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27th & 28th February, 2024

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HUMAN SPACE EXPLORATION: CURRENT STATUS AND DEVELOPMENTS

SOURCE: INDIAN EXPRESS

TAG: GS Paper II- **Government Policies & Interventions, Human Resource**

GS Paper III- **Space Technology, ISRO**

Mains Practice Question:

Q. Discuss how Gaganyaan Mission helps in building India's dominance in space sector? Analyse the possible impacts of success of Gaganyaan mission.

WHY IN NEWS?

- Recently, Prime Minister Narendra Modi has announced the selection of four astronauts for India's Gaganyaan Mission.
- The astronauts-designate are **Shubanshu Shukla, Prashanth Balakrishnan Nair, Angad Prathap,** and **Ajit Krishnan.** These **astronauts will be part of India's first crewed mission to space, known as the Gaganyaan Mission.**
- The **announcement took place at the Vikram Sarabhai Space Centre (VSSC) in Thiruvananthapuram.** The **Gaganyaan Mission involves both unmanned and manned flights.**

HISTORICAL BACKGROUND:

- **In 1984, Wing Commander Rakesh Sharma** marked his name in history as **the first Indian to journey into space,** aboard a **Soviet spacecraft bound for the Salyut 7 space station.**
- This milestone ignited India's aspirations for space exploration. Subsequently, in 2006, India initiated efforts towards an indigenous orbital vehicle mission, laying the groundwork for what would eventually be known as the **Gaganyaan mission.**

AIMS AND OBJECTIVES:

- **Gaganyaan-1 Unmanned Test Flight:**
  - **Aim:** To assess technological readiness and capabilities for subsequent manned missions.
  - **Objective:** Conduct a comprehensive evaluation of spacecraft systems and operations in a simulated space environment.
  - **Target:** Scheduled for completion by the end of 2024.
- **Manned Mission (Gaganyaan):**
  - **Aim:** To propel India into the league of nations capable of manned spaceflight.
  - **Objective:** Transport a three-member crew to a low earth orbit at an altitude of 400 km for a duration of three days, followed by a safe return to Earth.
  - **Target:** Following the successful completion of Gaganyaan-1, the manned mission will be undertaken, marking a significant milestone in India's space exploration journey.

HUMAN RATING OF LAUNCH VEHICLE:

- **ISRO has designated its LVM3 rocket, formerly known as GSLV-MkIII, for all Gaganyaan missions.**
- This **robust launch vehicle, comprising liquid, solid, and cryogenic stages, has successfully completed seven missions without any failures.**
- **To ensure human safety,** ISRO has meticulously reconfigured all components of LVM3 to meet stringent human rating requirements. Notably, **the cryogenic engine, CE20, underwent final tests on February 14** and **emerged successfully, earning certification for human space missions.**

- The Vikas engine and solid booster, integral to the liquid and solid stages respectively, have already met mission qualifications. Furthermore, acceptance tests for the special flight engine, pivotal during liftoff, have been satisfactorily concluded, marking significant progress toward mission readiness.

CREW MODULE AND ESCAPE SYSTEM:

- As part of preparations for human space flight**, ISRO is actively developing life support systems to ensure a hospitable environment for the crew in space.**
- **Emergency escape provisions** and **crew management protocols for training, recovery,** and **rehabilitation** are **being evolved.** Precursor missions like Gaganyaan-1 will gauge the technological preparedness before the manned mission.
- This unmanned mission will deploy an unpressurized crew module to space and back, primarily to test safe re-entry and module orientation upon splashdown. Subsequent missions will feature pressurized crew modules, enabling comprehensive testing of life support systems. The second unmanned flight will introduce **Vyommitra, a humanoid robot, to assess the flight's impact on humans.**

TRAINING OF THE ASTRONAUTS:

- **Four astronauts underwent generic training at Russia's Yuri Gagarin Cosmonaut Training Centre between February 2020 and March 2021,** facilitated through an MoU **between ISRO and Glavkosmos.**
- Presently, **the astronauts are undergoing rigorous training at ISRO's astronaut training facility in Bengaluru,** focusing on subsystem functioning and module design refinement.
- Continuous fitness and psychological training are integral to their preparation. Furthermore, one astronaut is expected to receive training from NASA, highlighting international collaboration in India's ambitious space endeavours.

CONCLUSION

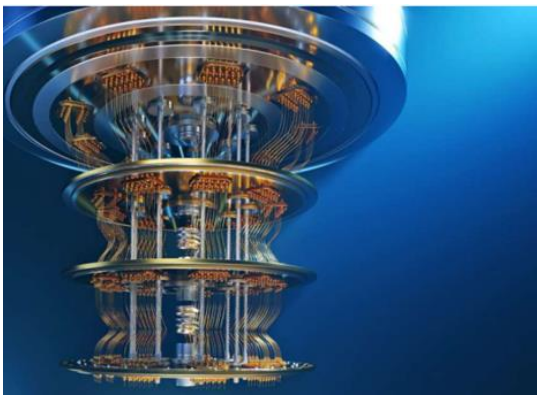
- India's **Gaganyaan mission represents a remarkable leap forward in the nation's space exploration endeavors.** With meticulous attention to detail and rigorous testing, ISRO has demonstrated its commitment to ensuring the safety and success of human spaceflight. The human rating of the launch vehicle, meticulous development of the crew module and escape system, and comprehensive training of astronauts underscore the thoroughness of preparations for this historic mission.

PRELIMS POINTERS:

27th & 28th February, 2024

TOPIC	DESCRIPTION
SWEDEN CLEARS FINAL HURDLE TO JOIN NATO AS HUNGARY APPROVES BID	**WHY IN NEWS?** ❖ *Hungary's parliament **approves Sweden's NATO membership**, ending 18-month delay amid **Russia-Ukraine conflict**. Last **NATO member to ratify**, enhancing alliance, **despite diplomatic tensions with Sweden.*** **ABOUT NATO:** ❖ NATO is a **security alliance formed in 1949** with **30 member countries from North America and Europe**, recently joined by **Finland as the 31st member**. ❖ Its fundamental goal is to **protect the freedom and security of its member nations** through political and military cooperation. ❖ NATO **operates on the principle of collective defence**, meaning an attack on one member is considered an attack on all, **as stated in Article 5 of the Washington Treaty**. ❖ The **headquarters of NATO is located in Brussels, Belgium**.  **RECENT EXPANSION OF NATO** ❖ **NATO Expansion:** ☛ Hungary finally **agrees to let Sweden join NATO** after more than 18 months of delay. ☛ **Finland also recently joined**, responding to Russia's actions in Ukraine. ❖ **Member Countries' Support:** ☛ **All 31 NATO members must agree for new countries to join**. ☛ **Hungary's approval was the final step for Sweden.**
COLOUR MOLECULES IN QUANTUM COMPUTING	**WHY IN NEWS?** ❖ *In a recent breakthrough reported in Science Advances, researchers achieved **qubits operating at room temperature using a metal-organic framework (MOF),** marking a significant advancement in quantum computing.* **FEATURE OF QUBIT SYSTEM:** ➢ **Superposition:** Qubits can **exist in multiple states simultaneously**. ➢ **Entanglement: Quantum states of qubits** can be correlated regardless of distance. ➢ **Coherence:** Qubits can maintain their **quantum states** over time without external interference. ➢ **Addressability:** Individual qubits can be selectively **manipulated within a quantum system**. ➢ **Measurement:** Extracting classical information from **qubits' quantum states through measurement.** **CONCERNS WITH QUANTUM COMPUTING** ❖ Imperfections in manufacturing make it challenging **to ensure that qubits are identical**.

- Qubit systems need to be controllable and robust **at room temperature for long periods**.
- Quantum computers based on **current technologies are expensive**.



RECENT BREAKTHROUGH

- Researchers achieved **qubits that operate at room temperature**, a significant advancement.
- **MOFs are used**, a novel idea for quantum computing, **consisting of repeated molecular arrangements** with metal atoms and attached organic molecules.
- Qubits work at room temperature using singlet fission**, where energy jumps between molecules.**
- **Interactions between molecules in MOFs** help create and maintain the qubits' special states.
- **Interaction between chromophores in MOFs** facilitates the creation and maintenance of superposition.

BALEEN WHALES

WHY IN NEWS?

- ***Recent discovery unveils baleen whales'*** *modified* ***larynx for vocalization, shedding light on their iconic songs*** *and vulnerability* ***to anthropogenic noise pollution****.*

ABOUT BALEEN WHALES

- **Evolution from Land-Dwelling Mammals:**
  - Baleen whales **evolved from land-dwelling mammals** and initially vocalized **using their larynx**, a structure also **used for preventing food from entering the respiratory system.**
- **Specialized Vocalization Structures:**
  - **Toothed whales**, like **dolphins**, do not use their **larynx for sound production**; instead, **they have evolved specialized organs in their noses.**
- **Mystery of Baleen Whale Songs:**
  - The **production of the deep**, **haunting tones** of baleen whale songs **has long puzzled researchers.**
- **Limitations in Vocalization:**
  - While baleen whales can **produce powerful vocalizations**, their **anatomy limits the frequency** and depth of the sounds they can make.
- **Impact of Anthropogenic Noise Pollution:**
  - The **limited vocal range** of baleen whales leaves them **vulnerable to anthropogenic noise pollution**, as they are unable to escape noise occurring in their vocal range.

GRANT PERMANENT COMMISSION TO WOMEN: SC TO COAST GUARD

WHY IN NEWS?

- *The Supreme Court of India has directed the **Indian Coast Guard to ensure the grant of permanent commission to women**, emphasizing **gender equality and fair treatment in the armed forces**, following a legal plea seeking parity **for women Short Service Commission Officers.***

PERMANENT COMMISSION FOR WOMEN IN THE ARMY:

- **Background:**
  - Women under the **Short Service Commission (SSC) scheme served for 10 years, extendable to 14 years**, with limited roles.
  - They were restricted from combat arms roles **like infantry and armoured corps**.
  - Permanent commission (PC) and command appointments were **unavailable, affecting benefits like government pension.**
- **Policy Change:**
  - In February 2019, the **government endorsed PC for women officers** in 10 streams of Combat Support Arms and Services.
  - However, they were excluded from command appointments and confined to staff posts.

- **PC vs. SSC:**
  - SSC officers serve **for a limited period**, while **PC officers continue till retirement**.
  - SSC officers have **options after 10 years**: **PC, opt-out, or 4-year extension**.
  - PC grants continuous **service till retirement, unlike the extendable SSC**.

RECENT SUPREME COURT RULING:

- The Supreme Court of India **urges the Indian Coast Guard to ensure women receive permanent commission,** emphasizing equality**.**
- The **Supreme Court allows women SSC officers' pleas for PC**, citing flawed and discriminatory ACR evaluation processes.
- This decision opens **avenues for women officers to serve longer** and access benefits like **command appointments and pensions**.

JUDICIAL OBSERVATIONS

- The court criticizes the **government's patriarchal approach**, highlighting judgments supporting **permanent commissions for women in the armed forces**.

EQUALITY AND REPRESENTATION:

- The court emphasizes fair treatment and representation of women, **rejecting the idea of a 10% quota and urging for a policy treating women equally.**

GARBHINI-GA2

WHY IN NEWS?

- ***Development of India-specific AI model** for fetal gestational age, **part of GARBH-Ini program**, promises **improved maternal care, addressing India's unique healthcare needs.***

ABOUT THE GARBH-INI PROGRAMME

- **Interdisciplinary Research Initiative:**

- The model is **part of the GARBH-Ini programme**, initiated by the **Indian government's Department of Biotechnology (DBT)** to advance research on birth outcomes.

❖ **Research Collaboration:**

- Researchers from the **Indian Institute of Technology-Madras** and the **Translational Health Science and Technology Institute, Faridabad**, collaborated on this project.

FEATURES OF THE GARBHINI-GA2 MODEL

❖ **Tailored for Indian Population:**

- Unlike existing models designed for Western populations, Garbhini-GA2 is specifically developed and **validated using Indian population data, addressing variations in fetal growth.**

❖ **Improved Accuracy:**

- The model significantly **enhances accuracy**, **reducing estimation error by almost three times** compared to current methods.

POTENTIAL IMPACT

❖ **Enhanced Maternal and Infant Care:**

- **Accurate gestational age estimation facilitates** appropriate **care for pregnant women**, potentially **reducing maternal and infant mortality rates**.

❖ **Precise Birth Date Determination:**

- The model aids in determining the **precise date of birth**, contributing to **improved maternal** and infant healthcare outcomes.

SIMILIPAL TIGER RESERVE

WHY IN NEWS?

❖ *Tiger population rises in **Odisha's Similipal Reserve from 16 to 27**, highlighting conservation success. **Genetic diversity needed due to inbreeding**, prompting calls for **introducing female tigers.***

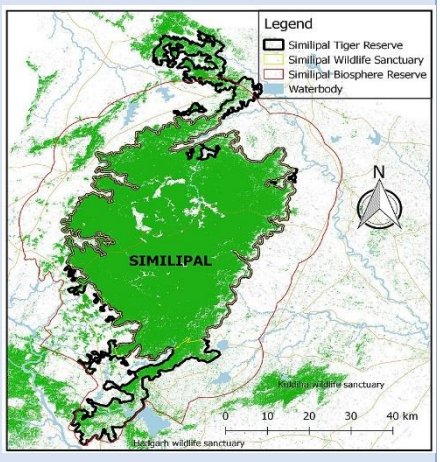
SIMILIPAL TIGER RESERVE OVERVIEW

❖ **Location:**

- Situated in **Orissa's Mayurbhanj district**, **Similipal Tiger Reserve** spans 2750 sq km, known for its diverse flora and fauna.

❖ **Geographical Features:**

- Surrounded by plateaus and hills, notable **peaks include Khairiburu and Meghashini**.
- Rivers like **Burhabalanga and Salandi** flow through the reserve.



HISTORICAL BACKGROUND:

❖ **Origin:**

- Former hunting grounds, declared a **wildlife sanctuary in 1979** and a **tiger reserve under Project Tiger in 1973.**

❖ **Recognition**:

- **Designated as a biosphere reserve in 1994** by the Government of India and listed as a **UNESCO Biosphere Reserve in 2009.**

FLORA AND FAUNA:

❖ **Vegetation:**

- Mix of forest types dominated by **Sal trees, with extensive grasslands**.

❖ **Wildlife:**

- High tiger population, alongside **leopards, elephants, deer, gaur**, and **various bird species like hornbills.**

❖ **Reptiles:**

- **King cobra and Tricarinate hill turtle** are notable, with a thriving mugger crocodile population.

ASTRONAUT WINGS FOR GAGANYAAN'S IAF PILOTS

WHY IN NEWS?

❖ *PM Modi announces **four IAF officers for Gaganyaan mission**, symbolizing **India's space aspirations and self-reliance.** They're dubbed **"four Shakti" for their role**.*

ABOUT THE ASTRONAUT WINGS FOR GAGANYAAN'S IAF PILOTS:

❖ These astronauts are Indian Air Force (IAF) pilots **selected for India's first manned space flight.**

❖ They will follow the **footsteps of Rakesh Sharma**, **India's first astronaut**, who went to space in 1984.

❖ Four IAF pilots, **Group Captains Prasanth Balakrishnan Nair, Angad Pratap, Ajit Krishnan, and Wing Commander Shubhanshu Shukla,** were selected.

❖ They have been undergoing **training under anonymity for the last four years**.

❖ One pilot is **likely to fly to the International Space Station** as part of a NASA mission.

❖ Others would be part of **Gaganyaan mission**, India's first manned space flight.

❖ Gaganyaan mission **aims to demonstrate human spaceflight capability** by launching **a crew of three members to low earth orbit** for a three-day mission.