Topics

- Light and Viral infection
- Venus Volcanism and Magellan
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By saurabh Pandey

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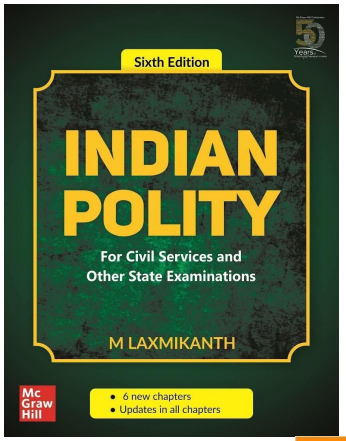

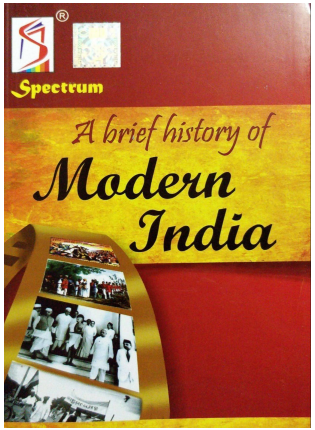

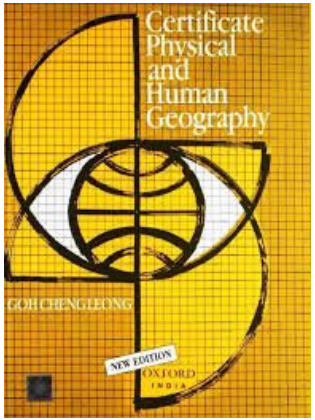

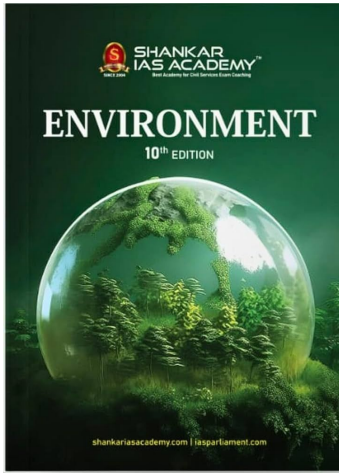

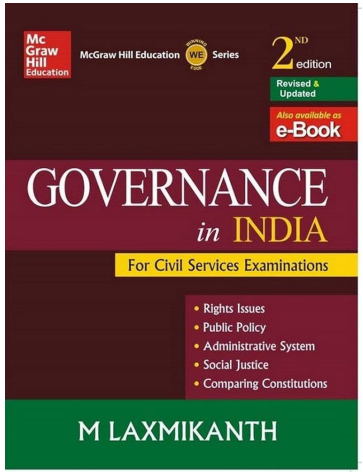

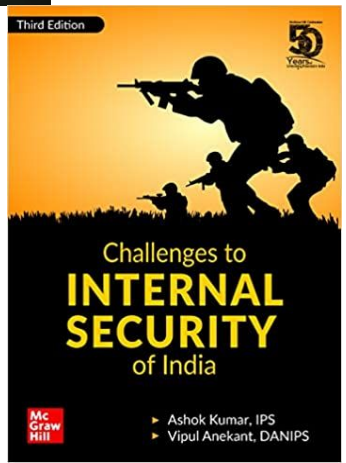

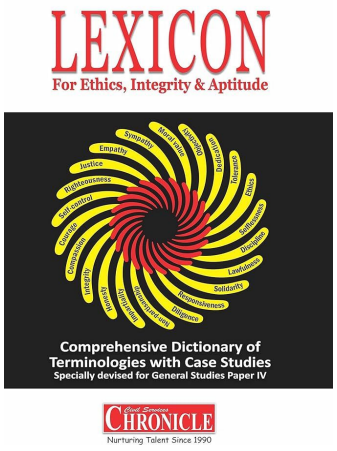

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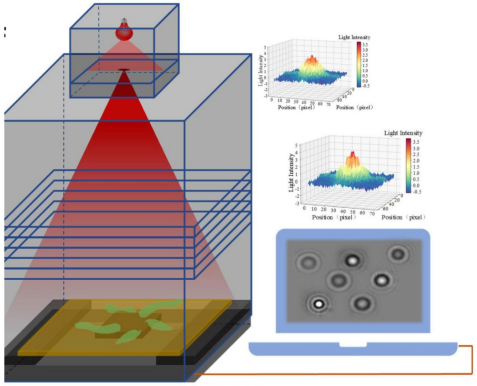
New light-based tool could cut cost of spotting viral infections

A viral infection can stress cells and change their shapes and sizes. As the infection gains the upper hand and the body becomes 'diseased', the changes become more stark. Researchers have translated these cellular changes into patterns that can be used to say if a cell has been infected

Joel P. Joseph



A schematic diagram of the test setup which could reduce the cost of testing livestock for virus. DOI: 10.1126/SCIADV.ADL3466

Viruses infect plants, animals, and humans. A virus' spread from animals to humans could unleash pandemics like COVID-19 – significant public health crises with considerable economic and social fallout. To nip such infections in the bud, public health researchers have advocated the 'One Health' approach: monitoring and protecting plant, animal, environment, and human health in an integrated fashion.

Quick, easy, and cost-effective methods of detecting viral infections can go a long way in ensuring this outcome. Recently, researchers from Harvard University, Cambridge, and Jiangsu University, Zhenjiang, reported developing one such tool: it can detect if cells have been infected by a virus using only light and some knowledge of high-school physics.

Their paper was published in the journal *Science Advances* in March this year.

A fingerprint of infection

A viral infection can stress cells and change their shapes, sizes, and features. As the infection gains the upper hand and the body becomes 'diseased', the changes become more stark.

The researchers behind the new study translated these cellular changes into patterns that could be used to say if a cell had been infected. They infected cells from a pig's testicles with pseudorabies virus, shone light on them through a microscope, and tracked how changes in the cells distorted the light.

The researchers recorded these distortions at different points of time so that the light data mimicked a progressing viral infection. Then they compared these distortions with those in light that had been shone through healthy cells. They finally reported that the difference between the two light patterns represented a 'fingerprint' of virus-infected cells.

Changes in contrast

The distortion in question referred to diffraction patterns. Diffraction is the tendency of light waves to spread out after they pass through narrow openings or around small objects. Once this diffracted light reaches, say, a wall, it renders a pattern of alternating light and dark rings or stripes around a dark centre.

The fingerprint was based on two parameters: the contrast between the light and dark stripes and the inverse differential moment, a mathematical value that defined how textured the diffraction pattern was.

The method can differentiate between uninfected, virus-infected, and dead cells. Virus-infected cells were elongated and had more clear boundaries than uninfected cells. This changed the contrast between light and dark stripes of the diffraction fingerprint, and increased the differences in light intensity.

Less time, money, complexity

Current methods to detect virus infections in cells are not straightforward. For example, in one technique, researchers isolate infected cells in the lab and add chemical reagents like dimethyl thiazolyl diphenyl tetrazolium bromide to them. The reagent destroys the cells, but not before the enzymes in the cells – called oxidoreductases and dehydrogenases – react with the reagent to produce purple crystals of a chemical entity called formazan. This colour change tells researchers the cells could have had a viral infection. Cells dying of a viral infection lack these enzymes and thus produce little to no amounts of formazan crystals.

The researchers compared their new technique with this standard for accuracy, time, and cost. They reported that their light-based method could detect viral infections as accurately or even more accurately than the standard method.

The new method was also cheaper than the standard: while the equipment cost for the standard method using chemical reagents is about $3,000 (₹2.5 lakh), the cost of the new method described in this paper was about a tenth. Many research facilities around the world also procure reagents from other places, adding potential time delays and vulnerability of their research to supply-chain inefficiencies.

Finally, the new method reportedly takes only about two hours to detect virus infected cells, against the 40 hours the current standard required.

Advantages for livestock

According to the paper, the researchers placed a sample of cells on slides under a microscope and light was shone on them. They obtained and subsequently analysed the diffraction fingerprint, and correlated each fingerprint with the corresponding condition of the cells. The team is yet to conduct real-world tests.

> Researchers have developed a tool that can detect cells infected by a virus using only light and some knowledge of high-school physics

The low cost and ease of use point are likely to be lucrative to people working closely with animals, especially "livestock or common pets such as dogs and cats," the researchers wrote in their paper. The new tool can help spot viral infections in their bodies as well as for "the selection and breeding of excellent livestock and poultry species at the cellular level."

A new tool in the arsenal

Indeed, the new method could help catch viral infections early – which could be very helpful during, say, a virulent bird flu outbreak. The one going on around the world killed more than 131 million poultry in 81 countries in 2022 and 2023, according to the World Health Organisation.

Scientists typically test samples from any part of the bird the virus could infect: windpipe, cloaca (the waste chamber for urine and faeces), or their waste itself. If a bird dies after displaying the symptoms associated with the infection, they also look for the pathogen in the carcase's tissues.

The methods they use include polymerase chain reaction (of the 'PCR' fame during the COVID-19 pandemic) or antigen tests, which detect the genes or proteins associated with the H5N1 virus.

While the new method is not specific to certain kinds of viruses, it can help detect viral infections in general and help stakeholders take preventive measures in time to avoid significant losses.

In fact, the tool's generic nature could also be an advantage by catching a viral infection that is not due to H5N1, perhaps even a new virus.

Against the spread of viruses

Viral outbreaks in animals have significant economic consequences. According to a 2018 study in the journal *Transboundary and Emerging Diseases*, bird flu outbreaks in the Kuttanad region of Kerala imposed losses of ₹23 lakh in 2014. The study also estimated the Government of Kerala spent ₹5.4 crore "to contain the spread of the disease through massive culling, surveillance and monitoring of poultry and humans due to [the] zoonotic nature of the disease."

Against this backdrop, a rapid and cost-effective way to detect viral infections could help improve surveillance and reduce the cost of selecting healthy animals or birds for breeding. The existing methods to select animals for breeding require expensive DNA-sequencing tools, even if these tools are very good at identifying some desired features in an animal.

The light-based tool could also help low- and middle income countries with limited resources to realise the WHO's recommendation to "rapidly detect, report and respond to animal outbreaks as the first line of defence" against the spread of viruses.

(Joel P. Joseph is a freelance science journalist and researcher)

Light and Viral infection

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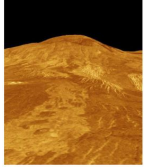

A computer-generated 3D model of Venus shows the volcano Sif Mons, which is 300 km wide. REUTERS/NASA

More volcanism on Venus than was previously known: study

Reuters

Venus appears to be more volcanically active than previously known, according to scientists whose new analysis of decades-old radar images has spotted evidence of eruptions at two additional sites on the surface of the earth's inhospitable planetary neighbour.

Radar images obtained by NASA's Magellan spacecraft from 1990 to 1992 indicated large lava flows at these two locations in the Venusian northern hemisphere at the time of the observations, the researchers said. These findings, coupled with previous studies, indicate that the planet's volcanic activity is comparable to the earth's, they added.

Magellan mapped 98% of the Venusian surface. Advances in computing capability have made analysing Magellan's radar data easier in recent years.

"These findings significantly change our understanding of the degree to which Venus is volcanically active, suggesting it could be much more active than previously thought," said planetary scientist Davide Sulcanese of D'Annunzio University in Pescara, Italy, lead author of the study published this week in the journal *Nature Astronomy*.

One of the two sites is a volcano called Sif Mons, which is about 300 km wide

Magellan mapped 98% of the Venusian surface. Advances in computing capability have made analysing Magellan's radar data easier in recent years

and situated in a region called Eistla Regio. The before-and-after radar images indicate a lava flow amounting to about 30 sq. km of rock. The other site is a large volcanic plain in a region called Niobe Planitia. About 45 sq. kilometers of rock was produced in this lava flow.

"Both Sif Mons and the volcanoes in Niobe Planitia are shield volcanoes, characterized by broad, gentle slopes formed by low-viscosity lava flows," said d'Annunzio University planetary scientist and study co-author Giuseppe Mitri.

The new rock at both locations was estimated to have an average depth between about three and 20 meters.

"The lava flows observed along the western flank of Sif Mons exhibit linear features with sinuous patterns that follow the direction of the maximum slope, generally towards the west," said planetary scientist and study co-author Marco Mastrogiuseppe of University Sapienza in Rome and Link Campus University in Rome.

"Regarding the flows in Niobe Planitia, the lava flows appear to originate near small shield volcanoes and extend towards the northeast, also following the direction of the slope," Dr. Mastrogiuseppe added.

The new study builds on previous findings of ongoing Venusian volcanic activity. A 2023 study found that a volcanic vent on Maat Mons in a region called Atla Regio, near the equator, expanded and changed shape during the Magellan mission.

"Our study is the first to provide direct proof of lava flows formed during the Magellan mission period," Sulcanese said.

Studying volcanic activity provides a fuller understanding of a planet's internal heat and geological processes. "It provides insights into the planet's thermal evolution, surface renewal processes and atmospheric interactions," according to

Venus Volcanism and Magellan

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The Magellan spacecraft

- The Magellan spacecraft, which arrived at Venus in 1990, made the first global map of the surface of Venus as well as global maps of the planet's gravity field.
- The mission produced surprising findings about Venus, including a relatively young planetary surface possibly formed by lava flows from planet-wide volcanic eruptions.
- In October 1994, the Magellan spacecraft intentionally plunged to the surface of Venus to gather data on the planet's atmosphere before it ceased operations.
- It marked the first time an operating planetary spacecraft had been intentionally crashed.

An overview of the AMRUT scheme

What was the purpose of the Atal Mission for Rejuvenation and Urban Transformation? What was the revenue set aside for the scheme? What has been its progress so far? What are the various shortcomings and how should they be addressed?

EXPLAINER

Tikender Singh Panwar

The story so far:

Around 36% of India's population is living in cities and by 2047 it will be more than 50%. The World Bank estimates that around $840 billion is required to fund the bare minimum urban infrastructure over the next 15 years. The AMRUT (Atal Mission for Rejuvenation and Urban Transformation) scheme was a flagship programme launched by the NDA-1 government in June 2015, with its 2.0 version launched on October 1, 2021.

What is the AMRUT scheme?

Some of the challenges in infrastructure development with respect to water, mobility, and pollution were to be met by this scheme with some financial assistance from the Centre and the rest of the share mobilised by both States and respective cities. The mission was drawn to cover 500 cities and towns with a population of over one lakh with notified municipalities. The purpose of the AMRUT mission was to (i) ensure that every household has access to a tap with assured supply of water and a sewerage connection (ii) increase the value of cities by developing greenery and well-maintained open spaces such as parks and (iii) reduce pollution by switching to public transport or constructing facilities for non-motorised transport. The total outlay for AMRUT was ₹50,000 crore for five years from FY 2015-16 to FY 2019-20.

AMRUT 2.0 was aimed at making cities 'water secure' and providing functional water tap connections to all households in all statutory towns. Ambitious targets were set up such as providing 100% sewage management in 500 AMRUT cities. The total outlay for AMRUT 2.0 is ₹2,99,000 crore, with the Central outlay being ₹76,760 crore for five years, and the rest of the amount to be mobilised by the States and cities.

At work: The Lions Park being renovated under AMRUT-2 by Kozhikode Corporation in 2023. FILE PHOTO

How much money has been utilised?

The AMRUT dashboard shows that as of May 19, 2024, a sum of ₹83,357 crore has been dispersed so far. This amount has been utilised to provide a total of 58,66,237 tap connections, and 37,49,467 sewerage connections. A total of 2,411 parks have been developed, and 62,78,571 LED lights have been replaced. These works include the contributions made by States and cities.

What is the reality?

It is estimated that about 2,00,000 people die every year due to inadequate water, sanitation and hygiene. In 2016, the disease burden due to unsafe water and sanitation per person was 40 times higher in India than in China. This has not improved much. Huge amounts of waste water and little treatment enhances the vulnerability and incidence of diseases. The 150 reservoirs monitored by the central government, which supplies water for drinking and irrigation, and are the country's key source of hydro-electricity, were filled to just 40% of its capacity a few weeks ago. Around 21 major cities are going to run out of ground water. In a NITI Aayog report it was stated that 40% of India's population will have no access to drinking water by 2030. Nearly 31% of urban Indian households do not have piped water; 67.3% are not connected to a piped sewerage discharge system; and average water supply per person in urban India is 69.25 litres/day, whereas the required amount is 135 litres.

Additionally, air quality in AMRUT cities and in other large urban settlements continue to worsen. A National Clean Air Programme was launched by the central government in 2019, as AMRUT 2.0 focused only on water and sewerage and because the air quality concerns of AMRUT 1.0 were far from addressed.

What went wrong?

The basic fundamental of the scheme was erroneously constructed. Instead of a holistic approach, it took on a project-oriented attitude. Furthermore, AMRUT was made for cities with no participation from the cities. It was quite mechanical in design, with hardly any organic participation of the elected city governments, and driven by mostly private interests. The project was owned by bureaucrats, parastatals, and large technology-based companies. For example, in the governance architecture, the apex committee is headed by the secretary of the Ministry of Housing and Urban Affairs (MOHUA) and all the members are non-elected. Similarly, the State level high powered committee is headed by the chief secretary with a private nexus of consultants and professionals. Peoples' representatives are completely missing, in violation of the 74th constitutional amendment.

Moreover, water management in cities must factor in climate and rainfall patterns of the area and existing infrastructure of combined sewers. It is no big surprise that most of the sewage treatment plants are designed in such a way that the travel distance of average faecal matter is more than the average commute of a worker to work! Since the drivers are large private players and builders, real estate development has become a proxy for urban planning – disappearance of water bodies and lakes, disrupted storm water flows, and absence of storm water drainage is very common.

The scheme needs nature based solutions and a comprehensive methodology with a people centric approach and empowering local bodies.

Author is former Deputy Mayor, Shimla, and Member, Kerala Urban Commission.

THE GIST

- The AMRUT (Atal Mission for Rejuvenation and Urban Transformation) scheme was a flagship programme launched by the NDA-1 government in June 2015.
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Amrut scheme

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- **The total outlay for AMRUT was ₹50,000 crore for five years from FY 2015-16 to FY 2019-20.**
- **AMRUT 2.0 was aimed at making cities ‘water secure’ and providing functional water tap connections to all households in all statutory towns.**
- **Ambitious targets were set up such as providing 100% sewage management in 500 AMRUT cities.**

RITES looks to increase exports to boost order book and profit margins

Maitri Porecha
NEW DELHI

Crossing borders: The firm expects to turn the tide by raising exports as it gears to supply 200 coaches to Bangladesh Railway. AFP

Indian Railway PSU RITES declared a marnigally lower net profit and revenue in FY24 compared with FY23 due to a significant dip in exports revenue and its quality assurance business. The company expects to turn the tide by raising it's exports business as it gears up to supply 200 coaches to Bangladesh Railway, an order worth ₹915 crore.

The firm's FY24 net profit was ₹495 crore down from ₹571 crore year-on-year (YoY).

Speaking to *The Hindu*, Rahul Mithal, Chairman and MD, RITES Ltd. said exports revenue was a mere ₹6 crore in Q4 FY24. With the "signing of agreements to supply ten locomotives to Mozambique and 200 passenger coaches to Bangladesh Railway, revenue from the export is expected to pick up from second half of FY25," Mr. Mithal added.

"While coaches are quicker to make, locomotives are heavier pieces of equipment than coaches and take longer to manufacture. Final designs and approvals are underway. We have to freeze the designs and get prototypes approved before starting mass manufacture," Mr. Mithal said.

While the export order for Bangladesh is being funded by the European Investment Bank, an export order that RITES was expecting with the National Railways of Zimbabwe has been delayed. "The order will go through, subject to Zimbabwe securing funding. We had signed an MoU with Zimbabwe and have been in touch with them to convert it into formal LoA," he said.

On the India Middle East EU Corridor (IMEC) front, Mr. Mithal said following last year's G20 announcement to establish trade links between India, Middle East and Europe, and the intergovernmental framework agreement signed between India and the UAE in February, feasibility assessments along the corridor have begun.

"One port each from India and the UAE are being identified to prepare a proof of concept (PoC) to establish ease of movement, executing digitisation while moving cargo on an alternate route. It is like a confidence building measure, and the PoC can be replicated along other legs of the corridor," Mr. Mithal said.

Among the ports that could be connected on the India's west coast, Mundra and Kandla in Gujarat, and Jawaharlal Nehru Port Trust in Navi Mumbai, have been identified. In the Middle East, at least five ports have been shortlisted to be connected to Indian ports that include Fujairah, Jebel Ali, and Abu Dhabi in the UAE and Dammam and Ras Al-Khair in Saudi Arabia. It is to be noted that apart from government-owned ports, both Mundra in India and Haifa in Israel are privately controlled by the Adani Group, and have been highlighted in proposal documents accessed by *The Hindu*.

'Robust order book'

RITES consolidated operating revenue dipped to ₹2453 crore in FY24 from ₹2628 crore in FY23. Total revenue slid to ₹2539 crore from ₹2730 crore in FY23.

Q4 FY24 revenue was ₹668 crore against ₹706 crore in Q4 FY23. Net profit for the quarter was ₹137 crore, marginally lower ₹139 crore in Q4 FY23.

After a gap of four years, RITES received export orders worth ₹1200 crore. The firm secured more than 100 orders worth about ₹940 crore in Q4 FY24, continuing to be a 'one-order-a-day' company, Mr. Mithal said. "Q4 ended with a healthy order book of ₹5690 crore," he added.

RITES

- **RITES Limited, a Navratna and Schedule 'A' Central Public Sector Enterprise under the Ministry of Railways, incorporated on April 26, 1974,**
- **It is a multidisciplinary engineering and consultancy organization, providing a comprehensive range of services from concept to commissioning in all facets of transport infrastructure and related technologies.**
- **The company's market capitalization has placed it among the top 500 listed companies in India, a testament to the high-quality solutions and services it delivers, driven by its talented pool of professionals**

- **RITES is uniquely placed in terms of diversification of services and geographical reach in various sectors such as railways, highways, metros, tunnels, bridge, urban engineering, sustainability & green mobility, airports, ports, ropeways, institutional buildings, inland waterways, etc.**

BRUSSELS

EU creates 'AI Office' to regulate technology under tough new law

REUTERS

The European Union on Wednesday announced the creation of an "AI Office" of tech experts, lawyers and economists to regulate artificial intelligence under a sweeping new law. The EU this year approved the world's first comprehensive rules to govern AI, especially powerful systems like ChatGPT after intense talks. AFP

AI Office

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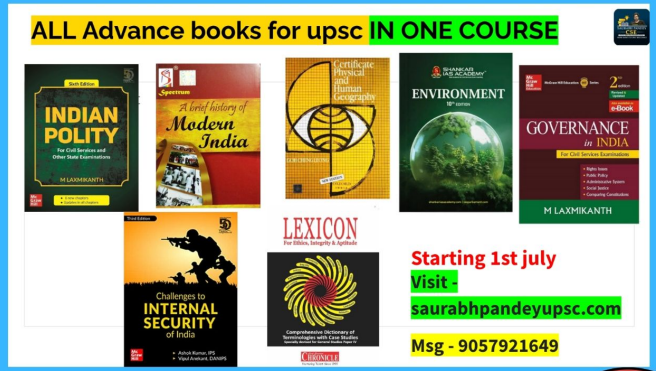

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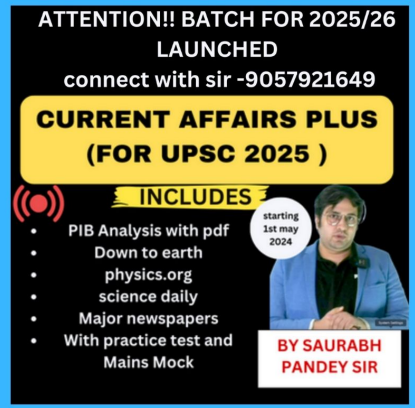

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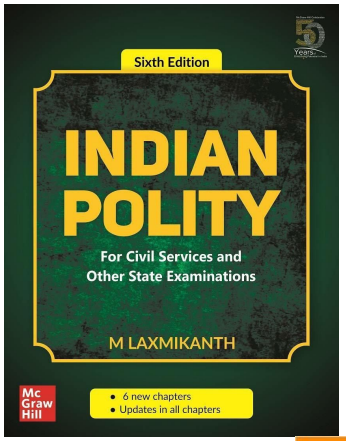

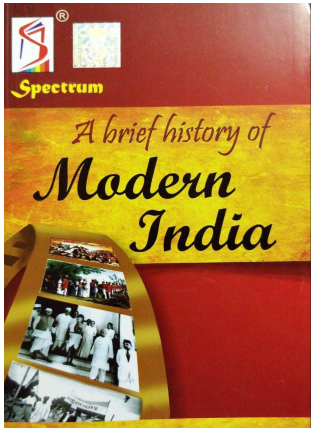

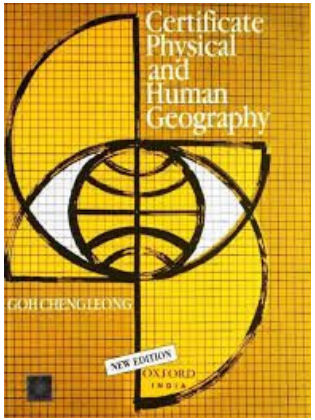

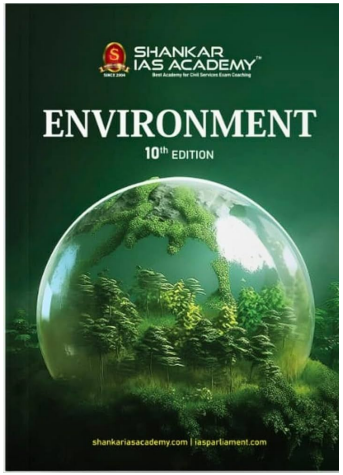

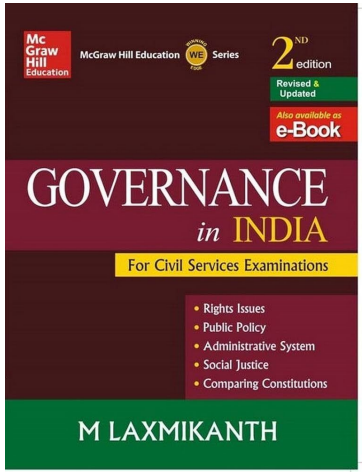

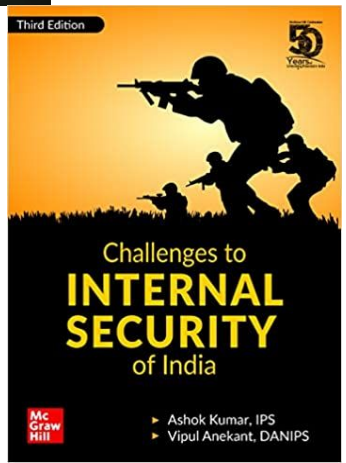

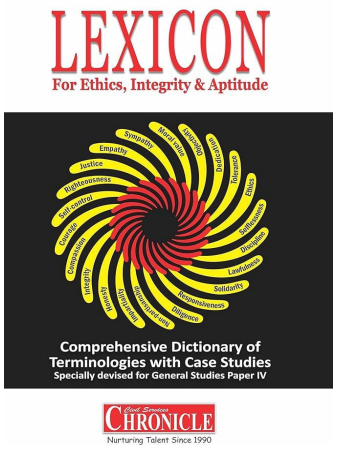

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