



PAPER - III

THIRTY METER TELESCOPE



1. What is the 30 Meter Telescope (TMT)?

- The TMT is a next-generation astronomical observatory with a 30-meter primary mirror designed to provide unprecedented resolution and sensitivity for exploring the universe.

2. Where it is located?

- The preferred site for the Thirty Meter Telescope (TMT) is Mauna Kea in Hawaii, one of the world's premier astronomical locations. However, due to opposition from indigenous Hawaiians who consider the site sacred, alternative locations such as the Observatorio del Roque de los Muchachos on La Palma in the Canary Islands, Spain, are being explored.

3. What are the goals of the project?

- Study the early universe and formation of the first galaxies and stars.



- Investigate the formation, structure, and evolution of galaxies.
- Examine the relationship between supermassive black holes and their host galaxies.
- Explore the formation of stars and planetary systems.
- Characterize exoplanets and study their atmospheres.

4. What are its special features?

- **Mirror System:** 30-meter primary mirror composed of 492 hexagonal segments.
- **Adaptive Optics System (AOS):** Uses deformable mirrors and laser guide stars to correct atmospheric turbulence, featuring the Narrow Field Infrared Adaptive Optics System (NFIRAOS).
- **Scientific Instruments:** Includes the Infrared Imaging Spectrometer (IRIS) and the Wide-Field Optical Spectrograph (WFOS).

5. What is its significance to India?

- India contributes through hardware, instrumentation, software, and funding worth \$200 million.
- Indian scientists developed an open-source tool to create an all-sky NIR star catalogue for the NFIRAOS, ensuring high-quality images.
- Key contributions come from institutions like the Indian Institute of Astrophysics, the Inter-University Center for Astronomy and Astrophysics, and the Aryabhata Research Institute for Observational Sciences.

MODEL QUESTIONS

1. With reference to the Thirty Meter Telescope (TMT) project, consider the following statements:

1. The primary mirror of the TMT is composed of 492 hexagonal segments.
2. The TMT will primarily be used to study only exoplanets and their atmospheres.
3. The preferred location for the TMT is Mauna Kea in Hawaii, but alternative sites are also being considered.

Select the correct statements using the code given below:

- (a) 1 and 2
- (b) 1 and 3
- (c) 2 and 3
- (d) 1, 2, and 3



Answer: (b) 1 and 3

2. Regarding the goals of the Thirty Meter Telescope (TMT), consider the following statements:

1. To investigate the formation, structure, and evolution of galaxies.
2. To study the relationship between supermassive black holes and their host galaxies.
3. To explore oceanographic phenomena and marine ecosystems.

Select the correct statements using the code given below:

- (a) 1 and 2
- (b) 1 and 3
- (c) 2 and 3
- (d) 1, 2, and 3

Answer: (a) 1 and 2

3. With respect to India's involvement in the Thirty Meter Telescope (TMT) project, consider the following statements:

1. The Indian Institute of Astrophysics (IIA) is a major contributor to the TMT project.
2. Indian scientists developed a tool to create an all-sky Near-Infrared (NIR) star catalogue for the TMT's Adaptive Optics System (AOS).
3. India's contribution to the TMT project includes only funding and no technical or scientific input.

Select the correct statements using the code given below:

- (a) 1 and 2
- (b) 1 and 3
- (c) 2 and 3
- (d) 1, 2, and 3

Answer: (a) 1 and 2

FOR MAINS

Geopolitical Significance of the Visit

Indian Prime Minister Narendra Modi's recent visit to Moscow holds significant geopolitical implications amidst global tensions over Russia's invasion of Ukraine. Despite international outcry,



Modi's trip underscored India's strategic autonomy and its multi-alignment approach in international relations. The visit coincided with NATO discussions in Washington, where India's engagement with Russia drew attention amid Western efforts to isolate Moscow.

Indo-Russian Synergy of Political Vision

Modi's visit emphasized the enduring Indo-Russian relationship, rooted in historical defense cooperation and shared strategic interests. Both nations reiterated their commitment to a multipolar world order and opposed unilateral sanctions, affirming their mutual stance against hegemonic dominance. This synergy reflects a strategic alignment beyond immediate geopolitical pressures, aiming for long-term stability and cooperation.

India's Clarity on the Ukraine Conflict

While expressing concern over the humanitarian impact of the Ukraine conflict, Modi emphasized dialogue and diplomacy as the path to peace. India refrained from explicitly criticizing Russia, focusing instead on humanitarian assistance and urging respect for Ukraine's sovereignty and territorial integrity. This balanced approach aimed to navigate India's complex relationships with both Russia and Western allies amid escalating global tensions.

Charting New Areas of Economic and Scientific Cooperation

Modi's discussions with Putin explored avenues to expand economic and scientific collaboration. Key areas included energy cooperation, with India increasing its purchase of discounted Russian oil amid Western sanctions. Both leaders aimed to boost bilateral trade, targeting a substantial increase to \$100 billion by 2030. Cooperation in nuclear energy and space technology also featured prominently, highlighting mutual efforts to diversify and strengthen economic ties.

Prospects of Trade Growth Post-Visit

The visit highlighted India's efforts to address trade imbalances and enhance economic resilience. Despite challenges posed by sanctions, bilateral trade surged to \$65.7 billion in recent years, driven by energy imports and new avenues in agriculture and automotive sectors. Efforts to establish new payment mechanisms and enhance connectivity projects such as the International North-South Transport corridor were discussed, signaling a commitment to expand trade horizons.

Conclusion

Modi's visit to Moscow underscored India's diplomatic balancing act amid global geopolitical shifts. It reaffirmed India's commitment to strategic autonomy and multi-alignment, navigating complex relationships with both Russia and Western allies amidst the Ukraine crisis.

The focus on economic diversification and scientific collaboration reflects a forward-looking approach, aiming to capitalize on mutual strengths and chart a sustainable path for Indo-Russian cooperation in the evolving global landscape.



PRACTICE QUESTIONS

1. "Examine the key areas of economic and scientific cooperation discussed during Prime Minister Modi's visit to Russia. How do these collaborative efforts aim to address the trade imbalance and enhance bilateral relations between India and Russia? Evaluate the potential impact of these initiatives on India's economic and strategic interests." (250 words).
2. What are the important outcome of Modi's recent Visit to Russia? (150 words)
3. Prime Minister Narendra Modi's recent visit to Russia reaffirms India's strategic autonomy and non-alignment policy in several key ways: Elucidate. (150 words)

ANSWERS

Question: 1

1.Examine the key economic and scientific cooperation areas discussed during Prime Minister Modi's visit to Russia. How do these collaborative efforts aimed to address the trade imbalance and enhance bilateral relations between India and Russia? Evaluate the potential impact of these initiatives on India's economic and strategic interests.

Introduction : During Prime Minister Modi's visit to Russia, key areas of economic and scientific cooperation were emphasized to bolster bilateral ties and address trade imbalances. Significant focus was placed on energy cooperation, with India increasing its imports of discounted Russian oil, crucial amidst Western sanctions on Russia.

Core : This move aims to stabilize India's energy needs while providing Russia with a reliable market. Additionally, cooperation in nuclear energy, space technology, and agriculture were key discussion points. These sectors are pivotal for both nations, offering opportunities for technological exchange and joint ventures.

The visit also aimed to boost bilateral trade, targeting an increase to \$100 billion by 2030, with efforts to enhance Russian investments in India and explore new areas for Indian exports. Initiatives such as the establishment of new payment mechanisms and development of connectivity projects like the International North-South Transport corridor are expected to facilitate smoother trade flows and reduce dependency on Western financial systems.



These collaborative efforts address the current trade imbalance, which heavily favors Russia, by promoting Indian exports and encouraging Russian investments in India's infrastructure and technology sectors. Strategically, this cooperation reinforces India's stance of maintaining strong ties with Russia while pursuing a diversified foreign policy. Economically, it helps India secure essential resources and technological expertise, vital for its growth.

Conclusion : Overall, these initiatives have the potential to significantly enhance India's economic resilience and strategic autonomy, contributing to its long-term development and stability in the global arena.

Question: 2

2. What are the important outcome of Modi's recent Visit to Russia?

1. **Energy Cooperation:** India has committed to increasing its imports of discounted Russian oil, vital for energy security amidst global price fluctuations.
2. **Defense and Military Collaboration:** Discussions focused on joint defense production and technology transfers, aiming to strengthen India's military capabilities while addressing supply chain concerns exacerbated by the Ukraine conflict.
3. **Nuclear Energy:** Agreements were made to enhance collaboration in nuclear energy development, with Russia continuing to provide technical assistance for India's nuclear power projects.
4. **Trade and Economic Relations:** Both nations aim to boost bilateral trade, targeting \$100 billion by 2030. Efforts include establishing new payment mechanisms to facilitate trade and mitigate the impact of Western sanctions.
5. **Scientific and Technological Cooperation:** Agreements were reached to collaborate in areas such as space technology, agriculture, and pharmaceuticals, fostering innovation and mutual growth.

These agreements not only bolster India's strategic autonomy and economic resilience but also reflect a commitment to a multipolar world order, balancing relationships with Russia and Western nations.



Question: 3

2.Prime Minister Narendra Modi's recent visit to Russia reaffirms India's strategic autonomy and non-alignment policy in several key ways: Elucidate

Strategic Autonomy

1. **Balanced Diplomacy:** By visiting Russia amidst the ongoing Ukraine conflict and Western pressure to isolate Moscow, Modi underscored India's ability to maintain independent foreign relations. India continues to engage with Russia, a long-standing defense and strategic partner, while also nurturing strong ties with Western countries, particularly the United States.
2. **Diversified Partnerships:** The visit highlights India's commitment to diversifying its international partnerships. Despite Western sanctions on Russia, India has increased its imports of discounted Russian oil, ensuring energy security. Simultaneously, India remains actively involved in Western-led initiatives like the Quad, showcasing its balanced approach.
3. **Defense Cooperation:** India's continued defense collaboration with Russia, including joint production and technology transfers, reaffirms its strategic autonomy. This partnership is crucial for maintaining India's defense capabilities, especially given its security concerns with neighboring countries.

Non-Alignment

1. **Neutral Stance on Conflicts:** India's nuanced position on the Ukraine conflict exemplifies its non-alignment policy. While expressing concern over humanitarian issues and advocating for dialogue, India avoids direct criticism of Russia, thus maintaining neutrality and promoting peaceful resolution.
2. **Global Multipolarity:** Modi's visit aligns with India's vision of a multipolar world, where power is distributed among various global players rather than dominated by a single bloc. Engaging with Russia while being part of Western-led forums signifies India's commitment to this principle.
3. **Economic and Scientific Collaboration:** Agreements in energy, trade, nuclear power, and technology further India's goal of non-alignment by fostering diverse international



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collaborations. These initiatives enhance India's economic resilience and technological capabilities without over-reliance on any single country or bloc.

Conclusion

Modi's visit to Russia demonstrates India's strategic autonomy by maintaining balanced relations and diversified partnerships, even amidst global pressures. It also reinforces India's non-alignment policy by promoting neutrality, advocating for a multipolar world, and engaging in diverse international collaborations. This approach allows India to navigate complex geopolitical landscapes while safeguarding its national interests and sovereignty.

