can be re-established.

In future autonomy can be used in enuour satellite — such satellites will focus immediately if there is any sudden movement and development

→ ISRO has also defined MOM as Technology Demostrator.

• Criticism → MOM couldn't help in resolving scientific problems/Questions related to Mars

Arguement ⟶ •X parameter
⟶ • ISRO Never claimed to do this
• " " said - Test Demonstration
• " " " - Deep space Commucation → Contingency management

→ Carrying 5 payloads → 15 kg, it consists
① Mars color camera
② Methane Sensors - identify the spots from where the methane is getting released.
③ MENCA - Mars Exosphere Neutral composition Analyser
④ LAP (lyman Alpha Photometer); will measure the relative abundance of the hydrogen isotopes in the atmosphere of mars
⑤ Thermal Infrared Imaging Spectroscopy - for the chemical analysis of the top soil.

⇒ MAVEN - NASA (Mars Atmospheric Volatile Evolution) -NASA

→ comparing to MOM → it is heavier and complex
→ looking to study Erosion of the outer part of martian atmosphere.

⇒ ROVERS OF NASA   ① Mars Pathfinder
② Spirit; Opportunity; Curiosity
③ Curiosity -AKA Mars Science Library
(Astro biology Mission/ Exobiology Mission)
- Nuclear powered rover which reached the planet in 2012
- Purpose is to collect the evidence which supports the presence of Microbial life. —no evidence yet
- Also study composition of Mars that will be helpful when next rover will be sent by NASA.

④ • PERSEVERENCE → also Astro Biology/Exo Biology (30 July 2020)
• Nuclear powered Rover
→ 4th Generation Rovers of NASA
→ 1st was MARS Pathfinder
→ 2nd " Spirit, Opportunity; → 3rd Curiosity

→ Perseverence will - look for microbial life

- Convert CO_2 to O_2 to see if life can be sustained there.

2024 - collect samples (42 Test tube)

↳ [will collect sample from different places from MARS], separate ↑

[Earth Return module will bring samples to Earth] ← [ascent vehicle will carry them to orbiter] ← [bring samples to lander] ← [then fetch Rover will be launched]
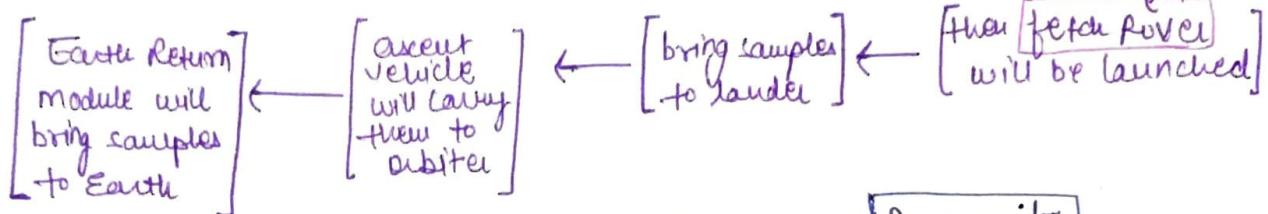
- It also has a helicopter called [Ingenuity]

→ [Payloads on Perseverence] ✓

(a) [SHERLOC] - collect samples for life
- has a camera WATSON will identify samples that have to be collected by sherloc

(b) [MEDA] - for weather

(c) [RIMFAX] subsurface RADAR.

(d) [Ingenuity] Helicopter

(e) [MOXIE] - collect CO_2 ⟶ convert to O_2

(f) [Supercam]

(g) [Mastcam-Z]

⟹ [INSIGHT]

→ lander of NASA

→ Insight will study inner composition and seismic activities on Mars (Marsquakes)

→ Insight will study the geology of the planet and how the evolution of planets took place.

→ [will prepare a 3D map] → will help in future space mining

⟹ [EXOMARS]

→ Joint venture of Russia and ESA → [launched in Jan 2016] (low energy transfer)

→ It has two parts :-

① [TRACE GAS ORBITER] → [Trace gases] (<1%) → mars → [Methane] which is continuously destroyed by UV rays despite that its concentration remains same that means that there are some sources which could be biological or geological.

purpose of this instrument to to identify that sources that's why exomars is an Astrobiology Exobiology mission

② Lander → called schiaparelli (Entry Descent Demonstration Module)
↳Landing failed ↳it crashed.

TIANWEN - 1 - CHINA
Question the Heaven
↳ 3rd to land on Mars

① US
② Russia

→ It is an orbiter, lander and Rover
→ Tianwen will • search for water
• study soil characteristics
• study Atmosphere

(23 | July | 2020)

→ 2012 chinese mission failed.
→ Hope, Perseverence, Tianwen were launched in July 2020 (same window)
b/c Earth and Mars closer;

⇒ HOPE - AKA → AL AMAL → UAE + NASA

→ Md. Bin Rashid Space Centre, UAE + University of California, Berkley
University of Arizona
University of Colarado-Boulder.

→ It is an
Orbiter launched from Tanegashima space Centre of Japan by using
H-ⅡA Rocket.

→ It is a true weather satellite. (First)
→ Hope will study the atmosphere related dynamics of Mars
• How a warm and wet planet became cold and Dusty?
• How Mars lost thickness of atmosphere?
• How H₂ and O₂ escape from Mars?

→ It will develop a complete portrait of the martian weather.
→ will collaborate its lower and upper atmosphere by carrying out the
studies.
→ will also study how hydrogen and oxygen escape from the atmosphere;

NOT AN ASTRBIOLOGYMISSION

SPACE POLLUTION | KESSLER SYNDROME

→ NASA portrayed **Big Sky Theory** → Debris produced from launch vehicles and satellites will gradually disperse in outer space but [1978] → **Donald J Kessler**

Debris → moving @ a speed of 2500 km/h
→ strike each other → Domino Effect

Research paper
"Collision frequency of Artificial satellites & the formation of Debris Belt"

→ [Arguement] → was [with the use of expandable vehicle] → no. of debris will increase and there will be a **domino effect** (the collision of these pieces that will further increase their no. and after a certain stage they will start affecting the space based systems

Known as [SPACE POLLUTION] / [Kessler Syndrome]

→ At present NASA is monitoring thousands of pieces (19000); size >10cm.

→ If range is from 1cm - 10cm → [no. crosses half a million.]

→ [India kept orbit to lower side so that debris won't reach orbit of space.]

→ Incidents which have contributed to space Debris:-
① China tested Antisatellite missile (2007) — targeted own remote sensing satellite (so that intelligence data cannot be taken by someone else)
② Non-functional satellite of USSR collided with USA satellite
   ↳ shredded into pieces.

→ International space station
   ↳ having tough time to avoid the collision; it has to continously change its path.

• Radars and telescopes are used to monitor these Debris.
• Around 90% of Debris → low earth orbit & remaining in geostationary earth orbit

→ **WAY OUT**:- ① Use Reusable Launch vehicles
                ② Monitor the pieces

→ **DARPA** → (Defence Advance Research Program Agency) —USA
   → planning to create an electromagnetic net and collect the debris
→ **Japan** planned a satellite to collect debris — [FAILED] (—FAILED)
→ **India** launched a program to track this debris.
   [NETRA] → by ISRO and IIA (Indian Institute of Astrophysics)
      → It is basically for **Space Situational Awareness** (means tracking the objects in space)
      → This project includes optical Telescope, Radars and Data processing centre.
→ **Britain** trying to changing the orbit of their satellite to avoid the collision.

ASTROSAT

→ It is India's space observatory.
→ Uses multiple wavelengths.
→ Observes neutron stars and black holes.
→ Along with Chandra X-Ray it has defined Blackholes.

GISAT (Geo-Imaging Satellite)

→ First ever Earth Observation satellite, to be placed in Geostationary orbit, all others have been placed in geo lower orbits or polar orbits.
→ will be launched by GSLV-F10.

IDRSS (Indian Data Relay Satellite System)

→ we will place satellites in geostationary earth orbit to observe low earth orbit.

→ First beneficiary will be the crew members of Gaganyaan ↳

BLACK HOLES

→ Structure that are produced at the end of the life of a star after supernova explosion.
→ supernova explosion create dense mass called → [Blackholes.]
→ Types of Blackholes ⟨ steller Blackholes (lighter)
⟨ super massive " (heavier)

ADITYA-L1

→ India's solar observatory
→ (L) stands for [Lagrangian point]
→ what is Langrangian point? → in earth-sun system, where gravitational pull becomes equal, there are 5 such points.
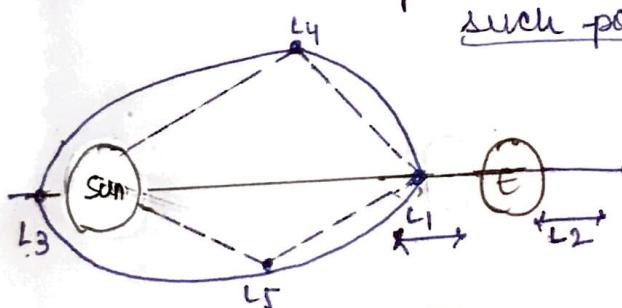
→ L1, L2 and L3 are highly unstable ; L4, L5 → stable → parking lots
→ orbits around langrangian points are called Halo orbits.
→ Advantage of putting Aditya at Halo point L1 is that it can observe all parts of sun at once.

$$\boxed{\text{MODULE - 5}\\ \text{DEFENCE}}$$

- Missiles → Ballistic
  - cruise
  - Anti-ballistic Missile system → THAAD
    - BMD of INDIA
    - S-400
    - Mission Sh
    - ASAT

- INDO-US DEFENCE CORP.

- DEFENCE ORGANISATION → MTCR, Au
  Hague Code

- DPP, FDI in Defence,

- Biological and Chemical weapon

- Latest developments.

MISSILES

→ BALLISTIC MISSILES → based on rocket technology.
  → They follow parabola to maximise range
  they're launched at angle of 45°.

exo
45° endo

→ Long range Ballistic missiles are known as reentry vehicles b/c they complete their journey in endoatmosphere and exoatmosphere.

→ 3 phases of Ballistic Missile three
  → Take off → midcourse → terminal phase.

→ surface to Air i.e., AKASH & S400, medium Range S2AM & LRS2AM
  • currently → china deployed S-400 at LAC.

→ Air to Air → ASTRA → beyond visual range A2A missile and AMRA2A (USA)

→ On basis of range → Short Range Ballistic missile (SRBM) → upto 799 km
  → MRBM → 800 km - 2499 km
  → Intermediate RBM → 2500-5400 km

→ Intercontinental RBM → > 5500 km e.g. Agni 5

→ MIRV → Multiple Independently Targatable entry vehicle

- they carry 3-10 ~~para~~ nuclear warheads.
  - ∴ Discussed in PSLV → multiple missiles.

→ **CRUISE MISSILE**

→ Based on Jet technology
→ Travel only in Endoatmosphere, trajectory is parallel to earth surface.
→ Difficult to detect them with help of ground based RADAR, they require Airborne RADAR.
→ Classification of cruise missiles is done on the basis of speed.

① **Subsonic** → speed less than speed of sound. e.g → **NIRBHAY** — **.7 Mach**
② **Supersonic** → 3x speed of sound
③ **Hypersonic** → 5-8x speed of sound

NIRBHAY — .7 Mach
range 1100-1300 km
nuclear capable
fire and forget

(a) Target of Nirbhay in Range
(b) Knows the position

Brahmos 2
→ Ind-Rus will jointly develop

Objective is to have cold stout military Doctrine

Not a Stealth missile
Invisible to radar

But difficult to intercept b/c it follows tree top trajectory

→ height where RADARs find it difficult to track missile.

- Sudden attack on enemy.
- Priority of attack are headquarters, info, communication of enemy.
- should be launched in shortest possible time → Nirbhay → can be fired ~~of~~ within 4 mins

Brahmos → unparalleled missile in the world.
→ Speed 2.8 Mach ; stealth missile ; fire & forget → GLONASS
→ Range → Earlier → 290 km, Now 600 km b/c of membership of MTCR in 2016.
  ↳ If two countries are its members 300 km restriction don't apply.
→ Only missile capable of forming 'S' shape in air → to avoid RADAR
→ Capable coming down vertically
  ∴ Brahmos will always be one option for India for carrying out pre-emptive strike.
→ India is looking to sell Brahmos to Vietnam.
→ RAMJET Technology.

ANTI BALLISTIC MISSILE SYSTEM → fully automated.

→ Can target anything which is airborne → Aircraft, Ballistic missile, UAV, satellites.

→ ① Tracking System Radar or Navigation satellite
② Battle Management system → calculates the details of incoming missile
③ missile firing Missile unit launches intercept.

| (AWACs) → Airborne Radar → Scan sky |
| detected a missile |
| Long Range Radar |
| locks on missile |
| Bms → calculate details of missile |
| launched |
| MFU Intercepters |
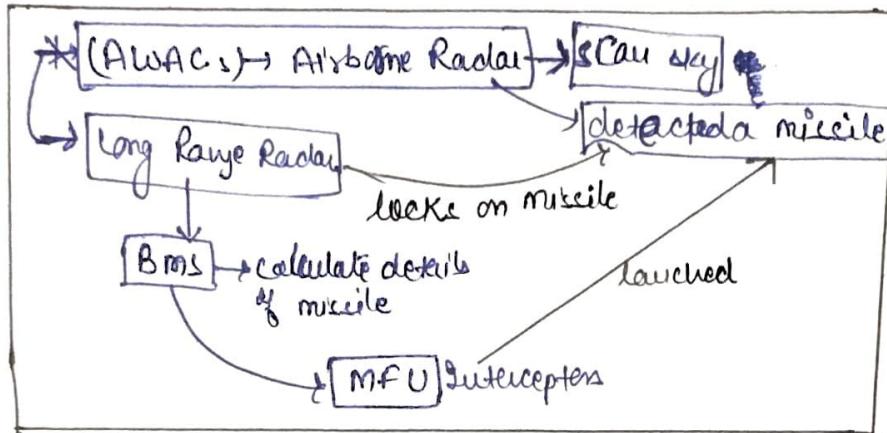
only four countries have this technology
- US, Russia, China, India

NATIONAL MISSILE DEFENCE OF USA

[1960s] Cuban Missile Crisis → USSR deployed Ballistic Missiles in Cuba, later they withdrew.

[1972] ANTI BALLISTIC MISSILE TREATY
→ USA and USSR
→ Neither USA nor USSR will deploy Anti Ballistic Missile system in vicinity of each other.

[1980] → USA developed laser based intercepter system called SDI (Strategic Defence Initiative).

[1991] → USSR collapsed. USA was only super power
→ First Gulf war → IRAQ V. world.
→ Patriot intercepter of USA was successfully in targeting the SCUD cruise missile.

→ Pentagon started working on ABM.

[1999] → Towards the end of Tenure of Bill Clinton a proposal was made to put in place a global anti ballistic missile shield but he left the decision on next incumbent.

[2002] → USA (Bush) announced to withdraw from 1972 treaty.
→ Since then all the President of USA have pursued this program
→ AUS, JAPAN, S. Korea, ALL NATO members UAE, saudi Polonal, Greenland have allowed installation of NMD of USA.

→ In the take off and terminal phase the interceptor are to be fired from naval platforms and to strengthen the terminal component a new incepter was introduced with the name of THAAD.

→ In the wake of N. Korea threat, this interceptor has been deployed in South Korea.

→ Russia and China are highly uncomfortable with this program,

For China → concerns are b/c of Xinjiang, South China Sea, Taiwan, Hong Kong b/c American Presence will increase separalist tendency.

For Russia → American influence in region which is described by Russian Policy makers as near abroad. Russian President want to all these countries into an arrangement resembling the former USSR.

→ **INDIA** → Neither supported nor opposed this program.
→ If in future USA is looking to push this initiative in India's vicinity then probably Indian Response would be same as that of Russia & China.

shot by ... **[2018 Pre]**

THAAD → American Interceptor
↳ Terminal High Altitude Area Defence
↳ Not a very good anti aircraft missile
∴ we're buying S-400

Take off — NAVY — MCP — NAVY
MCP
Ground Based Interceptor.
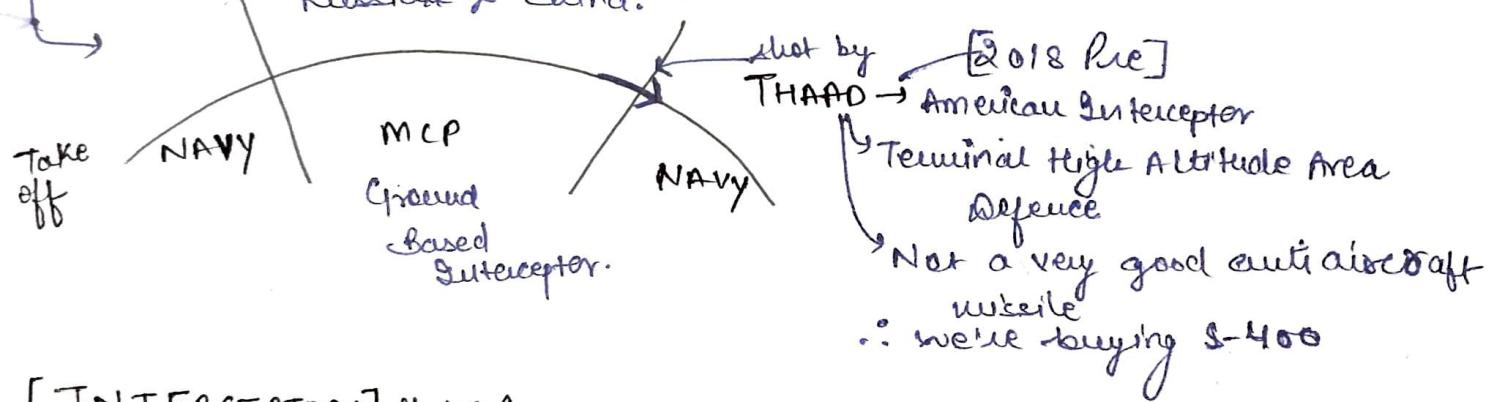
[INTERCEPTOR] of USA
↳ Patriot
↳ Arrow (Israel)
↳ Aegis

BALLISTIC MISSILE DEFENCE

1998 → DRDO founded BMD
2006 → PADE → Prithvi Air Defence Exercise
↓
→ when Prithvi missile was successfully intercepted.
IRNSS

→ Two stages in Indian program.
endoAtmospheric
Stage ① → Two Interceptors → Advance Air Defence or ASHWIN
RANGE → 15 km.

→ Pradyuman Air Defence i.e. Prithvi AD range - 50-80km.
↳ exoatmospheric in Nature

STAGE ② DRDO is working on two interceptors AD1 & AD2 capable
of reaching height of 150km.
→ Tracking system used is Sword Fish Radar which a
modified version of Greenpine radar from Israel.

* looking to replace Pradyuman Air Defence with
Pradyuman Defence Vehicle.

S-400

→ Also known as Triumf and NATO has given it a name SA21 Growler.
→ Probably the best interceptor in the world capable of striking best fighter
planes.
→ Purpose → To strengthen its air defence system.
→ In future pre-emptive strike like Balakot has to be carried out then
it could be either through Air force or through Brahmos (cruise).
→ Possible [retaliation] from other side will be through [aircraft] and to stop
those aircrafts, interceptors like S-400 will be crucial.
→ India has AKASH air defence system but its range is 25km and
there are some other issues also.
→ There is an initiative with Israel to develop surface to air missile but
again one of them will have range of just 17km and one more issue is the
no. of squadrons with IAF is also inadequate.
→ To address these concerns, the decision was taken to procure S400 which is
manually operated mobile operator.
→ It has [long range tracking radars] capable of locating multiple objects
simultaneously at a distance of >1000km.
→ Object is then to passed on to the [command vehicle] → which then
analysis the specific object and then best place [launcher] on multiple
launchers are instructed to fire the [Interceptor missiles] simultaneously.
→ The engagement radars then guides the interceptor toward the
target.
→ It is an atmospheric interceptor with making range of 30 km vertical
but it can engage dozens of objects of object simultaneously.
→ The deal is of 40 thousand crore and Russian vendor has been exempted
from offset requirement

MISSION SHAKTI

2007 China tested Anti Satellite missile.
→ " targeted its own non functional remote sensing satellite

2008 India created INTEGRATED SPACE CELL in under, headquarters of Integrated Defence staff.
→ Its mandate was to ensure safety of Indian satellites and to provided help to defence forces.

2010 SPACE SECURITY CO-ORDINATION GROUP was created under NSA, it was also having IAF, DRDO, NTRO [National Technical Research org].
* **NTRO** → Top most is top most technical spying agency of India with mandate to monitor the testing of the missiles and the launch of satellites in the neighbourhood.

Later It was decided instead of testing Antisat missile, Agni 5 or AD1/AD2 could be used for targeting satellite.

2018 → Micro-sat -R (optical satellite) was launched for DRDO. and

March 2019 → This satellite which was in orbit at 275 km was successfully targeting targetted.
→ India became 4th country to successfully shoot down a satellite in the orbit.

Facts
→ ASAT → new application of ABMS
→ ASAT can strike a satellite even beyond 1000 km.
→ India has acquired space deterrence.
→ This will ensure that others will be careful in dealing with our space based system.
→ China, USA, Russia have almost given up ASAT rather they have shifted to High Energy weapons or Direct Energy weapon where a laser can be used to destroy electronic component of a satellite
→ They are working on orbital manoeuvering (increasing height) of the satellite).

further Delepoment →

→ **Developments After Mission 'Shakti'**
→ Defence space Research Agency was set up, which will work in co-ordination with triservice and its job will be to provide weaponary for the space warfare
→ Defence Space agency was to be established in Bengaluru under an officer of the ranks of Air Vice Marshall.
* It will be supported by DSRA → responsibility of fighting the space war.

→ In future it will evolve into a space command which has been defined as 4th domain of warfare.
→ After setting up of DSA the next logical step was to carry out space warfare exercise how a war in the space will be fought. — SpacEX.

INDO-US DEFENCE DEAL

⇒ **FOUNDATIONAL AGREEMENT**
→ Term has been used by USA to improve military corporation b/w INDIA and USA.
→ It included the following :-
  → **GSOMIA (General Security of Military Information Agreement) - 2001**
    • India and USA will share military information.
    • Information passed shared by India can be shared by US govt. with its pvt sector but India can't.
  → **LEMOA (Logistics Exchange Memorandum of Association)** logistics support
    • Signed in Nov. 2016. Earlier known as LSA agreement.
    • Purpose is to bring co-ordination b/w the armed forces of two countries.
    • If an American warship is passed by India and it requires refuel or repairing services then India might consider their request to provide such supp services.
    • In case India need such service then US has to reciprocate. No provision for blanket support.
    • Services can be provided in case to case basis.
    • Agreement is not about military alliance.
    • There is no provision of military basis neither sending the troops for the US led military operations.

- **Positive** → Improve coordination, better outcome of military exercise, better coordination at the time of HADR operations.
- **Negative** → It will have an impact on Indo-Russia Relations & somewhere it might affect the traditional strategic autonomy of foreign policy.

→ **COMCASA** (Communication Compatibility Security Agreement)

- Earlier name was CISMOA
- As per COMSAC Law of USA (communication security law), if a country is interested in obtaining the last, safest, comm" devices which are available only to US armed forces at its allies then it has to sign COMCASA.
- In absence of sign, country has to settle for second grade costly commercial communication devices with lesser security mechanisms.
- COMCASA not signed → USA decided to with held vital communication devices for :—

    - C-17 Globe Master Aircraft
    - C-130 super Hercules
    - P8i submarine hunter
    - Chinook helicopters
    - AMRAAM

- US was insisting that in order to have communication devices for the above mentioned items, India has to sign COMCASA and it has to accept two conditions:—

    1. END USER MONITORING AGREEMENT WILL APPLY.
    2. ONLY AMERICAN TECHNICIAN WILL COME AND INSTALL THESE DEVICES.

    → these conditions were not accepted by India.

SEP 2014 Agreement was signed → It will facilitate Real time intelligence sharing b/w fighter planes of both countries.
→ It will allow Indian Navy the access of wide Area network est by American Navy through web and mail.

> **CENTRIX**
> Combined Enterprise Info.
> Exchange System

→ LEMOA + COMCASA → will be of great help in acheiving desired outcome of ACT EAST Policy, ensuring free and open Indo Pacific _and somewhere might contribute in the evolution of Asia-Africa growth of corridor planned by India and Japan.

→ BECA (Basic Exchange Co-operation Agreement), 2020

- Provide us geospatial Intelligence.
- India will be having access to information collected by American navigation system.
- Satellite Images
- Access to topographical data.
- Help in navigating the missiles and targeting.
- " " " natural disaster mitigation.

⇒ DTTI / CARTER INITIATIVE

→ Make In India, Atmanirbhar Bharat, FDI in defence (points to link with).

→ India and US signed Military Agreement for 10 years.

| 1995-2005 | , | 2005-15 | , | 2015-25 |

→ we procure 80% of defence equipment < high cost (100 Bn USD)
dependency.

→ New dimension of last agreement was DTTI which has provided a framework for [joint ventures b/w Indian and American companies] for the co-production and codevelopment of defence items.

→ It will result in Technology Transfer

→ will reduce dependence on defence imports.

→

* PROJECTS UNDER DTTI

① C130 J Super Hercules
② UAV - RAVEN
③ Hybrid Power System
④ Protective clothing to for Indian troops

→ B/c of lack of leadership push and bureaucratic apathy, things have not moved in the desired direction, ∴ there is an urgent need of DTTI2.0.

⇒ STA1 (Strategic Trade Authorisation 1)

→ India is one of the 3 countries in Asia to get this status after Japan, S. Korea and overall 37th. Even without being member of NSG (India).

→ Prior to India, USA gave this status only to those countries who have the membership of all 4 multilateral Export control Regime ie. NSG, MTCR, Australia Group, wassenar Arrangement.

→ USA gave India this status to convey a message to China and those countries which were blocking India's entry into NSG.

→ This status implies that now while importing defence items from USA we don't have to obtain licences. ∴ ToT will be easy. for us Defence export will ↑.

RAFALE (MMRCA - Medium multi Role Combat Aircraft)

→ Mirage - 2000 → Production has been stopped by Dasault (French Company)

2004 → Govt of India Issued → Expression of Interest
→ need 126 (Light Combat Aircraft)

→ Manmohan Singh Because PM → Changed expression of Interest to MMRCA
— sweden

2007 → Grypen, Sukhoi-35, F16, Eurofighter typhoon, Boeing, Rafale
                                                    USA   1.9 Mach

Offered India to be part &
manufacturing AESA Radar → Eye in sky
center   220° View
too bull → won't be available → come on later
                                          date.

• Joint Venture of Spain, Brit, Ger, Italy
• speed 2.2 mach

[better Aircraft in term of engine & speed.]

→ India First to place order
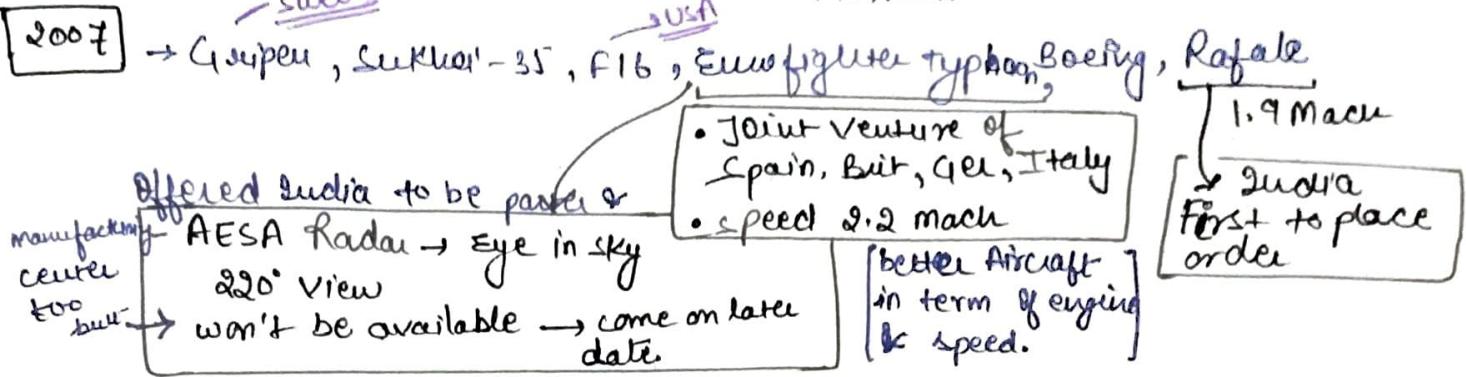
2012 India decided 126 Rafale
Imp. Condition → 50% offset → Amount paid for Rafale, 50% to be invested in India for defence.

→ 18 Rafale supposed to deliver within 36 months (ready to fly)
→ 108 Rafale → TOT clause
                    → HAL → manufacture 108 Rafales

2016 •Dassault → 95% Deal was done.

→ Deal cancelled by company. → Mirage will also be upgraded (new deal)
→ India decided to buy 36 Rafale from French Govt.   ↓
              Escrow account required to be   Controversial
              open b/w govts for transactions.

current
        → 7.8 Bn USD → 36 Aircrafts   [Extra payment
(Prev.   [8.2 Bn USD → 126 Aircraft   for upgradation and
 deal)   with technology transfer   weapon installation &
           to HAL   services]

MULTILATERAL EXPORT CONTROL REGIME

⇒ MTCR (Missile Technology Control Regime)
→ Created in 1987
→ India became 35th member in 2016.
→ MTCR deals with import and export of space and defence technology.
⁂ When India started signing the nuclear deals one of the requirement was to synchronize its space and defence import-export policies with list of and guidelines of MTCR.

| 2008 | Process of synchronization started.
| 2012 | " " " completed.

→ Charter of MTCR clearly states that there is no guarantee of TOT rather it has two list of prohibited items.

[List 1] → Rocket, subsystem of Rocket, cruise missiles of range > 300km and payload 500kg, UAV, Super Computers, Any item which can be used in manufacturing above items.

[List 2] → Propellent

→ China not a member b/c they can't share these with sKorea if they are MTCR member. China doesn't want MTCR.

→ [Benefit of MTCR]
• To strengthen the claim for membership of NSG.
• To strengthen the credentials of India as a country never indulged in any proliferation (preventing proliferation) to countries like Pakistan.
• We can block TOT from member to countries like Pakistan.
• India will be part of decision making
• India can add anything it doesn't want to be shared in prohibited list.
• India and Russia took decision to increase range of Brahmos to 600km.
• Membership will help in space program as well a

⇒ [AUSTRALIA GROUP]
→ India became 43rd Member
→ Deals with Biological and chemical weapon → Member Cannot Transfer
→ Includes 54 chemical compounds (banned)
→ To be a member, a country should be a signatory of chemical weapon convention and Biological and toxicological weapon convention.

→ SIGNIFICANCE

→ Strengthen our claim for membership of NSG.
→   "   " credential of being a country who produce Biological / does not
Chemical weapons.
→ Strengthen our credentials as a country not indulged in proliferation

⇒ WASSENAAR ARRANGEMENT

→ India 42nd member of this arrangement
→ Came into force in 1996.
→ During Cold war USA and allies created COCOM (Co-ordination committee on Multilateral Exop Exports), to prevent the transfer of weapon tech. to those close to USSR.
→ After cold war there was a need for an arrangement for terror control.
→ Purpose → to promote peace and stability at International level by having transparency in transfer of weapons and dual use ~~common~~ ~~access~~ to a nonmember.
    → to prevent transfer of above items to the terror organisations

→ CONTROLLED LIST 1 → Does not "prohibit"

   • Conventional Arms
   • Dual use goods and technology.
→ Can transfer to non-members but must inform other members ~~In~~ within 6 months.

→ CONTROLLED LIST 2

   • Dual Use Goods and technology
                    /   \
              Sensitive   General
           Member → Non   Member → Non member
                Member
   • Inform member within   • Inform members within
        60 days   6 months.
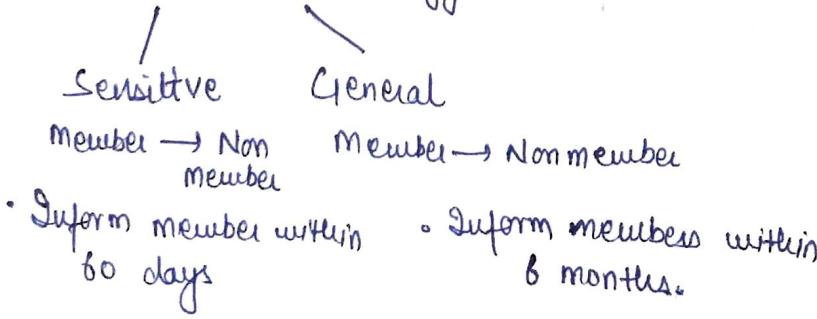
→ As far benefits are considered → It will allow access to some technology like radar, laser, inscription, surveillance.

→ India will allow India to buy conventional arm and it will strengthen the non-proliferation image of the country which will help in membership of NSG.

⟶ HAGUE CODE OF CONDUCT, 2002

→ India got membership in 2016
→ China, Iran, Pak, Israel → Not member.
→ Deals with Ballistic missiles and satellite launch vehicles
→ Does not include cruise missiles/UAVs.
→ If a member wants to test them then they have to inform, they have to submit their annual program in advance, for the test of Ballistic missile and launch of satellite launch vehicles.

FDI IN DEFENCE & DEFENCE PROCUREMENT POLICY

⟹ FDI In Defence
→ Acc. to one group, FDI shouldn't be allowed in defence b/c that company might stop production when it is required the most but supporters of FDI in defence argue that anyway we are importing 80% of our defence requirement. If that company heard us they will stop production
→ Then they continue that defence manufacturing nowadays is based on concept of global factory chain where the manufacturing activities are distributed in many countries. If they stop production their chain will also be affected.

| 2001 | Pvt. sector was allowed in defence sector. |

| 2002 | 26% FDI in defence was allowed. |

| 2004 | While responding to the Question (what will happen to defence PSUs?) |
→ Defence minister said there has been no FDI in defence
→ Reasons were some conditions imposed :—
   ⊛ Govt will decide what will you make, how much, to whom it will be sold and there is no guarantee that they will buy.
   ⊛ last clause kept investors away.

| 2004-2014 | Higher FDI in defence will be decided on case to case basis. |

| 2014 | Budget limit was increased to 49% (Automatic Route) later to 100%. But in case of modern technology only.

→ Significance
• Make In India
• Modernisation
• TOT
• Diversification

→ Negative
• Domestic companies will be wiped out.

→ Difference in Defence Sector and other Sectors

① Defence is a greenfield project i.e., project start from scratch.
② Investment is very high
③ Gestation period is long
④ Competition is high
⑤ Sensitive Nature (govt will have final says)
⑥ Follows the concept of global factory chain.

⟹ DEFENCE PROCUREMENT POLICY, 2016
→ Set of rules laid down by the govt for purchace of defence items.

→ Draft DPP 2020   [MAKE CATEGORY] → govt will finance 90% of total
                    cost of prototype → 10% by vendor.

* Indigenisation.

* Offset Clause → If there is defence procurement worth more than
                 2000 crore then atleast 30% has to be invested
link   back by having joint venture with an Indian
* DTTI}   Company, the offset has to be chosen by foreign
                 Vendor and then it needs to be communicated
                 to the govt.
                 → In case of Rafael the offset requirement is
                 50% from beggining of this process.

CATAGORIES

* INDIAN - IDDM (Indegenously Designed Developed & Manufactured)
    • If a defence product is designed in India, manufactured
      in India with at least 50% indigenous content then
      it will be classified as IDDM, at the time of procurement
      these products will be given priority.

* BUY INDIAN
    • If a defence product is designed abroad and manufac-
      -tured in India and indigenous content is 50%.

* DESIGNED ABROAD
    • Indigenous content should be 60% to be classified
      IDDM

* BUY GLOBAL
    • Buy from abroad e.g S-400, Rafale.

→ DPP talks about [*strategic partnership] with private sector.
→ Govt will join hands with ~~an~~ ~~Indian~~ company for :-
  private

  - Aircrafts
  - Helicoptors
  - Submarines
  - Tanks / Armoured vehicle
  - missiles
  - Communication devices, strategic material.

* [LEASE]