
Prelims Exam Topics

RK-251 DRUG

Context

The **Ministry of Science and Technology** has highlighted **RK-251**, a new targeted cancer drug candidate designed to activate mainly inside cancer cells.

About RK-251

- **Nature:** A **smart drug** designed to minimise damage to healthy cells by activating its anticancer action mainly in cancer cells.
- **Development:** Developed in collaboration with **Dr. Asis Bala of IASST** and **Dr. K.P. Bhabak of IIT Guwahati**.

Working Mechanism

- **ROS Activation:** High levels of **reactive oxygen species (ROS)** in cancer cells trigger the activation of RK-251.
- **Drug Release:** Activation releases **NBDHEX**, an anticancer compound that targets proteins involved in cancer-cell survival and treatment resistance.
- **Targeted Action:** The drug remains relatively inactive in normal tissues and becomes active in the **ROS-rich environment of cancer cells**.

Key Findings

- **Cancer Activity:** Showed strong activity against **triple-negative breast cancer cells**, with lower effects on healthy cells.
- **Fluorescence:** Produces a **fluorescence signal in the presence of ROS**, helping indicate drug activation inside cancer cells.
- **Potential:** Could offer a more targeted approach than conventional chemotherapy, but further research and clinical evaluation are required.

PARICHHA DAM

Context

The **International Commission on Irrigation and Drainage (ICID)** has recognised the historic **Parichha Dam** as a **World Heritage Irrigation Structure (WHIS)**.

About Parichha Dam

- **Location:** Built on the **Betwa River** in **Jhansi, Uttar Pradesh**.
- **Irrigation Role:** Forms part of the **Betwa Canal System**, supplying irrigation water to drought-prone areas of **Bundelkhand** in Uttar Pradesh and Madhya Pradesh.
- **Legacy:** Has supported irrigation in the region for nearly **140 years**.

About World Heritage Irrigation Structure (WHIS)

- **Programme:** **International Commission on Irrigation and Drainage (ICID)** recognises historically significant irrigation and drainage structures for their **engineering, historical and continuing agricultural importance**.
- **Eligibility:** Structures must generally be **more than 100 years old** and functionally related to agricultural water management.
- **Structures Covered:** Includes **irrigation dams, water-storage structures, barrages, diversion structures, canal systems, old waterwheels, shadoofs and agricultural drainage structures**.

About ICID

Established: 1950; an international, non-governmental, not-for-profit organisation working on **irrigation, drainage and flood management** to promote sustainable agricultural water management, with its headquarters at New Delhi.

DIVYASTRA MK3

Context

Lucknow-based defence start-up **Kawa UAV Pvt. Ltd.** has conducted the maiden flight test of the **Divyastra Mk3**, an indigenously designed and manufactured **jet-powered loitering munition**.

About Divyastra Mk3

- **Nature:** Indigenous **loitering munition**, designed to destroy enemy personnel, infrastructure and high-value assets by striking targets with an onboard warhead.
- **Developer:** Developed by **Kawa UAV Pvt. Ltd.** of Lucknow.
- **Propulsion:** Uses an **indigenous jet-propulsion system** developed by **DG Propulsion, New Delhi**.

Key Features

- **Jet Propulsion:** Uses a compact **jet engine** instead of a propeller-driven piston engine or electric motor, enabling higher speed.

- **Autonomous Operation:** Incorporates **autonomous flight control and AI-enabled target engagement**.
- **Indicative Specifications:** Reported estimates suggest a range of **300–400 km**, speed of **250–300 km/h**; official specifications are not disclosed.
- **Strategic Advantage:** Higher speed can reduce the time available for an adversary to **detect, track and intercept the** incoming munition.

CHRISTMAS ISLAND

Context

SpaceX recently towed its **Starship** to waters near Christmas Island after it remained in the Indian Ocean for nearly 24 days.

About Christmas Island

- **Location & Status:** Australian external territory in the **Indian Ocean**, south of Java and northwest of Australia.
- **Physical Features:** An **oceanic island** formed around a submerged mountain, with its highest point at **Murray Hill (361 m)** and steep coastal cliffs.
- **Settlement:** **Flying Fish Cove** is the main settlement and principal port.

Key Features

- **History:** Sighted by Europeans in **1615**, rediscovered in **1643**; phosphate discovery in **1887** led to British annexation in **1888**. It became an **Australian territory in 1958**.
- **Biodiversity:** About **63% of the island is a national park** and it is largely covered by tropical rainforest. It is famous for the **annual migration of Christmas Island red crabs**.
- **Marine Ecosystem:** Surrounding reefs support **coral and rare marine species** and are sometimes called **Australia's Galapagos Islands**, along with reefs near the Cocos (Keeling) Islands.

SEA URCHIN

Context

Researchers at **IIT Mandi** have developed a **sea urchin-inspired coating** for 3D-printed bone implants that can mechanically disrupt bacteria and improve bone integration.

About Sea Urchin

- **Classification:** Marine invertebrate belonging to the **echinoderm** group.

- **Habitat:** Found on the **seafloor** in rocky shores, coral reefs, seagrass beds and sandy bottoms, often attached to hard surfaces.
- **Body Structure:** Has a **spherical or flattened body** covered by movable spines.

Key Features

- **Tube Feet:** Slender, extendable **tube feet** emerge through pores and help in movement and attachment.
- **Feeding:** Mainly **herbivorous**, feeding on algae and plant material using **Aristotle's lantern**, a specialised mouthpart for scraping food from surfaces.

Significance

Bio-inspired Technology: Sea urchin surface structures can inspire **antibacterial and bone-integration technologies** in biomedical implants.

AIKOSH

Context

The **IndiaAI Mission** organised a workshop on **AIKosh**, focusing on data governance, harmonisation and responsible use of AI-ready datasets.

About AIKosh

- **Nature:** National platform under the **IndiaAI Mission** for datasets, AI models and related resources.
- **Purpose:** Enables greater **discoverability, access and responsible use** of AI-ready resources for India's AI ecosystem.
- **Developer Support:** Provides resources for **researchers, startups, developers and students** to build India-specific AI applications and models.

About IndiaAI Mission

- **Nodal Ministry:** **Ministry of Electronics and Information Technology (MeitY)**; aims to strengthen India's AI ecosystem through **compute capacity, datasets and models, innovation, skills, startup support and safe & trusted AI**.

THERMAL PROTECTION SYSTEM (TPS)

Context

As ISRO prepares for the **Gaganyaan uncrewed flight tests**, the crew module's **Thermal Protection System (TPS)** will protect it during atmospheric re-entry.

About Thermal Protection System

- **Nature:** External protective layer that shields spacecraft from **extreme aerodynamic heating** during high-speed atmospheric flight and re-entry.
- **Need:** During re-entry, intense shock-layer heating can raise temperatures to around **1,800°C**, while rapid deceleration makes passive thermal protection essential.
- **Function:** Protects the spacecraft structure and maintains a **safe temperature inside the crew module**.

How an Ablative TPS Works?

- **Heat Absorption:** The outer material absorbs intense heat and undergoes **pyrolysis**, a heat-driven chemical decomposition.
- **Char Formation:** The outer layer gradually breaks down and forms a **carbon-rich char layer**, which insulates the material below.
- **Mass Loss:** Material is progressively lost from the surface, carrying heat away from the spacecraft.
- **Gas Cushion:** Gases released during pyrolysis move outward and help reduce **convective heat transfer** to the capsule.

Key Features of Gaganyaan TPS

- **Thickness:** Heat shield is about **30–35 mm thick**, while maintaining structural temperatures below **150°C**.
- **Heat Shield Materials:** **Carbon-phenolic tiles** are used on the forward/nose section, while **silica-phenolic ablative tiles** protect the side and rear sections.
- **Technology Heritage:** Builds on ISRO's earlier experience with **ablative heat shields**, including the **Space Capsule Recovery Experiment (SRE)** and **Crew Module Atmospheric Re-entry Experiment (CARE)**.

ZHUQUE-3 Y2 REUSABLE LAUNCH VEHICLE

Context

Chinese private company **LandSpace** successfully launched **Zhuque-3 Y2**, placed the **Honghu-03 satellite** into orbit and recovered its first stage through a soft landing in Gansu.

About Zhuque-3

- **Nature:** Two-stage, **partially reusable orbital launch vehicle** developed by LandSpace, designed for **vertical take-off and vertical landing (VTVL)**.
- **Propulsion:** Uses **liquid oxygen-methane (methalox)** propulsion.
- **Objective:** Reduce launch costs by **recovering and reusing the first stage**, enabling frequent and economical satellite launches.

Key Features

- **Methalox Engines:** First stage uses **nine Tianque-12A engines**, generating over **760 tonnes of thrust**; methane produces less soot, supporting engine reuse.
- **Stainless-Steel Structure:** Uses a **stainless-steel airframe** for high-temperature resistance, re-entry durability and lower manufacturing costs.
- **Payload Capacity:** About **66.1 m long and 4.5 m wide**, with an estimated liftoff mass of **570 tonnes**; can carry about **14.2–18.3 tonnes to Low Earth Orbit (LEO) in expendable mode**.

Mains Exam Topics

SURROGATE ADVERTISING IN INDIA

Context

Regulators have issued **show-cause notices to celebrities** endorsing products such as flavoured cardamom, citing their potential to promote banned **pan masala** indirectly. The action highlights growing scrutiny of **surrogate advertising, celebrity accountability and public health compliance** in India.

How does surrogate advertising leverage brand recall to influence consumers in India?

- **Persistent Brand Visibility:** Surrogate advertisements repeatedly expose consumers to the **same brand identity**, keeping the restricted product brand in memory.
 - **Eg: Bagpiper Club Soda** uses the Bagpiper brand name and visual identity associated with its whisky brand.
- **Implicit Product Association:** The surrogate product acts as a **memory cue**, triggering consumers to recall the underlying restricted product.
 - **Eg: Imperial Blue Music CDs** have historically used the Imperial Blue identity, indirectly reinforcing recall of Imperial Blue whisky.
- **Positive Brand Conditioning:** Surrogate advertising links the brand with **aspirational lifestyles, entertainment and social experiences**, strengthening favourable perceptions.
 - **Eg: Blenders Pride Fashion Tour** connected the Blenders Pride brand with fashion, glamour and premium lifestyle imagery.
- **Repeated Recall at Purchase:** Frequent exposure increases **brand familiarity and top-of-mind recall**, which can influence consumers when choosing among competing products.
 - **Eg: Haywards 5000 Soda** advertising kept the Haywards name visible to consumers and reinforced recall of the beer brand.
- **Normalisation of Restricted Brands:** Indirect advertising keeps restricted brands **socially visible and culturally familiar**, allowing brand communication to survive regulatory restrictions.
 - **Eg: Pan Bahar** has used mouth-freshener advertising and celebrity-led campaigns to maintain visibility of the Pan Bahar brand despite restrictions on direct tobacco advertising.

How does digital advertising make surrogate advertising more difficult to regulate in India?

- **Disguised Promotion:** Influencer content and branded entertainment can promote restricted brands without appearing as conventional advertisements.
 - **Eg:** A liquor brand promoting a **music event through an Instagram influencer** can reinforce the parent brand without showing the liquor product.
- **Fragmented Dissemination:** Content is distributed across **Instagram, YouTube, OTT platforms and apps**, making comprehensive monitoring difficult.
 - **Eg:** The same **brand-sponsored lifestyle campaign** may appear as reels, videos and influencer posts across multiple platforms.
- **Micro-Targeting:** Algorithms deliver content to **specific consumer groups**, reducing regulatory visibility over who receives the advertisement.
- **Ephemeral Content:** Stories, disappearing posts and rapidly deleted content make **evidence collection and enforcement** difficult.
- **Diffuse Accountability:** Responsibility can be spread across the **brand, advertising agency, influencer and platform**, complicating enforcement.
- **Cross-Border Reach:** Digital advertisements can reach Indian consumers even when content is hosted or distributed outside India.

Why does regulating surrogate advertising raise concerns about business freedom in India?

- **Commercial Speech:** Restrictions can limit businesses' freedom to communicate with consumers through commercially relevant speech.
 - **Eg:** In *Tata Press Ltd. v. MTNL (1995)*, the Supreme Court protected commercial advertising under **Article 19(1)(a)**, showing that advertising restrictions can implicate free-speech rights.
- **Legitimate Brand Extension:** Businesses may face restrictions on advertising **lawful products** simply because their brand is associated with a prohibited product.
- **Brand-Building Freedom:** Strict regulation can constrain companies' ability to build a **unified brand identity across** legally permissible product categories.
 - **Eg:** A liquor company launching **packaged drinking water under its established brand** may be unable to freely use the parent brand in advertising if regulators consider it an indirect promotion of alcohol.

- **Regulatory Uncertainty:** Ambiguous boundaries between genuine extension and surrogate promotion can make businesses uncertain about **what constitutes permissible advertising**.
- **Proportionality:** Overbroad restrictions may suppress legitimate commercial activity beyond what is necessary to prevent indirect promotion.
 - **Eg:** A blanket ban on all advertising using an alcohol brand's identity could also restrict advertising for a **genuinely established non-alcoholic product**, creating a disproportionate burden on lawful business activity.

Way Forward

- **Legalise Regulatory Standards:** Give stronger statutory backing to recognised advertising standards, with **clear penalties, advertisement withdrawal and repeat-offender sanctions** rather than relying mainly on self-regulation.
- **Define Surrogate Advertising Clearly:** Establish a **precise legal definition** covering indirect promotion of prohibited products and harmonise standards across television, print, OTT, digital and social media.
- **Ensure Swift Enforcement:** Strengthen coordination among regulators to enable **rapid investigation, takedown and penalties** against brands, agencies and intermediaries involved in violations.
- **Cover Emerging Promotion Channels:** Extend regulation to **sponsorships, events, influencer marketing, branded content and digital campaigns** so that firms cannot circumvent restrictions through alternative promotional routes.
- **Use Technology for Monitoring:** Deploy **AI, data analytics and automated content detection** to identify recurring brand cues, influencer promotions and surrogate campaigns across digital platforms.
- **Build Consumer Media Literacy:** Conduct public-awareness campaigns to help consumers **recognise indirect brand promotion**, particularly among young and digitally exposed audiences.
- **Strengthen Industry Responsibility:** Encourage advertisers and brands to adopt **transparent brand-extension practices, responsible endorsements and internal compliance mechanisms**, complemented by effective self-regulation.
- **Fix Endorser Accountability:** Enforce existing consumer-protection provisions against **celebrities and influencers** who knowingly promote prohibited products through disguised or surrogate advertising, including financial penalties and restrictions on endorsements.