



# Topics



- Anticyclonic condition and Heat waves
- Internal combustion engine
- Pantabangan
- INS VIKRANT
- East china sea
- Mains



By saurabh pandey sir . . . . .



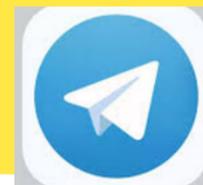
# Target Mains 2024/25 - essay topic



Q“Anticyclonic condition is the responsible factor for heat waves “ Elucidate

Q"एंटीसाइक्लोनिक स्थिति हीट वेव्स के लिए जिम्मेदार कारक है"  
स्पष्ट करें

send your answer - Saurabh pandey  
upsc telegram channel



Q] Ocean regulates the climate and climate shapes marine ecology "Discuss" - 10 marks

→ Ocean is the source point of every climate condition. like Tropical cyclone, convection, rainfall, navigation, fishing, etc.

\* Ocean regulates the climate

→ when ocean heats up, rain fall occurs, lapse rate  $\therefore$  high temperature low pressure. brings convectional rainfall

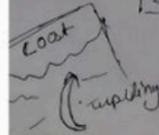
→ Cyclone - low pressure is the factor that develop cyclone. Continuous supply of low pressure. cyclone produce rain as well.

→ Salinity of ocean water brings more rain, water evaporates rapidly.

→ EL-Nino & La-Nina - effect of an climate; disturbance in formation of low pressure area.

\* Climate shapes marine ecology

→ upwelling - cold water comes at the shore with rich nutrient for nektons here fishing there and develop



→ Coral reef → coral reef grow in 21° to 28° temperature, and in shallow depth, grows on continental shelf. → rich in biodiversity, increase tourism e.g. diving

→ So climate is directly proportional to ocean health. Ocean covers most of the earth mass. so we have to work ~~introducing~~ the global warming because it also disturb ocean health as well as climate.

# Anticyclones, hanging even now over India, link warming to heat

The record warming of 2023 has so far not been fully explained since it was much warmer than expected just from the superposition of El Niño on global warming. But the impact of the El Niño during its pre-monsoon demise on the IEJ tends to produce a stronger and more persistent anticyclone and thus longer lasting and intense heat waves

Raghu Murtugudde

The complexities of the ways in which global warming manifests in local weather continue to underscore the need to model globally but predict locally.

The waning phase of the strong El Niño of 2023 brings the expected warm temperatures across the globe – while cooler temperatures spread from Pakistan across India to West Bengal during March. This band remained cool throughout 2023 even as record temperatures made relentless headlines.

What do the heat waves have to do with global warming?

Global warming also creates unique features locally that modulate heat waves on top of cool background temperatures. Heat waves over India have been of special concern this season because of the general elections. Some persistent circulation patterns have been creating heat waves and this pattern should serve as another focal point for improving predictions.

It was apparent in March that the anticyclonic circulations over the North Indian Ocean were the drivers of unusual rainfall over Odisha. An anticyclone has winds moving in a clockwise direction, with air sinking down in the middle of it. As this air hits the ground, it is compressed and warmed and can create a high pressure heat dome. An anticyclonic circulation could also explain the historic Dubai floods of April 17.

And these anticyclones exist over the North Indian Ocean and the Indian subcontinent even now.

## What links anticyclones to heat?

The persistence of the anticyclones is not unusual in and of itself. During the pre-monsoon season, the upper-level Indian Easterly Jet (IEJ) begins to take shape in the upper atmosphere, at around the 10 degrees N latitude, across the Arabian Sea, peninsular India, and the Bay of Bengal. A strong westerly jet exists to the north around 30 degrees N, and the two together can generate an anticyclonic pattern over the Indian Ocean and the Indian subcontinent.

An easterly jet refers to strong winds coming from the east while westerly jets come from the west. These are natural seasonal features. The westerly jet is pushed north during the monsoon season and the IEJ dominates the Indian subcontinent. During the pre-monsoon season, a strong anticyclone can bring dry and hot weather over many parts of India while a weak anticyclone produces milder weather.

The key question then is whether the anticyclone is strong this year and if that



A man covers his head with cloth to protect himself during a heat wave in Bhubaneswar. BISWARANJAN ROUT

is related to global warming and, thus, the heat waves.

## How are heat waves amplified?

The pre-monsoon season is India's summer and heat waves are to be expected. The focus is always on predicting them accurately and providing early warnings to save lives. The background drivers of the duration, intensity, and frequency of heat waves are helpful to identify the hotspots of heat waves at the timescales relevant to the evolution of the weather and the climate.

The record warming of 2023 has so far not been fully explained since it was much warmer than what we expected just from the superposition of El Niño on global warming. But the impact of the El Niño during its pre-monsoon demise on the IEJ tends to produce a stronger and more persistent anticyclone and thus longer lasting and more intense heat waves.

So, the heat wave season this year is consistent with the warmer temperatures due to the El Niño itself as well as the 'steroids' being added by the unexplained warming of 2023.

This background state of cool seasonal temperatures but a strong and persistent anticyclone is important. It can help the India Meteorological Department ensure predictions are done with accurate background conditions and build the early warnings accordingly.

## Stages of early warnings

Returning to the local manifestation of



Some persistent circulation patterns have been creating heat waves and this pattern should serve as another focal point for improving predictions.

global warming: accurate early-warning systems take a three-step approach called the 'ready-set-go' system, under the so-called 'Subseasonal-to-Seasonal Predictions' project of the World Climate Research Program under the World Meteorological Organisation. India is part of this project, has invested heavily in S2S predictions, and has made impressive progress in improving the accuracy of predictions.

Preparing the system and guiding the National Disaster Management Agency (NDMA) requires this three-step approach to function efficiently and effectively. Considering there are more than 1.2 million polling stations for the general elections this year, the optimal use of resources to prepare for, mitigate, and recover from extreme events requires location-specific information at each step.

The 'ready' step provides a seasonal outlook – where the background state, or the external factors (such as global warming and the El Niño), are used to maximise the accuracy of longer-lead forecasts. The 'ready' step allows the NDMA, its local agencies, and all local governments to ready their disaster

response systems.

The subseasonal predictions refer to the extended range of weeks two to four, which contribute to the 'set' step. Resource allocations and identifying potential hotspots to move resources including personnel ensure disaster-preparedness is set to go.

The 'go' step is based on short- (days 1-3) and medium- (days 3-10) range forecasts. At this step, everything hits the road to manage a disaster, including rescue efforts, hydration centres, heat shelters, etc.

## Preparedness and recovery

All evidence suggests India's prediction system and early warning systems continue to improve and the NDMA has worked these details well into its 'ready-set-go' system.

The remaining challenges are to build resilience for the future by better predicting the trajectory of the weather at every location over India. This is a significant challenge but budding efforts for predictions at 10-year timescales have shown promise.

The coordination from national to neighbourhood levels and early-warnings from days to a decade are taking shape. Governments, their departments, and the people at large need to be trained and engaged with to make this a sustained success. India's dream of sustained economic development depends on this.

(Raghu Murtugudde is a visiting professor at IIT Bombay and an emeritus professor at the University of Maryland.)

## THE GIST

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The background drivers of the duration, intensity, and frequency of heat waves are helpful to identify the hotspots of heat waves at the timescales relevant to the evolution of the weather and the climate

The background state of cool seasonal temperatures but strong and persistent anticyclones can help the India Meteorological Department with their predictions and also to build early warnings accordingly



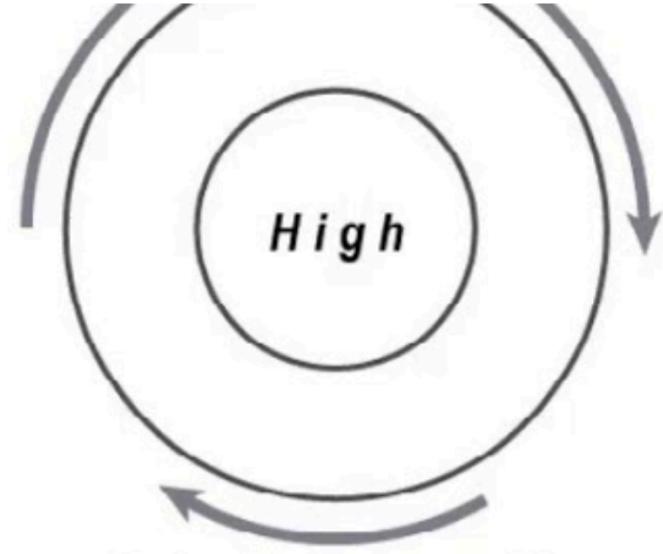


# Anticyclonic condition and Heat waves

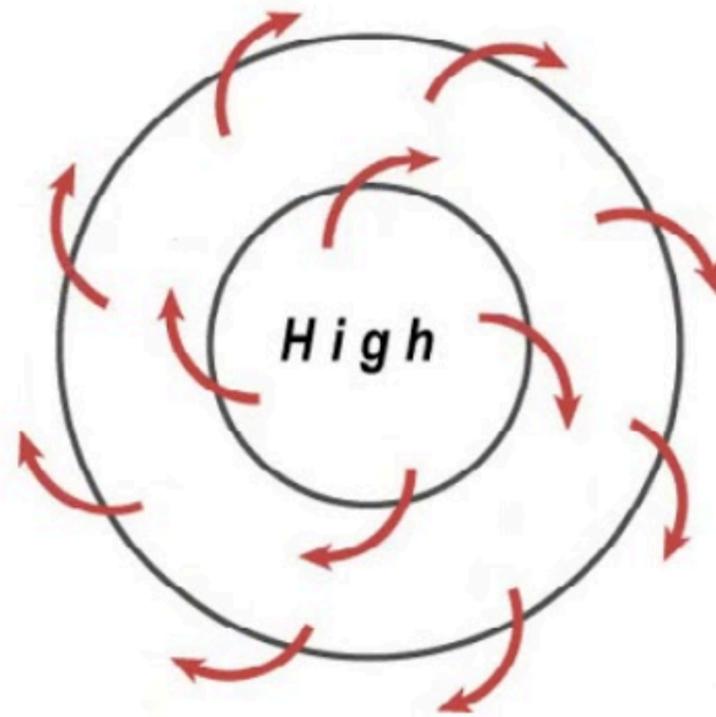
- **.An anticyclone has winds moving in a clockwise direction, with air sinking down in the middle of it.**
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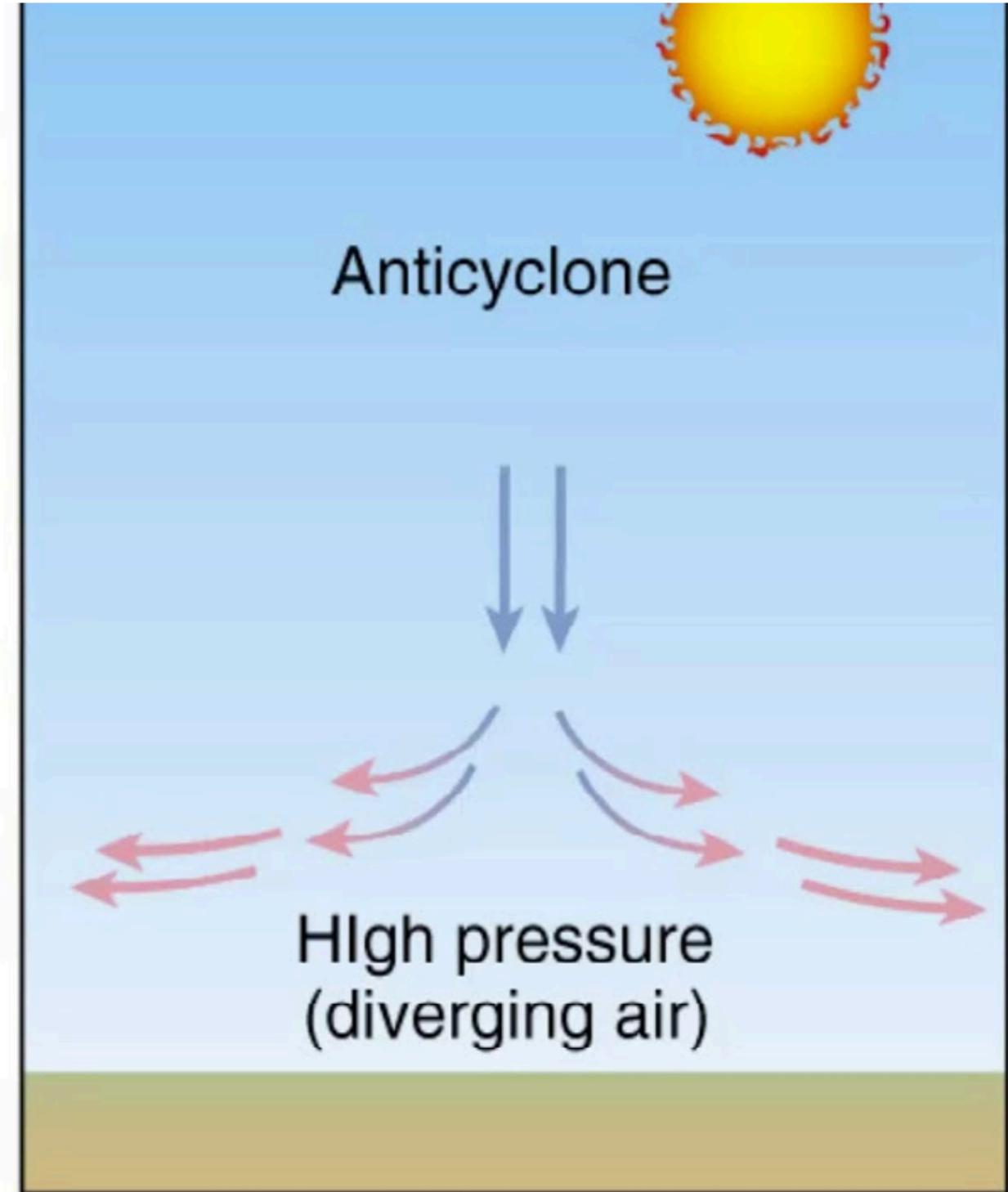


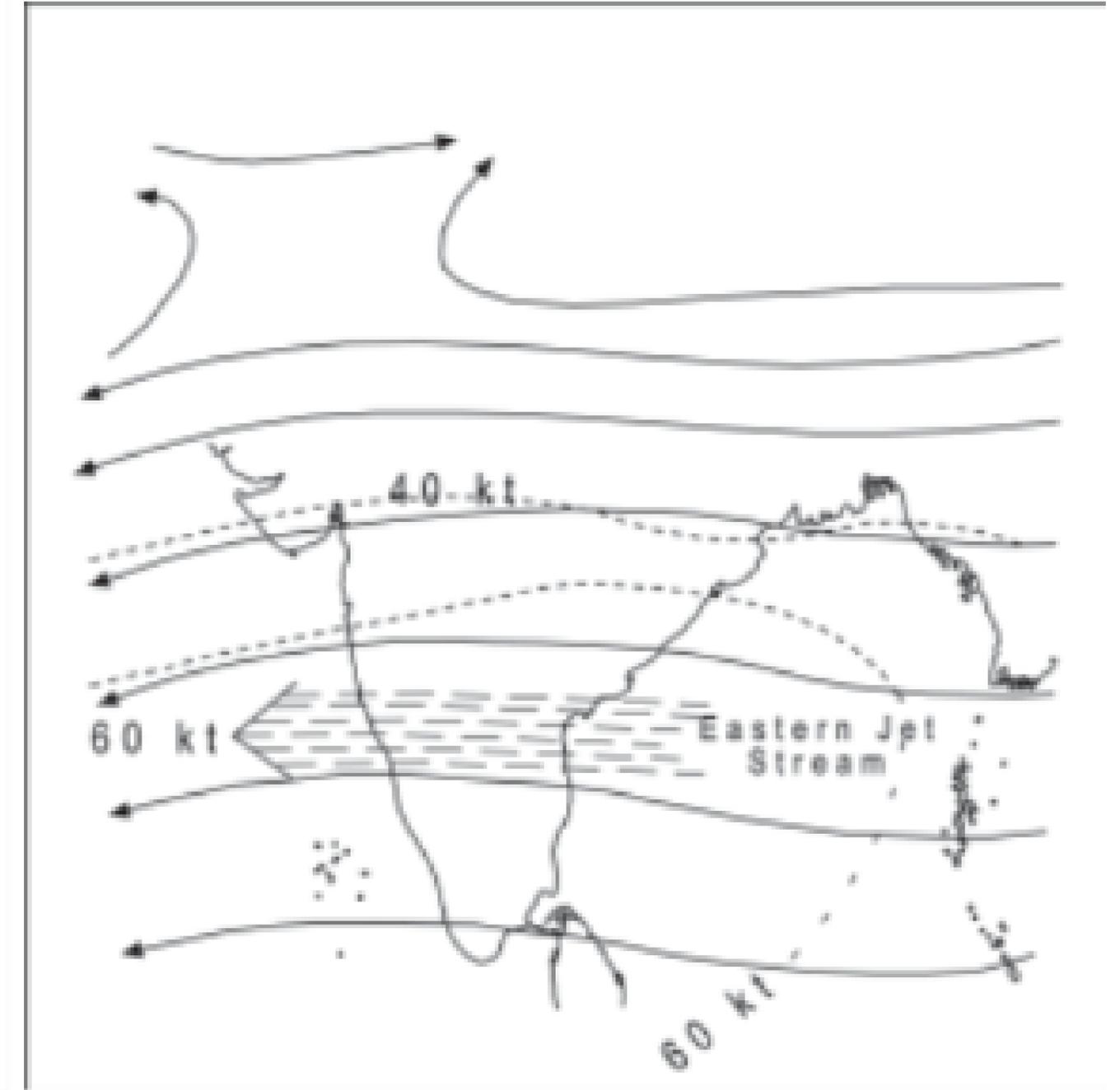
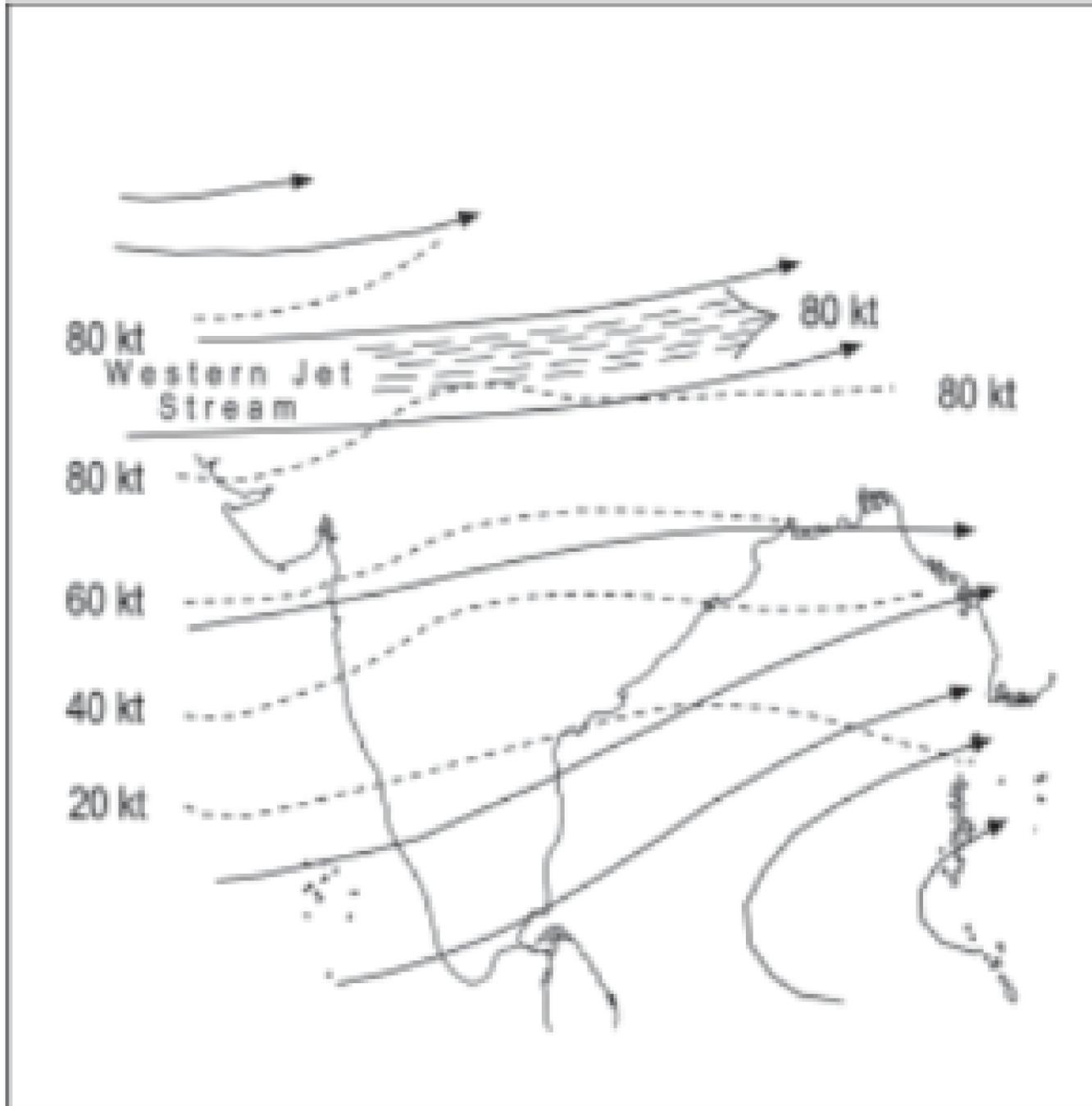


*Anticyclonic geostrophic  
clockwise flow*



*Anticyclonic divergent*







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- **These are natural seasonal features.**
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## WHAT IS IT?

# Combustion: a question of fuel

### Vasudevan Mukunth

Internal combustion engines are everywhere, yet they are not a common sight. They power most cars and motorcycles by combusting a fossil fuel like petroleum (although these vehicles are slowly being replaced by electric vehicles).

Combustion is a type of chemical reaction called a redox reaction, short for 'reduction-oxidation'.

Here, one substance loses electrons and the other gains them. The losing substance is called the oxidant. (Historically, the oxidant was a substance that provided oxygen atoms in a reaction. Over time chemists generalised the term to include all substances that participated in a chemical reaction the way oxygen did, by donating electrons.) The gaining substance is called the reductant. During combustion, the fuel is the reductant.

All combustion reactions release energy. Sometimes, the heat energy in this release will vaporise the fuel, producing a flame. The combustion reaction also releases a gaseous mix of highly oxidised matter called smoke. Combustion science is the branch of science devoted to studying combustion.

The combustion of fossil fuels in internal combustion engines and industrial processes is an

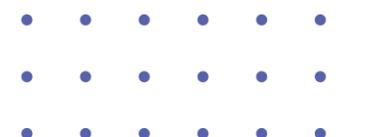


Combustion is a type of chemical reaction called a redox reaction. CULLAN SMITH/UNSPLASH

important cause of global warming. Combustion scientists study the reaction in different ways — including in space — to understand the different ways it can be controlled and the reaction products made cleaner.



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# Internal combustion engine

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## BIG SHOT



The old sunken town of Pantabangan in Nueva Ecija province, Philippines. Due to a severe drought in the Philippines, a settlement submerged since the 1970s has reemerged. This is the sixth appearance of the 300-year-old ruins, including parts of a church and tombstones, since the construction of a dam. The reservoir's water level has dropped nearly 50 meters below normal as the country faces extreme heat exacerbated by El Niño conditions, leading to official drought declarations in about half of the country's provinces.

GETTY IMAGES



# Pantabangan

- The old sunken town of Pantabangan in Nueva Ecija province, Philippines.
- Due to a severe drought in the Philippines, a settlement submerged since the 1970s has reemerged.
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The Hindu analysis by saurabh pandey sir



# The significance of carrier aviation

Why is the success of the INS Vikrant important? Who were involved in the development of DMR-249 steel? Is India on its way to get a 'third' aircraft carrier? Why is it important that the country should have a strong naval presence in the Indian Ocean Region (IOR)?

## EXPLAINER

Dinakar Peri

### The story so far:

In March 5, both aircraft carriers of the Indian Navy, INS Vikramaditya and INS Vikrant, showcased "twin carrier operations" with MiG-29K fighter jets taking off simultaneously from both and landing cross deck as Defence Minister Rajnath Singh looked on from onboard one of them. This demonstrated an ability that only a handful of nations can boast of. Further one of the carriers, INS Vikrant is indigenously designed and constructed. Commissioned in September 2022, INS Vikrant has been fully operationalised and integrated into the operational cycle in record time. As the two carriers sailed, they were joined by a flotilla of frontline warships of the Indian Navy, a combined tonnage of around 1,40,000 as well as aircraft.

### What does INS Vikrant signify?

A carrier is a floating city. The design work on the Indigenous Aircraft Carrier (IAC)-I, later christened Vikrant, began in 1999; however 2005-2006 were probably the most crucial years for the carrier and for India's war shipbuilding. The crucial decision was on the warship grade steel, which till then was procured from Russia. After much brainstorming, it was decided that it would be developed and produced in India, a collaborative effort between the Steel Authority of India, the Defence Research Development Organisation (DRDO) and the Indian Navy. The decision on the development of DMR-249 steel was a commercial decision, Madhu S. Nair, Chairman and Managing Director (CMD), Cochin Shipyard Limited (CSL) said speaking to *The Hindu* shortly after the commissioning of Vikrant. DMR-249 steel is now being used for the construction of all warships in the country.

The construction also ushered in several new processes and spin-offs benefitting the shipbuilding industry at large. For instance, in 2002, 3-D modelling was introduced for the first time in India and a joint team of 200 personnel from the Navy's Warship Design Bureau and CSL began work. The keel of Vikrant was finally laid in 2009, launched into water in 2013 and went through extensive user acceptance trials between August 2021 and July 2022 before its eventual commissioning.

### What is the composition of INS Vikrant?

Delays notwithstanding, Vikrant is an engineering marvel. It has a total area in excess of 12,450 m<sup>2</sup> which equals to about two and a half hockey fields. The 262m long and 62m wide ship is powered by four General Electric LM2500 engines generating 88 MW of power giving it a maximum speed of 28 knots and an endurance of 7,500 nautical miles. Built at an overall cost of around ₹20,000 crore and 76% indigenous content, the ship has around 2,200 compartments, for a crew of around 1,600 that include specialised cabins to accommodate women officers and sailors. Vikrant houses two galleys which cater to all onboard, preparing upto 4,500-5,000 meals every day. The galleys start operation at 3 am every morning and continue for almost 20 hours a day, an official said. "It is equipped with state of the art automatic chapati making machines, capable of making 6,000 chapatis per meal, large cooking boilers capable of preparing 4,00 kgs of rice, dal, vegetables and other dishes." Additionally, in order to cater for



Ready for action: Aircraft carriers INS Vikramaditya and INS Vikrant in formation.

a variety of items on the menu, it is also fitted with combi-steamers, a dosa machine and ovens for preparing, idlis, dosa, breads and other bakery items.

Noting that among manufacturing activities, shipbuilding has one of the highest employment multipliers of 6.48, the economic Survey 2022-23 said that Vikrant alone engaged approximately 500 MSMEs, 12,000 employees from ancillary industries, and 2,000 CSL employees.

### What are its capabilities?

Vikrant can operate an air wing of 30 aircraft comprising MiG-29K fighter jets, Kamov-31, MH-60R multi-role helicopters, in addition to indigenous Advanced Light Helicopters and Light Combat Aircraft (Navy). It uses the STOBAR (Short Take-Off but Arrested Recovery) method to launch and recover aircraft for which it is equipped with a ski-jump to launch aircraft, and three 'arrestor wires' for their recovery. About 200 men start the day by preparing the flight deck for flying operations. "First we clean the entire flight deck of any debris or left overs. Simultaneously, the pilots are briefed for the missions in the briefing room," one official onboard explained. "After all the aircraft are started up, the entire deck vibrates and generates noise in excess of 200 decibels."

The flight deck has an independent lighting system to assist for bad weather and night operations. Once the aircraft finishes the mission, they are safely vectored back to the ship and guided for a precision landing, the official stated. "The fighters which have a hook under the belly pick up one of the three arresting gear wires on flight deck. The aircraft with a speed of more than 250 kmph is stopped within a distance of just 90m in just 2-3 seconds." Vikrant has larger deck space and visibly larger hallways compared to previous carriers including Vikramaditya, which is of similar size. India is currently negotiating with France for the purchase of 26 Rafale-M carrier jets as the MiG-29Ks are in short supply while an indigenous twin engine deck-based fighter is currently under

development. Navy Chief Admiral R. Hari Kumar had expressed confidence that they will receive it by 2034 or so.

While the present Vikrant was the first carrier built in the country, India has had a long history of operating carriers. The erstwhile 19,500 tonne Vikrant was India's first carrier purchased from the U.K., which arrived in 1961 and played a vital role in the 1971 war. Then came the 28,700 tonne INS Viraat commissioned in 1987, formerly HMS Hermes, also from the U.K. INS Vikramaditya procured from Russia and commissioned in 2013 is India's third carrier.

### After Vikrant, what next?

An aircraft carrier is fundamental to command, control and coordination of operations from the sea and to project combat power ashore, over the seas or in the air, Adm Kumar told *The Hindu*, noting that the fragile maritime security situation across the Indian Ocean Region (IOR) and India's stature as the largest resident naval power necessitate a strong and robust Navy. "Aircraft carriers play a pivotal role in this and concurrent availability of two Carrier Battle Groups facilitate credible presence and preparedness on both Western and Eastern seaboard." The Navy has already moved a case for a second Indigenous Aircraft Carrier (IAC-II), a repeat of a Vikrant-like carrier. The proposal was cleared by the Defence Procurement Board last September and has since been forwarded for approval by the Defence Acquisition Council, expected to be taken up once it meets after the elections.

The IAC-II displacing 45,000 tonnes will see some modifications and newer technologies incorporated in the original design of the Vikrant and will also be manufactured by CSL. It will take around eight to 10 years to build a new carrier, Mr. Nair said recently, as long as the basic design, engines and propulsion are kept intact. The Navy has shelved its earlier plans for a 65,000 tonne carrier given the whole new technology cycle involved and the resultant cost and timelines.

The proposed IAC-II has often been

referred to as India's third aircraft carrier. However, that is not entirely right. Design, construction and operationalisation of a carrier takes a long time and the IAC-II, if it comes in time, will be a timely replacement for INS Vikramaditya. Adm Kumar acknowledged this last year. "We are of the view that we will go for a repeat order with improved capabilities and in the meantime we will study whether we need to go for a larger carrier. Till a third aircraft carrier gets ready and is commissioned, the life of INS Vikramaditya may also come to the end of its lifetime. Then we would need to build another carrier," he said on the sidelines of Aero India 2023. Therefore effectively, for the foreseeable future, the Indian Navy will have only two aircraft carriers in operation while it has long envisioned a force structure around three carriers, two at sea while one is in maintenance. Any delay in decision making could risk India losing its expertise of building and operating carriers, reminiscent of the submarine debacle of the 1980s.

While debate around carriers versus submarines continue, there is a renewed global interest with several countries now going for carriers of varying sizes. The U.S. is fielding new super carriers, and the U.K. has inducted new carriers while France and Russia have announced plans to build new ones. Japan has begun converting its helicopter carriers to operate F-35 fighter jets. Last month, China announced that it is building its fourth aircraft carrier, likely a nuclear-powered super carrier. From commissioning its first carrier, Liaoning, in 2012, launching second carrier Shadong in 2017, third carrier Fujian in 2022 and the fourth to be unveiled soon, China's pace is absolutely unprecedented.

It is not an either/or between carriers and submarines. Each has its merits in naval warfare with profound ability to influence wars. The current global trajectory shows that, the growing carrier targeting missiles and drones notwithstanding, the days of carrier aviation seem to be bright for the foreseeable future.

## THE GIST

▼ The design work on the Indigenous Aircraft Carrier (IAC)-I, later christened Vikrant, began in 1999. One of the crucial decisions with respect to Vikrant was on the warship grade steel, which till then was procured from Russia. After much brainstorming, it was decided that it would be developed and produced in India.

▼ Vikrant can operate an air wing of 30 aircraft comprising MiG-29K fighter jets, Kamov-31, MH-60R multi-role helicopters, in addition to indigenous Advanced Light Helicopters and Light Combat Aircraft (Navy).

▼ The Navy has already moved a case for a second Indigenous Aircraft Carrier (IAC-II), a repeat of a Vikrant-like carrier.





# INS VIKRANT

- **The 45,000 metric tons vessel, 262 meters (~860 ft.) long and almost 60 meters (~197 ft) wide, is built at an estimated cost of INR 20,000 Cr. (~\$ 2.5 Bn) – almost one-fifth the cost of a regular aircraft carrier.**
- **Built by Cochin Shipyard Ltd., it is also the biggest ship ever built in India.**
- **The aircraft carrier is capable of handling 30 aircrafts & helicopters and has a maximum design speed of ~28 knots (52 km/hr). The ship has a 16-bed hospital with two operation theatres and two ICUs. Its flight deck size is nearly 12,500 sq. m – almost as big as two-and-a-half hockey fields – and can operate 12 fighter planes and 6 helicopters at once**

The Hindu analysis by saurabh pandey sir





**The Hindu analysis by saurabh pandey sir**

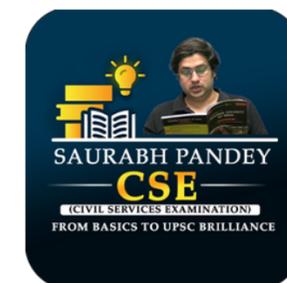


- **This development has brought India in an elite league of powerful nations that can build an indigenous aircraft carrier by themselves.**
- **While around 24 countries have past or ongoing aircraft carrier operations, only 5 nations – USA, UK, France, Russia, and China – have the capability to build their own carriers. These nations are also the five permanent UNSC members!**
- **With the induction of INS Vikrant, the Indian Navy now has two aircraft carriers in its array – INS Vikramaditya being the other one.**
- **The Indian defense forces have certainly got a boost with the latest development**

The Hindu analysis by saurabh pandey sir



# China confronts Japanese politicians in East China Sea



**Reuters**

BEIJING/TOKYO

China's coast guard confronted Japanese lawmakers in waters claimed by both countries in the East China Sea, China's embassy in Tokyo and Japanese media said on Sunday, the latest in a series of maritime disputes involving China and its neighbours.

Chinese vessels took unspecified law enforcement measures, the embassy said in a statement, adding that it had lodged solemn representations for what it called "infringement and provocation" by Japan near uninhabited islands that Beijing calls the Diaoyu and Tokyo calls the Senkaku.

The Japanese group, including former Defence Minister Tomomi Inada, was on an inspection mis-



**Troubled waters:** A China Coast Guard vessel sails near a Japan Coast Guard vessel in the East China Sea on Saturday. REUTERS

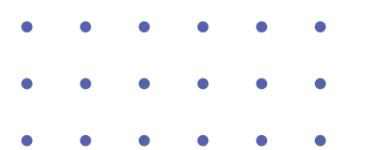
sion, according to the Chinese embassy and Japanese public broadcaster NHK. Mr. Inada's team spent three hours near the islands on Saturday, using drones to observe the area, and the Japanese coast guard vessel sought to fend off the Chinese coast guard, NHK said.

It was the first such inspection trip to the area in-

volving a member of Japan's parliament since 2013, NHK reported.

China strongly urged Japan to abide by what it called a consensus reached between the two countries and stop political provocations, the embassy said.

It asked Japan to "return to the right track... to avoid further escalation of the situation".





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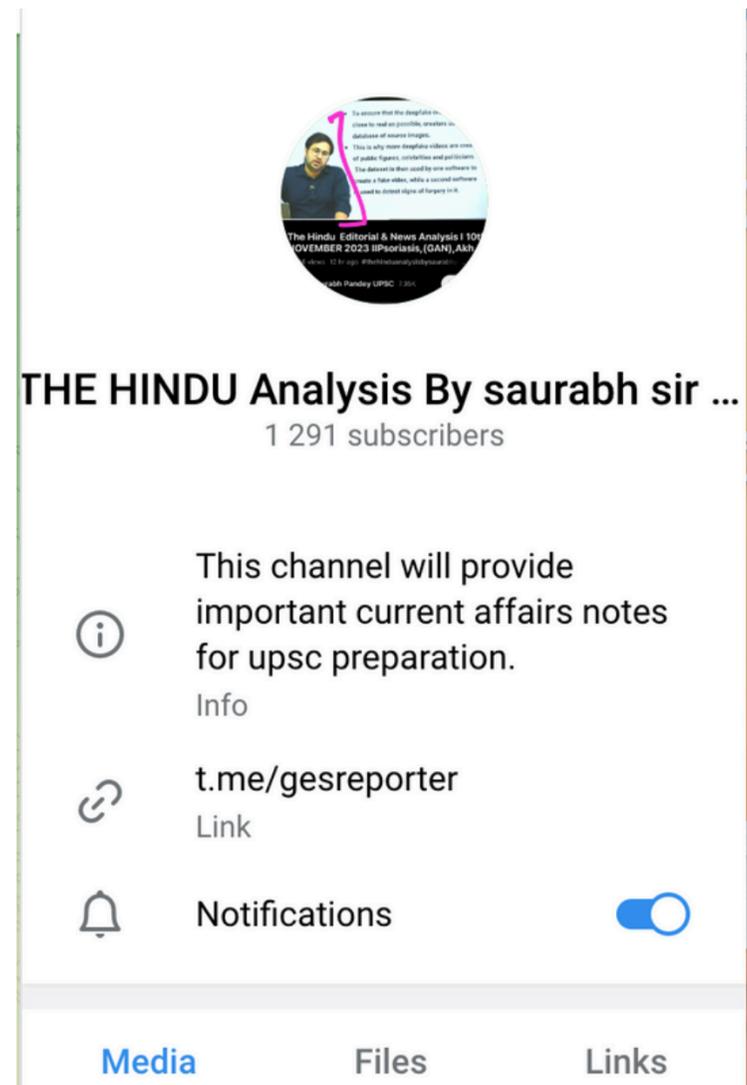


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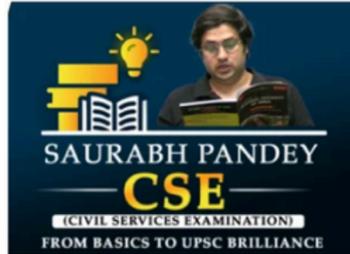


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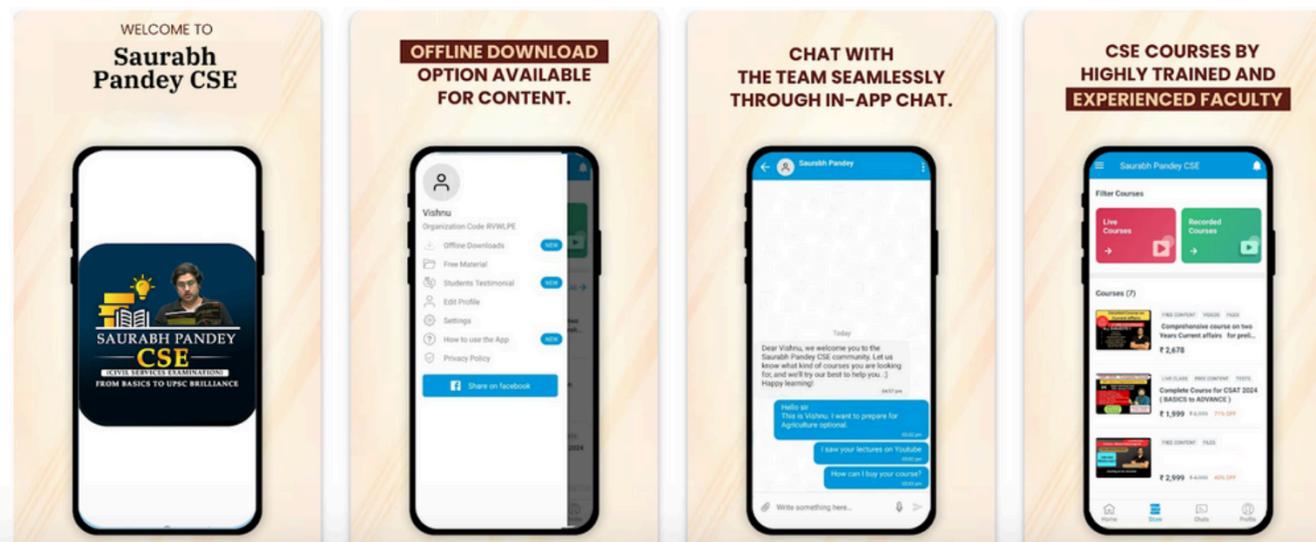
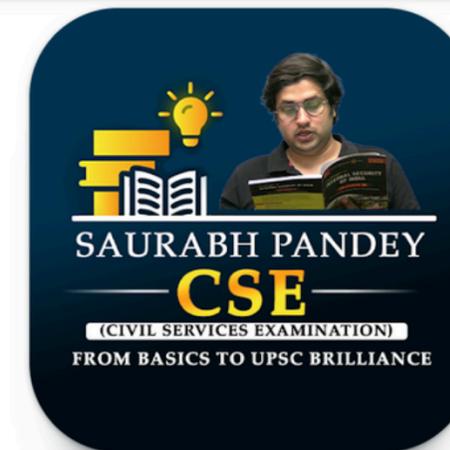
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