

NEXT IAS

GRADED ASSESSMENT TEST 2025

(To be filled by candidate)

TEST CODE : M25GAT03

TEST NO. : 03

Name of Candidate: SHUBHAM SINGH

Roll No.: Start Time End Time

Date of Examination: 06.07.25 Mobile No.

Q. No.	Maximum Marks	Marks Obtained
1	10	
2	10	
3	10	
4	10	
5	10	
Total Marks : 50		

Q. No.	Maximum Marks	Marks Obtained
6	15	
7	15	
8	15	
9	15	
10	15	
Total Marks : 75		

GRAND TOTAL -/ 125

EVAL CODE: GRADED DATE:

GENERAL INSTRUCTIONS

1. Immediately on receipt of the QCA booklet, please check that this QCA booklet does not have any misprint or torn or missing pages or items, etc. If so, get it replaced by a fresh QCA booklet.
2. Candidates must mention all relevant details like Name, Email, Roll No, Mobile, etc. in the space allocated.
3. Candidate is expected to attempt all 10 questions within the given timeline.
4. Answers must be written in the medium authorized at the time of admission.
5. Candidates must write answers for the specific question under the respective question itself. Any answer written outside the space allotted may not be given credit.
6. Please write neatly. Avoid illegible writing.
7. Do not write/mark irrelevant matters in the QCAB.
8. Only those copies that are submitted on the date of exam till 5 pm will be graded.

REMARKS:
.....
.....

MARKING SCHEME *

Marks Per Ques	Below Average	Average	Above Average
10 Marks	Below 2.50	3.00 - 3.50	4.00 and above
15 Marks	Below 4.00	4.00 - 5.50	6.00 and above

* Subject to change without prior notice.

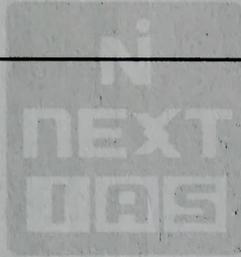
MACRO COMMENTS

The Purpose of evaluation@nextias.com is to provide constructive suggestions on 'How to improve Answer Writing and thereby score better marks.'

STRENGTHS OF THE CANDIDATE

AREAS OF IMPROVEMENT

IMPROVEMENT SUGGESTIONS



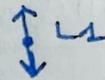
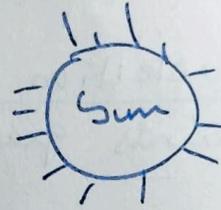
1. Aditya-L1 marks a significant milestone in India's space programme. Discuss its scientific objectives and the broader significance of the mission for India.

(Answer in 150 words) 10 marks

Aditya-L1 is a scientific mission of ISRO to expand its understanding of Sun and its structural composition.

Scientific Objectives

1. Placement of instruments at L1 orbit between Earth & Sun
2. Chromospheric study of sun's outer atmosphere
3. Studying coronal mass ejections & its correlation with dark spots on solar surface
4. Phenomenon of Solar cycle & its impact on solar winds, solar flares
5. To explore why Sun's photosphere is hotter than its surface
6. L1 orbit around Sun allows constant observation of Sun
7. Keeping an object around in a fixed orbit using boosters



Broader Significance

1. Space weather prediction based upon

Candidates must not
write on this margin

Intro :

Body :

Conc. :

Total :

Solar cycle, Solar flares

- ② Precise scheduling of Sat. launches based on space weather.
- ③ Early warning system for protection of Satellites from solar winds / flares
- ④ Protection of Earth's atmosphere as solar winds gradually eat away the atmosphere
- ⑤ Nuclear fusion energy may be utilized for energy security if understood well.
- ⑥ Global leadership - with knowledge & having with the world
- ⑦ Facilitate deep space exploration such as Shukrayaan mission, Mangalyaan-2
- ⑧ Complements NASA's Star Solar Parker Probe
- ⑨ Advancements in electro-optic sensors
- ⑩ Advanced thermal protection, radiation protection systems to be useful in space stations, Reusable launch vehicles

Understanding of space will determine future economic, technological and global influence.

2. What is the Internet of Things (IoT)? Discuss its transformative potential for India's information infrastructure and evaluate its role in enhancing agricultural productivity.
(Answer in 150 words) 10 marks

Internet of Things means • huge no. of sensors, devices connected through internet,
• actively interacting with each other.

Transformative Potential

Information Infrastructure

- ① Foundation for smart homes, smart buildings, smart urbanization
- ② IoT enables 5G, 6G n/w through enabling micro-cells, virtual towers
- ③ Immersive communication through 3D AR/VR
- ④ Dynamic spectrum allocation based upon feedbacks from IoT
- ⑤ IoT applies AI/ML in information infra for edge computing, cloud computing etc.
- ⑥ Tp Brain using IoT to allow virtual PC, virtual TV on almost any device

Candidates must not
write on this margin

Intro :

Body :

Conc. :

Total :

Evaluating role in Agri productivity

Positive

1. Precision farming using accurate flow of water, fertigation, timing of sowing etc.
2. Sensor based monitoring × automated advisories to farmers based on soil health, plant health, weather forecast
3. IOT can enable precise environmental control for smart warehousing for agri produce
4. Tracing of agri-produce along the supply chain from farm to fork
5. IOT can record data on field, farmers, produce for data-based credit models

Limitations of IOT

1. Quality ultimately would depend upon quality of seeds & other inputs
2. Benefit only on the margins
3. Capital intensive for small & marginal farmers
4. Lack of capacity among farmers

Project Farm Vibes of Microsoft in Baramati, Maharashtra has shown how if farmers are trained well, IOT can boost yield, reduce cost, and create sustainable agriculture.

3. Reusable launch vehicles (RLVs) present both technological promise and challenges. Discuss the hurdles in developing RLVs and outline India's progress in this field.
(Answer in 150 words) 10 marks

Reusable launch vehicles are recovered, post launch of satellites, to be used in subsequent launches. Example is Falcon 9 of SpaceX.

Technological Promise

1. Lower cost per launch
2. Advanced thermal protection system has spillover in defence, reactor designs etc.
3. opens avenues for space tourism, human spaceflight
4. Quick turnaround time for launches
5. Reduction of space debris
6. Dual-use applications for hypersonic glide missiles

Challenges & hurdles

- ① Thermal insulation during re-entry into the atmosphere
- ② Precise landing & recovery
- ③ Speed control during descent
- ④ Designing alloys, composites, which can withstand very high temp.
- ⑤ Precise ~~aerodynamic~~ shaping of ~~new~~ new alloys for aerodynamic efficiency.

Candidates must not
write on this margin

Intro :

Body :

Conc. :

Total :

- ⑥ Electronics, sensors need to function effectively at such high temperature & speed
- ⑦ Communication linkage with ground station through the launch & descent
- ⑧ Dual-use applications threaten proliferation means

India's progress

- ① Design ready for fixed wing reusable launch vehicle
- ② ~~Reusable Launch Vehicle~~ Reusable Launch Vehicle Technology Demonstrator has been successfully tested
- ③ ~~Human rated~~ Human rated semi-cryogenic engine for the vehicles has also been tested
- ④ Parachute based recovery mechanism has been readied

Rs 1000 cr Space VC fund
fund, In Space, must be leverage to ropeline
private sector, academia into R&D efforts
for space programme.

4. What is Digital Public Infrastructure (DPI)? Examine how DPI can accelerate India's development and evaluate the initiatives taken to build a digital stack for the agriculture sector. (Answer in 150 words) 10 marks

Digital Public Infrastructure is a shared, publicly funded, open source, digital platform, bringing several stakeholders together over a single platform for easier transactions.

DPI - Accelerating India's development

- ① **Finance**
 - **Digital payments** through UPI has brought down txn cost, reduced need for cash.
 - **Credit** through Unified Lending Interface (ULI) for digital info. collation & data based credit assessment.
- ② **Education** → National Digital Education Architecture (NDEAR) through facilitating MOOCs, teacher training DIKSHA platform, Apaar IDs for students for lifelong learning monitoring.
- ③ **Health** : Ayushman Digital Bharat Health Mission bringing together clinical establishments, pharmacies, professionals & EHRs of patients for telemedicine, portable insurance, reduced out of pocket expenditure.
- ④ **E-commerce** : ONDC has sought to reduce monopoly on any single platform by seamless integration of buyers, seller, & logistics service providers.

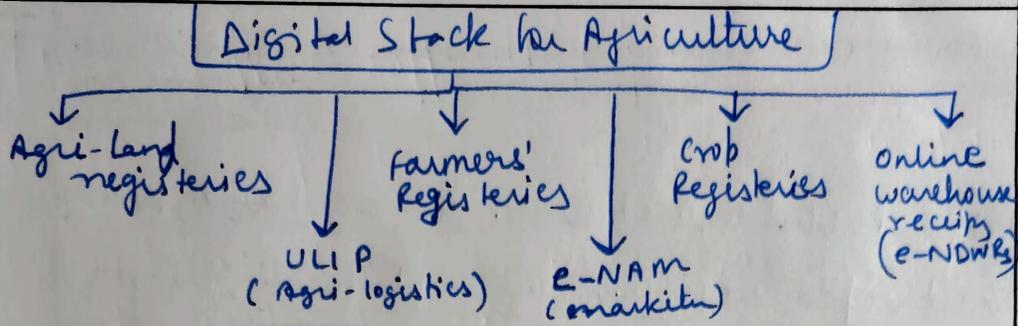
Candidates must not write on this margin

Intro :

Body :

Conc. :

Total :



Positive Impact

- ① Quick crop yield assessment → release of MSP
- ② Better targeting of farmers depending upon crops, fields → compensation under PM Fasal Bima Yojana
- ③ Recognition for land tenants ⇒ credit availability, insurance coverage → Price estimation
- ④ e-warehouse receipt based finance/credit to prevent distress sale & price slumps
- ⑤ End-to-end monitoring of agri produce from farmer gate to park → quality assurance, expert potential, block chain application

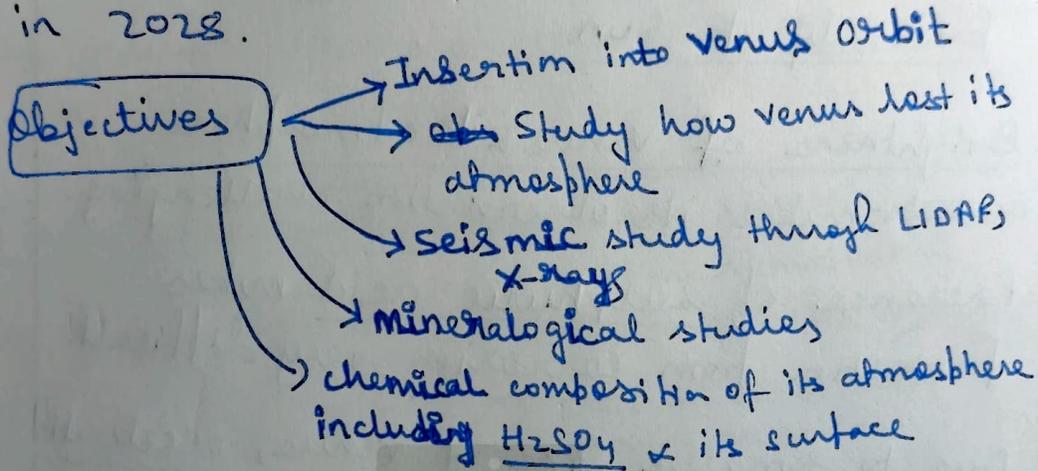
Limitations

- ① Constraint of storage facilities limits its full utilization
- ② Digital illiteracy among farmers
- ③ Limited access to marketing facilities
- ④ limited / inadequate agri-extension
- ⑤ Neglects livestock & other allied sector

DPI can be progressively implemented in other sectors such as energy (India Energy Stack by Nandan Nilekani led task force).

5. India's proposed mission to Venus poses multiple challenges. Discuss the scientific and technological difficulties associated with exploring Venus. (Answer in 150 words) 10 marks

Shukrayaan mission (Venus ~~orbit~~ orbiter mission) of Isro is scheduled to be launched in 2028.



~~Scientific & Tech~~

Scientific Difficulties

- ① Interaction of solar winds with a planet's atmosphere
- ② Source of sulphur into venetian atmosphere
- ③ How volcanic eruptions take place without plate tectonics
- ④ How Venus maintains its atmosphere without its own magnetic geo-magnetism
- ⑤ why Venus revolve around the Sun in opposite direction w.r.t. rest of the solar system.

Candidates must not
write on this margin

Technological Difficulties

- ① Thermal protection from high solar insolation
- ② Protection from solar radiation due to proximity to sun
- ③ Brightness of Venus & its atmosphere ~~not~~ makes its observation challenging
- ④ Presence of sulphuric acid makes protection from corrosion very difficult
- ⑤ Due to smaller size of Venus, acceleration around its orbit is higher (centripetal Force) \Rightarrow challenges of speed control, high speed observations
- ⑥ Data relay from Venus to Earth
- ⑦ Heavier payload launch vehicle with cryogenic -C tech to carry heavier instruments for observations

Intro :
Body :
Conc. :
Total :

6. Operation Sindoor highlighted the decisive role of technology in modern warfare. In this context, examine the technological advancements that contributed to its operational success.
(Answer in 250 words) 15 marks

Operation Sindoor demonstrated the significance of growing informatization of battlefield and use of precision strikes as response to grey zone warfare.

Tech. advancements which led to success

- ① Use of drones for
 - Real time surveillance
 - target acquisition (eg) Zeeb's Eagle
 - precision strikes using loitering munitions (eg) Sky Striker, Nagasha
- ② Growing importance of standoff weapons due to long range of precision strike capabilities
 - eg) Scalp on Rafale aircraft offer ~400km range with precision
- ③ Advancements in propulsion technologies for beyond visual range air to air attacks
 - eg) Astra MkI BVR ~100km
- ④ Advanced radars × real time fusion with weapons enabled multi-layered air defence
 - eg) Anti missile guns, Akash, MRSAM, S-400 worked seamlessly together
- ⑤ Electronic warfare deploying jamming, spoofing of electronic components, GPS denial etc.
 - eg) India deployed Samyukta EW against Pakistani drones

6. Anti-radiation tech enabled suppression of enemy's air fields & air defences
Key → Rustom-I, SAAW by DRDO
7. Real time battlefield situational awareness using integrated intelligence from Satellites, AEWACS, drones, SIGINT etc.
8. Cyber aggression against cyber attacks from Pakistan linked hackers

However, apart from tech, following other factors also helped in success:

- ① Political will & clarity
- ② Diplomacy to build international support
- ③ Non-kinetic actions such as abeyance of Indus Water Treaty, suspension of trade
- ④ Human intelligence from the ground
- ⑤ Civil-military coordination along border areas

Operation has also highlighted following gaps to be filled in technology for future:

1. Advanced Electronic Warfare suite for fighter aircrafts

Candidates must not write on this margin

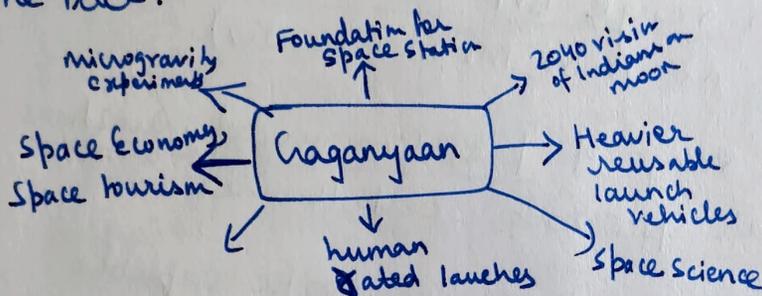
Intro :
Body :
Conc. :
Total :

2. more no. of AEWACs, tankers for force multipliers
3. Expediting Phase-3 of Space Based Surveillance program for real time situational awareness -ness
4. longer range BVR air to air missiles such as Astra MK-III (Chandiv)
5. Diverse range of precision guided munitions such as Spice 2000, Scalp, Hammer
6. High altitude precision strike capable UAS which is fully indigenous such as MA-2B ~~Star~~ Predator

Reforming defence procurement to involve private sector, startups; boosting defence R&D with prt. sector & academia; and diversifying defence relationships abroad should be followed for defence modernization.

7. Human spaceflight poses unique safety challenges. Discuss the major risks involved in human space missions and outline the steps taken under the Gaganyaan mission to address them. (Answer in 250 words) 15 marks

Gaganyaan is India's indigenous human spaceflight programme. It intends to carry human astronauts to Low Earth Orbit for few days and come back.



Major Risks Involved

During launch

- ① Failure risks, fire risks,
- ② Failure of systems designed to keep human comfortable during launch

Exit from atmosphere

- ① Sudden loss of pressure creates risk for blood vessels
- ② Gradual loss of gravity creates abnormal changes in body
- ③ Risk of failure of rocket upper stages as oxygenic stages require very precise combustion control

Injection into the orbit

- ① microgravity environment ⇒ muscle loss, bone loss deformities

- ② Risks of exposure to radiation - cosmic rays, X-rays, UV rays
- ③ Failure of precise environment control in the space crew modules
- ④ Threats from in-orbit space debris
- ⑤ Risk of failure of in-orbit manoeuvring by crew module

Re-entry

- ① Risk of insulation failure due to high thermal heat during re-entry
- ② Risk of speed control during descent as it can attain abnormally high speed
- ③ Precise landing at pre-determined location for safe recovery

Steps taken to manage the risks

- ① Human rated semi-cryogenic propulsion system being tested for safe launches
- ② SOP for pad abortion and regular trials & drills
- ③ Recovery of space crew module in case of launch failure mid-journey has been planned, designed & tested
- ④ Tests during Axiom-4 mission for space medicine, space environmental control systems designed by ISRO

Candidates must not
write on this margin

Intro :
Body :
Conc. :
Total :

- ⑤ Atmosphere - Re-entry tests for safe insertion-or back. Advanced thermal protection systems using reinforced composites
- ⑥ Reusable launch vehicle has been tested for safe recovery of astronauts
- ⑦ Extensive training of methodically selected astronauts
- ⑧ Dedicated Human Spaceflight Center at Bengaluru for careful execution of the mission
- ⑨ National Gaganyaan Advisory Council consisting of industrial experts, academic experts to utilize best practices, technologies available.

Gaganyaan is the critical first step towards deep space ambitions of India including operating its own Space Station by 2035 and landing astronauts on moon by 2040.

8. India has made notable progress in nuclear energy. Discuss the technological advancements in this domain and evaluate their contribution to India's developmental goals.

(Answer in 250 words) 15 marks

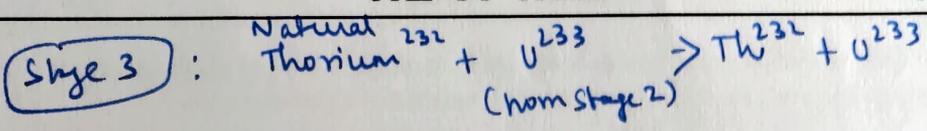
Nuclear energy contributes ~2% of India's total energy mix and India has announced plans of achieving 100 GW nuclear energy by 2030.

Notable progress by India

- ① Indigenous nuclear power plants capacity has reached upto 700 MW per unit from 220 MW per unit in the beginning
- ② Safety benchmarks : IAEA has regarded safety features installed at India's as good enough to withstand Fukushima type disaster
- ③ Fast Breeder Reactor at Kalpakkam, Tamil Nadu by Bhavini has been operating at pilot level to operationalize 2nd stage of India's nuclear program
- ④ Experimental Advanced Heavy Water Reactor (KAHWR) at Kalpakkam is being tested for 3rd stage
- ⑤ India has envisaged its own unique 3-stage nuclear programme:

Stage 1 : Natural Un-enriched Uranium ($U^{235} + U^{238}$) \rightarrow Pu^{239}

Stage 2 : Fast Breeder Reactors \rightarrow Pu^{239} (from Stage 1) + Natural Uranium
 \times Pu^{239} (from Stage 1 & 2) + Thorium \rightarrow Uranium 233



Technological Advancements

1. Thorium based reactors such as Molten Salt Reactor has been operationalized by China recently
2. Advanced / complex fuels such as mined Uranium - Thorium fuel
3. Generation IV+ safety features such as preventing Thermal Runaway, melting of core
4. Small Modular Reactors (SMRs) : modular, factory assembled, pre-fabricated $\sim 200-250\text{MW}$ reactors are getting more attention
5. Cold fusion energy using H_2 , palladium, Helium for fusion energy at room temperature
6. Tokamaks such as EAST, K-Star, ITER seeking to emulate sun like fusion cycle for energy

CONTRIBUTION TO India's Development

- ① cheap energy / Unit \Rightarrow energy security

Candidates must not write on this margin

Intro :

Body :

Conc. :

Total :

- ② Serves as stable base load allowing greater integration of intermittent Renewable energy thus addressing global warming
- ③ Cheap energy critical for manufacturing competitiveness & goal of reaching 25% GDP by manufacturing.

Limitations

- ① low share ~~sto~~ due to limited FDI so far
- ② Safety concerns such as Fukushima Incident
- ③ India lacks technology of big size Pressurized water reactors such as Chinese 1.5 GW reactors, or French 1.6 GW AP1000 reactors

Planned Nuclear Energy Mission plans to open up the sector for private sector, promote R&D & incentivize FDI to further boost nuclear energy.

9. What are mRNA vaccines? Explain how they function and highlight how they differ from DNA-based vaccines. (Answer in 250 words) 15 marks

mRNA vaccines induce adaptive immunity by delivering mRNA code for protein of the antigens.

Examples of mRNA vaccines include COVID-19 vaccines by Moderna & Pfizer.

How they function:

- ① Decoding the antigen and selecting particular feature of the antigen \Rightarrow Spike protein of COVID virus
- ② Synthesizing the code of mRNA which can guide ~~to~~ ribosomes to make antigen proteins
- ③ Cell-free production of mRNA
- ④ Delivering mRNA by encapsulating them within the lipid nanoparticles
- ⑤ mRNA enters host cell and gets collected within ribosomes
- ⑥ ribosomes bring relevant amino acids to produce proteins corresponding to mRNA
- ⑦ Antigen protein manifests on the host cells

- ⑧ Activates B-cell × T-cell both
- ⑨ β-Cell stimulates cytokine antibodies
and also create B-memory cells
for future
- ⑩ T-cell (helpers) stimulate killer T-cells
for acting against the antigens
- ⑪ memory T-cells remain for future immunity

mRNA vaccines

1. Only mRNA sequence code is delivered
2. Delivery through Lipid nanoparticles
3. No risk of genetic alteration within host cell
4. Synthetic production of mRNA in a cell-free environment.
5. mRNA is highly unstable
6. Requires extremely low temperature even up to $-70, -80^{\circ}\text{C}$
7. One time immunity × degrades with

DNA vaccines

1. Entire DNA sequence (gene) for the antigen protein is delivered
2. Delivery through viral vector
3. Risk of such modification - present
4. DNA (required) is produced within a harmless viral vector
5. DNA is a stable molecule
6. Works well at $10-20^{\circ}\text{C}$ as well
8. more persistent immunity as DNA continues to produce

Candidates must not
write on this margin

Intro :

Body :

Conc. :

Total :

degradation of mRNA

2. Not much risk of
excessive immunity
triggering cytokine
storm

antigens

2. may trigger cytokine
storm

Similarities

1. Both provide coding of antigens only and depend upon host cell for production
2. Both enable rapid customization for emerging variants
3. Fast mass-scale production friendly
4. Both avoid sending actual pathogens into the patients

Biotech Pride 2021,

Biopharma Mission × Bio E3 Policy aim
to make India a hub of mRNA, DNA based
products

10. What is fifth-generation warfare? Examine the emerging challenges associated with it and suggest measures India should adopt to strengthen its preparedness.

(Answer in 250 words) 15 marks

Modernization of Chinese PLA, Russia-Ukraine war, US new star wars program show how warfare has entered a new fifth generation era.

Fifth generation warfare

- ① Stealth technology evading detection by radar
- ② Man-unmanned teaming, i.e. integration of unmanned platforms with conventional jets, tanks
- ③ Precision munitions guided by camikaze drones, Inertial navigation, fire & forget
- ④ Integration of air & space into aerospace domain ⇒ militarization of near Earth orbit
- ⑤ New dimensions of cyber warfare, information warfare
- ⑥ Electronic warfare using comm. jamming, GPS spoofing, directed energy weapons
- ⑦ Gradual spectrum between actual war & greyzone warfare

Emerging Challenges

- ① Space weaponization violating Outer Space Treaty 1967's assurance of peaceful use
- ② Rapid changes in technology \Rightarrow quick outdated of existing weapons
- ③ Use of AI creating ethical issues such as machine attacking on civilians
- ④ New arms race into fighter jets, drones, hypersonic missiles
- ⑤ Expanding meaning of dual-use as entire electronics supply chain becomes dual use
- ⑥ Security of critical infrastructure such as power grids, telecomm. networks due to import dependence
- ⑦ Non-state actors also misusing such advanced tech \Rightarrow Houthis firing drones, missiles downing even F-16 of US
- ⑧ Import dependency for critical tech \Rightarrow Delays in Tejas Mk 2A due to delays in GE F404 engine delivery

Measures India should adopt

- ① Institutional → Comprehensive National Security Strategy covering all domains
 → Teintness among forces including cyber × space command

② Technological

- ↳ Using iDEX, defence startups through ADIT for private sector R&D contribution
- ↳ Industry - Academia - Government linkages through Technopark at IIT Kanpur, Defence Testing Infrastructure Scheme

③ Diplomacy

- ↳ Defence Industrial Partnerships with EU, USA, Japan, West Asian Gulf Countries, Israel etc.
- ↳ Technology transfers for addressing critical gaps
 Ex. 80% TOT in GE414 engine deal for AMCA × Tejas Mk II

④ Makeⁱⁿ India

- ↳ Streamlined procurement within fixed timeline
- ↳ longer horizon of likely purchases to incentivize Pvt. Investment.

former PSA to PM has submitted his report on reforming DRDO into US DARPA like body for next-generation warfare

Candidates must not write on this margin

Intro :

Body :

Conc. :

Total :