

VISION IAS

G.S.S.

Telegram : UPSC CSE Free Material (OPTIMISTIC IAS)
Telegram Account 8368616092

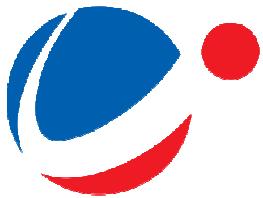
SCI & TECH

2021

Telegram : UPSC CSE Free Material (OPTIMISTIC IAS)
Telegram Account 8368616092

Copyright © by Vision IAS

All rights are reserved. No part of this document may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior permission of Vision IAS.



VISIONIAS

www.visionias.in

SCIENCE AND TECHNOLOGY (Part I)

VISIONIAS

Telegram : UPSC CSE Free Material (OPTIMISTIC IAS
Telegram Account 8368616092

Telegram : @upscmaterialoptimisticias

Copyright © by Vision IAS

All rights are reserved. No part of this document may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior permission of Vision IAS

Contents

Achievements of Indians in science & technology	6
1. RHODIOLA.....	6
Indigenization of technology and developing new technology	6
2. NATIONAL ELECTRIC MOBILITY MISSION PLAN 2020.....	6
3. SCIENCE, TECHNOLOGY AND INNOVATION POLICY (STI) 2013	7
4. NATIONAL CYBER SECURITY POLICY	8
IT and Computers.....	8
5. DIGITAL INDIA	8
6. CRITICAL INFRASTRUCTURE PROTECTION (CIP)	12
7. CRIME & CRIMINAL TRACKING NETWORK & SYSTEMS (CCTNS)	12
8. PARAM YUVA II.....	12
9. WATER JET PRINTER	13
10. BRAIGO	13
11. MAGNETORESISTIVE RANDOM ACCESS MEMORY (MRAM)	13
12. CERT-In (the Indian Computer Emergency Response Team)	13
13. IPv6 ADDRESSES	14
14. Cloud Technology based services	15
15. M-GOV	16
16. NATIONAL POLICY ON ELECTRONICS 2012.....	17
17. DECADE OF INNOVATION	18
18. NATIONAL OPTICAL FIBRE NETWORK (NOFN).....	19
19. NATIONAL INNOVATION COUNCIL (Ninc)	19
20. NATIONAL DATA SHARING AND ACCESSIBILITY POLICY (NDSAP-2012)	20
21. DIGITAL DIVIDE	20
22. VOIP	20
23. NATIONAL POLICY ON INFORMATION TECHNOLOGY 2012	20
24. PROJECT LOON	21
25. A4AI	21
26. CROWDSOURCING.....	21
27. HTTP 2.0.....	22
28. MOBILITY AS A SERVICE (MaaS)	22
29. CLICKTIVISM.....	22
30. COWL – CONFINEMENT WITH ORIGIN WEB LABELS	22
31. INTERNET OF THINGS (IoT)	22
32. EMAIL TURNED 32 – HISTORY OF EMAIL.....	23
Space Technology	23
33. CHANDRAYAAN II.....	23

Telegram : @upscmaterialoptimisticias

About Chandrayaan-I:.....	23
34. INSAT 3E	24
35. IRNSS.....	24
36. GSAT 16	25
37. GSLV MARK III	25
38. NISAR MISSION (NASA-ISRO SAR MISSION)	26
39. THIRTY METER TELESCOPE (TMT).....	26
40. GAIA (SPACECRAFT)	26
41. JUICE MISSION	27
42. ORBITING CARBON OBSERVATORY 2	27
43. SMAP	27
44. TOPS – TERRESTRIAL OBSERVATION AND PREDICTION SYSTEM	27
45. ILLUSTRIS	28
46. NEW EVIDENCE SHOWS PARTICLE FOUND IN 2012 IS THE HIGGS BOSON.....	28
47. VOYAGER-1	32
48. CLEANSPACE ONE	32
49. NuSTAR	33
50. JADE RABBIT	33
51. HR 5171A:.....	33
52. ROBOTICS TECHNOLOGY Robotics Technology.....	34
Defense Technology.....	34
53. DHVANI.....	34
54. ZERO PRESSURE TYRE	34
55. INS KOLKATA.....	34
56. NIRBHAY	35
57. DHANUSH.....	35
58. AWACS.....	35
59. WANKEL.....	36
60 AGNI-V	36
61. BALLISTIC MISSILE DEFENCE (BMD).....	36
62. HAWK MK 132	37
63. PRAGATI.....	37
64. AMPHIBIOUS AIRCRAFT.....	37
65. AKASH (SURFACE TO AIR MISILE SYSTEM)	37
66. ASTRA (BEYOND VISUAL RANGE AIR-TO-AIR MISSILE)	37
67. ABHYAS (HIGH-SPEED EXPANDABLE AERIAL TARGET)	38
68. LCA (LIGHT COMBAT AIRCRAFT-TEJAS)	38
69. LCA NAVY (NAVAL LIGHT COMBAT AIRCRAFT).....	38

Telegram Account : 836861609

70. LCA TRAINER	38
71. AEW&C (AIRBORNE EARLY WARNING AND CONTROL).....	39
72. HELINA.....	39
73. PRISM.....	39
74. TEMPORA.....	39
75. CMS INDIA	39
76. DONGFENG MISSILE	40
77. MEGATONS TO MEGAWATTS PROGRAM.....	40
Nano-Technology	40
78. NANODIAMONDS	40
Bio-Technology	41
79. PHANTOM – 3D MODEL OF HUMAN FINGERPRINTING	41
79. OXADIAZOLES	41
80. STEM CELLS AUXETICITY:.....	42
81. HSP 90:.....	42
82. BRCA GENES.....	42
83. DUA'S LAYER	43
84. BARCODES OF DNA.....	43
Energy Technology	44
85. NET ZERO BUILDING	44
86. NET METERING	44
87. FLOW BATTERIES	45
88. SOLAR FUEL	46
Science and Tech. developments and their applications and effects in everyday life	46
89. CABLE TV DIGITIZATION IN INDIA.....	46
90. NATIONAL EMF PORTAL	48
91. INNOVATION IN SCIENCE PURSUIT FOR INSPIRED RESEARCH (INSPIRE)	48
92. UN DECADE OF ACTION FOR ROAD SAFETY	49
93. VIRTUAL CLUSTERS	51
94. FASTags (ELECTRONIC TOLL COLLECTION)	52
Health Technology	52
95. MAXIMUM RESIDUE LIMITS (MRL).....	52
96. DRUG RESISTANCE: HOW AND HOW TO HANDLE IT.....	52
Environment Technology Technology	57
97. ZERO LIQUID DISCHARGE (ZLD)	57
98. GREEN TOILETS	57
99. GRIHA.....	57
100. IGBC GREEN BUILDING O&M RATING SYSTEM	58

Science Reporter Part I	59
101. NOBEL PRIZE - PHYSICS.....	59
102 NOBEL PRIZE - BIOLOGY	59
103. NOBEL PRIZE – CHEMISTRY	60
104. GOOGLE GLASS	60
105. NEUROSYNAPTIC CHIP.....	60
106. ANTI-COUNTERFEITING FILM BASED ON NANOTECHNOLOGY	61
107. GREENING THE SILK (TOPIC: INDIGENIZATION OF TECHNOLOGY).....	61
108. VULTURE RESTAURANTS (TOPIC: CONSERVATION)	61
109. SMART PENS	62
110. DIGITAL COIN.....	62

VISIONIAS

Achievements of Indians in science & technology

1. RHODIOLA

- Indian scientists have found a wonder herb which regulates the immunity system, adapts to challenging environment conditions and protects people from radiation, in the high peaks of the Himalayas mountains in southeast Asia.
- Rhodiola is a herb found in cold and highland climates, could be the end to the quest for Sanjeevani – the mythical herb that gave life to Ram's brother Lakshman in the great Indian Hindu epic.
- Rhodiola is also found in the US and China, where the herb is used in traditional Chinese medicine for combating altitude sickness. In Mongolia, physicians prescribed it for tuberculosis and cancer. Additionally, researchers in Russia studied its impact on athletes and cosmonauts.
- Rhodiola is locally known as 'Solo' in Ladakh.
- The Rhodiola herb can reduce the effects of gamma radiation used in nuclear bombs.

Benefits:

- Rhodiola is widely regarded as an herb remedy that boosts energy, attention span, mood and productivity.
- strengthen the nervous system
- fight depression
- enhance immunity
- elevate the capacity for exercise
- enhance mental capacity
- aid weight reduction
- increase sexual function
- improving athletic performance
- help the body adapt to and resist physical, chemical, and environmental stress
- used for treating cancer, tuberculosis, and diabetes;
- preventing cold and flu

Indigenization of technology and developing new technology

2. NATIONAL ELECTRIC MOBILITY MISSION PLAN 2020

- The principal end objectives of the National Mission for Electric Mobility (NMEM) are National energy security, mitigation of the adverse impact of vehicles on the environment and growth of domestic manufacturing capabilities.
- The NEMMP 2020 is a detailed plan based on an in-depth primary data study conducted jointly by government, automotive industry and academia/research institutes.
- The NEMMP is vital for reducing our dependence on fossil fuels, 80% of which is imported leading to massive foreign exchange deficit.

Target

- To put 6-7 million electric vehicles(EVs) on road by 2020; 4-5 million are expected to be two-wheelers.
- Reduce dependence on fossil fuels.
- To promote cleaner technologies.

Why is it important?

- India's excessive appetite for fossil fuel has an adverse impact on the environment and even on our foreign exchange reserves.
- Successful implementation of NEMMP will result in 2.2 – 2.5 million tones of fossil fuel savings by 2020, that's a monetary saving of Rs 30,000 crore.
- It will also lower vehicular emissions and decrease carbon di-oxide emissions by 1.3% to 1.5% by 2020.

- The production of hybrid and electric vehicles in India is an investment that will deliver economic growth, quality jobs and a cleaner future.

How will we do it?

- Both the government and the automotive industry will jointly invest Rs 23,000 crores to develop the EV eco-system in India.
- The government will invest close to Rs 14,000 crores over the next 5-6 years. The automakers will invest close to Rs 8,000 crores.
- India will deploy support measures that will quicken up the process of consumer acceptance of EVs.

Who is helping us?

- Germany is going to help India achieve its target and we couldn't have found a better partner.
- The Germans are strong supporters of electric mobility. Currently, Germany has about 1,500 EVs operating on German roads. By 2020, Germany aims to put at least one million electric vehicles on their roads. Thanks to these efforts, German cities are among the greenest in Europe.
- An Indo-German Joint Working Group (JWG) on Automotive Sector has been established to intensify cooperation in the development of efficient automotive technologies and alternate fuels and drives.

The Challenge ahead

- India's electric auto industry is really very small. The only manufacturer in India that produces EV is Mahindra REVA. There are a few makers in the two wheeler segment.
- The biggest challenge to the manufacturers is to convince an Indian consumer to pay a premium to go electric.
- On the other hand, the biggest challenge to the government will be to provide the necessary infrastructure to support EVs like charging stations that are spread across the country.

3. SCIENCE, TECHNOLOGY AND INNOVATION POLICY (STI) 2013

- Government unveiled the Science, Technology and Innovation Policy (STI) 2013.
- The STI Policy seeks to send a signal to the Indian scientific community, both in the private and public domain, that science, technology and innovation should focus on faster, sustainable and inclusive development of the people.
- It aims to bring all the benefits of Science, Technology & Innovation to the national development and sustainable and more inclusive growth.
- It seeks the right sizing of the gross expenditure on research and development by encouraging and incentivizing private sector participation in R & D, technology and innovation activities.
- The policy also seeks to trigger an ecosystem for innovative abilities to flourish by leveraging partnerships among diverse stakeholders and by encouraging and facilitating enterprises to invest in innovations.
- It also seeks to bring in mechanisms for achieving gender parity in STI activities and gaining global competitiveness in select technological areas through international cooperation and alliances.
- The policy goal is to accelerate the pace of discovery, diffusion and delivery of science led solutions for serving the aspirational goals of India for faster, sustainable and inclusive growth.
- A Strong and viable Science, Research and Innovation system for High Technology led path for India (SRISHTI) are the goal for the STI policy.**

The Key features of the STI policy 2013

- Promoting the spread of scientific temper amongst all sections of society.
- Enhancing skills for applications of science among the young from all social sectors.
- Making careers in science, research and innovation attractive enough for talented and bright minds.
- Establishing world class infrastructure for R&D for gaining global leadership in some select frontier areas of science.
- Positioning India among the top five global scientific powers by 2020.

- Linking contributions of Science Research and innovation system with the inclusive economic growth agenda and combining priorities of excellence and relevance.
- Creating an environment for enhanced private sector participation in R & D.
- Enabling conversion of R & D output with societal and commercial applications by replicating hitherto successful models, as well as establishing of new PPP structures.
- Seeking S&T based high risk innovation through new mechanisms.
- Fostering resource optimized cost-effective innovation across size and technology domains.
- Triggering in the mindset & value systems to recognize respect and reward performances which create wealth from S&T derived knowledge.
- Creating a robust national innovation system.

4. NATIONAL CYBER SECURITY POLICY

- The Union Government of India approved a National Cyber Security Policy with the objective to create a secured computing atmosphere across the country.

Aim:

- Capacity-building to bolster the existing set-up and increase the focus on manpower training.
- Augmentation of the India's indigenous capabilities in terms of developing the cyber security set-up.
- Provide a broad coverage by including home as well as small users, medium and large enterprises and government and non-government entities.
- To create cyber security framework to address all related issues pending over a long period.
- To enhance the security posture of nation's cyber space via specific actions and programmes.
- To enhance the intelligence as its integral component and help in anticipating attacks and adopt, countermeasures.

IT and Computers

5. DIGITAL INDIA

Even though India is known as a powerhouse of software, the availability of electronic government services to citizens is still comparatively low. The National e-Governance Plan approved in 2006 has made a steady progress through Mission Mode Projects and Core ICT Infrastructure, but greater thrust is required to ensure effective progress in electronics manufacturing and e-Governance in the country. The Digital India vision provides the intensified impetus for further momentum and progress for this initiative and this would promote inclusive growth that covers electronic services, products, devices, manufacturing and job opportunities. India in the 21st Century must strive to meet the aspirations of its citizens where government and its services reach the doorsteps of citizens and contribute towards a long-lasting positive impact.

Vision

The vision of Digital India aims **to transform the country into a digitally empowered society and knowledge economy** by leveraging IT as a growth engine of new India.

The programme will be **implemented in phases** from the current year till 2018. The Digital India is transformational in nature and would ensure that Government services are available to citizens electronically. It would also bring in public accountability through mandated delivery of government's services electronically, a **Unique ID** and **e-Pramaan** based on authentic and standard based interoperable and integrated government applications and data basis.

Scope of Digital India:

The overall scope of this programme is:

- Digital India is a **Programme to prepare India for a knowledge future.**
- The focus is on being **transformative– to realize IT + IT = IT**
- The focus is on making **technology central to enabling change.**

- It is an **Umbrella Programme** – covering many departments.
 - It weaves together a large number of ideas and thoughts into a **single, comprehensive vision** so that each of them is seen as part of a larger goal.
 - Each individual element stands on its own. But is also part of **the larger picture**.
 - It is **coordinated by DeitY, implemented by the entire government**.
 - The weaving together makes the Mission **transformative in totality**
- The Programme:
 - Pulls together many **existing schemes**.
 - These schemes will be **restructured and re-focused**.
 - They will be **implemented in a synchronized manner**.
 - Many elements are only **process improvements with minimal cost**.
- The **common branding** of programmes as **Digital India** highlights their transformative impact.

Vision of Digital India : is Centered on 3 Key Areas

Vision Area 1:Infrastructure as a Utility to Every Citizen	Vision Area 2: Governance & Services On Demand	Vision Area 3: Digital Empowerment of Citizens
<ul style="list-style-type: none"> • High speed internet as a core utility • Cradle to grave digital identity -unique, lifelong, online, authenticable • Mobile phone & Bank account enabling participation in digital & financial space • Easy access to a Common Service Centre • Shareable private space on a public cloud • Safe and secure Cyber-space 	<ul style="list-style-type: none"> • Seamlessly integrated across departments or jurisdictions • Services available in real time from online &mobile platform • All citizen entitlements to be available on the cloud • Services digitally transformed for improving Ease of Doing Business • Making financial transactions electronic & cashless • Leveraging GIS for decision support systems & development 	<ul style="list-style-type: none"> • Universal Digital Literacy • Universally accessible digital resources • All documents/ certificates to be available on cloud • Availability of digital resources / services in Indian languages • Collaborative digital platforms for participative governance • Portability of all entitlements through cloud

Digital India aims to provide the much needed thrust to the nine pillars of growth areas, namely

Pillars	Detail
1. Broadband Highways,	Broadband for all Rural 250,000 GP by 2016. Integration of SWAN, NKN, NOFN. To be implemented in 2 years
2. Universal Access to Mobile Connectivity,	Remaining uncovered villages (~ 42,300 villages) by 2018
3. Public Internet Access Programme,	CSCs – made viable, multi-functional end-points for service delivery. Post Offices to become Multi-Service Centres
4. e-Governance: Reforming Governmentthrough Technology,	<ul style="list-style-type: none"> • Government Business Process Re-engineering using IT to improve transactions <ul style="list-style-type: none"> ◦ Form Simplification, reduction ◦ Online applications and tracking, Interface between departments ◦ Use of online repositories e.g. school certificates, voter ID cards, etc. ◦ Integration of services and platforms – UIDAI, Payment Gateway, Mobile Platform, EDI • Electronic Databases – all databases and information to be electronic, not manual • Workflow automation inside government • Public Grievance Redressal - using IT to automate, respond, analyse data to

	<p>identify and resolve persistent problems – largely process improvements</p> <ul style="list-style-type: none"> To be implemented across government - critical for transformation.
5. e-Kranti - Electronic Delivery of Services,	<ul style="list-style-type: none"> Technology for Education – e-Education <ul style="list-style-type: none"> All Schools connected with broadband Free wifi in all schools (250,000) Digital Literacy program MOOCs – develop pilot Massive Online Open Courses Technology for Health – e-Healthcare <ul style="list-style-type: none"> Online medical consultation Online medical records Online medicine supply Pan-India exchange for patient information Pilots – 2015; Full coverage in 3 years Technology for Planning <ul style="list-style-type: none"> GIS based decision making National GIS Mission Mode Project Technology for Farmers <ul style="list-style-type: none"> Real time price information Online ordering of inputs Online cash, loan, relief payment with mobile banking Technology for Security <ul style="list-style-type: none"> Mobile Emergency Services Technology for Financial Inclusion <ul style="list-style-type: none"> Mobile Banking Micro-ATM program CSCs/ Post Offices Technology for Justice <ul style="list-style-type: none"> e-Courts, e-Police, e-Jails, e-Prosecution <ul style="list-style-type: none"> Technology for Security <ul style="list-style-type: none"> National Cyber Security Co-ordination Center Ongoing Programme (NeGP) – will be revamped to cover these elements
6. Information for All,	<ul style="list-style-type: none"> Online Hosting of Information & documents <ul style="list-style-type: none"> Citizens have open, easy access to information Open data platform Government pro-actively engages through social media and web based platforms to inform citizens <ul style="list-style-type: none"> MyGov.in 2-way communication between citizens and government Online messaging to citizens on special occasions/programs Largely utilise existing infrastructure – limited additional resources needed
7. Electronics Manufacturing,	<ul style="list-style-type: none"> Target NET ZERO Imports is a striking demonstration of intent Ambitious goal which requires coordinated action on many fronts <ul style="list-style-type: none"> Taxation, Incentives Economies of Scale, Eliminate cost disadvantages Focused areas – Big Ticket Items <ul style="list-style-type: none"> FABS, Fab-less design, Set top boxes, VSATs, Mobiles, Consumer & Medical Electronics, Smart Energy meters, Smart cards, micro-ATMs Incubators, clusters Skill development Government procurement There are many ongoing programs which will be fine-tuned.

	<ul style="list-style-type: none"> <u>Existing Structures inadequate to handle this goal. Need strengthening.</u>
8. IT for Jobs	<ul style="list-style-type: none"> Train people in smaller towns & villages for IT sector jobs IT/ITES in NE Train Service Delivery Agents to run viable businesses delivering IT services Telecom service providers to train rural workforce to cater to their own needs
9. Early Harvest Programmes.	<p>Biometric attendance Wi-fi in All Universities Public wifi hotspots School Books to be eBooks</p>

Program Management Structure:

A programme management structure would be established for monitoring implementation. Key components of the management structure would consist of the Cabinet Committee on Economic Affairs (CCEA) for according approval to projects, a Monitoring Committee headed by the Prime Minister, a Digital India Advisory Group chaired by the Minister of Communications and IT, an Apex Committee chaired by the Cabinet Secretary and the Expenditure Finance Committee (EFC) / Committee on Non Plan Expenditure (CNE).

- Overall Costs of Digital India**

- ~ Rs 100,000 Cr in ongoing schemes (only DeitY, DOT & not incl. those in other line Ministries)
- ~ Rs 13,000 Cr for new schemes & activities

- ✓ Impact of Digital India by 2019**

- Broadband in 2.5 lakh villages, universal phone connectivity
- Net Zero Imports by 2020
- 400,000 Public Internet Access Points
- Wi-fi in 2.5 lakh schools, all universities; Public wi-fi hotspots for citizens
- Digital Inclusion: 1.7 Cr trained for IT, Telecom and Electronics Jobs
- Job creation: Direct 1.7 Cr. and Indirect at least 8.5 Cr.
- e-Governance & eServices: Across government
- India to be leader in IT use in services – health, education, banking
- Digitally empowered citizens – public cloud, internet access

- Challenges**

- ✓ Program on this scale never conceived**
- ✓ Each Pillar/program has own challenges**
- ✓ Human Resource Issues**
 - NIC - not equipped for a fraction of this task (obsolesce) - needs revamping & restructuring
 - DeitY – needs program managers – at least 4 more officers at senior levels
 - **Ministries – Need a Chief Information Officer / Chief Technology Officer (CIO/CTO)**
 - Could begin with CIOs 10 major Ministries
 - Can be anyone – from within or outside government
 - To be patterned as AS & FAs – dual reporting

- ✓ Financial Resource Issues**

- Mostly structured around ongoing programs : Better focus, need some restructuring
- Some others are process improvements or better utilisation of resources
- A few new programs may be needed – particularly in Electronics manufacturing and Skill Development

- ✓ Coordination Issues**

- Program covers many other departments
- Need commitment and effort
- Leadership and support critical for success

6. CRITICAL INFRASTRUCTURE PROTECTION (CIP)

- Critical infrastructure protection (CIP) is a concept that relates to the preparedness and response to serious incidents that involve the critical infrastructure of a region or nation.
- In India, it will be realized by National Critical Information Infrastructure Protection Centre (NCIPC).
- “NCIPC” will implement a 5-Year Project for Cyber Security of Critical Sectors -**Critical infrastructure protection**.

7. CRIME & CRIMINAL TRACKING NETWORK & SYSTEMS (CCTNS)

- Project which seeks to make use of technology in bringing greater transparency and accountability into government functioning.
- All the States and Union Territories across the length and breadth of the country are in the process of implementing the CCTNS project.
- CCTNS Project will create a nation-wide environment for the real-time sharing of crime and criminal information.
- A Mission Mode Project under the **National e-Governance Plan** of Government of India.
- Aims at creating a comprehensive and integrated system for enhancing the efficiency and effectiveness of policing through adopting the principle of e-Governance.
- The Project also includes the creation of a nationwide networking infrastructure for evolution of **IT-enabled-state-of-the-art tracking system** around ‘Investigation of crime and detection of criminals’.

8. PARAM YUVA II

India's **supercomputer PARAM Yuva II**, developed by the Centre for Development of Advanced Computing (C-DAC), has been ranked first in India, ninth in the Asia Pacific Region and 44th in the world among the **most power efficient computer systems** as per the Green 500 List announced at the Supercomputing Conference (SC 2013) in Denver, Colorado, in the US.

Note:

As of June 2014, India has 9 systems on the Top500 list ranking 52, 101, 119, 123, 132, 136, 281, 441 and 483.

Rank	Site	Name	Rpeak(TFlop/s)
52	Indian Institute of Tropical Meteorology	PRITHVI (iDataPlex DX360M4)	790.7
101	Centre for Development of Advanced Computing	PARAM Yuva - II	520.4
119	Indian Institute of Technology Kanpur	Cluster Platform SL230s Gen8	359.6
123	CSIR Centre for Mathematical Modelling and Computer Simulation	Cluster Platform 3000 BL460c Gen8	362.0
132	National Centre for Medium Range Weather Forecasting	iDataPlex DX360M4	350.1
136	IT Services Provider	Cluster Platform SL250s Gen8	373.2
281	Vikram Sarabhai Space Centre, ISRO	SAGA - Z24XX/SL390s Cluster	394.8
441	Manufacturing Company India	Cluster Platform 3000 BL460c Gen8	175.7
483	IT Services Provider (B)	Cluster Platform 3000 BL460c Gen8	195.3

9. WATER JET PRINTER

- It is newly invented computer printer which uses water instead of ink to print.
- It uses paper coated with special dyes and the used paper fades back to white within a day, enabling it to be reused. Technology allows each page to be reprinted dozens of times —based on 50 times of rewriting, the cost is only about one percent of the inkjet prints. A money and tree-saving option in a digital world that still relies heavily on hard copy.

10. BRAIGO

- It is a low cost Braille-printer developed by a 12 year old boy of Indian Origin Shubham Banerjee.
- Braigo, is short for Braille with Lego as this printer uses toy components manufactured by toy brand Lego.
- Users can type in letters, and the Braigo's needle will hammer out the translated message in raised dots on paper
- This concept slashes the price of a printer from more than \$2000 to around \$350 for education, teaching and home use purposes. Thus giving a more cost effective printer for the disadvantaged. The printer is also faster than most other commercially available Braille printers in the market.
- Braille printers receive data from computer devices and emboss that information in Braille onto paper

11. MAGNETORESISTIVE RANDOM ACCESS MEMORY (MRAM)

- MRAM, also known as magnetoresistive RAM or magnetic RAM, is a type of non volatile RAM memory which uses magnetic charges in order to store data. This is different from SRAM and DRAM, which use electric charges to store data. The advantage of MRAM is that it retains data when power is turned off. It requires only a small amount of electricity to be able to store data bits. MRAMs work by using two iron plates which "sandwich" a thin insulating layer. One of the iron plates is a magnet which is set to a specific charge, whereas the other plate is variable and allows for the polarity to change according to the pull of the external fields. Millions of magnetic "sandwiches" work together to make up the MRAM memory device. MRAM requires less power than other memory storage systems because it writes and stores data by using magnetic fields instead of electrical circuits.
- Application: computers, consumer electronics, transportation, military and avionics systems, robotics etc.
- In News: A team of researcher at National University of Singapore (NUS) have developed new MRAM technology.

The technology will drastically increase storage space and enhance memory

12. CERT-In (the Indian Computer Emergency Response Team)

- CERT-In (the Indian Computer Emergency Response Team) is a **government-mandated information technology (IT) security organization**.
- The **purpose** of CERT-In is to respond to computer security incidents, report on vulnerabilities and promote effective IT security practices throughout the country.
- CERT-In was created by the Indian Department of Information Technology in 2004 and operates under the auspices of that department.
- According to the provisions of the **Information Technology Amendment Act 2008**, CERT-In is responsible for overseeing administration of the Act.
- CERT organizations throughout the world are independent entities, although there may be coordinated activities among groups.
- The first CERT group was formed in the United States at Carnegie Mellon University.

Background

What is the IT Amendment Act (ITA-2008)?

The Information Technology Amendment Act, 2008 (IT Act 2008) is a substantial addition to India's Information Technology Act (ITA-2000). The IT Amendment Act was passed by the Indian Parliament in October 2008 and came into force a year later. The Act is administered by the **Indian Computer Emergency Response Team (CERT-In)**.

The original Act was developed to promote the IT industry, regulate e-commerce, facilitate e-governance and prevent cybercrime. The Act also sought to foster security practices within India that would serve the country in a global context. The Amendment was created to address issues that the original bill failed to cover and to accommodate further development of IT and related security concerns since the original law was passed.

Changes in the Amendment include:

- Redefining terms such as "communication device" to reflect current use.
- Validating electronic signatures and contracts.
- Making the owner of a given IP address responsible for content accessed or distributed through it.
- Making corporations responsible for implementing effective data security practices and liable for breaches.

Issues:

The Amendment has been **criticized** for decreasing the penalties for some cybercrimes and for lacking sufficient safeguards to protect the civil rights of individuals. Section 69, for example, authorizes the Indian government to intercept, monitor, decrypt and block data at its discretion. The Act has provided Indian government with the power of surveillance, monitoring and blocking data traffic. The new powers under the amendment act tend to give Indian government a texture and color of being a surveillance state.

13. IPv6 ADDRESSES

- **Indian Registry for Internet Names and Numbers (IRINN)** has started issuing next version of Internet addresses 'IPv6', which would make it easy for security agencies to identify each Internet user.
- The Internet addresses under the present version IPv4 (Internet Protocol version 4), are limited and service providers often assign single IP address to many users, making it difficult to identify the end user.
- **APNIC**, which is one of the five authorised bodies for issuing Internet addresses, has recognised **Indian Registry for Internet Names and Numbers (IRINN)** for issuing IP addresses in India.
- The new addresses will be **multiple times cheaper** for companies than IPv4 addresses.

Advantages of IPv6 over IPv4

- IPv6 solves the **IPv4 public address depletion problem** by providing an address space to last well. The business benefit of moving to IPv6 is that mobile cell phones, personal data assistants (PDAs), automobiles, appliances, and even people can be assigned multiple globally reachable addresses.
- Connectivity between disjoint networks requires intermediate devices such as NATs or proxy servers. With IPv6, both homes and enterprises will be assigned **global address prefixes and can seamlessly connect**, subject to security restrictions such as firewall filtering and authenticated communication.
- With IPv6, public address prefixes are **assigned to regional Internet registries**, which, in turn, assign address prefixes to other ISPs and organizations based on justified need. This new address allocation practice ensures that address prefixes will be distributed globally based on regional connectivity needs, rather than by historical origin.
- With IPv6, **NATs are no longer necessary** to conserve public address space, and the **problems associated with mapping addresses and ports disappear** for developers of applications and gateways.
- Unlike IPv4 addresses, IPv6 addresses have a scope, or a **defined area of the network** over which they are unique and relevant.
- IPv6 is a streamlined version of IPv4. Excluding prioritized delivery traffic, IPv6 **has fewer fields to process and fewer decisions to make in forwarding** an IPv6 packet.

- The result of designing IPv6 with security and mobility in mind is an implementation that is a defined standard, has fewer limitations, and is **more robust and scalable to handle the current and future communication needs** of the users of the Internet.

Background

Internet Service Provider(ISP)

- An Internet service provider (ISP) is a business or organization that **offers users access to the Internet and related services**.
- Many but not all ISPs are telephone companies or other telecommunication providers.
- They provide services such as Internet access, Internet transit, domain name registration and hosting, dial-up access, leased line access and colocation.
- Internet service providers may be organized in various forms, such as commercial, community-owned, non-profit, or otherwise privately owned.

National Internet Exchange of India (NIXI)(IT)

- The National Internet Exchange of India is the **neutral meeting point of the ISPs in India**.
- Its main **purpose** is to **facilitate exchange of domestic Internet traffic** between the peering ISP members.
- This enables more efficient use of international bandwidth, saving foreign exchange.
- It also improves the Quality of Services for the customers of member ISPs, by avoiding multiple international hops and thus reducing latency.

Indian Registry for Internet Names and Numbers (IRINN)(IT)

- Indian Government has launched the National Internet Registry which will **manage IP address allocations and other internet resources**.
- NIR has been named Indian Registry for Internet Names and Numbers (IRINN) which is a division in National Internet Exchange of India (NIXI).
- NIR functions under Regional Internet Registry (RIR) which is **Asia Pacific Network Information Centre** in Brisbane, Australia. APNIC manages IP address allocation and other internet resources for the Asia Pacific region.
- Earlier IP addresses had to be bought directly from APNIC which proved out to be time consuming and quite expensive. With NIR, buying IP addresses will become up to 70% cheap and will also help the country in cyber crime investigations.

14. Cloud Technology based services

- Cloud Computing is a technology that uses the internet and central remote servers to maintain data and applications.
- Cloud computing allows consumers and businesses to use applications without installation and access their personal files at any computer with internet access.
- This technology allows for much more efficient computing by centralizing data storage, processing and bandwidth.
- Network-based data collection and analysis required the use of a computer to not only host the data, but to handle traffic either through a server company owned or one leased from a service provider.
- Cloud computing leverages the power of the Internet to eliminate the need for the purchase, installation and maintenance of independent data centers and networks.

Types of Cloud Services

Software as a Service (SaaS)

- This is the most common form of cloud services. Software is provided to support the service on a fee basis. Users can access the software and configure it to their needs.

Platform as a Service (PaaS)

- This service offers users a platform to build, test, or host applications that can be accessed by other users. Users don't need to build or host their own platforms. Companies that use PaaS can, in turn, offer SaaS services to their customers.

Infrastructure as a Service (IaaS)

- This is infrastructure on demand and can be anything from storage servers to applications to operating systems. The cloud service provider sets up and maintains the infrastructure and charges a pay per use fee.

15. M-GOV

It is the extension of e-Government to mobile platforms, as well as the strategic use of government services and applications which are only possible using cellular/mobile telephones, laptop computers, personal digital assistants (PDAs) and wireless internet infrastructure.

It is now evolving on four dimensions:

- Transforming e-Government services directly to the mobile platform
- Providing access to mobile technologies and application for the field workers of the public sector
- Enabling smart / flex working and
- Providing citizen services any time, any where

Benefits of mGovernment

- Cost reduction
- Efficiency
- Transformation/modernization of public sector organizations
- Added convenience and flexibility
- Better services to the citizens
- Ability to reach a larger number of people through mobile devices than would be possible using wired internet only

Main measures laid down by Department of Information Technology (DoIT)

- Web sites of all Government Departments and Agencies shall be made mobile-compliant, using the "One Web" approach.
- Open standards shall be adopted for mobile applications for ensuring the inter operability of applications across various operating systems and devices as per the Government Policy on Open Standards for e-Governance.
- Uniform/ single pre-designated numbers (long and short codes) shall be used for mobile-based services to ensure convenience.
- All Government Departments and Agencies shall develop and deploy mobile applications for providing all their public services through mobile devices to the extent feasible on the mobile platform. They shall also specify the service levels for such services.

To ensure adoption and implementation of the framework in time bound manner the government will develop Mobile Service Delivery Gateway (MSDG) that is the core infrastructure for enabling the availability of public services in through mobile devices.

Issues with mGovernment

- Wireless and mobile networks and related infrastructure, as well as software, must be developed

- To increase citizen participation and provide citizen-oriented services, governments need to offer easy access to mGovernment information in alternative forms
- Mobile phone numbers and mobile devices are relatively easily hacked and wireless networks are vulnerable because they use public airwaves to send signals
- Adopted legislation for data and information practices that spell out the rights of citizens and the responsibilities of the data holders (government)

Suggestions for mGovernment Development

- Perfecting mGovernment relevant laws, regulations and standards
- Establishing the information security system of mGovernment
- Rebuilding and optimizing the administrative business processes
- Strengthening the evaluation of eGovernment

16. NATIONAL POLICY ON ELECTRONICS 2012

- The National Policy on Electronics aims to address the issue with the explicit goal of transforming India into a premier Electronic System and Design and Manufacturing (ESDM) hub.
- The policy is expected to create an indigenous manufacturing eco-system for electronics in the country.
- It will foster the manufacturing of indigenously designed and manufactured chips creating a more cyber secure ecosystem in the country.
- It will enable India to tap the great economic potential that this knowledge sector offers.
- The increased development and manufacturing in the sector will lead to greater economic growth through more manufacturing and consequently greater employment in the sector.

The key objectives of the Policy:

- To create an eco-system for a globally competitive Electronic System Design and Manufacturing (ESDM) sector in the country.
- To build on the emerging chip design and embedded software industry to achieve global leadership in Very Large Scale Integration (VLSI), chip design and other frontier technical areas.
- To build a strong supply chain of raw materials, parts and electronic components.
- To increase the export in ESDM sector.
- To significantly enhance availability of skilled manpower in the ESDM sector.
- To create an institutional mechanism for developing and mandating standards and certification for electronic products and services to strengthen quality assessment infrastructure nationwide.
- To develop an appropriate security ecosystem in ESDM.
- To create long-term partnerships between ESDM and strategic and core infrastructure sectors – Defence, Atomic Energy, Space, Railways, Power, Telecommunications, etc.
- To become a global leader in creating Intellectual Property (IP) in the ESDM sector by increasing fund flow for R&D, seed capital and venture capital for start-ups in the ESDM and nanoelectronics sectors.
- To develop core competencies in strategic and core infrastructure sectors like telecommunications, automotive, avionics, industrial, medical, solar, Information and Broadcasting, Railways, etc through use of ESDM in these sectors.
- To use technology to develop electronic products catering to domestic needs, including rural needs and conditions, as well as international needs at affordable price points.
- To become a global leader in the Electronic Manufacturing Services (EMS) segment by promoting progressive higher value addition in manufacturing and product development.
- To expedite adoption of best practices in e-waste management.

- To source, stockpile and promote indigenous exploration and mining of rare earth metals required for manufacture of electronic components.

Strategy

To achieve these objectives, the policy proposes the following strategies:

- Creating eco-system for globally competitive ESDM sector.
- Promotion of Exports.
- Human Resource Development.
- Developing and mandating standards to curb inflow of sub-standard and unsafe electronic products.
- Create a complete secure cyber eco-system in the country, through suitable design and development of indigenous appropriate products through frontier technology/product oriented research, testing and validation of security of products.
- Creating long-term partnerships between domestic ESDM industry and strategic sectors for sourcing products domestically .
- Providing Defense Offset obligations for electronic procurements through ESDM products.
- Creating ecosystem for vibrant innovation and R&D in the ESDM sector including nanoelectronics.
- Creation of an Electronic Development Fund.
- Supporting and developing expertise in the electronics in other sectors of economy: automotive, Industrial, medical, solar photovoltaics, Information and Broadcasting, Railways etc.
- The strategy includes various initiatives to facilitate environment friendly e-waste handling policies.

17. DECADE OF INNOVATION

The Government of India has declared 2010-2020 as the 'Decade of Innovation'.

To discuss, analyze and help implement strategies for inclusive innovation in India and prepare a Roadmap for Innovation in the country, the Prime Minister has constituted the **National Innovation Council (NIC)** in September 2010 with members from diverse fields.

Ministry of Communications and IT has taken a number of initiatives to promote an ecosystem for innovation through ICT, in various sectors of the economy.

Two Key initiatives:-

The Triad of policies

Three, interdependent and synergistic policies for **Telecom, IT and Electronics Manufacturing** have been released after consulting all stakeholders.

The three policies together drives the National agenda for ICTE.

The **principal objectives of this policy** are:

- Optimally leverage our existing and developing ICT infrastructure and capabilities to meet our growing need for high quality social sector services like skill development, welfare programs, e-governance services as well as for banking and insurance.
- To use the ICTE capabilities to enhance competitiveness and efficiency in manufacturing across the board and in key infrastructure sectors like power, transport and aviation.
- Leveraging the mushrooming demand for ICTE products and services to foster innovation, encourage R&D through academic institutions and industry.

- To reposition the mobile phone from a mere communication devise to an instrument of empowerment which combines communication with proof of identity, full secure financial and other transaction capability, multi-lingual services and the like.
- The Triad of policies has extensive programs for R&D, IPR creation and financing of innovative projects in Telecom, Information Technology and Electronics Manufacturing sectors.

18. NATIONAL OPTICAL FIBRE NETWORK (NOFN)

- To accelerate the reach of connectivity and to enhance development and innovation at the grassroots, NOFN will provide optic-fiber based Broadband connectivity to 250,000 Panchayats in the country.
- The aim is to leverage this connectivity so as to improve service delivery with transparency & accountability and to provide a platform for collective solution building and knowledge sharing for local populations through relevant applications and an associated ecosystem.
- The Government of India is committed to spend Rs. 20,000 crore for implementing this project by Dec 2013.
- NOFN will ensure that Panchayats are equipped with not just broadband connections, but also with computers, software and people to create, organise, distribute and deliver relevant information and provide needs-based applications which could be developed by understanding local needs, context and applicability.
- Services such as birth certificate, death certificate, land records, police reports, school admissions, health records, court papers, government documentation, renewal of licenses, tax submissions, etc. can be facilitated through broadband connectivity.
- It will thus enrich G2C (Government to Citizen) and B2C (Business to Citizen) interactions leading to greater collaborations.

19. NATIONAL INNOVATION COUNCIL (NInC)

The NInC will seek to create a strategy for fostering innovations at the National, State and sectoral levels by focusing on five key parameters:

- Platform
- Inclusion
- Eco-system
- Drivers
- Discourse

Aim:

- To re-define innovations to go beyond formal R&D parameters.
- Facilitate innovative solutions that lead to inclusive growth for the people and by the people.
- Foster an innovation eco-system across domains and sectors to strengthen entrepreneurship.
- Focus on key drivers to ensure sustainability, durability and quality and expand the space for dialogue and discourse on innovation.
- NInC will also be involved in facilitating State level and sectoral innovations. This will create an eco-system to boost innovation performance in the country.

20. NATIONAL DATA SHARING AND ACCESSIBILITY POLICY (NDSAP-2012)

- The NDSAP policy is designed to promote data sharing and enable access to central government owned data for national planning and development.
- The Union Cabinet also approved the guidelines for establishing Joint Venture Companies by Defence Public Sector Undertakings, DPSUs.
- The data can be shared in both human readable and machine readable formats through a network across the country.
- The guidelines will provide a streamlined, fair and transparent framework for entering into Joint Ventures with the ultimate objective of better risk-management, greater-efficiency and enhancing self-reliance in the defence sector as a whole.
- It is expected that the guidelines will foster better and deeper partnerships between the DPSUs and private partners.

21. DIGITAL DIVIDE

- A term used to describe the discrepancy between people who have access to and the resources to use new information and communication tools, such as the Internet, and people who do not have the resources and access to the technology.
- The term also describes the discrepancy between those who have the skills, knowledge and abilities to use the technologies and those who do not.
- The digital divide can exist between those living in rural areas and those living in urban areas, between the educated and uneducated, between economic classes, and on a global scale between more and less industrially developed nations.

22. VOIP

- Voice over IP (voice over Internet Protocol, VoIP) is a methodology and group of technologies for the delivery of voice communications and multimedia sessions over Internet Protocol (IP) networks, such as the Internet.
- They transport audio streams over IP networks using special media delivery protocols that encode voice, audio, video with audio codecs and video codecs as Digital audio by streaming media.

Legal issues in India

- In India, it is legal to use VoIP, but it is illegal to have VoIP gateways inside India.
- This effectively means that people who have PCs can use them to make a VoIP call to any number, but if the remote side is a normal phone, the gateway that converts the VoIP call to a POTS call is not permitted by law to be inside India.

23. NATIONAL POLICY ON INFORMATION TECHNOLOGY 2012

The Policy aims to leverage Information & Communication Technology (ICT) to address the country's economic and developmental challenges.

The **thrust areas** of the policy include:

- To increase revenues of IT and ITES (Information Technology Enabled Services) Industry.
- To gain significant global market-share in emerging technologies and Services.
- To promote innovation and R&D in cutting edge technologies and development of applications and solutions in areas like localization, location based services, mobile value added services, Cloud Computing, Social Media and Utility models.
- To encourage adoption of ICTs in key economic and strategic sectors to improve their competitiveness and productivity.
- To provide fiscal benefits to SMEs and Startups for adoption of IT in value creation

- To create a pool of 10 million additional skilled manpower in ICT.
- To make at least one individual in every household e-literate.
- To provide for mandatory delivery of and affordable access to all public services in electronic mode.
- To enhance transparency, accountability, efficiency, reliability and decentralization in Government and in particular, in delivery of public services.
- To leverage ICT for key Social Sector initiatives like Education, Health, Rural Development and Financial Services to promote equity and quality.
- To make India the global hub for development of language technologies, to encourage and facilitate development of content accessible in all Indian languages and thereby help bridge the digital divide.
- To enable access of content and ICT applications by differently-abled people to foster inclusive development.
- To leverage ICT for expanding the workforce and enabling life-long learning.
- To strengthen the Regulatory and Security Framework for ensuring a Secure and legally compliant Cyberspace ecosystem.
- To adopt Open standards and promote open source and open technologies.

The policy attempts to optimally leverage India's global edge in ICT to advance national competitiveness in other sectors, particularly those of strategic and economic importance. The Policy will promote an inclusive and equitable society. The Policy is oriented towards use of ICT to consciously promote decentralization and empowerment of citizens.

24. PROJECT LOON

- Project Loon is a research and development project being developed by Google with the mission of providing Internet access to rural and remote areas.
- It is a network of balloons travelling on the edge of space, designed to connect people, help fill coverage gaps, and bring people back online after disasters.
- Project Loon balloons float in the stratosphere, twice as high as airplanes and the weather.
- They are carried around the Earth by winds and they can be steered by rising or descending to an altitude with winds moving in the desired direction.
- People connect to the balloon network using a special Internet antenna attached to their building.
- The signal bounces from balloon to balloon, then to the global Internet back on Earth.

25. A4AI

- A number of government bodies, NGOs and private companies have formed a coalition named Alliance for Affordable Internet (A4AI) which aims at reducing the cost of internet access worldwide.
- The coalition will push for policy and regulatory reforms to bring down the cost of bandwidth in developing and poor countries, where cost of internet access remains exorbitant.
- The global sponsors of the A4AI are Google, UK Department for International Development, US Agency for International Development and Omidyar Network, a firm that often invests in non-profit entities.

26. CROWDSOURCING

- Crowdsourcing is the practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an online community, rather than from traditional employees or suppliers.
- This process is often used to subdivide tedious work or to fund-raise startup companies and charities, and can also occur offline.
- Famous Example: Wikipedia. Instead of Wikipedia creating an encyclopedia on their own, hiring writers and editors, they gave a crowd the ability to create the information on their own.
- Crowdfunding involves asking a crowd of people to donate money to your project.

27. HTTP 2.0

- The next generation of the principal system of digital rules (or protocols) that define the way communications work over the World Wide Web, HTTP 2.0, will include multiplexing.
- The latest working copy of HTTP 2.0 is out, released by members of the Internet Engineering Task Force.
- Unlike previous versions of the HTTP protocol, this version will be a binary format (currently it is human readable), which was put in mainly to reduce the huge delay in web surfing.

28. MOBILITY AS A SERVICE (MaaS)

- Mobility as a Service (MaaS) is the ability to consume mobile products, software, and services—all under a **per-device, per-month fee**.
- It brings together all the necessary components, including applications, security software, ongoing services such as provisioning, and the device itself.
- This is particularly helpful given the diversity and complexity that companies face in dealing with today's mobile environments.
- Users love the variety and greater levels of mobile functionality available to them, but that same variety introduces risk because devices have different levels of security and encryption, which makes it difficult for companies to control and secure an environment as a whole.

29. CLICKTIVISM

- Clicktivism refers to the **use of social media and the Internet to advance social causes**.
- It uses the metrics available through Web analytics to optimize Web pages, emails and online petitions.
- This optimization is meant to increase user engagement and maximize a campaign's page views.
- It allows organizations to quantify their success **by keeping track of how many "clicked"** on their petition or other call to action.

What is the issue?

- Critics of clicktivism state that this new phenomenon turns social movements to resemble advertising campaigns in which messages are tested, click through rate is recorded, and A/B testing is often done.
- In order to improve these metrics, messages are reduced to make their "asks easier and actions simpler."
- This in turn reduces social action to having members that are a **list of email addresses, rather than engaged people**.

30. COWL – CONFINEMENT WITH ORIGIN WEB LABELS

- Researchers have built a new system that protects Internet users' privacy. It also helps to increase the flexibility for web developers to build web applications that combine data from different web sites, dramatically improving the safety of surfing the web.
- The system called "Confinement with Origin Web Labels" (COWL) works with Mozilla's Firefox and Google's Chrome web browsers and prevents malicious codes in websites from leaking sensitive information to unauthorised parties.

31. INTERNET OF THINGS (IoT)

- The Internet of Things (IoT) is a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.
- It is a new era of technological interconnectedness in which everything from garage doors to hospital health systems will be linked and controlled through computer networks.

In News: The world's first 'online murder' via a hacked internet-connected device could happen by the end of this year, experts have warned. (THE HINDU). Governments are ill-prepared to combat the looming threat of "online murder" (TOI)

32. EMAIL TURNED 32 – HISTORY OF EMAIL

- In 1978, an Indian American V.A. Shiva Ayyadurai developed a full-scale emulation of the interoffice mail system which he called "E-mail" and copyrighted in 1982.

Space Technology

33. CHANDRAYAAN II

About Chandrayaan-I:

- India's first mission to moon, was launched successfully on October 22, 2008 from Sriharikota.
- The spacecraft was orbiting around the Moon at a height of 100 km from the lunar surface for chemical, mineralogical and photo-geologic mapping of the Moon.

About Chandrayaan-II:

- Chandrayaan-2 will be an advanced version of the previous Chandrayaan-1.
- Chandrayaan-2 is configured as a two module system comprising of an Orbiter Craft module (OC) and a Lander Craft module (LC) carrying the Rover developed by ISRO.
- The functions of the two modules are as follows:
- The Orbiter Craft with payloads onboard will orbit around the moon and perform the objectives of remote sensing the moon. The payloads on the orbiter will conduct mineralogical and elemental studies of the Moon's surface.
- The Lander Craft with scientific payloads will soft land on the lunar surface at a predetermined location on the lunar surface.
- The Rover is released by the Lander Craft and has the mission objective of performing mobility activities on low gravity and vacuum of Moon surface with Semi-Autonomous navigation and hazard avoidance capability.



Payloads:

The Orbiter payloads are : Large Area Soft X-ray Spectrometer (CLASS) and Solar X-ray Monitor (XSM) for mapping the major elements present on the lunar surface; L and S band Synthetic Aperture Radar (SAR) for probing the first few tens of meters of the lunar surface for the presence of different constituents including water ice; Imaging IR Spectrometer (IIRS) for the mapping of lunar surface over a wide wavelength range for the

study of minerals, water molecules and hydroxyl present; Neutral Mass Spectrometer (ChACE-2) to carry out a detailed study of the lunar exosphere and a Terrain Mapping Camera-2 (TMC-2) for preparing a three-dimensional map essential for studying the lunar mineralogy and geology.

The Laser Induced Breakdown Spectroscopic (LIBS) and Alpha Particle X-Ray Spectrometer (APXS) payloads onboard Rover would perform elemental analysis of the lunar surface near the landing site.

- Few technological elements in a lander which need to be developed:
 1. Need to reduce the velocity of the lander as it comes for soft landing.
 2. To develop the mechanism that is involved in a lander.
 3. To locate precisely where to land by taking pictures and then steering the lander to a place it has to land
- **Status:** Charayaan 2 will be launched using GSLV by 2016 or 2017.

34. INSAT 3E

- INSAT-3E was the fourth satellite launched in the geostationary orbit in the INSAT-3 series.
- It is an exclusive communication satellite to further augment the communication services that are being provided by the INSAT System.
- In April 2014, INSAT-3E completed its life and gone out of service. Built to last 15 years, it has completed ten-and-a-half years in orbit.
- **Reason:** It ran out of the on-board oxidizer.

35. IRNSS

About Satellite:

- Indian Regional Navigation Satellite System (IRNSS) is an independent regional navigation satellite system being developed by India.
- It is designed to provide accurate position information service to users in India as well as the region extending up to 1500 km from its boundary, which is its primary service area.

Architecture:

- The proposed system would consist of a constellation of seven satellites¹ and a support ground segment. Three of the satellites in the constellation will be placed in geostationary orbit. The four satellites in geo-synchronous orbit will revolve in independent 29° inclined orbits, making a figure of '8'.
- Such an arrangement would mean all seven satellites would have continuous radio visibility with Indian control stations.
- The satellite payloads would consist of atomic clocks and electronic equipment to generate the navigation signals.

Services:

IRNSS will provide two types of services, namely, Standard Positioning Service (SPS), which is provided to all the users and Restricted Service (RS), which is an encrypted service provided only to the authorized users.

¹A special case of geosynchronous orbit is the geostationary orbit, which is a circular geosynchronous orbit at zero inclination (that is, directly above the equator).



The IRNSS System is expected to provide a **position accuracy of better than 20** m in the primary service area.

The navigation centre will also be responsible for time reference, generation of navigation messages and monitoring and control of ground facilities.

The key to global positioning system (GPS)-based navigation support is the time reference to which all ground-based systems and satellite clocks are synchronized. The time reference is generated by the high precision timing facility at the navigation centre, which is equipped with high stability, high precision atomic clocks.

Technologically, IRNSS is expected to provide better signal even for the civilian usages.

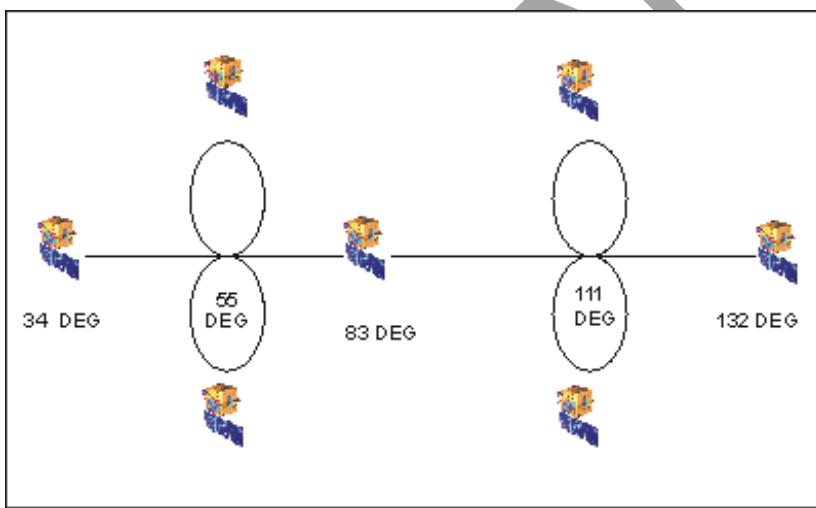
Why substantially less satellites:

India's requirements are regional and hence India is presently making investments only to develop a regional system constituting of seven satellites.

Conventionally, navigational satellites are positioned in the Medium Earth Orbit (MEO). The Indian satellites are placed at a higher so-called geostationary orbit to have a larger signal footprint and lower number of satellites to map the region.

Progress & Challenges:

- Till now, India has launched two satellites, IRNSS-1A and 1B successfully.
- In IRNSS, we are utilizing geostationary satellites instead of MEO (Medium Earth Orbit) satellites and thus the receiver antenna size may offer some challenges. Since S-band frequency has never been used in the past few experts are of the opinion that the problems could arise in **miniaturizing the receiver antenna** for S-band.
- Also, since the satellites are positioned at high elevation, they **could restrict the system for providing accurate indoor applications.**



36. GSAT 16

- GSAT-16 is a geostationary communication satellite which will carry 24 C-band, 12 Ku-band and 12 Upper Extended C-band transponders. GSAT-16 satellite will support satellite based telecommunication, television, VSAT and other services in the country.
- The satellite is aimed as a replacement for satellite INSAT-3E
- Launch - GSAT-16 is planned to be launched by the first week of December 2014 by Ariane 5.

37. GSLV MARK III

- GSLV Mark III is a launch vehicle currently under development by the ISRO.
- It is conceived and designed to make ISRO fully self-reliant in launching heavier communication satellites of INSAT-4 class, which weigh 4500 to 5000 kg.

- It would also enhance the capability of the country to be a competitive player in the multimillion dollar commercial launch market.
- The vehicle envisages multi-mission launch capability for GTO, LEO, Polar and intermediate circular orbits.
- GSLV-Mk III is designed to be a three stage vehicle. First stage comprises Large Solid Booster (LSB) with 200 tonne solid propellant. The second stage is re-startable liquid stage. The third stage is the cryo stage.
- It can put 4-5 Tonne satellite into Geosynchronous Transfer Orbit (GTO) and 10 Tonne satellite into low Earth orbit (LEO).

In News: GSLV-Mk III expected to be launched in first half of December

38. NISAR MISSION (NASA-ISRO SAR MISSION)

- NISAR - Nasa-ISRO Synthetic Aperture Radar (NISAR) mission is a joint project between NASA and ISRO to co-develop and launch the first dual frequency synthetic aperture radar satellite.
- It is planned to be used for remote sensing
- It is designed to observe and take measurements of some of the planet's most complex processes, including ecosystem disturbances, ice-sheet collapse, and natural hazards such as earthquakes, tsunamis, volcanoes and landslides.
- Data collected from NISAR will reveal information about the evolution and state of Earth's crust, help scientists better understand our planet's processes and changing climate, and aid future resource and hazard management.
- Scientific Instruments used –
 - L-band (24-centimeter wavelength) Polarimetric Synthetic Aperture Radar (To be produced by NASA)
 - S-band (12-centimeter wavelength) Polarimetric Synthetic Aperture Radar (To be produced by ISRO).

In News: The agreement was signed recently.

39. THIRTY METER TELESCOPE (TMT)

- It is a large Ground-based telescope, under construction on Mauna Kea in Hawaii USA.
 - It is designed for observations from near-ultraviolet to mid-infrared.
 - Its adaptive optics system will help correct for image blur caused by the atmosphere of the Earth.
 - In comparison with others, TMT will have highest altitude and will be **second largest** after E-ELT (European Extremely Large Telescope). If completed on schedule (2020), TMT could be the first of the new generation of Extremely Large Telescopes.
 - Partner countries - United States, China, Japan, Canada and India.
 - India joined TMT project as an observer in 2010 and became partners, with representatives on the TMT board in 2012.
- In News:** Construction of the telescope began on 28 July 2014.

40. GAIA (SPACECRAFT)

Importance Level: General Awareness

- Gaia (originally an acronym for Global Astrometric Interferometer for Astrophysics) is a European Space Agency (ESA) space mission in astrometry launched on 19 December 2013 by Arianespace from Kourou in French Guiana.
- Gaia is an ambitious mission to chart a three-dimensional map of our Galaxy, the Milky Way, in the process revealing the composition, formation and evolution of the Galaxy. Gaia will provide unprecedented positional and radial velocity measurements with the accuracies needed to produce a stereoscopic and kinematic census of about one billion stars in our Galaxy and throughout the Local Group. This amounts to about 1 per cent of the Galactic stellar population.

41. JUICE MISSION

- The Jupiter Icy Moon Explorer (JUICE) is a planned European Space Agency (ESA) spacecraft to visit the Jovian system, focused in particular on **studying three of Jupiter's moons; Ganymede, Callisto, and Europa.**
- Exploring the emergence of habitable worlds around gas giants.
- A proposed timeline is launch in 2022 and arrival at the Jupiter system in 2030.

42. ORBITING CARBON OBSERVATORY 2

- It is a satellite launched by NASA to track carbon dioxide, a leading greenhouse gas that is responsible for global warming.
- The satellite is now on its way to join the A-Train, a constellation of five other international Earth-observing satellites.
- The OCO-2 mission is to analyse the sources and sinks of this carbon dioxide and to find better ways to manage it.
- The observatory with field of view about one square mile (three square kilometres) will take 24 measurements of carbon in the atmosphere every second but clouds are a major obstacle.

43. SMAP

- NASA's Soil Moisture Active Passive (SMAP) satellite that can predict the severity of droughts worldwide and help farmers maximise crop yield.
- SMAP uses two microwave instruments to monitor the top 5 centimetres of soil on Earth's surface.
- Currently, there is no ground-or satellite-based global network monitoring soil moisture at a local level. SMAP's data will provide an objective assessment of soil moisture to help farmers with their management strategy.
- At present, schedule modifications are based mostly on growers' observations and experience. Some farmers handle drought by changing irrigation patterns, SMAP's measurements could fill a significant void.
- SMAP observations will be used to characterize hydrologic and ecosystem processes including land-atmosphere exchanges of water, energy, and carbon and will play an important role in improved disaster preparation and response

44. TOPS – TERRESTRIAL OBSERVATION AND PREDICTION SYSTEM

It's a modeling software system developed by NASA. It enables the daily monitoring and prediction of numerous biospheric variables that are important indicators of the events happening within the Earth system. It Integrates various technologies (information technology, weather/climate forecasting, ecosystem modeling, and satellite remote sensing) to enhance **better decision making (related to floods, droughts, forest fires, human health, and crop, range, and forest production).**

- It is designed to provide nowcasts² and forecasts services..
- In News: A senior Indian earth scientist from NASA, Ramakrishna Nemani, hailing from Hyderabad, has modified and adapted NASA technology to secure Indian farmers from risks of climate change like floods and droughts and ensure that crop insurance reaches the deserving farmer and not to undeserving farmers.
- The project recently received 15 months extension, after testing it in real world conditions for the past two years on pilot basis, by the Maharashtra government.

²The forecasting of the weather within the next six hours is often referred to as nowcasting

45. ILLUSTRIS

Why in news?

- A simulation model of our current ideas on the formation and evolution of galaxies.

About Illustris

- The Illustris project is an international collaboration of scientists to simulate galaxy formation in the universe since the Big Bang in a comprehensive physical computer model based on the latest scientific information.
- It is a set of large-scale cosmological simulations, where
 - the expansion of the universe,
 - the gravitational pull of matter onto itself,
 - the hydrodynamics of cosmic gas, as well as
 - the formation of stars and black holes,

are all modeled starting from initial conditions resembling the very young Universe 300,000 years after the Big Bang.

Significance:

- It's a significant step which can further enhance our understanding of the galaxy formation process.

46. NEW EVIDENCE SHOWS PARTICLE FOUND IN 2012 IS THE HIGGS BOSON

- In a breakthrough, researchers at CERN have found the first evidence for the direct decay of the Higgs boson into fermions — a strong indication that the particle discovered in 2012 is the Higgs boson.
- The findings confirm that the bosons decay to fermions — a group of particles that includes all leptons and quarks — as predicted by the Standard Model of particle physics.
- In July 2012 researchers from the ATLAS and Compact Muon Solenoid (CMS) experiments at the European Organisation for Nuclear Research (CERN), said they had observed a new particle in the mass region of 125 to 126 gigaelectronvolts (GeV).
- Preliminary studies showed the new particle's properties were consistent with those predicted for the Higgs boson by the Standard Model, but much more work was needed to confirm.
- Researchers wanted to clarify whether there was a single Higgs or many different Higgs particles, as predicted by various extensions of the Standard Model
- Now the team from the CMS Collaboration has demonstrated that the bosons also decay to fermions in a way that is consistent with the Standard Model Higgs.

More info

Large Hadron Collider (LHC)

- world's largest particle collider
- a 17-mile ring based deep underneath the Swiss-French border,
- trying to ascertain whether or not the Higgs boson exists.

Higgs Boson

- The Higgs boson is a **hypothetical** (not found yet) **fundamental particle** (meaning it is not made of anything) which is one of the building blocks of the universe.
- There are other fundamental particles, but this one is special in that when the fundamental particles which make up matter **interact with the Higgs boson, they acquire mass**.
- Without this interaction, these particles would have no mass, and would travel at the speed of light, as does the photon.

- The significance of the word "Higgs" is that **Peter Higgs*** is one of the scientists who theorized this particle. In fact, there were three independent groups of scientists who theorized the Higgs mechanism in 1964 (Guralnik, Hagen, Kibble; Higgs; Englert, Brout).
- It is predicted by a theory called "the **Standard Model*** of particle physics*".
- Massive elementary particle whose mass is expected to be in the **GeV*** range [1 **GeV=109 electron Volt (eV), a unit of mass and/or energy**].

Particle Physics:

- Particle physics is research that answers about smallest building blocks of the universe and their characteristics.

Standard Model of particle physics

- The standard model of particle physics is a well-tested theory that explains what the **fundamental building blocks of the universe are, and how they interact with each other**.
- The particles are divided into fermions and bosons.
- **Fermions**, such as electrons, are the constituents of matter.
- **Bosons**, such as photons, are force carrying particles, and can transform matter from one particle to another or transform its properties.
- All fields, such as electric fields, are recognized as being composed of individual particles or quanta.
- The fields and forces that we have a quantum-level understanding of are the electric field, the weak field, the and the strong field.
- We also have a unified theory of the electric and weak fields called the **electroweak field theory***. The **Higgs field*** is unverified so far, but is part of the standard model. Finding the Higgs boson will provide that evidence

Three generations of matter (fermions)			
	I	II	III
mass →	2.4 MeV/c ²	1.27 GeV/c ²	171.2 GeV/c ²
charge →	2/3 u	2/3 c	2/3 t
spin →	1/2 up	1/2 charm	1/2 top
name →			γ photon
Quarks			
mass →	1.8 MeV/c ²	104 MeV/c ²	4.2 GeV/c ²
charge →	-1/3 d	-1/3 s	-1/3 b
spin →	1/2 down	1/2 strange	1/2 bottom
name →			g gluon
Leptons			
mass →	<2.2 eV/c ²	<0.17 MeV/c ²	<15.5 MeV/c ²
charge →	0 ν _e	0 ν _μ	0 ν _τ
spin →	1/2 electron neutrino	1/2 muon neutrino	1/2 tau neutrino
name →			Z boson
mass →	0.511 MeV/c ²	105.7 MeV/c ²	1.777 GeV/c ²
charge →	-1 e	-1 μ	-1 τ
spin →	1/2 electron	1/2 muon	1/2 tau
name →			W ⁺ W boson
Gauge bosons			

Higgs field

- The Higgs field is a field that fills the universe like a water fills a pool.
- As particles move through the universe they acquire mass by interacting with the Higgs field.**
- One way to imagine the Higgs field is to imagine trying to walk through a pool: The water pushes against you making you feel heavier, and making it harder for you to move. This effectively generates inertia or mass.
- Of course, one can climb out of the pool and walk normally. But particles can never escape the Higgs field since it is everywhere, including the vacuum of space.

The Hypothesis

- SM theory says that as the universe cooled after the Big Bang, an invisible force known as the **Higgs field** was formed. The field can be pictured as a pool of molasses that sticks to the otherwise massless elementary particles that pass through the field, converting them into particles with mass. **The more strongly a particle interacts with the field, the heavier it becomes.** The mass-less particles, such as photons, do not interact at all with the Higgs field. **The Higgs boson is assumed to be an unstable particle created in fraction of a second after the Big Bang before decaying into smaller particles that form the building blocks of the universe.**

Experimental Set-up at the LHC

- To find the Higgs boson, scientists attempt to recreate the **conditions that existed just after the Big Bang.**

- This is done by firing **two proton beams at each other through** the LHC, and detecting the particles created by their collision.
- In the LHC, two 3.5 TeV (1TeV=10¹² eV) proton beams are travelling in the opposite direction at **99.99% of the speed of light**.
- This series of events is measured by **detectors** [OPERA[^], ATLAS*, CMS*] that capture various characteristics of this collision (e.g. path and energy of the beams and mass of particles created). After extensive processing to remove the background noise in the data, the ‘footprint’ of the Higgs boson shows up as a bump in the graphs in which the particle mass data is plotted.

Why Higgs boson is so illusive

- Higgs bosons, if they exist, are **very short lived and can decay in many ways**.
- LHC experiments rely on observing the particles that the Higgs bosons decay into, rather than the Higgs boson itself.

What if we find Higgs Boson

- Evidence that the Higgs boson exists would definitely help **solve a big puzzle: why some objects in the universe such as the quarks (the constituents of protons, neutrons and many other subatomic particles) have mass while others like photons and gravitons (hypothetical elementary particles that mediate the force of gravitation in the framework of quantum field theory) possess only energy but zero rest mass**.
- Its discovery may help explain why anything in our universe has mass, and it could thus rank as **one of the biggest scientific discoveries of all time**.
- On the other hand, if it cannot be found, then the **field will be left open for physicists to develop a completely new theory to explain the origin of particle mass**, rubbishing what theorists have been talking about for more than forty years. It is because of such high stakes that the CERN experiments continue diligently despite significant challenges.
- It can account for why everything in the universe has weight/mass, and forms a key component of everything from humans to star and planets. Its discovery would also shed light on the vast majority (96%) of the universe that is invisible. Twenty-three per cent of this includes **dark matter*** (**ordinary matter that does not interact even with photons and is thus not seen**) and 73% is **dark energy*** (**repulsive force that acts against the gravitational force and tends to accelerate the rate of expansion of the universe**).

Current Status of Higgs Boson

- A promising sign is that a modest significant excess of elementary particles has been found in the data from the latest experiments at LHC. One of the experiments performed on the detector known as **ATLAS (A Toroidal LHC Apparatus)*** suggests that Higgs boson could have a mass in the range of 116 to 130 GeV, with other masses excluded at 95% confidence level. The other experiment performed on the detector known as **CMS (Compact Muon Solenoid)*** pegged the particle’s mass at 115 to 127 GeV with 95% certainty.
- When evaluating results in particle physics, the scale of certainty used by researchers is the sigma scale. Researchers actually need a five-sigma level of certainty to make a bona-fide formal discovery, which means there is only a one in a million chance that the result is a statistical error.
- **The sigma probabilities for the Higgs hunt in the ATLAS experiment is 2.8 sigma and in the case of CMS experiment 1.9 sigma (where three sigma level of certainty means nearly 99% accurate result).**

Why it is called God Particle:

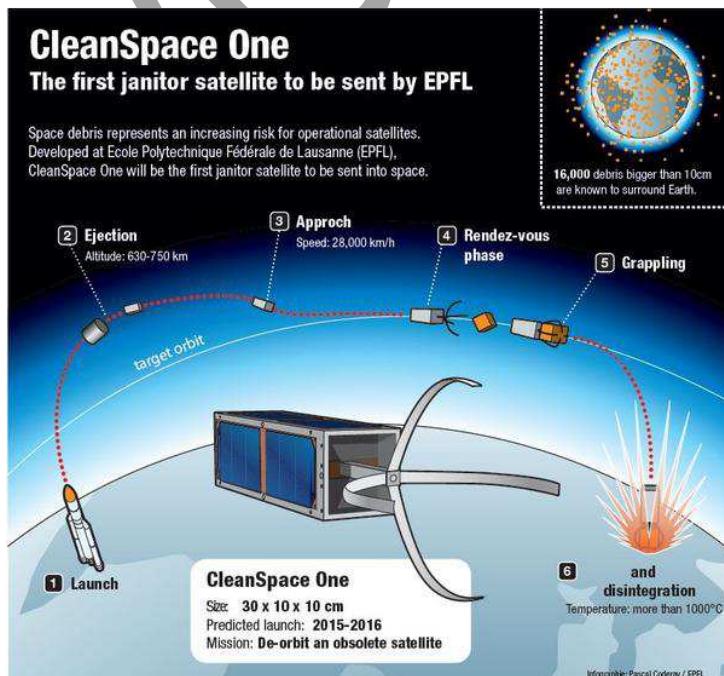
- Higgs boson is often referred to as the “God particle” by the media. This name was bestowed **by the Nobel Prize winning Physicist Dr. Leon Lederman in his book “The God Particle: If the Universe Is the Answer, What is the Question?”** written with Dick Teresi.
- Dr. Lederman chose this name as he felt the particle was “so central to the state of physics today, so crucial to our final understanding of the structure of matter, yet so elusive.”
- Most physicists, including Peter Higgs himself, do not like **this name as it is grandiose and overstates the implications of the research.**

47. VOYAGER-1

- Voyager-1 was a space probe launched by NASA to study the outer Solar System.
- Thirty-six years after being launched and having travelled about 19 billion kilometres from the sun, Voyager 1 has become the first human-made object to venture into **interstellar space**.
- Voyager 1 has been travelling for about a year through plasma, or ionised gas, present in the space between stars.
- Voyager is in a transitional region immediately outside the solar bubble, where some effects from our sun are still evident.
- Voyager 2, launched before Voyager 1, is the longest continuously operated spacecraft.
- Why In News: In 2012, Nasa's Voyager 1 spacecraft was believed to have achieved what was once unimaginable - becoming the first manmade object to breach interstellar space and move beyond mankind's solar system - more than 11 billion miles distant and 36 years after it was launched.
- But, in the nearly two years since that historic announcement, it has become increasingly uncertain about whether Voyager 1 really crossed the threshold.

48. CLEANSPACE ONE

- The proliferation of debris orbiting the Earth – primarily jettisoned rocket and satellite components – is an increasingly pressing problem for spacecraft, and it can generate huge costs. To combat this scourge, the Swiss Space Center at EPFL is announcing the launch of CleanSpace One, a project to develop and build the first installment of a family of satellites specially designed to clean up space debris.



- The cleanup satellite has three major challenges to overcome, each of which will necessitate the development of new technology that could, in turn, be used down the road in other applications.

49. NuSTAR

- **Why in News:** Using NASA's Nuclear Spectroscopic Telescope Array (NuSTAR), astronomers have found a pulsating, dead star beaming with the energy of about 10 million Suns.
- This is the brightest pulsar - a dense, stellar remnant left over from a supernova explosion - ever recorded.
- The Nuclear Spectroscopic Telescope Array- NASA's mission
- It is an Explorer mission that will allow astronomers to study the universe in high energy X-rays. Launched in June of 2012, NuSTAR is the first focusing hard X-ray telescope to orbit Earth. It is expected to greatly exceed the performance of the largest ground-based observatories that have observed this region of the electromagnetic spectrum. NuSTAR complements astrophysics missions that explore the cosmos in other regions of the spectrum.
- X-ray telescopes such as Chandra and XMM-Newton have observed the X-ray universe at low X-ray energy levels. By focusing higher energy X-rays, NuSTAR will start to answer several fundamental questions about the Universe including:
 - How are black holes distributed through the cosmos?
 - How were heavy elements forged in the explosions of massive stars?
 - What powers the most extreme active galaxies?
 - NuSTAR's primary science objectives include:
 - Conducting a census for black holes on all scales using wide-field surveys of extragalactic fields and the Galactic center.
 - Mapping radioactive material in young supernova remnants; Studying the birth of the elements and to understand how stars explode.
 - Observing relativistic jets found in the most extreme active galaxies and to understand what powers giant cosmic accelerators.
 - NuSTAR will also study the origin of cosmic rays and the extreme physics around collapsed stars while responding to targets of opportunity including supernovae and gamma-ray bursts. NuSTAR will perform follow-up observations to discoveries made by Chandra and Spitzer, and will team with Fermi, making simultaneous observations which will greatly enhance Fermi's science return.

50. JADE RABBIT

- Yutu or Jade Rabbit is an unmanned lunar rover that forms part of the Chinese Chang'e 3 mission to the Moon.
- **In News:** China's moon rover that moved between 100-110 metres before stalling in late January owing to a mechanical failure is awake (communicating with earth and still gathering some useful data) but still immobile.

51. HR 5171A:

- It is the largest yellow star discovered till now.
- It is around 1300 times more than diameter of sun.
- Scientists have used a technique called interferometry that combines the light collected from multiple individual telescopes to discover the star.
- Yellow hypergiants are very rare and only about a dozen of such stars are known in our galaxy. These stars are among the biggest and brightest known stars and are at an unstable stage of their lives and are changing rapidly. This instability allows them to expel material outwards by forming a large extended atmosphere around themselves.

52. ROBOTICS TECHNOLOGY Robotics Technology

Kirobo

- Japan's **talking robot-astronaut**.
- It is about 34 centimetres tall and weighs about one kilogramme, which makes it smaller than most robots that go into space.
- It has a **wide range of physical motion**, will also play a role in some missions, relaying messages from the control room to the astronaut.
- Back on earth, twin robot **Mirata** will be on the lookout for any problems encountered by its electronic counterpart.
- Named after a combination of the Japanese word kibo, or "hope", and the word "robot", the Kirobo project is part of an experiment that will see the **first human-robot conversation** held in space.

Defense Technology

53. DHVANI

- DHVANI (Detection and Hit Visualization using Acoustic N-wave Identification) is state-of-the-art target training system developed by Council of Scientific and Industrial Research (CSIR) for shooters of the Indian Army.
- This acoustic sensor-based indigenous system will help the Army develop shooting techniques for its combat personnel and perfecting marksmanship skills.
- Paramilitary forces and sportspersons could also use the system for their target training exercises.
- It will cost, 40% lower than existing similar systems available elsewhere in the world.

54. ZERO PRESSURE TYRE

- Zero pressure tires are designed to operate for a limited time with **little or no air pressure** without causing damage to the tire casing.
- Zero pressure tyres have been around for a long time, with major drawbacks such as **bumpy rides and overheating**.
- A newly developed prototype dissipates heat and has the tyre flexibility and strength to support the heavy military pick-up weight while providing a relatively smooth ride.
- In News: An Indian-American owned engineering firm Akron is developing zero pressure tyre for the US military, which would change the dynamics of **not only war** but also the **auto industry**. (TOI)

55. INS KOLKATA

- INS Kolkata is the lead ship of the indigenously designed and constructed **Kolkata-class guided missile destroyers**, built by Mazagon Dock Limited, Mumbai.
- INS Kolkata incorporates **new design concepts for stealth** and has many firsts to her credit, including a very large indigenous combat component. The ship is packed with the most sophisticated state-of-the-art weapons and sensors including the vertically launched Long Range Surface to Air Missiles (LRSAM) coupled with the MF-STAR multi-function active phased array radar, which is fitted for the first time on an Indian Naval ship. She is equipped with advanced supersonic and long range **BrahMos** Surface to Surface Missiles – a joint Indo-Russian venture.
- The ship can be truly classified as a '**Network of Networks**' as it is equipped with sophisticated digital networks, such as ATM based Integrated Ship Data Network (AISDN)

- The unique feature of this ship is the **high level of indigenisation** achieved with most of the systems onboard sourced from within the country which has generated a sound vendor base for future ships. Some of the major indigenised equipment/ systems onboard INS Kolkata include Combat Management System (CMS), Auxiliary Control System (ACS), Automatic Power Management System (APMS), Foldable Hangar Doors, Helo Traversing System and bow mounted HUMSA NG system. Crew comfort is a significant feature of INS Kolkata and has been ensured through ergonomically designed accommodation and galley compartments on modular concept.
- In News: PM Modi inducts India's largest indigenously built warship INS Kolkata.

56.NIRBHAY

- All-weather low-cost medium-range cruise missile with stealth and high accuracy.
- Range of 1,000 km.
- It will carry a ring laser gyroscope for high-accuracy navigation and a radio altimeter for the height determination.
- Capable of being launched from multiple platforms on land, sea and air and shall be inducted into Indian Navy, Army, and Air Force.
- Capable of carrying nuclear warheads.
- Capable of flying at different altitudes ranging from 500 m to 4 km above the ground.
- Good loitering capability, control and guidance with high degree of accuracy for maximum impact.

57.DHANUSH

- Dhanush is a variant of the surface-to-surface Prithvi II missile, which has been developed for the Indian Navy.
- It is capable of carrying both conventional as well as nuclear warheads with pay-load capacity of 500 kg and can strike targets in the range of 350 km.
- The Dhanush missile can be used as an anti-ship weapon as well as for destroying land targets depending on the range.

58. AWACS

- It is basically an aircraft fitted with sophisticated radar and can be said to be radar on the move.
- India plans to develop its own Airborne Warning and Control System (AWACS) aircraft as part of the modernization program of the Indian air force (IAF).
- AWACS are meant as force multipliers for specific area cover and not for surveillance of the entire space of our country. It would increase India's ability to patrol and act at extended ranges.
- AWACS is described as an 'Eye in the Sky' as it can carry out surveillance at about 400-km range under all-weather situations, and to lock on to 60 targets at a time simultaneously.
- They are capable of detecting hostile aircraft, cruise missiles and other incoming aerial threat far before ground-based radars.
- India already has AWACS aircraft under development using the Russian IL-76 platform and the Israeli Phalcon Radar, and three in service.
- The AWACS with special electronic observation devices atop aircraft will complement the smaller and homegrown AEW&CS (airborne early warning and control system).

Why AWACS planes are so valuable?

- The system can receive transmissions from other air and ground stations to round out its surveillance picture, and uses sensor fusion to provide a complete picture of the battlespace out to several hundred kilometers.
- On-board communications allow these AWACS planes to direct communications-compatible forces and allies based on the bigger picture.

How is it different from AEW&C system?

- AWACS is a heavier and high endurance system, which can give you in terms of coverage about 360 degrees as against AEW&C which is about 270 degree coverage.
- AWACS flies at a higher altitude and it can penetrate into the enemy territory by way of radars and EW (electronic warfare) systems to longer distances and it can be in sky for larger durations, besides giving better visibility.

59. WANKEL

- India has developed its **own propulsion engine** 'Wankel' for future **UAVs** (Unmanned Aerial Vehicles).
- The Wankel engine is a type of internal combustion engine using an eccentric rotary design to convert pressure into a rotating motion instead of using reciprocating pistons.
- The **55-hp engine** is developed by three national research agencies – National Aerospace Labs, Aeronautical Development Establishment, and the Vehicle Research and Development.
- Wankel will be used to power the home-grown UAVs Nishant, Lakshya and Rustom-1 and 2 versions used to observe and survey border areas.
- The engine weighs about 30 Kgs, and is known for its **high power to weight ratio** in single rotor category.
- The engine can also be used for powering smaller air vehicles, automotive, outboard motors, and Industrial applications.

60AGNI-V

- **3 stagesolid propellant Ballistic Missile** [some news claim Inter-Continental Ballistic Missile (ICBM) status but for ICBM generally range of 5500 km is needed].
- Range: **5000 Km**- longest range missile in India's arsenal
- Capable of reaching deep into China and Europe.
- Payload: 1.5 tonne **nuclear war head**
- Speed: 24 Mach
- The very high accuracy **Ring Laser Gyro based Inertial Navigation System (RINS)** and the most modern and accurate **Micro Navigation System (MINS)*** ensure that the missile reaches the target point **within a few metres of accuracy**.
- **MIRV*** Capable [multiple independently targetable reentry vehicles (MIRVs), allowing a single missile to carry several warheads, each of which can strike a different target.]
- **While Agni-V can destroy targets more than 5,000 km away, it can easily be further enhanced to become an Inter Continental Ballistic Missile (ICBM).**

61. BALLISTIC MISSILE DEFENCE (BMD)

- The Indian Ballistic Missile Defence Programme is an initiative to develop and deploy a multi-layered ballistic missile defence system to protect India from ballistic missile attacks.
- India's missile defence system is set to get a big boost as it is developing capability to intercept enemy missiles fired from a distance of up to 5,000 km, in effect tackling any possible threat from countries such as China.
- It is a double-tiered system consisting of two interceptor missiles, namely the Prithvi Air Defence (PAD) missile for high altitude interception, and the Advanced Air Defence (AAD) Missile for lower altitude interception.
- The capability is being developed by DRDO as part of the Ballistic Missile Defence (BMD) shield, whose first phase is ready for deployment possibly in Delhi.
- Development of the first phase of the BMD programme has been completed. Under this, the BMD shield can tackle enemy missiles fired at from ranges up to 2,000 km.

- The DRDO is enhancing the capability of BMD in phase-II to deal with threat from missiles of longer range of up to 5,000 km.
- Why in News: India is hurrying up the deployment of an advanced missile defence system to stave off threats from ballistic missiles at a time China's arsenal is growing in sophistication and numbers.

62. HAWK MK 132

- Hindustan Aeronautics Ltd. delivered the first Hawk Mk-132 **advanced jet trainer aircraft** to the Indian Navy.
- Hawk MK 132 is the latest entry into HAL-made and maintained aircraft and helicopters of Indian Navy which include Kiran and Do-228 aircraft, Advanced Light Helicopter (ALH), Chetak and Cheetah helicopters.
- The Hawk Advanced Jet Trainer is a **dual seat multi-purpose aircraft powered by a single Rolls Royce Adour Mk.871 engine**.
- The Hawk AJT is primarily used for **basic, advanced and weapons training of the pilots**.
- However, the aircraft has the capabilities to be used as a **ground attack aircraft or for air defence**.
- The Hawk AJT has **excellent flying characteristics** with good stability. It can be flown at night and can perform wide range of aerobatic manoeuvres.

63. PRAGATI

- India has developed a newtactical surface-to-surface missile 'Pragati' with a range between 60-170 km.
- The government has approved that it may be offered to friendly countries if anyone shows interest in it.
- The new missile is based on the Prahaar missile developed by the DRDO for the Army and can be termed as its export variant with minor differences.
- Pragati like Prahar also depends on an indigenous ring laser gyro based inertial navigation system that can receive GPS updates to remove accumulated errors.

64. AMPHIBIOUS AIRCRAFT

- An amphibious aircraft or amphibian is an aircraft that can take off and land on both land and water.
- Fixed-wing amphibious aircraft are seaplanes (flying boats and floatplanes) that are equipped with retractable wheels, at the expense of extra weight and complexity, plus diminished range and fuel economy compared to planes designed for land or water only.

65. AKASH (SURFACE TO AIR MISILE SYSTEM)

- Akash is a medium range surface to air missile system which provides area air defence to mobile, semi-mobile and static vulnerable points/ areas against multi directional air threats.
- The weapon system can operate in autonomous or group mode of operation.
- State of the art real time OS and open system architecture of the weapon system provides fully automatic and network centric operation.

66. ASTRA (BEYOND VISUAL RANGE AIR-TO-AIR MISSILE)

- Astra is a BVR Air-to-Air Missile having high Single Shot Kill Probability (SSKP), and is very reliable.
- It is an all aspect, all weather missile with active Radar terminal guidance.
- It has excellent ECCM features, smokeless propulsion and process improved effectiveness in multi-target scenarios.
- It can be launched in both autonomous and buddy mode operation with features for lock-on before

launch (LOBL) and lock-on after launch (LOAL).

67. ABHYAS (HIGH-SPEED EXPANDABLE AERIAL TARGET)

- High-speed Expendable Aerial Target (HEAT) offers a realist threat scenario for practice of weapon systems.
- HEAT-ABHYAS is an expendable high-speed unmanned aerial target developed by DRDO.
- ABHYAS is designed for autonomous flying with the help of an autopilot.
- A lunberg lens in the nose cone improves the RCS of the target for weapon practice.
- It also has an Acoustic Miss Distance Indicator (AMDI) to indicate the miss distance.

68. LCA (LIGHT COMBAT AIRCRAFT-TEJAS)

- The Light Combat Aircraft (LCA) is an indigenous fighter aircraft developed by ADA with Hindustan Aeronautics Limited as its principal partner, in India.
- The air force variant christened Tejas is the smallest, light weight, multi role, single engine, tactical fighter aircraft with compound delta wing.
- LCA is being developed to meet the versatile and stringent requirements of the Indian Air Force (IAF), as its front line multi mission tactical aircraft.
- LCA fighter has take-off clean weight of 9800 Kg and can carry external stores of up to 3500 kg.
- The special features of LCA fighter are compound delta Planform, Relaxed static stability, composite structure, fly-by-wire flight control system, glass cockpit, etc.
- LCA fighter can carry Air-to-Air missiles, Air-to-ground missiles, Anti-ship missiles, Laser guided Bombs, Drop Tanks, Night targeting pod, EW suite and bombs of various weights.
- LCA Tejas is an amalgamation of contemporary concepts and technologies which makes the aircraft very agile and carefree maneuvering capabilities.
- LCA fighter has excellent handling qualities and performance characteristics. It rockets off the runway and into the air in a mere 500 meters.

69. LCA NAVY (NAVAL LIGHT COMBAT AIRCRAFT)

- LCA Navy will operate from an Aircraft Carrier with a concept of Ski-jump and lands in 90 meters using an arrester hook engaging an arrestor wire on the ship.
- Derived from the Air force version it is longitudinally unstable, fly-by-wire aircraft making it an agile war machine.
- Flight control system of LCA Navy is augmented with Leading Edge Vortex Controller (LEVCON) aiding reduction in approach speed for landing.
- Auto throttle function incorporated in LCA Navy reduces pilot load by maintaining constant angle of attack during the critical phase of flaw-less carrier landing.
- Fuel dump system is an additional feature in LCA Navy to enable safe landing by reducing weight in the event of an emergency immediately after launch from a carrier.
- Landing gear of LCA Navy has been adequately strengthened to withstand increased landing loads in carrier operations.
- LCA Navy is supersonic at all altitudes and has Air-to-Air, Air-to-Sea and Air-to-Ground roles.

70. LCA TRAINER

- LCA Trainer is a two seat tandem configuration Air Force Trainer derived from the fighter version.
- It is mainly used for training purpose, even though it has the capability to launch weapons.
- It has been an endeavour on the part of the developers to maintain maximum commonality amongst all the LCA variants i.e. LCA fighter, LCA Trainer, Navy Trainer and Navy fighter.

71. AEW&C (AIRBORNE EARLY WARNING AND CONTROL)

- AEW&C systems detect, identify and classify threats present in the surveillance area and act as a command and control center to support different air operations.
- The system with its multiple Communication and data links alerts and directs fighters against threats while providing "Recognizable Air Surface Picture" to Commanders at Ground Exploitation Stations.
- It also comprises electronic and communication support measures that interrupt and classify unfriendly radar transmissions and communication signals.

72. HELINA

- Helina, (HELIcopter launched NAg) with a range of 7–8 km, launched from twin-tube stub wing-mounted launchers on board the armed HAL Dhruv and HAL Light Combat Helicopter produced by state-owned Hindustan Aeronautics Ltd (HAL). It will be structurally different from the Nag. The Helina will make use of an IIR seeker for target engagement like the Nag. Launchers have been cleared for captive carriage trials and handed over to Hindustan Aeronautics Limited (HAL) for carriage trials. The Helina was tested in 2010. The first ground launches of the missiles were conducted in 2011. During which the missile was launched onto a target and landed. While the missile was in flight, a second target was chosen for the missile to hit which got destroyed. This demonstrated the capability of the missile to lock onto and hit another target while in flight. A 2-way RF command-video data link has been released which is intended to be fired from HAL ALH.

73. PRISM

- PRISM is a clandestine mass electronic surveillance data mining program known to have been operated by the United States National Security Agency (NSA).
- The Prism program collects stored Internet communications based on demands made to Internet companies such as Google and Facebook.
- It allows officials to collect material including search history, the content of emails, file transfers and live chats.
- PRISM was publicly revealed when classified documents about the program were leaked to journalists of the Washington Post and The Guardian by Edward Snowden – at the time an NSA contractor – during a visit to Hong Kong.

74. TEMPORA

- UK's surveillance programme, aimed at tapping up as much online and telephone traffic as possible.
- There is no public acknowledgement or debate over this programme.
- It has a key ability to tap into and store huge volumes of data drawn from fibre-optic cables for up to 30 days so that it can be sifted and analysed.

75. CMS INDIA

- New proposed Centralized Monitoring System (CMS) has all-encompassing surveillance capabilities.
- Once implemented, the CMS will enhance the government's surveillance and interception capabilities far beyond 'meta-data,' data mining, and the original expectation of "instant" and secure interception of phone conversations.

- CMS being set up by C-DoT - an obscure government enterprise located on the outskirts of New Delhi - will have the capability to monitor and deliver Intercept Relating Information (IRI) across 900 million mobile (GSM and CDMA) and fixed (PSTN) lines as well as 160 million Internet users, on a 'real time' basis through secure ethernet leased lines.
- The CMS will have unfettered access to the existing Lawful Interception Systems (LIS), currently installed in the network of every fixed and mobile operator, ISP, and International Long Distance service provider.

76. DONGFENG MISSILE

- Dongfeng – literally means 'East Wind' in Chinese.
- It is a series of intermediate and intercontinental ballistic missiles operated by China.
- The DF-31 system has an estimated range of nearly 10,000 km, enough to deliver a nuclear warhead to the capitals of Europe or the west coast of the US.
- China recently flight-tested it.

77. MEGATONS TO MEGAWATTS PROGRAM

- It is popular name given to the program which is also called the United States-Russia Highly Enriched Uranium Purchase Agreement.
- Launch – Feb'1993 and successfully completed in Dec'2013
- Under this Agreement Russia agreed to supply the US with low-enriched uranium (LEU), obtained from high-enriched uranium(HEU) found to be in excess of Russian defense purposes.
- Nuclear industry sources forecasted high demand trends that would require finding other uranium supply sources after the completion of the Megatons to Megawatts agreement.

Nano-Technology

78. NANODIAMONDS

Why in news?

- Researchers from Cardiff University have unveiled a new method for viewing Nanodiamonds inside human living cells for purposes of biomedical research.

About Nanodiamond

- Nano diamonds are **carbon-based particles** that are roughly 4 to 5 nanometers in diameter.
- Nano diamonds are produced as the result of a carefully controlled explosion. They are usually extracted from the explosion's resulting soot through the use of pressure, heat, and acid. Alternately, Nanodiamonds can also be produced using graphite-based processes.
- Beginning in the late 20th century, research in medical applications revealed that Nanodiamonds are effective agents for both delivering and monitoring chemotherapy drugs. These tiny diamonds are used in industrial applications involving a wide range of products.
- Current methodology uses organic fluorophores for drug delivery. Nanodiamonds because of their low toxicity can be used as a carrier to transport drugs inside cells. They also show huge promise as an alternative to the organic fluorophores usually used by scientists to visualize processes inside cells and tissues.

Important characteristics:

- Nanodiamonds possess a very large surface area relative to their size so that hydrocarbon and water molecules attach readily to them.
- The Nanodiamond particles also tend to cluster and adhere to each other strongly.
- These characteristics make handling them challenging while also giving them many potential industrial and medical applications.

Applications:

- Medical Applications
 - They are one of the most promising carbon nanomaterials for drug delivery applications.
 - They offer great medical potential when used in conjunction with anti-cancer chemotherapy drugs.
 - Due to their purity, the diamonds are not attacked by the immune system while binding strongly to molecules containing medicines, thus overcoming the tendency of tumors to resist medicines.
- Industrial applications: They are used
 - In dry lubricants,
 - as reinforcement for plastics and rubber
 - in polishing
 - as an additive to motor oils.
 - In Optical Processing
 - For faster Quantum Computing
 - In biological sensors

Way ahead:

- The next step for the researchers will be to push the technique to detect nanodiamonds of even smaller sizes and to demonstrate a specific application in drug delivery.

Bio-Technology

79.PHANTOM – 3D MODEL OF HUMAN FINGERPRINTING

Why in news?

A team of Michigan State University computer scientists led by Indian Institute of Technology (IIT) Kanpur alum **Anil Jain** have built the first three-dimensional model of a human fingerprint.

About Phantom

- It is a method that takes a two-dimensional image of a fingerprint and maps it to a 3-D finger surface.
- The 3-D finger surface, complete with all the ridges and valleys that make up the human fingerprint, is made using a 3-D printer. It creates what Jain's team called a fingerprint "**phantom**."
- In health care, a 3-D heart or kidney can be created because the dimensions are known, they can be put into a scanner and the imaging system can be calibrated.

Application

- It could advance fingerprint sensing and matching technology. One can evaluate fingerprint readers in a better way as the true dimensions of the fingerprint features on this phantom.
- Tools like this would help improve the overall accuracy of fingerprint-matching systems, which eventually leads to better security in applications ranging from law enforcement to mobile phone unlock.

79. OXADIAZOLES

- It's a new class of antibiotics recently discovered Oxadiazoles can treat antibiotic resistant infections such as methicillin-resistant *Staphylococcus aureus* or MRSA³.MRSA is a bacterium that developed resistance to penicillin and certain other groups of antibiotics.

³ UPSC Mains 2010: Q7(a)-MRSA infection

- MRSA has become a global public-health problem since the 1960s because of its resistance to antibiotics. Only three drugs currently are effective treatments, and resistance to each of those drugs already exists. The researchers have been seeking a solution to MRSA for years.
- The Oxadiazole are the only available antibiotics for MRSA that can be taken orally.

80. STEM CELLS AUXETICITY:

Why in news?

- Cambridge scientists have discovered a new property(Auxeticity) in the nuclei of embryonic stem cells that could pave the way for gen-next bulletproof vests.

About Stem Cells:

- Stem cells have the remarkable potential to develop into many different cell types in the body during early life and growth.
- In addition, in many tissues they serve as a sort of internal repair system, dividing essentially without limit to replenish other cells as long as the person or animal is still alive.
- When a stem cell divides, each new cell has the potential either to remain a stem cell or become another type of cell with a more specialized function, such as a muscle cell, a red blood cell, or a brain cell.

About Stem Cells Auxeticity:

- Most materials when stretched will contract. For example, if one pulls on an elastic band, the elastic itself will get thinner. The opposite is also true: squeeze a material and it will expand – for example, if one squeezes a tennis ball between both hands, the circumference around the ball gets larger.
- However, Auxeticity has the opposite effect — squeeze it and it will contract, stretch it and it will expand. This means that auxetic materials act as excellent shock absorbers or sponges, a fact that is being explored for various uses.
- Until now auxeticity has only been demonstrated in manmade materials and rarely in nature. However, researchers have observed auxeticity in the nuclei of embryonic stem cells.

Application:

- This may have application as wide-ranging as soundproofing, super-absorbent sponges and bulletproof vests.

81. HSP 90:

- Recently scientists discovered a potential silencing mechanism: Heat shock protein 90 (HSP90).
- HSP90 keeps the genetic mutation under check in normal circumstances .In stressful situations reservoirs of HSP90 get depleted allowing the genetic mutation to manifest as a trait.This allows the organism to quickly adapt to changes in environment.
- The research team has used HSP90 to explain the adaption to pitch blackness in cave blindfish.

82. BRCA GENES

- The BRCA genes – **BRCA1 and BRCA2** – are two genes that have been associated with hereditary forms of breast and ovarian cancer.
- BRCA1 and BRCA2 are believed to be tumor suppressor genes, which mean that when they are functioning normally, they suppress the growth of cancerous cells.
- Women who have certain mutations along these genes have an elevated lifetime risk of developing breast and ovarian cancer because their ability to suppress cancerous growth has been reduced.

Why is it in news?

- US Supreme Court ruled that isolated **human genes cannot be patented**, a partial defeat for Myriad Genetics, a company that had been awarded patents on the so-called BRCA1 and BRCA2 genes in the 1990s.
- But DNA molecules engineered by man -- including so-called "cDNAs" -- are eligible for patents.
- Company found an important and useful gene, but separating that gene from its surrounding genetic material is not an act of invention.

Whose rights are violated by gene patents?

- Scientific researcher's rights are violated because gene patents prevent them from freely engaging in research and exchanging information about the patented genes.
- If a researcher wants to study a gene that has been patented, s/he must obtain permission from the patent holder or risk being sued for violating the patent.
- Clinical geneticist's and genetic counselor's rights are violated because gene patents infringe on their freedom to provide their patients with information about their susceptibility for genetic diseases.
- Like researchers, clinicians must obtain licenses to conduct clinical testing, and as with research licenses, the USPTO(United States Patent and Trademark Office's) gives the patent holder the authority to refuse to grant testing licenses, to charge high fees, and to shut down un-licensed testing.
- Genetic counselors are forced to refer their patients to the laboratory dictated by the patent holder and are restricted in the service they can provide their patients.
- Individual patients' rights are violated because gene patents impede access to medical information and care.
- The patent holder controls what information people can obtain about their own genes, how they may obtain this information, and from whom.
- Public's rights are violated because gene patents permit an unfair monopoly that limits the public's right to benefit from scientific breakthroughs that advance medical research.

What about the argument that patents are a necessary incentive for research?

- People who support gene patents often argue that genetic investigation is like drug development and will not take place without the incentive of the patent system. But studies have established that gene patents, unlike other patents, are not required to incentivize research.
- The Human Genome Project sequenced the entire human genetic sequence and did not patent any of the genes it identified.

83. DUA'S LAYER

- Dua's layer, according to a 2013 paper by Harminder Singh Dua's group at the University of Nottingham, is a layer of the cornea that had not been detected previously.
- It is the fourth layer from the front.
- Despite its thinness, the layer is very strong and impervious to air.

84. BARCODES OF DNA

- A team of researchers claim that they have developed a technique by which any product can be tagged with synthesized DNA and then subsequently read as a means of identification.
- Scientists at the University of Aveiro, Portugal, believe that they can create and replicate a certain type of 'molecular tag' or 'molecular barcoded labels' in large quantities.
- Each tag or label, depending on what it is used for, is made up of a cocktail of chimerical molecules of deoxyribonucleic acid (DNA).
- These tags, which are non-toxic, can then be applied to a number of products—where they stay attached and can be easily read using low-cost portable equipment.

Why it matters?

- A unique property of these DNA barcodes is that they can simply be read like regular barcodes; no DNA-sequencing devices are required.
- These will have immense use in combating the counterfeiting of products, as the tags can be used as a method of verifying authenticity.
- According to the research team, the tags can even be combined with ink to verify someone's signature.

(not to be confused with another DNA barcoding.

DNA barcoding

- DNA barcoding is a taxonomic method that uses a short genetic marker in an organism's DNA to identify it as belonging to a particular species.)

Energy Technology

85. NET ZERO BUILDING

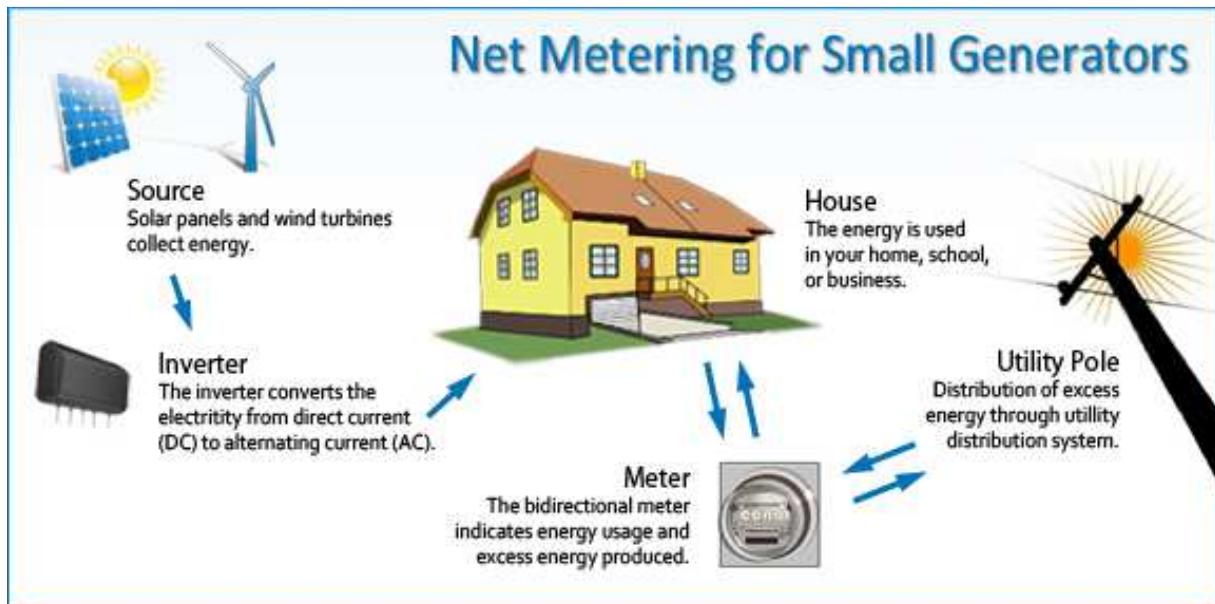
Net Zero Building - is a structure with zero net energy consumption where the total amount of energy used in the premises on an annual basis is more or less equal to the amount of renewable energy created on the site.

- Indira Paryavaran Bhawan is India's first on site Net Zero Building built by adoption of solar passive design and energy efficient building material.
- The building is designed in such a way that 75% of natural daylight is utilised to reduce energy consumption.
- Total energy savings of about 40% has been achieved by adoption of energy efficient 'Chilled Beam' system of Air Conditioning. This is an innovative air conditioning system, where air conditioning is done by convection currents rather than air flow through diffusers and chilled water is circulated right up to the diffuser points unlike the conventional systems.
- Some other provisions are-Effective Ventilation,use of Green materials, rain water harvesting ,use of curing compounds during construction,earthquake resistan,Robotic parking system etc.
- The building has been designed as the highest green rated building, i.e., **GRIHA 5-Star** and **LEED** India Platinum and received an award an award from Adarsh/GRIHA of MNRE for exemplary demonstration of Integration of Renewable Energy Technologies

86. NET METERING

Net metering allows residential and commercial customers who generate their own electricity from solar/renewable power to feed electricity they do not use back into the grid. Delhi, Andhra Pradesh, Karnataka, Bihar, Gujarat, West Bengal and Maharashtra have adopted net metering for renewable power

- Net metering is a billing mechanism that credits solar energy system owners for the electricity they add to the grid. For example, if a residential customer has a PV system on the home's rooftop, it may generate more electricity than the home uses during daylight hours. If the home is net-metered, the electricity meter will run backwards to provide a credit against what electricity is consumed at night or other periods where the home's electricity use exceeds the system's output. Customers are only billed for their "net" energy use. On average, only 20-40% of a solar energy system's output ever goes into the grid. Exported solar electricity serves nearby customers' loads.
- Without net metering, a second meter is usually installed to measure the electricity that flows back to the provider, with the provider purchasing the power at a rate much lower than the retail rate.



Advantages:

- Net metering is a **low-cost, easily administered** method of encouraging customer investment in renewable energy technologies.
- It increases the value of the electricity produced by renewable generation and allows customers to **"bank" their energy** and use it a different time than it is produced, giving customers more flexibility and allowing them to maximize the value of their production.
- Providers may also benefit from net metering because when customers are producing electricity during peak periods, the **system load factor is improved**.
- The net metering is a necessary policy to boost the **growth of renewable energy**, the energy sovereignty and the energy self-production.
- Giving customers **control over their electricity bills** - Net metering allows utility customers to generate their own electricity cleanly and efficiently. During the day, most solar customers produce more electricity than they consume; net metering allows them to export that power to the grid and reduce their future electric bills.
- Net metering provides substantial economic benefits in terms of jobs, income and investment. (Jobs in renewable sector)
- Protecting the Electric Grid - By encouraging generation near the point of consumption, net metering also reduces the strain on distribution systems and **prevents losses in long-distance electricity transmission** and distribution.

87. FLOW BATTERIES

- A flow battery is a type of rechargeable battery where rechargeability is provided by two chemical components dissolved in liquids contained within the system and most commonly separated by a membrane. This technology is akin to both a fuel cell and a battery - where liquid energy sources are tapped to create electricity and are able to be recharged within the same system.
- One of the biggest advantages of flow batteries is that they can be almost instantly recharged by replacing the electrolyte liquid, while simultaneously recovering the spent material for re-energization.
- Different classes of flow cells (batteries) have been developed, including redox, hybrid and membraneless. The fundamental difference between conventional batteries and flow cells is that energy is stored as the electrode material in conventional batteries but as the electrolyte in flow cells.

Why in News:

New battery material could help wind and solar power go big

- Harvard University researchers say they have developed a new type of battery that could make it economical to store a couple of days of electricity from wind farms and other sources of power.

- The new battery is based on an organic molecule — called a **quinone** — that's found in plants such as rhubarb and can be cheaply synthesised from crude oil. The molecules could reduce, by two-thirds, the cost of energy storage materials in a type of battery called a **flow battery**, which is particularly well suited to storing large amounts of energy.

88. SOLAR FUEL

- A solar fuel is a fuel produced from sunlight through artificial photosynthesis or a thermochemical reaction. Light is used as an energy source, with solar energy being transduced to chemical energy, typically by reducing protons to hydrogen, or carbon dioxide to organic compounds.
- Several platforms are under investigation for generating solar fuel but the primary focus is on Dye Sensitized Photoelectrosynthesis Cells (DSPEC).

Dye-sensitised photoelectrosynthesis cell (DSPEC)

- Solar energy has long been used as a clean alternative to fossil fuels such as coal and oil, but it could only be harnessed during the day when the sun's rays were strongest.
- According to a path-breaking study, researchers have built a system that converts the sun's energy not into electricity but hydrogen fuel and stores it for later use - allowing us to power our devices long after the sun goes down.
- The new system, known as dye-sensitised photoelectrosynthesis cell (DSPEC), generates hydrogen fuel by using the sun's energy to split water into its component parts.
- After the split, hydrogen is sequestered and stored, while the byproduct, oxygen, is released into the air

Science and Tech. developments and their applications and effects in everyday life

89. CABLE TV DIGITIZATION IN INDIA

(In News: The Centre is mulling to complete the third phase of digitization of cable television by 2015.)

- Digitalization of Cable TV simply means that cable TV will bring digital signal to consumers doorstep.
- Analog cable services have been existing in India for more than two decades in India. Digital services in India have been started less than a decade back and are gaining popularity and acceptance in India mainly because of their superior picture and sound quality.

Advantages:

- The state of art digital technology will make available enhanced picture and sound quality, large no. of channels and value added services like movies on demand, broadband, games, pay per view, HD etc.
- Digital Cable TV is not affected by rainy weather unlike the DTH service.
- The digital cable TV service will be available through a Set Top Box. The Bill will prevent local cable operators from bypassing the digital set-top box. TV broadcasters will be able to monitor their subscriber base and control the flow of revenues. This will render obsolete the role of the "middleman".
- Advertisers too will be able to create targeted campaigns owing to higher knowledge or analytics about the viewership patterns of users.
- For Government, greater customer declaration will lead to better tax compliance and tax revenues.

Mandatory dates of digitalization:

- An ordinance has been passed by the Government of India making digitization of cable services compulsory. According to this amendment made in the section 9 of the Cable Television Networks (Regulation) Amendment Ordinance, 1995, the Ministry of Information & Broadcasting will make Digital Addressable System (set-top box) mandatory.
- Phases of Digitalization of CATV in India

Phase – I	4 Metros (Mumbai, Delhi, Kolkata, Chennai)	31th October, 2012
Phase – II	Cities with over 10 lakh population	31st March, 2013
Phase – III	All other urban areas (Municipal corporations/ Municipalities) except cities/ town/ areas specified for the corresponding Phase - I and Phase - II above.	30th September, 2014
Phase – IV	Rest of India	31st December, 2014

Criticism/Challenges:

- Critics have wondered if the digitization schedule has been created in haste without adequate preparation both in the industry and among consumers.
- There are issues about the ability of distribution players to successfully raise incremental funds.
- Customers' response and acceptability of the value proposition offered by digitization have not been considered properly.
- The level of competitive intensity in the industry may impair industry profitability.

Similar issues asked by UPSC:

- Mains 2009: Q: Trace the significance steps in the evolution of Television in the country.
- Mains 2010: Q: Bring out the salient features of the evolution and the current status of the 'Bharat Stage' vehicle emission norms in the country.

Additional Info:

DAS or Digital Addressable System:

- Digital Addressable System (DAS) is a description normally used for a set of hardware devices and connected software used at different stages of distribution of a TV channels through which the channels are transmitted in encrypted form. It contains the following attributes:
- The subscriber is given an authorization depending upon his request to view one or more of such encrypted channels of his choice.
- The subscriber will pay for those channels which he or she has chosen to view in such a system.
- The authorization is given and controlled by the Multi System Operator (MSO) who owns the DAS in a Cable Television Network. In this, he is often assisted by the Local Cable Operator.
- "Addressable system" signifies that a subscriber is identifiable.
- The Multi System Operator and the broadcaster will know the exact number of subscribers of a channel or a bouquet of channels and the amount that is due from that subscriber.

Set Top Box:

"Set top box"(STB) is a device, which is connected to a television set at the subscribers' premises and which allows a subscriber to view encrypted channels of his choice on payment. The basic function of the Set Top Box is to decrypt/decode the signals of those channels which the subscriber has been authorized by the multi system operator to receive and to convert the digital signals into analogue mode for viewing on television sets.

Multi System Operator:

"Multi-System Operator (MSO)" means a cable operator who receives a programming service from a broadcaster and/or his authorized agencies and re-transmits the same or transmits his own programming service for simultaneous reception either by multiple subscribers directly or through one or more local cable operators (LCOs), and includes his authorized distribution agencies by whatever name called.

90. NATIONAL EMF PORTAL

- To address the concerns arising out of fears over electromagnetic radiation the government has decided to launch a **National EMF portal**.
- It will list every mobile phone tower in the country.
- It will also provide information about EMF and its effects on humans.
- According to guidelines issued by DoT, the specific absorption rate (SAR), a measure of radiation, on mobile phones sold in India should not exceed 1.6 watt/kg averaged over a mass of 1 gram of human tissue. Most countries allow an SAR of 2 watts from mobile phones. In India it is already low.
- People are still hesitant about hiring out their roof tops for locating the BTS.
- **Possible Effects of EMF on Human health**
- So far, no conclusive evidence has been found on adverse health effects by EMF radiation from mobile handset and cellphone towers by the World Health Organisation (WHO).
- The limits set by India are much lower than the internationally adopted recommendations of the International Commission on Non Ionising Radiation Protection (ICNIRP), which account for thermal and non-thermal effects. So there should not be any cause of concern for adverse thermal health affects on human beings living close them.
- A lot of research is going around globally. Some countries are taking a precautionary approach by reducing EMF levels below those specified by ICNIRP and India is one of them that has reduced prescribed EMF radiation levels by a factor of 10.

91. INNOVATION IN SCIENCE PURSUIT FOR INSPIRED RESEARCH (INSPIRE)

- INSPIRE is an innovative programme sponsored and managed by the Department of Science & Technology for attraction of talent to Science.
- The basic objective of INSPIRE is to communicate to the youth of the country:
 - the excitements of creative pursuit of science,
 - attract talent to the study of science at an early age
 - build the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base.
- INSPIRE Scheme has included three components.

Component	Schemes	Details
a) Scheme for Early Attraction of Talents for Science (SEATS),	INSPIRE Award INSPIRE Internship	Scheme for Early Attraction of Talent (SEATS) aims at attracting talented youth to study science by providing INSPIRE Award, to experience the joy of innovations, of Rs.5,000/- to one million young learners in the age group 10-15 years. There shall be annual Summer/Winter Camps for about 50,000 youth at more than 100 locations, for toppers in Class X board examinations for exposure with global leaders in Science, through INSPIRE Internship.
b) Scholarship for Higher Education (SHE) and	INSPIRE Scholarship	Scholarship for Higher Education (SHE) aims at attracting talented youth into undertaking higher education in science intensive programmes, by providing scholarships and mentoring through 'summer attachment' to performing researchers. The scheme offers 10,000 scholarships every year @ Rs 0.80 lakh per year to talented youth in the age group 17-22 years, for undertaking Bachelor and Masters level education in Natural and Basic sciences.
c) Assured Opportunity for Research Careers (AORC).	INSPIRE Fellowship INSPIRE Faculty Scheme	Assured Opportunity for Research Careers (AORC) aims at attracting, attaching, retaining and nourishing talented young scientific Human Resource to strengthened the R&D foundation and base by offering doctoral INSPIRE

		Fellowship in the age group 22-27 years, in both Basic and Applied sciences (including engineering and medicine). It also aims at assuring opportunities for post-doctoral researchers through a scheme (similar to the New Blood programme of the Royal Society of UK) through contractual and tenure track positions for five years in both Basic and Applied sciences areas through an INSPIRE Faculty Scheme.
--	--	---

- A striking feature of the programme is that it does not believe in conducting competitive exams for identification of talent at any level. It believes in and relies on the efficacy of the existing educational structure for identification of talent.

92. UN DECADE OF ACTION FOR ROAD SAFETY

Why in news ?

- Death of Union Minister Gopinath Munde in road accident
- General Assembly adopted a resolution in April on “Improving global road safety” in April 2014 which encourages the inclusion of road safety in the post-2015 development agenda; invites WHO to continue monitoring progress in the Decade of Action amongst other things
- Save LIFE Foundation and United Centre for India and Bhutan released a report on road safety in India post Union Minister for Rural Development Gopinath Munde’s death.
- Entry level car prices will rise by Rs. 30,000 to Rs. 35,000 from October next year as the government will make it mandatory for all new passenger cars in India to have basic safety features such as air bags, anti-lock braking systems, child restraint systems, seat belt reminders and reinforced body structures. (Hindustan Times)

What is it ?

- The Decade of Action for Road Safety 2011–2020 was officially proclaimed by the United Nations General Assembly in March 2010. Its goal is to stabilize and reduce the forecast level of road traffic deaths around the world. It is estimated that 5 millions lives could be saved on the world's roads during the Decade
- The United Nations Road Safety Collaboration has developed a Global Plan for the Decade of Action for Road Safety 2011-2020 as an overall framework for activities which may take place in the context of the Decade. The categories or "pillars" of activities are: road safety management; safer roads and mobility; safer vehicles; safer road users; and post-crash response.

Status of Road Safety in India:

- India accounts for 10 per cent of the global road crash fatalities when it has around 1 percent of global automobile share
- Every four minutes a life is lost in a road accident in India with 1,40,000 deaths recorded in 2012 alone.
- In the past decade, over a million people have lost their lives in road accidents in the country and over 5 million have been left seriously injured or permanently disabled

Why there is high mortality rate in India?

- Road designs and planning is unscientific and dangerous
- Detailed investigations are a rarity, and officials in-charge are almost never held accountable,
- Indian laws remain poorly enforced. The sole statute governing road safety in India, the Motor Vehicles Act-1988 (MVA), has proved ineffective in addressing any of these issues decisively

FOR A SAFE DRIVE



■ From October 2015, all new cars to hit Indian roads will come with safety features such as air bags, anti-lock braking system, child restraint system and seat-belt reminders

- Govt will give manufacturers another 2 years — until 2017 — to equip cars sold before October 2015 with enhanced features
- New norms part of India's first New Car Assessment Programme (NCAP) that will be notified early next year. NCAP is accepted safety standard followed in Europe and the US
- Road ministry has proposed a vehicle regulation and road safety authority to enforce regulation
- Govt plans hefty penalties against violators

₹30,000-
₹35,000
expected rise in
car prices after
new features, say
manufacturers

UNSAFE ROADS

India has one of the highest numbers of road fatalities in the world

4,86,476
accidents
reported in
2013

1,37,576
lives lost
(377 deaths a day)



Source: Road ministry

Electronic Stability Control:

- It is a vehicle safety feature that aims to increase vehicle stability. It does so by detecting and reducing loss of traction (*skidding*).
- During normal driving, ESC works in the background and continuously monitors steering and vehicle direction. It compares the driver's intended direction (determined through the measured steering wheel angle) to the vehicle's actual direction (determined through measured lateral acceleration, vehicle rotation and individual road wheel speeds).
- An ECS system will automatically apply brakes in case it detects skidding and try to steer the vehicle in the direction driver intended it to.
- It applies brakes to outer front wheel to counter over steer the inner rear wheel to counter under steer. It may also reduce engine power till the vehicle regains control.

Traction Control System(TCS)

Traction control is one of the newest safety features. A traction control system uses sensors to continuously detect the speed of each wheel. If the system observes a wheel spinning faster than others, it automatically

prompts the brakes of that wheel to slow it down. Some traction control systems also apply engine reduction to take power away from the wheel.

Anti-Lock Braking System (ABS)

- An antilock braking system works with the regular or foundation brakes on vehicle.
- ABS simply keeps base brakes from locking up. In vehicles not equipped with ABS, the driver can manually pump the brakes to prevent wheel lockup.
- In vehicles equipped with ABS, the driver's foot remains firmly on the brake pedal, allowing the system to automatically pump the brakes.

Why is that important?

- When brakes lock up on wet and slippery roads or during a panic stop, driver lose steering control and vehicle can spin.
- Rear wheel ABS prevents wheel lockup so that car stays in a straight line.
- If car has ABS control on all four wheels, driver also keep steering control.
- If driver have steering control, it is possible to avoid a crash by steering around hazards if a complete stop cannot be accomplished in time.

Airbags

Airbags are key components in automotive safety systems, and, although we cannot see them perform under normal conditions with the naked eye, they soften the impact of collisions by keeping passengers from contacting the steering wheel, dashboard, front glass, and other parts of the automobile.

Modern vehicles may contain multiple airbag modules in various side and frontal locations of the passenger seating positions, and sensors may deploy one or more airbags in an impact zone at variable rates based on the type, angle and severity of impact; the airbag is designed to only inflate in moderate to severe frontal crashes.

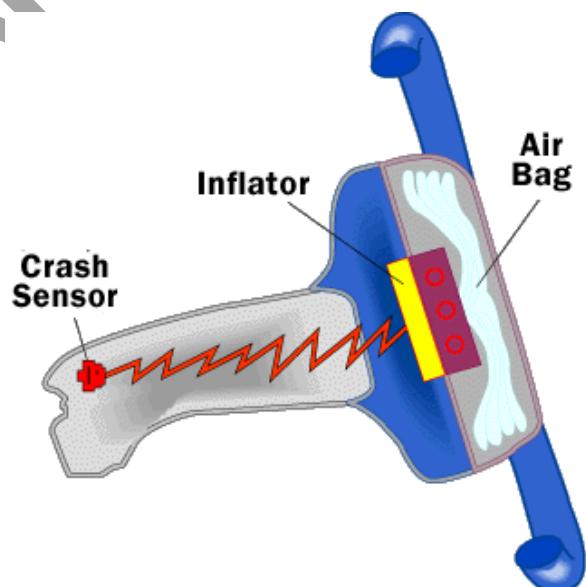
How airbag works

The goal of an airbag is to slow the passenger's forward motion as evenly as possible in a fraction of a second. There are three parts to an airbag that help to accomplish this feat:

The bag itself is made of a thin, nylon fabric, which is folded into the steering wheel or dashboard or, more recently, the seat or door.

The sensor is the device that tells the bag to inflate. Inflation happens when there is a collision force equal to running into a brick wall at 10 to 15 miles per hour (16 to 24 km per hour). A mechanical switch is flipped when there is a mass shift that closes an electrical contact, telling the sensors that a crash has occurred. The sensors receive information from an accelerometer built into a microchip.

The airbag's inflation system reacts sodium azide (NaN_3) with potassium nitrate (KNO_3) to produce nitrogen gas. Hot blasts of the nitrogen inflate the airbag.



93. VIRTUAL CLUSTERS

- The MSME Ministry launched a virtual network wherein different clusters of MSMEs can connect on a common platform and share information to help them expand their businesses.
- Aim – to link up academic and research institutes, financial institutions like SIDBI and commercial banks which will be a network of different stakeholders.
- It overcomes the limitations of the current 'Physical Clusters' Scheme requiring the location of the units in one geographical area besides substantial resources for creation of infrastructure.
- It will enable small businesses across different sectors to co-exist with their peers on a web-portal.

Under the initiative, around 2,000 industrial clusters have been identified for undertaking soft and hard interventions with a view to increase the competitiveness of the enterprises.

94. FASTags (ELECTRONIC TOLL COLLECTION)

Why in news?

- Government announced to bring all toll plazas on National Highways under electronic toll collection(ETC).

About Fastags:

- FASTag is a Radio Frequency Identification (RFID) device which will be attached to the windscreens of cars which will be recharged with money, will allow one to drive seamlessly through FASTag lanes at toll plazas without having to stop and pay the toll tax at the window.
- Normal and applicable toll fees will automatically be deducted from the Tag Account and the information for the same will be relayed through SMS alerts on registered phone number.
- The FASTag will also be extended for fuel payments and fee payments at State Border check-posts soon.

Future implications and scope of ETC:

- It can be used to automate the process of traffic surveys, which in turn can help regulate collection of data (and toll tax) to create a central data repository.
- Fastag will not only help government plug revenue leakages from toll collection it will also help track vehicles in case of criminal incidences.
- The real time data on traffic movement on highways will help government to plan better infrastructure and traffic management.

Health Technology

95. MAXIMUM RESIDUE LIMITS (MRL)

- Pesticide residues on crops are monitored through the use of Maximum Residue Limits (MRL), which are based on the analysis of the quantity of a given chemical remaining on food product samples.
- In India, MRLs are listed in The Prevention of Food Adulteration Act and Rules now administered by Food Safety and Standard Authority of India .
- The Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India in collaboration with Indian Agriculture Research Institute, New Delhi under All India Network Project on Pesticide Residues has been implementing a project on “Monitoring of pesticide residues at National level”

In News:

High levels of pesticide residue found in vegetables in Kerala (THE HINDU)

Japanese Health Ministry Fixes MRL for Ethoxyquin in Shrimps at 0.2 ppm (PIB)

96. DRUG RESISTANCE: HOW AND HOW TO HANDLE IT

Why in News:

Deadly NDM-1 ‘superbug’ raises fears of antibiotic resistance in city hospitals (HT)

100 million Indians could be carrying NDM-1(TOI)

- **Antimicrobial resistance*** – also known as drug resistance – occurs when microorganisms such as bacteria, viruses, fungi and parasites change in ways that render the medications(mainly **antibiotics***) used to cure the infections they cause ineffective. When the microorganisms become resistant to most

antimicrobials they are often referred to as “**superbugs***”. This is a major concern because a resistant infection may kill, can spread to others, and imposes huge costs to individuals and society.

- Alexander Fleming discovered the first antibiotic, Penicillin* in 1927.
- The first superbugs appeared on the scene less than twenty years, in 1947 after the discovery of Penicillin.

How Antibiotics attack Bacteria

Antibiotics are designed to block some essential steps in the life cycle of the bacteria and prevent their growth and survival.

How Bacteria may develop resistance

Bacteria have great ability to adapt to hostile environments. They develop resistance to agents that threaten their survival. All these resistance mechanisms are generated through genetic modifications so that the progeny will also be resistant to the drug. These genetic modifications occur at two levels: mutations in the chromosomal genes and **horizontal transfer* of resistance genes** from one bacterium to another.

Unlike human and animal cells, bacterial cells have a thick cell wall. Antibiotics of the class beta-lactams (which includes penicillin) bind and inactivate an enzyme (called ‘penicillin binding protein’- PBP), which is essential for the synthesis of the cell wall. **A bacterial cell without a robust cell wall cannot survive.**

There are many ways by which bacteria can defend themselves from hostile aspects of an environment. For example, bacteria can produce an enzyme that binds to the drug and makes it ineffective. Penicillin is deactivated through the production of beta-lactamase. Alternatively, the target itself may be altered so that the drug may no longer be able to bind to it. This can be seen in the other types of penicillin resistant bacteria where the structure of the binding site PBP is altered. If an essential metabolite is altered by the drug, the bacteria may stop needing that metabolite.

Folic acid is required by both bacteria and humans for the synthesis of nucleic acids and proteins. Unlike humans, bacteria cannot use pre-formed folic acid and synthesize their own folic acid. An important starting compound for the synthesis of folic acid is para-aminobenzoic acid (PABA). Sulfonamides and other sulfa drugs are analogous to PABA and bacteria cannot distinguish between the two. These compounds compete with PABA in biochemical reactions. **When chosen, they block the synthesis of folic acid and thus the formation of nucleic acids and proteins, killing the bacteria.**

Resistance to sulfonamide arises when bacteria develop the ability to utilize the pre-existing folic acid rather than synthesizing it. And then some bacteria may reduce the permeability of the cell wall to the drug or increase the active efflux (pumping out) of the drug from across the cell wall so that it may not be available at a high enough concentration to be effective.

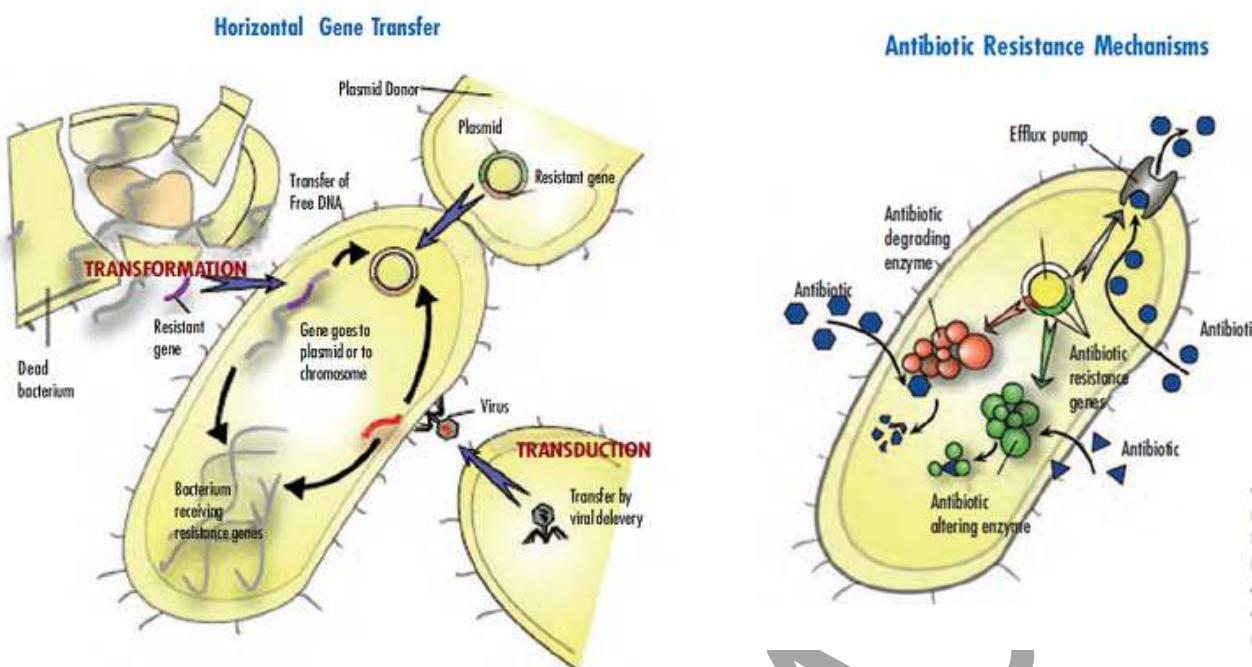
An essential step in DNA replication prior to cell division is the unwinding of the double stranded DNA molecule. This is carried out by an enzyme called DNA gyrase. **A class of antibiotics known as Fluoroquinolones bind to bacterial DNA gyrase and inhibit DNA replication, preventing bacterial**

In a series of complex genetic maneuvers, the cell will be able to repair the damage and resume DNA replication. However, this process known as the “SOS repair” is error-prone; it can randomly substitute the wrong bases during DNA replication leading to gene mutations. Most of these random mutations are harmful to the bacteria. But some of them may be beneficial to

<p>growth.Rifamycins inhibit RNA synthesis in an analogous manner.</p>	<p>the bacteria and provide an advantage to its survival by triggering a defense mechanism.</p>
<p>Ribosomes are structures on which protein synthesis takes place. Tetracycline, Erythromycin and similar antibiotics bind to ribosomes to prevent protein synthesis</p>	

Adapting by Acquiring Genes

- A process known as “**horizontal gene transfer***” can also confer drug resistance to bacteria. There are three mechanisms by which horizontal gene transfer can take place: conjugation, transformation and transduction.
- Bacteria contain a DNA entity called the ‘plasmid’. Plasmids are circular DNA strands capable of replication independent of the chromosomal DNA. **A unique property of plasmids is that copies of replicated DNA can be transferred from one bacterium to another, sometimes even across the species.** Known as **conjugation**, this process is akin to mating in higher organisms. When two bacteria come close to each other, a hollow bridge-like structure called the ‘pilus’ forms between them to facilitate a copy of the plasmid to move from one to another. Plasmids may contain genes that render the bacteria resistant to specific antibiotics. In such a case, the recipient bacteria also become resistant to that antibiotic.
- Another means by which bacteria can acquire a readymade resistance gene is a process called ‘**transformation***’. When a cell dies, it breaks apart and releases its DNA to the surrounding environment. Bacteria may scavenge these free-floating DNA pieces and incorporate them into their own chromosomes. If the DNA contained an antibiotic resistance gene, the recipient bacteria too can begin to exhibit that property.
- A virus may also act as a vehicle for horizontal transfer of genes. Some viruses known as ‘**bacteriophages***’ (or simply ‘phages’) are specific to bacteria. When a phage infects a bacterium, it takes over the host biochemical machinery to reproduce itself, ultimately destroying the host. This is known as the lytic phase in the life cycle of the virus.
- During this process, known as transformation, the virus may inadvertently incorporate some bacterial genes into its own genome. Upon the death of the bacterium, the phages infect other bacteria. From the lytic phase the virus enters the lysogenic phase of its life cycle; here the virus will not reproduce in the bacterial cell but integrate its genome with the bacterial genome and replicate along with it. Such bacteria continue to survive and reproduce, expressing even the viral genes. If the viral genome contained a drug resistance gene, the host bacterium will display resistance to the drug.



The response

- One of the fertile targets is the SOS repair pathway as **preventing the induction of SOS repair** reduces formation of drug resistance not only through chromosomal mutations, but also other mechanisms like horizontal gene transfer and homologous recombination.
- However, some researchers feel that such attempts may only extend the time needed for resistance development and will not eliminate the problem completely.
- This is because antibiotic resistance is an unavoidable consequence of the indiscriminate use of antibiotics.
- According to the Food and Drug Administration of the USA, drug resistance “is an outcome of natural selection and should be viewed as an expected phenomenon of the **Darwinian biological principle of ‘Survival of the fittest’**”.
- As long as the effectiveness of the drug is based on chemical processes, bugs can always develop resistance to the process. Hence, departing from the conventional approach, some researchers are trying to develop next generation antibiotics that may attack bacteria through **physical or mechanical means**.
- Scientists at the IBM research center are developing organic **nanoparticles**. These particles are so designed that they are physically attracted to the bacteria like a magnet, break through the cell wall.
- Researchers at the Gamaleya Institute of Epidemiology and Microbiology, Moscow have some exotic technology in their kitty—**cold plasma** to kill the bacteria!

How We Help Superbugs Thrive?

- There are many situations in which bacteria may find an environment suitable for development of resistance.
- **When a person is treated with antibiotics, about 30% is absorbed and the rest passes through the body into the sewage system.** Antibacterial soaps and disinfectants used in homes and hospitals are also washed into the sewer. Animal breeders mix antibiotics with farm feed, often indiscriminately, to increase the animal's weight. Such use not only contaminates the meat but also increases the variety and quantity of antibiotics in the sewage.
- **Antibiotics are not readily degradable.** Ultimately the sewage enters a **treatment plant, which encourages the growth of bacteria to digest the sewage.** During this process, in the presence of low levels of antibiotics, some bacteria may develop resistance. When the digested sludge is dried and used as manure, some of the farm products may get contaminated with bacteria and enter the food chain. In addition, **sewers may directly contaminate the drinking water system**, as often happens in our country. Both aid the spread of resistant bacteria in the community.
- Thus, in a large population of bacteria there may be a few that have developed resistance to

antibiotics. When an infected person is treated with antibiotics, the susceptible ones perish, leaving behind the resistant ones, which will multiply at the opportune moment. Next time when the same antibiotic is given to the patient, it may not be effective in controlling the infection. When a class of bacteria becomes resistant to a particular drug, the pharmacologist develops a new kind of antibiotic. It takes more than a decade to develop an antibiotic and the bacteria become resistant to even the new drug in due course.

- The case of Tuberculosis in India illustrates how various shortcomings in the healthcare system have led to the emergence of Extremely Drug Resistant TB (XDR-TB). **Poor compliance of drug course by patients, the tendency of doctors to over-prescribe antibiotics, improper screening of patients and spurious or sub-standard drugs floating around in the market** are some of the factors that have led to the strengthening of resistance mechanisms in TB drugs.

Some Important Superbugs

MRSA^A

The best-known superbug is the Methicillin-resistant Staphylococcus aureus (MRSA). Staphylococcus aureus first developed resistance to Methicillin—a penicillin-class antibiotic—in 1947.

- It is easily contacted in places like gym, schools and hospitals.
- MRSA has also been successful in transmitting resistance genes to a completely different species of bacteria.

Streptococcus pneumoniae

- It has been a major cause of community-acquired infection such as upper respiratory infection, bronchitis, pneumonia, otitis media, pharyngitis and meningitis.
- Even though it was once almost eradicated by penicillin, it has now developed significant resistance to penicillin, trimethoprim sulfamethoxazole, macrolides, tetracyclines, and fluoroquinolones and thus has become a major problem.

Mycobacterium tuberculosis.

- It is reported that tuberculosis kills about 1.7 million people around the world, of which three to four lakh deaths occur in India due to the presence of resistant strains like **Multi- Drug Resistant TB (MDR-TB)*** and **Extremely Drug Resistant TB (XDR-TB)***.
- Now, Hinduja Hospital, Mumbai has reported the isolation of yet another resistant strain known as **Totally Drug- Resistant TB (TDR-TB)***, which is found to be resistant to twelve drugs.

NDM-1

- Recently, a new resistant strain of Klebsiella pneumoniae was detected in a Swedish patient of Indian origin. This produces an enzyme named New Delhi-metalloc-beta-lactame-1 (NDM-1), which inactivates a broad range of beta-lactam antibiotics. Since this was first found in a patient who had undergone medical treatment in India, the researchers named it after New Delhi. The gene for NDM-1 can spread horizontally and at least twenty strains of bacteria, each resistant to one or many antibiotics, are now known.

Chennai Declaration on Antimicrobial Resistance

- For the first time, medical societies in India came together and organised a symposium, A Roadmap to Tackle the Challenges of Antimicrobial Resistance, in Chennai to discuss the problem of antimicrobial resistance and possible solutions.
- International experts were invited to explain how high-income countries were trying to tackle antimicrobial resistance.
- **The Chennai Declaration calls for urgent initiatives to formulate an effective national policy to control the rising antimicrobial resistance, including a ban on over-the-counter sale of antibiotics, and to bring about changes in the medical education curriculum to include training in antibiotic usage and infection control.**

Environment Technology Technology

97. ZERO LIQUID DISCHARGE (ZLD)

- Zero Liquid Discharge is a process that is beneficial to industrial and municipal organizations as well as the environment because money is being saved and no effluent, or discharge, is left over.
- ZLD systems employ the most advanced wastewater treatment technologies to purify and recycle virtually all of the wastewater produced.
- Zero Liquid Discharge System ZLD systems provide numerous economic and environmental advantages for plant managers—water is recycled and reused, saving on the cost and treatment of raw water.
- Since all water is reclaimed, no effluent is discharged from the plant, avoiding the cost of environmental impact.
- The technology is particularly appropriate in water-short areas.

Zero Liquid Discharge Technologies for Water Recycle Reuse Applications:

- Biological Treatment Systems
- Physical/Chemical Treatment Systems
- Conventional Filtration Systems
- Membrane Filtration and Separation Systems
- Chemical Feed and Disinfection Systems

Why is it in news?

- If the Centre gets states on board, it will not allow any of the 140 drains between Gangotri and Gangasagar to open into the river Ganga to discharge municipal and industrial waste water. A small step in this direction was taken recently when the government decided to launch a pilot project to usher in a 'zero liquid discharge' regime. (TOI)

98. GREEN TOILETS

- All trains maintained by the Delhi Division will have green toilets.
- Open discharge toilets on trains have been under constant criticism because of creating the problem of manual scavenging which led to a series of trials with green toilets on train.
- The new toilets will have a collection tank fitted with anaerobic bacteria to decompose faecal matter completely and only a colourless, odourless benign liquid that does not pollute the environment will be released.

99. GRIHA

- GRIHA, an acronym for Green Rating for Integrated Habitat Assessment, is a rating tool.
- It evaluates the environmental performance of a building holistically over its entire life cycle, thereby providing a definitive standard for what constitutes a 'green building'.
- The rating system, based on accepted energy and environmental principles, will seek to strike a balance between the established practices and emerging concepts, both national and international.
- GRIHA attempts to minimize a building's resource consumption, waste generation, and overall ecological impact to within certain nationally acceptable limits / benchmarks.
- TERI has developed GRIHA (Green Rating for Integrated Habitat Assessment), which was adopted as the national rating system for green buildings by the Government of India in 2007.

100. IGBC GREEN BUILDING O&M RATING SYSTEM

- The Indian Green Building Council (IGBC) has launched 'IGBC Green Existing Building O&M Rating System' to address the National priorities. By applying IGBC Green Existing Building O&M criteria, existing buildings can be sustainable over the life cycle of the building. This rating programme enables the building owner / developer to apply green concepts and criteria, so as to reduce the environmental impacts, which are measurable. The programme covers methodologies to cover diverse climatic zones and changing lifestyles.

Unique features of IGBC Existing Buildings (O & M)

- Focus is on implementation and results achieved
- Documentation requirements are minimal. Instead, it is more of evidence like photos and calculations
- The rating can be applied to both air-conditioned and non-air conditioned buildings
- The rating is designed to suit all building types in all climatic zones. Exclusions are residential and Factory buildings for which IGBC's existing ratings can be applied
- Water being of prime national concern, is given higher weightage
- For energy related aspects, Energy Conservation Building Code (ECBC) or the Energy Performance Index (EPI) as recommended by Bureau of Energy Efficiency (BEE), is the reference standard.
- Buildings are all about people. A separate module called 'health and comfort' is included, to address health and wellbeing of occupants in the buildings.

Science Reporter Part I

101. NOBEL PRIZE - PHYSICS

- Isamu Akasaki, Hiroshi Amano and Shuji Nakamura from Japan have been jointly awarded Nobel Prize for physics for inventing **Blue LEDs**.

Why LED is important?

- The light in most homes is produced by incandescent sources. For the bulb to produce light an electric current is passed through a conductor and the tungsten is heated to the point at which it gives off light.
- These bulbs are not very energy efficient; roughly 10% of the energy is used to make visible light.
- White LEDs are much more energy efficient than traditional incandescent and fluorescent light thus replacing traditional bulbs with LED leads to drastic reduction in power requirements.
- For poor countries with poor electricity grid LED becomes even more useful.
- LED bulbs produce less carbon than older bulbs, which can be very useful to get rid of the ill effects of global warming.
- These energy saving bulbs have a very long life, and they are able to remain consistent despite of long-term use.
- LEDs are used in electrical equipment like TV, Mobile, and Computers etc.

How do LED lights work?

- Light Emitting Diode (LED) is made of semiconductor materials. A diode is a device that allows current to flow in only one direction.
- When electricity is passed through the diode the atoms in one material (within the semiconductor chip) are excited to a higher energy level and the excess energy is then released in the form of light as the atoms shed electrons to the other material within the chip.
- The color of the light from the LED is a function of the materials and processes that make up the chip.

Why Blue LED is so important?

- Red, Green and blue colored LEDs mixed together produce white LED.
- Red and Green LEDs were easily produced; however synthesizing BLUE LED light source turned out to be challenge for scientific community.
- **With the use of Gallium Nitride (GaN) blue LEDs can be produced; however to grow gallium nitride crystals of high enough quality was the real challenge.**
- These three physicists were able to produce it by two methods
- With the help of blue LEDs they also invented **blue-ray discs** which can store 4 times more information than infrared light.
- Using the same approach for LEDs energetic ultraviolet light can also be made which helps in sterilizing surface and water treatment.

*UPSC generally asks about importance of materials. For example here importance of **Gallium Nitride (GaN)** can be asked.

102 NOBEL PRIZE - BIOLOGY

- John O'Keefe (UK), May-Britt and Edvard Moser (Norway) have been jointly awarded Nobel prize for biology.
- They discovered that human brain has its own **internal positioning system** like GPS and thus we remember things and their locations in a room.
- Nerve cells responsible for this are located in a brain region termed as Hippocampus and these cells form a map of the outside world.
- This discovery doesn't have any direct impact on new medicines however it can help in causes behind loss of spatial awareness in strokes patients or other dementia patients like Alzheimer.

- Alzheimer is currently untreatable and if we know the causes of this dementia; in future treatments can be developed.

103. NOBEL PRIZE – CHEMISTRY

- Eric Betzig, Stefan W. Hell and William E. Moerner jointly have been awarded Nobel Prize for Chemistry for the development of super-resolved fluorescence microscopy.
- **Optical resolution of a microscope** describes the ability to resolve detail in the object that is being imaged.
- Scientists assumed that optical microscopy was limited to half the wavelength of light. Ernst Abbe propounded that a maximum resolution of 0.2 micrometers can be achieved through optical microscopy known as Abbe limit.
- These three scientists surpassed the Abbe limit and have enabled scientists to analyze the nano-dimension.
- Two different approaches known as stimulated emission depletion (STED) microscopy and single molecule microscopy was adopted.

104. GOOGLE GLASS

Google Glass is a type of wearable technology with an optical head-mounted display with many features.

- It can record videos and take pictures which can be emailed or shared on social networking websites.
- It can show text messages and allows the user to reply them via voice commands.
- It can find things on internet just via voice command and can also show Google maps.
- It can keep track of daily habits of users and suggest accordingly. For example it will give you information about traffic updates and may update you if you need to change normal route.
- It can also translate sentences in many languages.
- Recently, German scientists have developed an app for Google Glass to measure human emotions by analyzing their facial expressions. It can also tell a person's age and detect gender.
 - The integrated CPU in glass does these calculations in real time. This software will also help people suffering from communicative disabilities like autism. With the help of glasses useful missing information can be accessed by these people.
 - A visually impaired person can also be benefited from this app as it can provide audio feedback for missing information.

105. NEUROSYNAPTIC CHIP

- This is a chip inspired by human brain and developed by scientists from Defence research project agency (DARPA) with collaboration from IBM.
- This chip mimics the connection between neurons in brain and has 5 million transistors and 250 million synapses.
- Unmanned aircrafts and robotic ground can be developed with the use of this chip in a limited budget as this chip requires only a fraction of the electrical power normal chip consumes.

106. ANTI-COUNTERFEITING FILM BASED ON NANOTECHNOLOGY

What is anti-counterfeiting?

- Counterfeiting is a huge problem world-wide, from money to goods and the measure to prevent imitation and reproduction without permission of ownership holder for the purpose of cheating is termed as anti-counterfeiting. These techniques can identify genuinity of a product.
- Customers often get fooled by fake packaging but now researchers have developed a label that will change when consumers breathe upon and will reveal hidden images.
- A grid of columns known as nano-pillars (100 times thinner than a human hair) will be studded at the surface of a product package and once breathed the gaps between pillar will be filled and the moisture of breath will help in creating the hidden images.
- These sheets are made up of polyurethane and epoxy. These are durable, scalable and resist being rubbed away. These sheets are cost effective and could stick to plastic, fabric, paper, metal, glass and even leather.
- This simple and smart innovation will make it easier for customers to identify real products and not get fooled by false packaging.

107. GREENING THE SILK (TOPIC: INDIGENIZATION OF TECHNOLOGY)

- Why?
 - Silk is extensively used in India; however its natural color is either white or yellow. To have different varieties of color silk fabrics are put through an extensive dyeing process.
 - This dyeing process not only poses health risk to working laborers but the entire dyeing industry is considered as highly polluting.
 - Huge amount of water is consumed and the remaining waste water is dumped in environment without treatment.
- This pollution can be avoided if the methods of dyeing is used **at the very source i.e. silkworms producing colored silk.**
- In India scientists at Central Sericultural Research and Training Institute (CSRTI) with collaboration from National Chemical Laboratory have been successful to achieve this goal. How?
 - *The feeding procedure used for silkworms was modified. The leaves given for feeding were sprayed with known concentration of a given dye.*
 - Azo dyes were used for this purpose which is inexpensive and is easily available.
 - Many colored cocoons were obtained by this variety and CSRTI is in the process of synthesizing new dye molecules to have desired colored silk.
 - Silk Sarees with light violet and pink colors have been released under the name Naturals or RMKV silks by using this technology.
- Thus, the entire process of treating toxic dye effluents is significantly reduced that are generated in the traditional dyeing process.
- **Researchers have applied for patent claiming that this is the first ever naturally colored silk in the world.**

108. VULTURE RESTAURANTS (TOPIC: CONSERVATION)

Vulture restaurants are a unique idea to save Vultures which are on the brink of extinction. These critically endangered (IUCN status) birds play an important ecological role by consuming animal carcasses.

Why Endangered?

- The most important reason for their decline is attributed to a drug named **Diclofenac** used for livestock. Diclofenac is a type of **NSAID** (Non-steroidal anti-inflammatory drug) which causes kidney failure in vultures when they eat dead cattle.
- The demand of food, land and other resources by human beings has also caused destruction of vulture habitats.
- Vultures aren't getting enough food as poor farmers sell their old and sick cattle to slaughterhouses.
- In south India certain communities used to catch vultures and eat them leading to their extinction in the region.
- Electrocution, motor interferences and superstitious beliefs have also led to death of many vultures.

Safe food by collecting dead animals from local people is being supplied to vultures at strategic locations in our country. For example, presently there are three 'Vulture Restaurants' in Gadchiroli forest division at Marakbodi, Madetukum and Nimgaon.

This is an in-situ conservation method and can play a very important role in the conservation of vultures.

NSAID: These are a class of drugs that provides pain-killing and fever-reducing effects, and, in higher doses, anti-inflammatory effects. Aspirin, ibuprofen and naproxen are the most common examples of NSAID.

(A question in prelims was asked on Vultures in 2011)

109. SMART PENS

- This pen will alert users of spelling and penmanship mistakes by releasing gentle vibrations.
- It has three interchangeable tips: Pencil, Fountain pen and ballpoint.
- It has an embedded Linux system and a motion sensor, processor, memory, vibration module and Wi-Fi module.

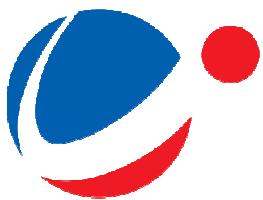
110. DIGITAL COIN

- Bitcoin is a peer-to-peer (i.e. no central authority to issue new money or to keep track of the transactions) network based anonymous (that the real world identity of the parties of a transaction can be kept hidden from the public or even from the parties themselves) digital currency.
- It was started by an anonymous software developer (going by the name of Satoshi Nakamoto) in 2008 and since its inception; it has grown into a technology, a currency, an investment vehicle, and a community of users.
- How is Bitcoin an innovation?
 - In Digital payment system the tough part is making sure that nobody spends the same money more than once. Traditionally, a central authority (For Example - PayPal) verifies all of the transactions.
 - However in Bitcoin the core innovation is that it uses consensus in a massive peer-to-peer network to verify transactions.
 - **This result in a system where payments are non-reversible, accounts cannot be frozen, and transaction fees are much lower.**
- How is it generated?
 - These are mathematically generated by a complex procedure termed as "mining" is used to generate Bitcoin. It is designed in such a way that it becomes progressively difficult to mine Bitcoins over time.

- Thus only a maximum limit (a total of 21 million) of Bitcoins can be generated over time with about 12 million in circulation currently.
 - Bitcoin is like a mobile app or computer program that provides a personal Bitcoin wallet and allows a user to send and receive Bitcoins with them.
 - By three routes one can acquire a Bitcoin: Purchasing, Exchanging and Generating one through mining.
- What is mining?
 - Some users put their computers to work verifying transactions in the peer-to-peer network mentioned above. These users are rewarded with new bitcoins proportional to the amount of computing power they donate to the network.
 - However as mentioned above it becomes more and more difficult to mine new coins, profitable mining now requires specialized hardware that can perform more computations with greater power efficiency.
 - Why is RBI worried?:
 - It is not backed by any financial authority and thus not subjected to same regulations as other currencies.
 - In case of theft identifying perpetrator will be difficult as the user remains anonymous.
 - The currency is very volatile and while players who entered early may be profiting but latecomer investors may suffer huge losses.
 - Because of anonymity RBI can't impose taxation on transaction and taxes are an important part of an economy for developmental purposes.
 - Bitcoins may be linked to black money and money laundering. Since users don't know the identity of person they are dealing with, they may also be involved in anti-national activities or supporting criminal activities unknowingly.
 - Similar to physical Cash, Bitcoins wallets can be lost, deleted or stolen.
 - There is so much uncertainty associated with the Bitcoin that many genuinely think that this may be the future of world economy while others are afraid that it can destroy economies, but many from both sides agree that if Bitcoin or something like Bitcoin works and people starts trusting digital currency to work without the middlemen (i.e. central authorities), the way world's economy functions could be transformed for better.

Copyright © by Vision IAS

All rights are reserved. No part of this document may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior permission of Vision IAS



Part 2: SCIENCE & TECHNOLOGY: Emerging and Significant Technologies

Contents

1. LASER TV	5
How does it works?	5
What is the Advantages with Laser TV?	5
2. AUTONOMOUS CAR	5
Benefits:	5
Example projects	6
3. 3D HOLOGRAM TECH	6
Why in news?	6
About Holography	6
About 3D Hologram Projection Technology	6
Other 3D Display Technologies	6
3D television/3D Display Technologies	6
With filters/lenses:	7
4. QUANTUM DOT DISPLAY/QLED OR QDLED	7
QLEDs advantages:	8
Disadvantages:	8
5. NEAR FIELD COMMUNICATION (NFC):	8
Applications:	8
6 MICROBIAL FUEL CELL (MFC)	9
7. AGRIBOT	10
Benefits:	10
8. RFID – RADIO FREQUENCY IDENTIFICATION	11
Why in news?	11
About RFID	11

Why use RFID?	11
Applications:RFID can help:	12
Future Prospects:	12
9. QR CODE / QRC / 2D BARCODES	12
10. CARBON SEQUESTRATION	13
Carbon Sequestration	13
“Carbfix Project”	13
11. BIONIC EYE	13
12. DESIGNER BABY	13
13. BIOSIMILAR	13
14. POD-CARD/PERSONAL RAPID TRANSIT (PRT)	14
15. AMPAKINES	15
Working:	15
Uses:	15
16.BRAIN-COMPUTER INTERFACE (BCI)/MMI/BMI	15
Applications:	16
17. BRAIN READING	17
Background:	17
fMRI	17
MRI	17
18. NEUROINFORMATICS	17
19. GENENETWORK-	17
20. NEUROPROSTHETICS	18
21. IN VITRO MEAT	18
22. VERTICAL FARMING- (farm vertically)	19
Advantages of Vertical Farming	19
23. PROSTHESIS-	20
24. HEAD TRANSPLANT-	20
25. ISOLATED BRAIN-	20
26. LIFE EXTENSION-	21
27. HIBERNATION-	21
28. NANOMEDICINES-	21
29. PERSONALIZED MEDICINE-	22
30. FULL GENOME SEQUENCING-	23
31. REGENERATIVE MEDICINE-	23
32. ROBOTIC SURGERY-	24
33. STEM CELL TREATMENTS	24

34. TISSUE ENGINEERING-	25
35. VITRIFICATION-	26
36. CRYOPROTECTANT-	26
37. ADAPTIVE OPTICS (AO)-	27
38. ULTRA HIGH DEFINITION TELEVISION-	28
39. OLED-	29
40. MEMRISTOR-	30
41. ELECTRONIC NOSE-	31
Recent Advances	31
42. E-TEXTILES/ FIBRETRONICS-	32
43. 3D IC-	32
44. QUANTUM CRYPTOGRAPHY-	33
45. QUANTUM COMPUTER-	33
46. OPTICAL COMPUTING-	34
47. PROTEIN COATED DISC-	34
48. LS-R DISC-	34
49. HVD-	35
50. EXOCORTEX-	35
51. SEMANTIC WEB-	35
52. CYBERMETHODOLOGY-	36
53. SPEECH RECOGNITION-	36
54. 5G	37
55. 4G-	37
56. VIRTUAL REALITY-	38
57. ARTIFICIAL BRAIN-	38
58. 3D PRINTING-	38
59. CLAYTRONICS-	39
60. MOLECULAR ASSEMBLER-	39
61. UTILITY FOG-	40
62. AEROGEL-	40
63. SILICENE-	41
Silicenevsgraphene	41
64. HIGH TEMPERATURE SUPERCONDUCTORS-	41
65. CARBON NANOTUBES(CNT)-	42
Structure-	42
66. METAMATERIALS-	43
67. PROGRAMMABLE MATTER-	44

68. QUANTUM DOT-	45
69. AUTONOMOUS ROBOTS-	45
70. PROPRIOCEPTIVE SENSORS-	46
Self – Monitoring	46
Examples of Proprioceptive Sensors:	46
71. MOLECULAR NANOTECHNOLOGY-	46
72. LS3-LEGGED SQUAD SUPPORT SYSTEMS	47
73. SYNTHETIC APERTURE RADAR(SAR)-	47
74. SPACE-BASED SOLAR POWER	48
Advantages	48
Disadvantages	48
75. Chemical Computer	48
76. DNA Computer	49
77. SOLAR PHOTOVOLTAIC TECHNOLOGIES	49
Solar Cells	49
Solar Arrays	49
Concentrated PV (CPV) Systems	49
78. BIO-DIGESTER	49
Benefits of using a Biodegester:	50
79. INDUCED PLURIPOTENT STEM CELLS (iPSC)	50
80. BIO-INSPIRED TECHNOLOGY	50
81. ENCODE PROJECT	50
82. COMPACT FLUORESCENT LIGHTS (CFLs)	51
Pros	51
Cons	51
83. MAGLEV BULLET TRAIN	51
Magnetic levitation technology (maglev)	51
84. GRAVITATIONAL LENSING	52
85. LETHAL AUTONOMOUS ROBOTS (LARs)	52
86. 3D BUMP	52
87. DEEP WEB	53
88. NEED FOR DEEP WEB	53

1. LASER TV

- Laser color television (in short, Laser TV) is the TV powered by a laser instead of the old mercury lamps. RGB-color: red, blue and green lasers are used to build up the image like in a computer memory. When one of these colors are zero, for example when the TV is showing all-red then red laser is going full and green and blue laser is zero, then the laser lamp is simple turned off. This is creating the effect of total blackness which can not be seen in today's Plasma TV and LCD TV monitors. Black is really black when viewing a laser TV, and when you see this it is a really cool effect!

How does it work?

- The Laser TV has one red laser, one green laser, and one blue laser. These laser lights are sent through lenses and mirrors crystal and Digital Light Processing (DLP)-chips, to produce the actual image. Like in CRT TV the emitters are not always on, thus eliminating the motion blur that can occur in LCD TV and Plasma TV sets.

What are the Advantages with Laser TV?

- Laser Television has a lot of advantages over Plasma and LCD television. The main advantage for Laser TV is in the technology. This is because it is relatively simple to build large television sets using laser technology.

2. AUTONOMOUS CAR

- An autonomous car, also known as robotic or informally as driverless or self-driving, is an autonomous vehicle capable of fulfilling the human transportation capabilities of a traditional car. As an autonomous vehicle, it is capable of sensing its environment and navigating on its own.
- A human may choose a destination, but is not required to perform any mechanical operation of the vehicle.
- Autonomous vehicles sense the world with such techniques as radar, lidar, GPS and computer vision.
- Advanced control systems interpret the information to identify appropriate navigation paths, as well as obstacles and relevant signage. Autonomous vehicles typically update their maps based on sensory input, such that they can navigate through uncharted environments.
- There have been several programs around the world.
- In June 2011 the state of Nevada was the first jurisdiction in the United States to pass a law concerning the operation of autonomous cars.
- The Nevada law went into effect on March 1, 2012, and the Nevada Department of Motor Vehicles issued the first license for a self-driven car in May 2012.
- The license was issued to a Toyota Prius modified with Google's experimental driverless technology.

Benefits:

- Safer roads with fewer traffic collisions and therefore a reduction in road injuries and road deaths.
- Increased roadway capacity and reduced traffic congestion due to reduced need of safety gaps and the ability to manage traffic flow more efficiently.
- Reduced journey times as fewer traffic jams.
- If all cars were autonomous speed limits could possibly be increased whilst remaining safe.
- Drivers would no longer have the physical and mental exertion of manual driving.

Example projects

- Google driverless car, with a test fleet of autonomous vehicles that as of August 2012 has driven 300,000 miles (480,000 km).
- Marvin Car
- AutoNOMOS

3. 3D HOLOGRAM TECH

Why in news?

- BJP used 3D projection of Shri Narendra Modi's rallies.

About Holography

- Holography is a technique which enables three-dimensional images (holograms) to be made. It records the light scattered from an object, and then presents it in a way that appears three-dimensional.
- Holography can be thought of as somewhat similar to sound recording, whereby a sound field created by vibrating matter like musical instruments or vocal cords, is encoded in such a way that it can be reproduced later, without the presence of the original vibrating matter.
- Holography has application in field of Art, Data storage, Sensors or biosensors, Security holograms and many more fields.

About 3D Hologram Projection Technology

- This is entirely a Latest and very unique “Hi - Definition Projection Technology” inwhich a person is Captured in 3 - dimentional Aspect with a Sp. Hi - Definition Camera on a specially built Stage and Projected “As Is “ at various Distant Locations “At –A –Time”.
- Viewers at the other end will feel the presence of REAL Person in front of them and also interact with the projected ‘Virtual’ person, without wearing any kind of 3D glasses, as they interact with ‘Actual Person’.
- A hologram requires a laser as the sole light source. Lasers can be precisely controlled and have a fixed wavelength, unlike sunlight or light from conventional sources, which contain many different wavelengths.
- Application: Holograms and 3D displays are increasingly being used in a variety of industrial and commercial applications. These include engineering design (CAD), architecture, simulation, medical imaging, computer graphics and scientific visualization. Emerging markets include cinema, gaming and advertising.

Other 3D Display Technologies

- #### **3D television/3D Display**
- 3D television (3DTV) is television that conveys depth perception to the viewer .
 - Most modern 3D television sets use an active shutter 3D system or a polarized 3D system and some are autostereoscopic (without the need of glasses).
 - The stereoscope was first invented by Sir Charles Wheatstone in 1838
 - It showed that when two pictures are viewed stereoscopically, they are combined by the brain to produce 3D depth perception.
 - Stereoscopic 3D television was demonstrated for the first time on 10 August 1928 by John Logie Baird (Inventor of TV)

Technologies

- There are several techniques to produce and display 3D moving pictures.
- The basic requirement is to display offset images that are filtered separately to the left and right eye.

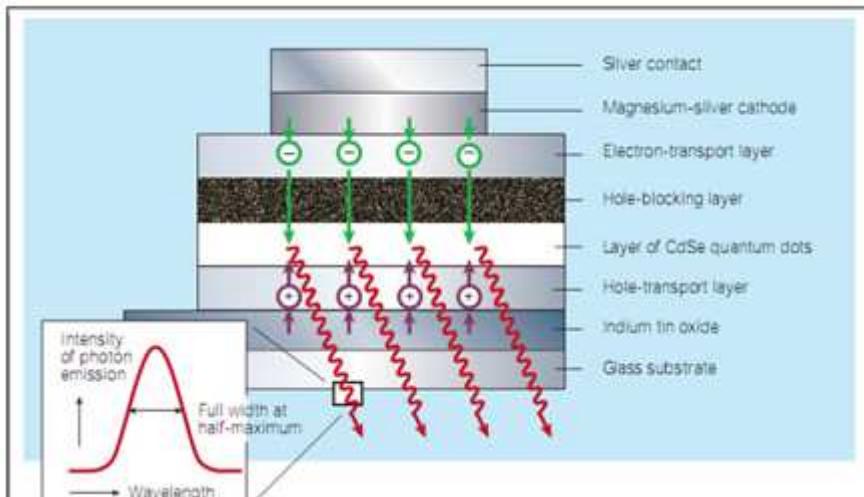
- Two strategies have been used to accomplish this:
 1. have the viewer wear eyeglasses to filter the separately offset images to each eye,
 2. or have the light source split the images directionally into the viewer's eyes (no glasses required).
- Common 3D display technology for projecting stereoscopic image pairs to the viewer include

With filters/lenses:

1. Anaglyph 3D - with passive color filters
2. Polarized 3D system - with passive polarization filters
3. Active shutter 3D system - with active shutters
4. Head-mounted display - with a separate display positioned in front of each eye, and lenses used primarily to relax eye focus
 - **1,2 also** called
 - **Active 3D:**
 - It works by openly presenting the image intended for the left eye while blocking the right eye's view, then presenting the right-eye image while blocking the left eye, and repeating this so rapidly that the interruptions do not interfere with the perceived fusion of the two images into a single 3D image.
 - 3 also called
 - **Passive 3D:**
 - To present stereoscopic images and films, two images are projected superimposed onto the same screen or display through different polarizing filters. The viewer wears low-cost eyeglasses which contain a pair of different polarizing filters. As each filter passes only that light which is similarly polarized and blocks the light polarized in the opposite direction, each eye sees a different image.
 - **Without lenses:** Autostereoscopic displays, sometimes referred to commercially as Auto 3D.
 - **Others: Few new technologies are developed**
 - **3D-ready TV**
 - 3D-ready TV sets are those that can operate in 3D mode (in addition to regular 2D mode).
 - **Health effects**
 - Some viewers have complained of headaches and eyestrain after watching 3D films.
 - Motion sickness, in addition to other health concerns, are more easily induced by 3D presentations.
 - There have been several warnings, especially for the elderly
 - There are primarily two effects of 3D TV that are unnatural for the human vision: crosstalk between the eyes, caused by imperfect image separation, and the mismatch between convergence and accommodation, caused by the difference between an object's perceived position in front of or behind the screen and the real origin of that light on the screen.

4. QUANTUM DOT DISPLAY/QLED OR QDLED

- QD LED or QLED is considered as a next generation display technology after OLED-Displays.
- QLED means Quantum dot light emitting diodes and are a form of light emitting technology and consist of nano-scale crystals that can provide an alternative for applications such as display technology. The structure of a QLED is very similar to the OLED technology. But the difference is that the light emitting centers are cadmium selenide (CdSe) nanocrystals, or quantum dots. A layer of cadmium-selenium quantum dots is sandwiched between layers of electron-transporting and hole-transporting organic materials. An applied electric field causes electrons and holes to move into the quantum dot layer, where they are captured in the quantum dot and recombine, emitting photons. The spectrum of photon emission is narrow, characterized by its full width at half the maximum value.



QLEDs advantages:

- **Pure color** — Will deliver 30-40% luminance efficiency advantage over organic light emitting diodes (OLEDs) at the same color point.
- **Low power consumption** — QLEDs have the potential to be more than twice as power efficient as OLEDs at the same color purity.
- **Low-cost manufacture** — The ability to print large-area QLEDs on ultra-thin flexible substrates will reduce luminaire manufacturing cost.
- **Ultrathin, transparent, flexible form factors** — QLEDs will enable designers to develop new display and lighting forms not possible with existing technologies.

Disadvantages:

- Quantum dots from most suppliers also contain cadmium, a toxic metal whose use is restricted in many countries.

5. NEAR FIELD COMMUNICATION (NFC):

- Near Field Communication (NFC) is a wireless connectivity technology that enables convenient short-range communication between electronic devices. It allows for simplified transactions, data exchange, and wireless connections between two devices in close proximity to each other, usually by no more than a few centimeters. The technology allows short-range data transfer, usually at a distance of 10 cm or less.

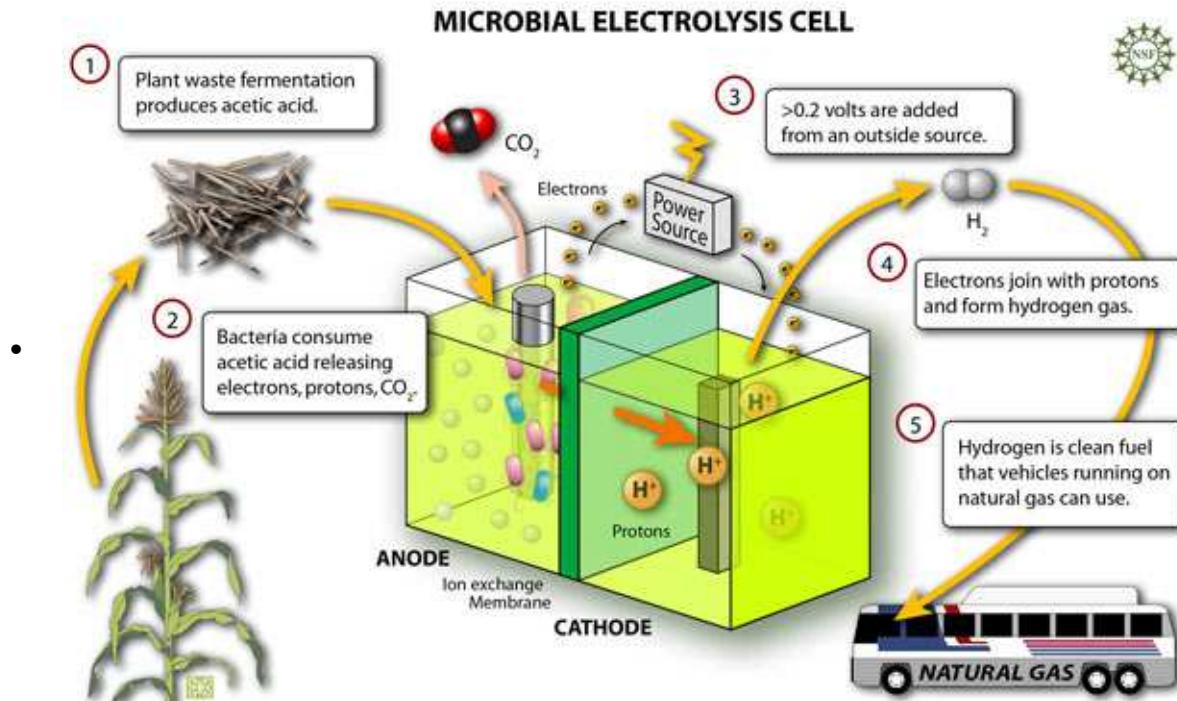
Applications:

1. An NFC enabled device can work as an RFID (radio frequency identification) tag scanner
2. This new technology has the potential to replace plastic money with a phone
3. Thirdly, NFC-enabled phones can be used to easily exchange data.

With NFC, you can easily bring devices together to be automatically prompted to initiate Bluetooth pairing by a tap on each screen.

6 MICROBIAL FUEL CELL (MFC)

- The use of microbes to generate electricity is not a new concept and has been used in the treatment of waste water and sewage plants.
- Microbial Fuel Cells, which work in a similar way to a battery, use bacteria to convert organic compounds directly into electricity by a process known as bio-catalytic oxidation.



Biofilm

- A biofilm is a complex aggregation of microorganisms growing on a solid substrate.

Until now, the biofilm has been allowed to grow un-checked but this new study shows for the first time that by manipulating the biofilm you can significantly increase the electrical output of the fuel cell.



7. AGRIBOT



- Agribot is a robot designed for agricultural purposes.
- It is designed to minimize the labor of farmers in addition to increasing the speed and accuracy of the work.
- The main area of application of robots in agriculture is at the harvesting stage.
- It performs the elementary functions involved in farming i.e. ploughing the field, sowing of seeds and covering the seeds with soil.
- Some examples of Agribot – Fruit picking robot, Strawberry picking robot, rice planting robot etc.

Benefits:

- Time savings - Maintenance-free sprayer can save a considerable amount of farmers time. Agribot can be easily programmed to perform operations 24 hours a day, to meet optimal weather conditions specially for spraying operations.
- Savings in pesticides - Agribot can save up to 40% of used pesticides. Tunnel sprayer is equipped with pesticides recovery system in form of special gutters that collects excess of sprayed fluid. The working fluid is filtered and withdrawn into the tank for reuse.
- Ability to use the robot for irrigation - Irrigation can protect flowers and fruits before spring frosts. Knowing weather information for the coming frost we may program the Agribot to spray water over the trees in the orchard, which will protect flowers and fruit from freezing.
- Special small droplet nozzles - Specially designed nozzles that produce droplets can significantly reduce water consumption and improve surface coverage of plant.
- Protecting people from the harmful effects of pesticides - Agribot does not require direct human supervision during the operation.
- Environmentally friendly spraying method - Extremely low amount of plant protection products is sprayed on the soil.
- Ability to use biological methods of plant protection - The use of microorganisms to control insects.

8. RFID – RADIO FREQUENCY IDENTIFICATION

Why in news?

- Identification tool that has significant advantages over the other existing methods such as bar code and magnetic strip(in ATMs).
- Radio Frequency Identification Devices (RFID) has been made mandatory in newly-registered medium and heavy motor vehicles in Kerala.

About RFID

- RFID is a form of wireless communication that uses radio waves to identify and track objects.
- RFID takes the barcoding concept and digitizes it for the modern world providing the ability to:
 - Uniquely identify an individual item beyond just its product type
 - Identify items without direct line-of-sight
 - Identify many items (up to 1,000s) simultaneously
 - Identify items within a vicinity of between a few centimeters to several meters

An RFID system has readers and tags that communicate with each other by radio. RFID tags are so small and require so little power that they don't even need a battery to store information and exchange data with readers. This makes it easy and cheap to apply tags to all kinds of things that people would like to identify or track.



Why use RFID?

RFID technology has the capability to both greatly enhance and protect the lives of consumers, and also revolutionize the way companies do business. As the most flexible auto-identification technology, RFID can be used to track and monitor the physical world automatically and with accuracy.

RFID can tell you what an object is, where it is, and even its condition, which is why it is integral to the development of the Internet of Things—a globally interconnected web of objects allowing the physical world itself to become an information system, automatically sensing what is happening, sharing related data, and responding.

RFID use is increasing rapidly with the capability to “tag” any item with an inexpensive communications chip and then read that tag with a reader. Endless applications range from supply chain management to asset tracking to

authentication of frequently counterfeited pharmaceuticals. Applications are limited, in fact, only by the imagination of the user.

Applications:RFID can help:

- Automate inventory and asset-tracking in healthcare, manufacturing, retail, and business sectors
- Identify the source of products, enabling intelligent recall of defective or dangerous items, such as tainted foods, defective toys, and expired or compromised medication
- Prevent use of counterfeit products in the supply chain
- Improve shopping experience for consumers, with fewer out-of-stock items and easier returns
- Provide visibility into the supply chain, yielding a more efficient distribution channel and reduced business costs
- Decrease business revenue lost to theft or inaccurate accounting of goods
- Improve civilian security through better cargo monitoring at ports
- Wirelessly lock, unlock and configure electronic devices
- Enable access control of certain areas or devices

Future Prospects:

- Whatever the application, RFID has the potential to increase
 - efficiency of operations,
 - improve asset visibility and traceability,
 - decrease reliance on manual processes,
 - reduce operations costs, and
 - provide useful data for business analytics.

9. QR CODE / QRC / 2D BARCODES

- QR or Quick Response Codes are a type of two-dimensional(matrix) barcode that can be read using smartphones and dedicated QR reading devices, that link directly to text, emails, websites, phone numbers and more. Below is the QR code of visionias.in



- QR codes are huge in Japan and across the East, and are slowly beginning to become commonplace in the West.
- Ordinarily we think of a barcode as a collection of vertical lines; 2D Barcodes or QR Codes are different in that the data is stored in both directions and can be scanned vertically OR horizontally.
- Whilst a standard 1D Barcode stores up to 30 numbers, a QR Barcode can store up to a massive 7,089! It is this massive amount of data that enables links to such things as videos, Facebook or Twitter pages or a plethora of other website pages.

10. CARBON SEQUESTRATION

Carbon Sequestration

- Sequestration is the carbon-capturing method which involves injecting the gas directly into underground geological formations. Oil fields, gas fields, saline formations, unminable coal seams, and saline-filled basalt formations have been suggested as storage sites.

"Carbfix Project"

- It is project that aims at pumping carbon deep underground in southwest Iceland where it will mix with minerals and become rock.
- A primary goal of the CarbFix project is to imitate the natural storage process of CO₂ already observed in geothermal fields.
- The project's implications for the fight against global warming may be considerable, since basaltic bedrock susceptible of CO₂ injections are widely found on the planet.

11. BIONIC EYE

- A visual prosthesis, often referred to as a bionic eye, is an experimental visual device intended to restore functional vision in those suffering from partial or total blindness
- Argus II, manufactured by Second Sight Medical Products Inc. is the only such device to have received marketing approval.

12. DESIGNER BABY

- The word designer baby has been defined in Oxford dictionary as a baby whose genetic makeup has been artificially selected by genetic engineering combined with in vitro fertilisation to ensure the presence or absence of particular genes or characteristics.
- The technology behind designer babies is based on Pre-implantation Genetic Diagnosis (PGD). The embryo is created through In Vitro Fertilisation (IVF). A single cell is removed from the embryo within five days, and it is then genetically tested. The parents then decide whether to discard the embryo or implant it.

UPSC Mains 2011: Q:'Designer' poultry eggs

13. BIOSIMILAR

- The term biosimilar refers to products that are marketed after expiration of patents, which are claimed to have similar properties to existing biologic products. Due to the complexity of biologics, a product can only be made that is similar, but not identical.
- Biosimilars are generic impersonations (although not identical copies) of biotech drugs.
- Manufacturing processes for biologics differ greatly from the manufacturing processes for small molecule drugs.

Size & Complexity – Small Molecule Drugs & Proteins

	Small Molecule Drug	Large Molecule Drug	Large Biologic
Size	Aspirin 21 atoms	hGH ~ 3000 atoms	IgG Antibody ~ 25,000 atoms
Complexity	Bike ~ 20 lbs	Car ~ 3000 lbs	Business Jet ~ 30,000 lbs (without fuel)

14. POD-CARD/PERSONAL RAPID TRANSIT (PRT)

- Personal rapid transit (PRT), also called podcar, is a public transportation mode featuring small automated vehicles operating on a network of specially built guide ways.
- PRT is a type of automated guideway transit (AGT), a class of system which also includes larger vehicles all the way to small subway systems.
- In PRT designs, vehicles are sized for individual or small group travel, typically carrying no more than 3 to 6 passengers per vehicle.
- The award winning ULTra PRT system began passenger trials at London Heathrow Airport, Terminal 5, in October 2010 and opened for full passenger service 22 hours a day, 7 days a week, in May 2011.

Pods to Make Transportation Personal

- Driverless pods on elevated tracks
- On-call, point-to-point, service
- Six persons to an A/c pod
- Coast along at 40 km/hr
- Pay fares using smart cards



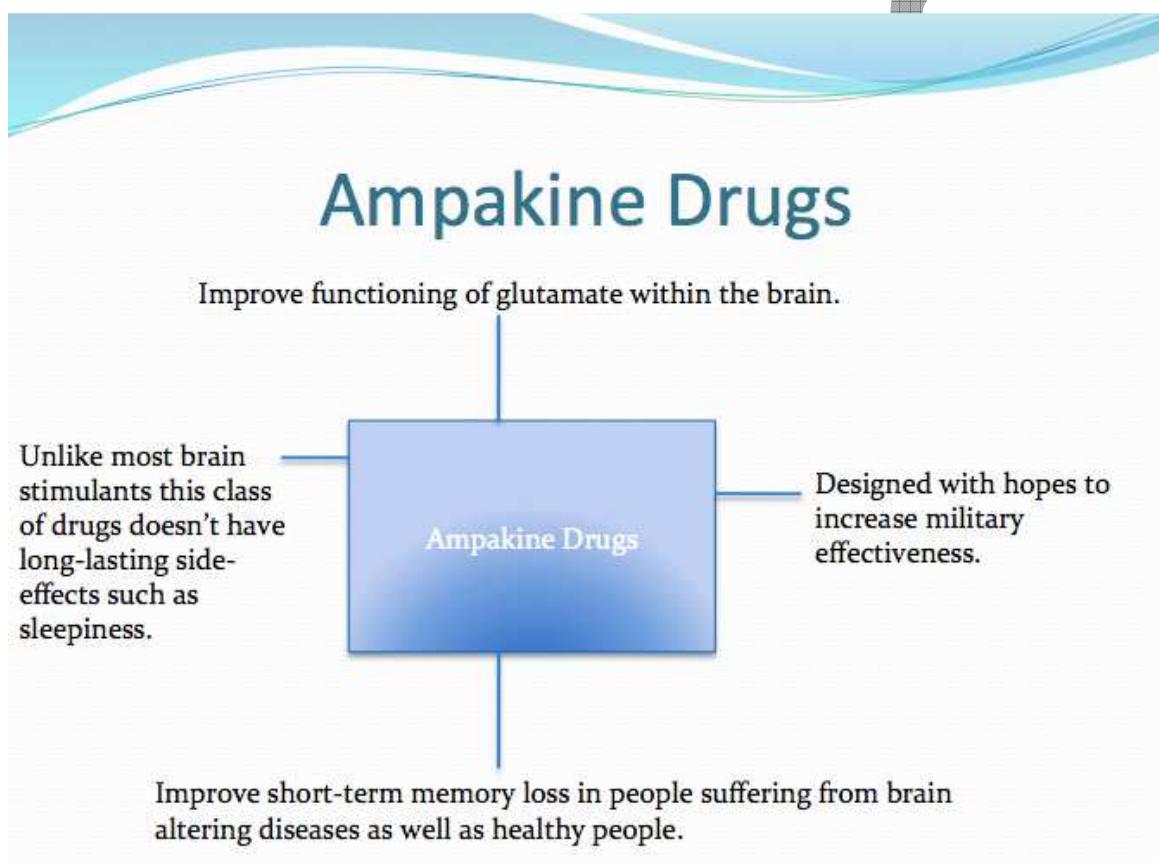
15. AMPAKINES/AMPAKINES TECHNOLOGY-

AMPAKINES

- Ampakines are a class of compounds known to enhance attention span and alertness, and facilitate learning and memory.

Working:

- The brain is filled with connections – trillions of connections. Ampakines work by enhancing the communication between the connections in the brain. In doing so, they are able to facilitate learning and memory, and to overcome some of the chemical imbalances that can occur in the brain with certain diseases.



Uses:

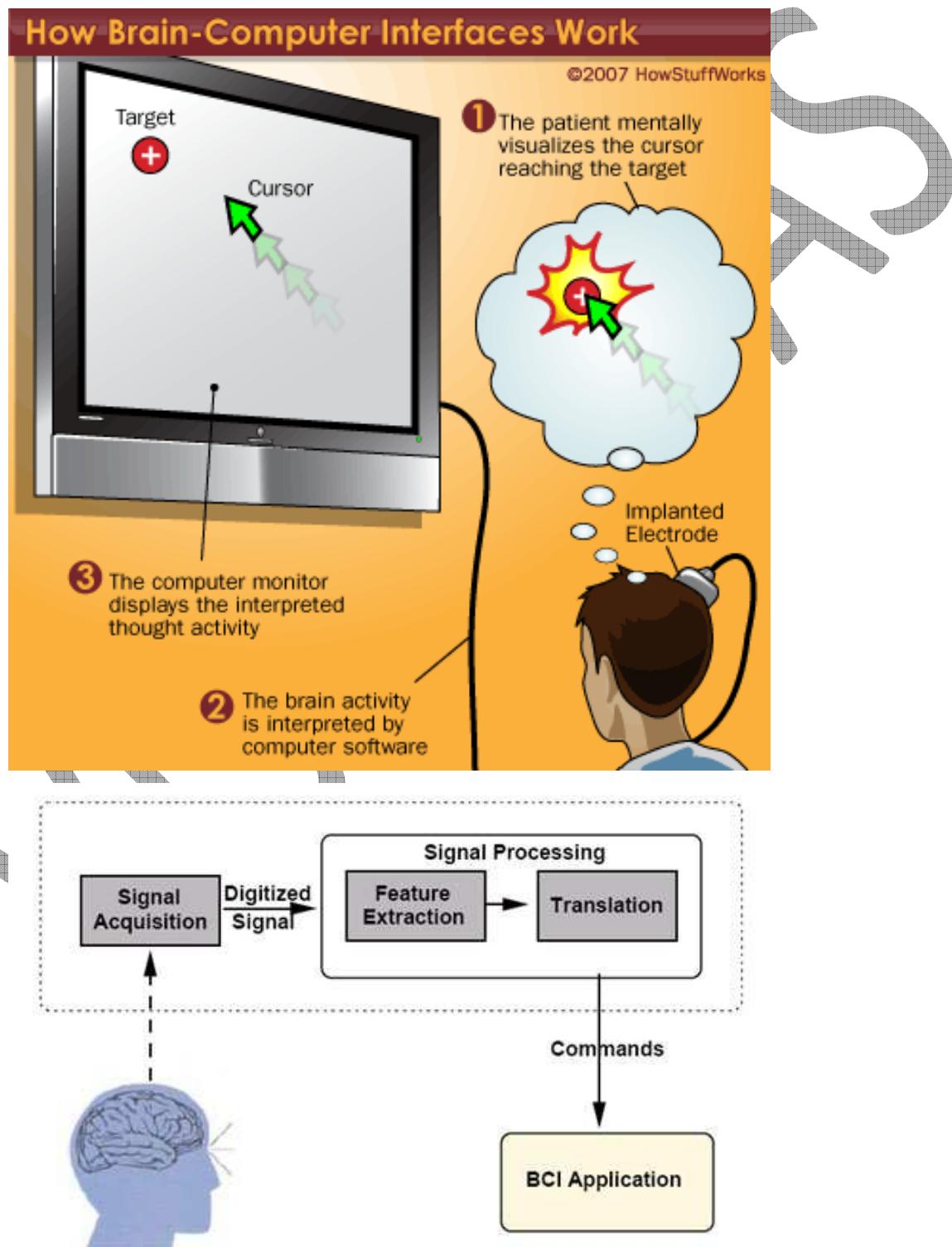
1. Ampakines can be used to treat the effects of Alzheimer's disease, attention-deficit disorder, strokes, and the dementias associated with Parkinson's disease and schizophrenia, treatment-resistant depression (TRD), Rett syndrome et.
2. Ampakines have shown to have an effect after they had left the body, continuing to enhance learning and memory.
3. Ampakines have been investigated by DARPA for potential use in increasing military effectiveness.

16.BRAIN-COMPUTER INTERFACE (BCI)/MMI/BMI

A brain-computer interface (BCI), often called a mind-machine interface (MMI), or sometimes called a direct neural interface or a brain-machine interface (BMI), is a direct communication pathway between the brain and an external device. BCIs are often directed at assisting, augmenting, or repairing human cognitive or sensory-motor functions. THIS IS YOUR BRAIN ON SILICON..!

Applications:

- It holds the promise of bringing sight to the blind, hearing to the deaf, and the return of normal functionality to the physically impaired.
- By interfacing with a computer through a direct neural connection, patients report a higher rate of mental engagement and, ultimately, recovery.
- BCI technology shows promising signs in both preventing and delaying the onset of dementia, Alzheimer's and Parkinson's disease in the elderly.
- BCI has military, consumer electronics and other uses as well. Its leading edge technology is known as "MindReader". A simple thought in mind could be digitalized and become reality.



17. BRAIN READING

- Every thought is associated with a characteristic pattern of activation in the brain. By training a computer to recognize these patterns, it becomes possible to read a person's thoughts from patterns of their cerebral activity. In this way a person's brain activity can betray their thoughts and emotions, can give clues whether they are lying, or can even predict what they are about to do.
- This recent progress in brain science has made completely new insights into thought processes possible. We can now investigate how thoughts are stored in the brain, or how intentions unconsciously arise and affect our behaviour. But these findings are not just of interest for the scientific disciplines involved. They have important implications for our understanding of human nature. Also, they lay foundations for important applications: For example, with the help of a "brain computer interfaces", paralysed patients can control technical devices solely "with the power of their thoughts".
- Brain reading uses fMRI in order to decode the original stimulus.

Background:

fMRI

- Functional magnetic resonance imaging or functional MRI (fMRI) is an MRI procedure that measures brain activity by detecting associated changes in blood flow.

MRI

- Magnetic resonance imaging (MRI) is a test that uses a magnetic field and pulses of radio wave energy to make pictures of organs and structures inside the body.

18. NEUROINFORMATICS

- Neuroinformatics is an emerging research area at the interface between information technology with and brain research. It covers all aspects of studying the brain, including its form, function, development, and illnesses. Techniques of particular interest are the many kinds of neuroimaging and the analysis of such images, brain databases of all kinds, and computational modeling of brain function.
- Combining informatics research and brain research provides benefits for both fields of science. On one hand, informatics facilitates brain data processing and data handling, by providing new electronic and software technologies for arranging databases, modeling and communication in brain research. On the other hand, enhanced discoveries in the field of neuroscience will invoke the development of new methods in information technologies (IT).
- Neuroinformatics integrates information across all levels and scales of neuroscience - from genes to behavior - to help understand the brain and treat disease. It encompasses the tools and techniques for data acquisition, sharing, publishing, storage, analysis, visualization, modeling and simulation.

19. GENENETWORK-

- Networks of interacting genes are responsible for generating life's diversity. Gene networks play a central role in our sophisticated immune response, the ability to digest food, and even for causing cancer - the disaster that occurs when gene networks become un-regulated. Thus understanding the properties of gene networks is of fundamental importance in the post-genomic era.
- GeneNetwork consists of two major components:
 - Massive collections of genetic, genomic, and phenotype data for large families

- Sophisticated statistical analysis and gene mapping software that enable analysis of regulatory networks and genotype-to-phenotype relations
- GeneNetwork is primarily used by researchers but has also been adopted successfully for undergraduate courses in genetics, bioinformatics, physiology, and psychology. Researchers and students typically retrieve sets of genotypes and phenotypes from one or more families and use built-in statistical and mapping functions to explore relations among variables and to assemble networks of associations. Key steps include the analysis of these factors:
 1. The range of variation of traits
 2. Covariation among traits (scatterplots and correlations)
 3. Architecture of larger networks of traits
 4. Quantitative trait locus mapping and causal models of the linkage between sequence differences and phenotype differences

20. NEUROPROSTHETICS

- Neuroprosthetics (also called neural prosthetics) is a discipline related to neuroscience and biomedical engineering concerned with developing neural prostheses (In medicine, a prosthesis, prosthetic, or prosthetic limb is a device that replaces a missing body part). Neural prostheses are a series of devices that can substitute a motor, sensory or cognitive modality that might have been damaged as a result of an injury or a disease. Cochlear implants (The cochlea is the auditory portion of the inner ear)-(for hearing aid) provide an example of such devices. These devices substitute the functions performed by the ear drum and Stapes, while simulating the frequency analysis performed in the cochlea. A microphone on an external unit gathers the sound and processes it; the processed signal is then transferred to an implanted unit that stimulates the auditory nerves through a microelectrode array. Through the replacement or augmentation of damaged senses, these devices intend to improve the quality of life for those with disabilities.
- These implantable devices are also commonly used in animal experimentation as a tool to aid neuroscientists in developing a greater understanding of the brain and its functioning. In wirelessly monitoring the brain's electrical signals sent out by electrodes implanted in the subject's brain, the subject can be studied without the device affecting the results.

21. IN VITRO MEAT

- In vitro meat, also known as cultured meat or shmeat, is an animal flesh product that has never been part of a complete, living animal. Alternative names include hydroponic meat, test-tube meat, vat-grown meat, victimless meat and vitro meat. This form of meat has been described, sometimes derisively, as "laboratory-grown" meat. A long-term goal for in vitro meat laboratories would be to grow fully developed muscle tissue after they made the first-generational products economically feasible for most people. Cultured meat is currently prohibitively expensive, but it is anticipated that the cost could be reduced to about twice that of conventionally produced meat. Potentially, any animal's muscle tissue could be grown through the in vitro process, even human.
- In vitro meat production is a specialized form of tissue engineering, a biomedical practice in which scientists try to grow animal tissues like bone, skin, kidneys and hearts. Proponents say it will ultimately be a more efficient way to make animal meat, which would reduce the carbon footprint of meat products.

- With the costs of conventional meat farming techniques constantly increasing and an increased demand from a rising world population, in vitro meat may be one of several new technologies needed to maintain food supplies by the year 2050.
- Shmeat is a nickname given to lab-created meat grown from a cell culture of animal tissue.

22. VERTICAL FARMING- (farm vertically)

- Vertical farming is a proposal to build high rise buildings within urban areas to enable the growing of food crops to help avoid the impending food shortage which is envisaged in the near future. It is thought that by the year 2050 the world's population will have grown by a further 3 billion people and with more land needed than is available to grow the crops needed to feed everybody, ideas have to be considered to how these extra crops can be grown. Vertical farming could provide year round food production and better crop production, being able to yield more produce by area like for like compared to traditional horizontal farming. To put in a nutshell vertical farming is like a high rise greenhouse, sometimes having the label farmscrapers.

Advantages of Vertical Farming

- Year-round crop production; 1 indoor acre is equivalent to 4-6 outdoor acres or more, depending upon the crop (e.g., strawberries: 1 indoor acre = 30 outdoor acres)
- No weather-related crop failures due to droughts, floods, pests
- All VF food is grown organically: no herbicides, pesticides, or fertilizers
- VF virtually eliminates agricultural runoff by recycling black water
- VF returns farmland to nature, restoring ecosystem functions and services
- VF greatly reduces the incidence of many infectious diseases that are acquired at the agricultural interface
- VF converts black and gray water into potable water by collecting the water of evapotranspiration
- VF adds energy back to the grid via methane generation from composting non-edible parts of plants and animals
- VF dramatically reduces fossil fuel use (no tractors, plows, shipping.)
- VF converts abandoned urban properties into food production centers
- VF creates sustainable environments for urban centers
- VF creates new employment opportunities
- We cannot go to the moon, Mars, or beyond without first learning to farm indoors on earth
- VF may prove to be useful for integrating into refugee camps
- VF offers the promise of measurable economic improvement for tropical and subtropical LDCs. If this should prove to be the case, then VF may be a catalyst in helping to reduce or even reverse the population growth of LDCs as they adopt urban agriculture as a strategy for sustainable food production.
- VF could reduce the incidence of armed conflict over natural resources, such as water and land for agriculture



23. PROSTHESIS-

Prosthesis, artificial substitute for a missing part of the body. The artificial parts that are most commonly thought of as prostheses are those that replace lost arms and legs, but bone, artery, and heart valve replacements are common, and artificial eyes and teeth are also correctly termed prostheses. The term is sometimes extended to cover such things as eyeglasses and hearing aids, which improve the functioning of a part. The medical specialty that deals with prostheses is called prosthetics.

24. HEAD TRANSPLANT-

- A head transplant is a surgical operation involving the grafting of an organism's head onto the body of another. It should not be confused with another, hypothetical, surgical operation, the brain transplant. Head transplantation involves decapitating the patient. Although it has been successfully performed using dogs, monkeys and rats, no human is known to have undergone the procedure.
- This technique has been proposed as possibly useful for people who are already quadriplegics and who are also suffering from widespread organ failures which would otherwise require many different and difficult transplant surgeries. Quadriplegia may be an acceptable option for the terminally ill. There is no uniform consensus on the ethics of such a procedure.

25. ISOLATED BRAIN-

- Isolated brain refers to keeping a brain alive in-vitro. This is done either by perfusion by a blood substitute, often an oxygenated solution of various salts, or by submerging the brain in oxygenated artificial cerebrospinal fluid (CSF). An isolated brain however is more typically attached to an artificial perfusion device rather than a biological body.

- The brains of many different organisms have been kept alive in-vitro for hours, or in some cases days. The central nervous system of invertebrate animals is often easily maintained as they need less oxygen and to a larger extent get their oxygen from CSF, for this reason their brains are more easily maintained without perfusion. Mammalian brains on the other hand have a much lesser degree of survival without perfusion and an artificial blood perfusate is usually used.

26. LIFE EXTENSION-

- Life extension science, also known as anti-aging medicine, experimental gerontology, and biomedical gerontology, is the study of slowing down or reversing the processes of aging to extend both the maximum and average lifespan. Some researchers in this area, and "life extensionists" or "longevists" (who wish to achieve longer lives for themselves), believe that future breakthroughs in tissue rejuvenation with stem cells, molecular repair, and organ replacement (such as with artificial organs or xenotransplantations) will eventually enable humans to have indefinite lifespans (agerasia) through complete rejuvenation to a healthy youthful condition.
- The sale of putative anti-aging products such as nutrition, physical fitness, skin care, hormone replacements, vitamins, supplements and herbs is a lucrative global industry.
- During the process of aging, an organism accumulates damage to macromolecules, its cells, its tissues and its organs. This accumulated damage is the result of oxidation damage to the cell contents caused by free radicals. Theoretically, extension of maximum lifespan could be achieved by reducing the rate of aging damage, by periodic replacement of damaged tissues, or by molecular repair or rejuvenation of deteriorated cells and tissues and the enhancement of telomerase enzyme activity.

27. HIBERNATION-

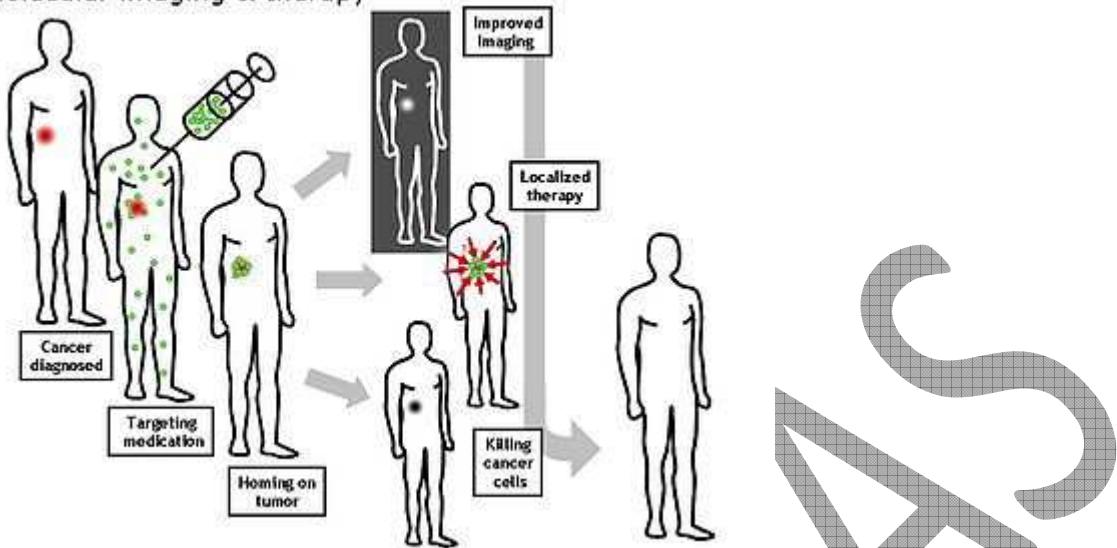
- Hibernation is a state of inactivity and metabolic depression in animals, characterized by lower body temperature, slower breathing, and/or lower metabolic rate. Hibernating animals conserve energy, especially during winter when food supplies are limited, tapping energy reserves, body fat, at a slow rate. Hibernation during summer months is known as aestivation.
- Although often associated with cold temperatures, the root purpose of hibernation is to conserve food during a period when sufficient food is scarce. It is the animal's slowed metabolic rate which leads to a reduction in body temperature and not the other way around. Hibernation may last several days, weeks, or months depending on the species, ambient temperature, time of year, individual animal's body condition, and fur on the animal's body.
- Before entering hibernation, most species eat a large amount of food and store energy in fat deposits to survive the winter. Some species of mammals hibernate while gestating young, which are either born while the mother hibernates or shortly afterwards.

28. NANOMEDICINES-

- Nanomedicine is the medical application of nanotechnology. Nanomedicine ranges from the medical applications of nanomaterials, to nanoelectronic biosensors, and even possible future applications of molecular nanotechnology.
- Nanomedical approaches to drug delivery centre on developing nanoscale particles or molecules to improve drug bioavailability. Bioavailability refers to the presence of drug molecules where they are needed in the body and where they will do the most good. Drug delivery focuses on maximizing bioavailability both at specific places in the body and over a period of time. This can potentially be

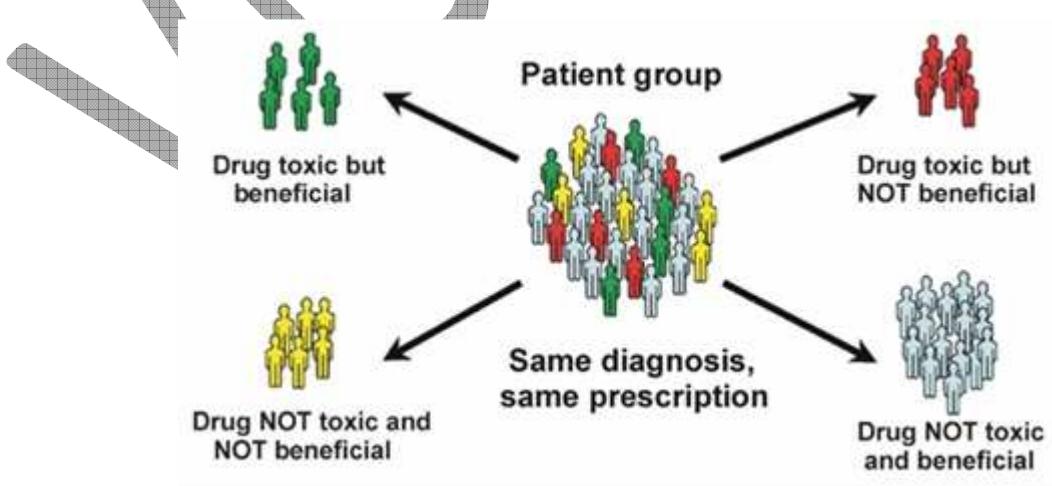
achieved by molecular targeting by nanoengineered devices. It is all about targeting the molecules and delivering drugs with cell precision.

Molecular imaging & therapy



29. PERSONALIZED MEDICINE-

- Personalized medicine is a young but rapidly advancing field of healthcare that is informed by each person's unique clinical, genetic, genomic, and environmental information. Because these factors are different for every person, the nature of diseases—including their onset, their course, and how they might respond to drugs or other interventions—is as individual as the people who have them.
- Personalized medicine is about making the treatment as individualized as the disease. It involves identifying genetic, genomic, and clinical information that allows accurate predictions to be made about a person's susceptibility of developing disease, the course of disease, and its response to treatment.
- Specific advantages that personalized medicine may offer patients and clinicians include:
 - Ability to make more informed medical decisions
 - Higher probability of desired outcomes thanks to better-targeted therapies
 - Reduced probability of negative side effects
 - Focus on prevention and prediction of disease rather than reaction to it
 - Earlier disease intervention than has been possible in the past
 - Reduced healthcare cost

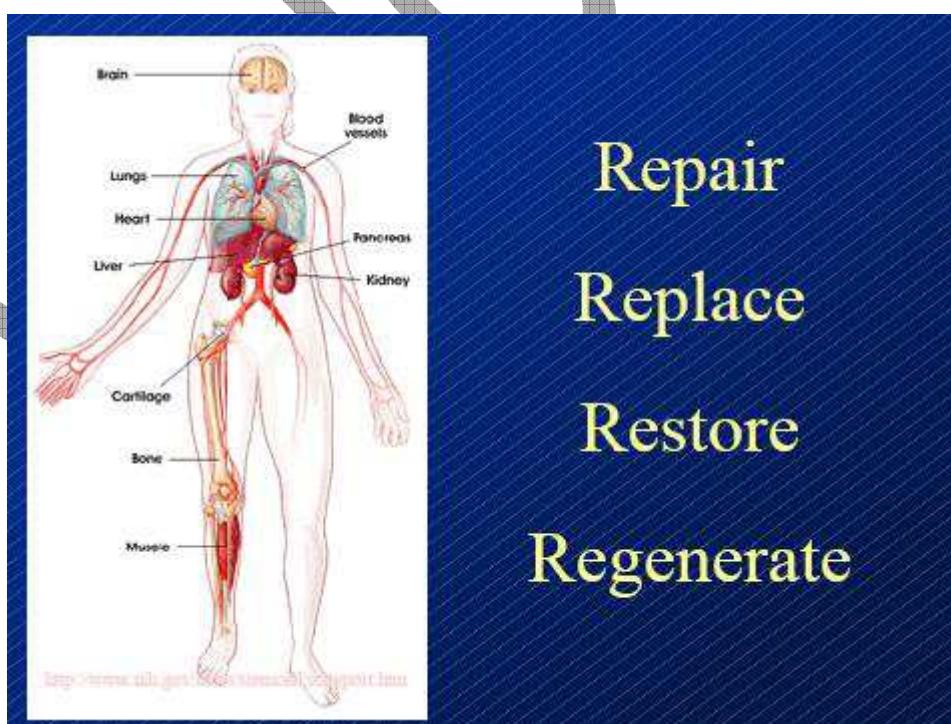


30. FULL GENOME SEQUENCING-

- Whole genome sequencing (also known as full genome sequencing, complete genome sequencing, or entire genome sequencing), is a laboratory process that determines the complete DNA sequence of an organism's genome at a single time. This entails sequencing all of an organism's chromosomal DNA as well as DNA contained in the mitochondria and, for plants, in the chloroplast. Almost any biological sample—even a very small amount of DNA or ancient DNA—can provide the genetic material necessary for full genome sequencing. Such samples may include saliva, epithelial cells, bone marrow, hair (as long as the hair contains a hair follicle), seeds, plant leaves, or anything else that has DNA-containing cells.
- Full genome sequencing will allow health care professionals to analyze the entire human genome of an individual and therefore detect all disease-related genetic variants, regardless of the genetic variant's prevalence or frequency. This will enable the rapidly emerging medical fields of Predictive Medicine, Preventive Medicine and Personalized Medicine and will mark a significant leap forward for the clinical genetic revolution. Full genome sequencing is clearly of great importance for research into the basis of genetic disease and has shown significant benefit to a subset of individuals with rare disease in the clinical setting.

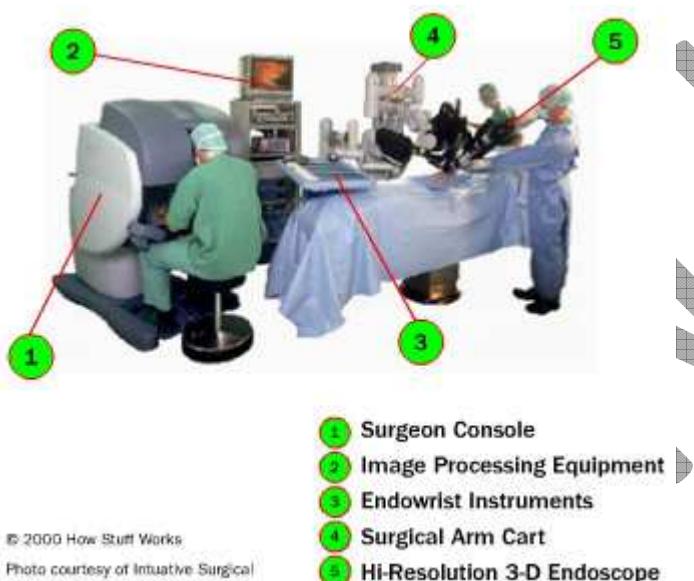
31. REGENERATIVE MEDICINE-

- Regenerative medicine helps natural healing processes to work faster and better. These technologies and techniques create an environment in which missing or damaged tissue that would not ordinarily regrow in fact regenerates fully.
- Strategies presently under development include transplants of stem cells, the manipulation of the patient's own stem cells, and the use of scaffold materials that emit biochemical signals to spur stem cells into action. Regenerative therapies have been demonstrated (in trials or the laboratory) to heal broken bones, bad burns, blindness, deafness, heart damage, nerve damage, Parkinson's disease, and a range of other conditions. Work continues to bring these advances to patients.



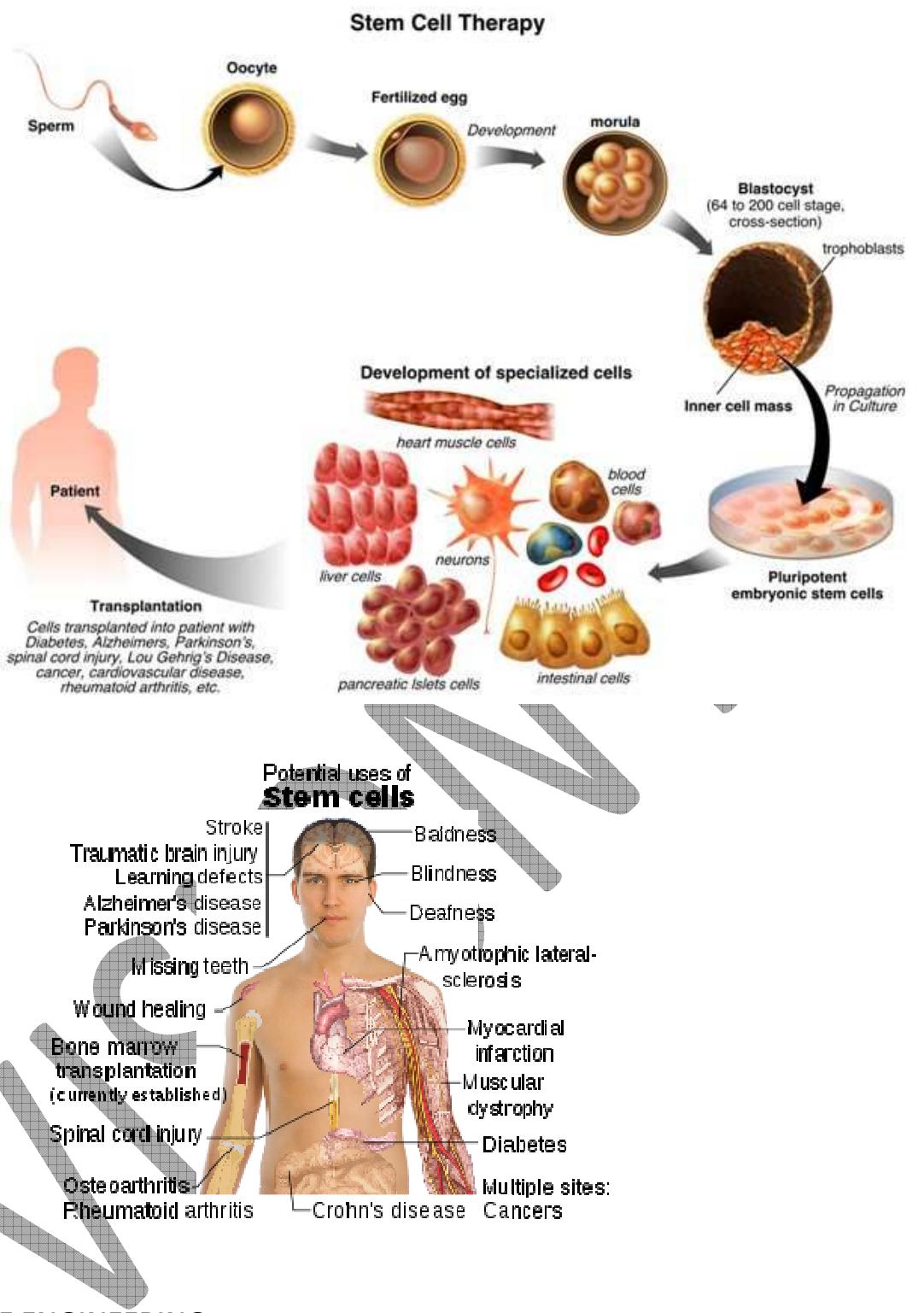
32. ROBOTIC SURGERY-

- Robotic surgery is a technique in which a surgeon performs surgery using a computer that remotely controls very small instruments attached to a robot.
- The surgeon first inserts these instruments into your body through small surgical cuts. Under the surgeon's direction, the robot matches the doctor's hand movements to perform the procedure using the tiny instruments.
- A thin tube with a camera attached to the end of it (endoscope) allows the surgeon to view highly magnified three-dimensional images of your body on a monitor in real time.
- Major advances aided by surgical robots have been remote surgery, minimally invasive surgery and unmanned surgery. Some major advantages of robotic surgery are precision, miniaturization, smaller incisions, decreased blood loss, less pain, and quicker healing time. Further advantages are articulation beyond normal manipulation and three-dimensional magnification, resulting in improved ergonomics. Robotic techniques are also associated with reduced duration of hospital stays, blood loss, transfusions, and use of pain medication.



33. STEM CELL TREATMENTS

- Stem cell treatments are a type of intervention strategy that introduces new adult stem cells into damaged tissue in order to treat disease or injury. Many medical researchers believe that stem cell treatments have the potential to change the face of human disease and alleviate suffering. The ability of stem cells to self-renew and give rise to subsequent generations with variable degrees of differentiation capacities, offers significant potential for generation of tissues that can potentially replace diseased and damaged areas in the body, with minimal risk of rejection and side effects.
- But there is widespread controversy over the use of human embryonic stem cells. This controversy primarily targets the techniques used to derive new embryonic stem cell lines, which often requires the destruction of the blastocyst. Opposition to the use of human embryonic stem cells in research is often based on philosophical, moral or religious objections.

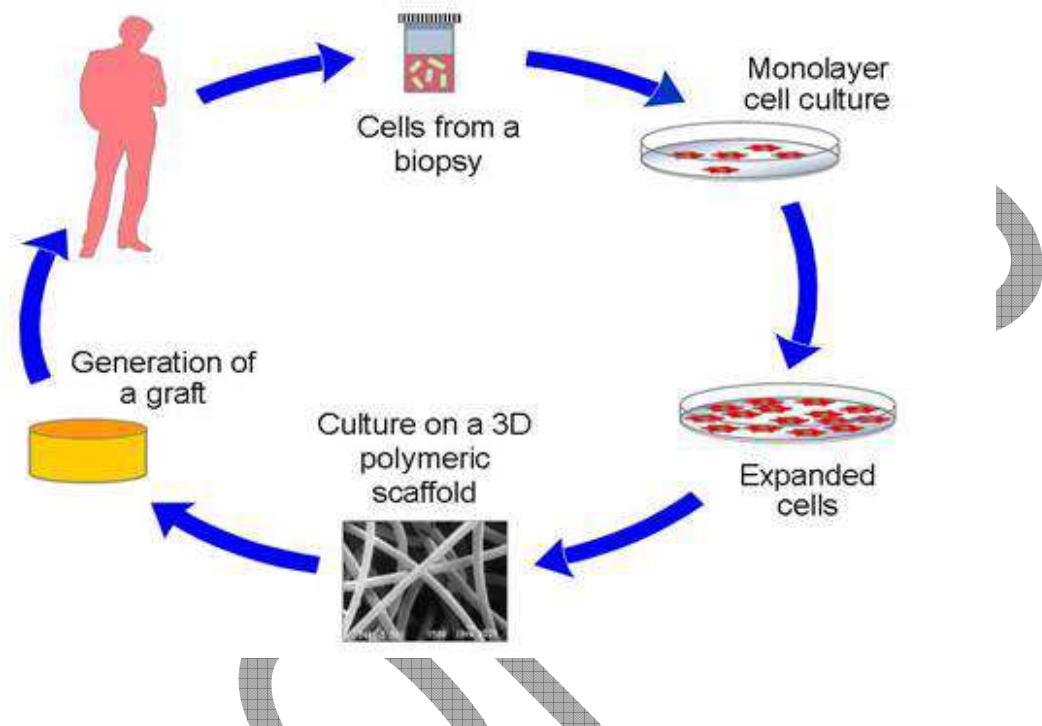


34. TISSUE ENGINEERING-

- Tissue engineering is the use of a combination of cells, engineering and materials methods, and suitable biochemical and physio-chemical factors to improve or replace biological functions.
- While most definitions of tissue engineering cover a broad range of applications, in practice the term is closely associated with applications that repair or replace portions of or whole tissues (i.e., bone, cartilage, blood vessels, bladder, skin, muscle etc.). Often, the tissues involved require certain mechanical and structural properties for proper functioning. The term has also been applied to efforts to perform specific biochemical functions using cells within an artificially-created support system (e.g. an artificial pancreas, or a bio artificial liver).

- Tissue Engineering is a multidisciplinary field that applies the principles of Biology, Chemistry, Physics and Engineering for the development of substitutes that replace, repair or enhance biological function of diseased and damaged human body parts, by manipulating cells via their extracellular microenvironment. This three dimensional extracellular architecture ("scaffold") can be fabricated in the shape of the tissue we want to restore

Basic principles of Tissue engineering



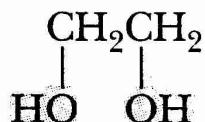
35. VITRIFICATION-

- Vitrification (from Latin *vitrum* meaning "glass") is the transformation of a substance into a glass. Usually, it is achieved by rapidly cooling a liquid through the glass transition. Certain chemical reactions also result in glasses. An important application is the vitrification of an antifreeze-like liquid in cryopreservation.
- Vitrification is characteristic for amorphous materials or disordered systems and occurs when bonding between elementary particles (atoms, molecules, forming blocks) becomes higher than a certain threshold value. Thermal fluctuations break the bonds; therefore, the lower the temperature, the higher the degree of connectivity.
- In a wider sense, the embedding of material in a glassy matrix is also called vitrification.

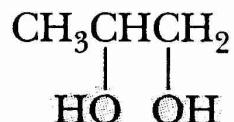
36. CRYOPROTECTANT-

- A cryoprotectant is a substance that is used to protect biological tissue from freezing damage (i.e. that due to ice formation). Arctic and Antarctic insects, fish and amphibians create cryoprotectants (antifreeze compounds and antifreeze proteins) in their bodies to minimize freezing damage during cold winter periods. Insects most often use sugars or polyols as cryoprotectants. Arctic frogs use glucose, but Arctic salamanders create glycerol in their livers for use as a cryoprotectant. Cryoprotectants operate simply by increasing the solute concentration in cells. However, in order to be biologically viable they must (1) easily penetrate cells, and (2) not be toxic to the cell.

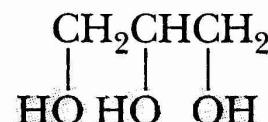
- Conventional cryoprotectants are glycols (alcohols containing at least two hydroxyl groups), such as ethylene glycol[citation needed], propylene glycol, and glycerol. Ethylene glycol is commonly used as automobile antifreeze, and propylene glycol has been used to reduce ice formation in ice cream. Dimethyl sulfoxide (DMSO) is also regarded as a conventional cryoprotectant. Glycerol and DMSO have been used for decades by cryobiologists to reduce ice formation in sperm and embryos that are cold-preserved in liquid nitrogen.



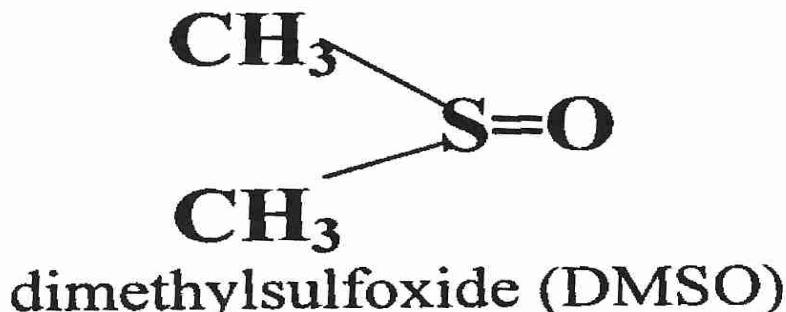
1,2-Ethanediol
(Ethylene glycol)



1,2-Propanediol
(Propylene glycol)



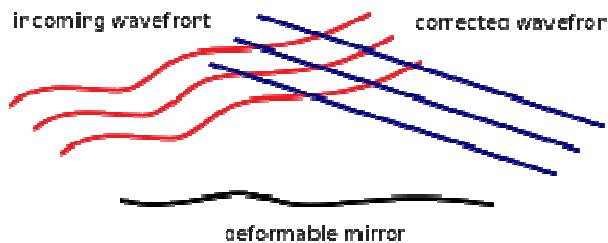
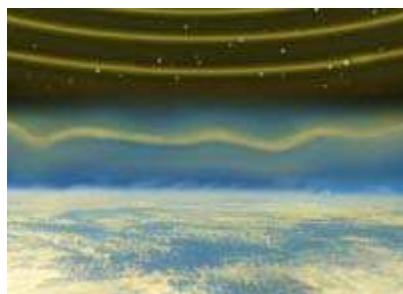
1,2,3-Propanetriol
(Glycerol, Glycerin)



37. ADAPTIVE OPTICS (AO)-

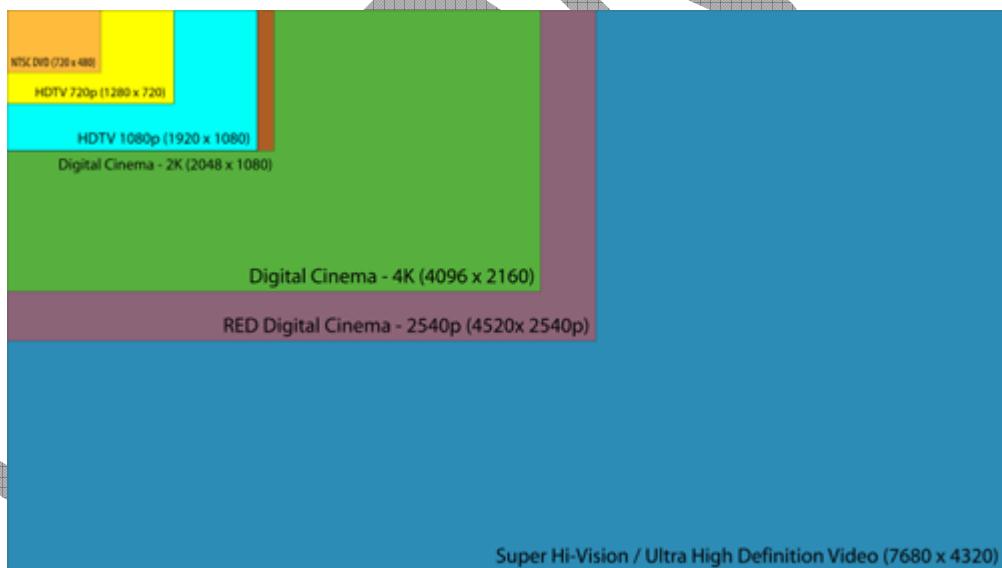
- Light from a distant star or galaxy is distorted as it passes through the turbulent earth's atmosphere, preventing a telescope on the surface of the earth from forming sharp images. Instruments using a new method called adaptive optics can eliminate the blurring effect of the atmosphere. Thus images formed with the 100-inch telescope using adaptive optics are as sharp as those from NASA's Hubble Space Telescope. This is the most revolutionary technical development in astronomy since Galileo first used an astronomical telescope in 1609.
- Adaptive optics works by measuring the distortions in a wavefront and compensating for them with a device that corrects those errors such as a deformable mirror or a liquid crystal array. AO was first envisioned by Horace W. Babcock in 1953.

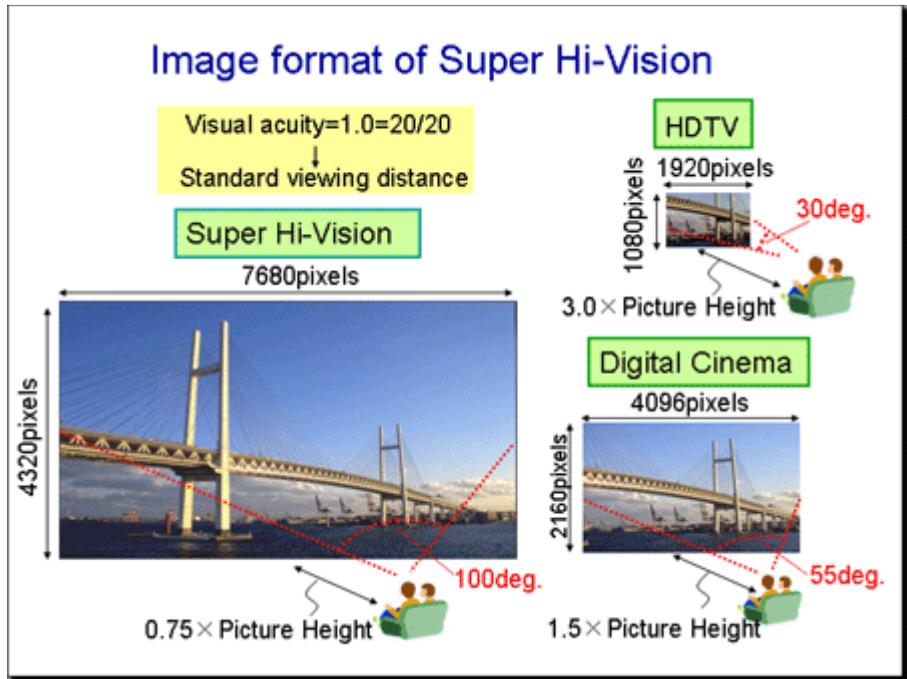




38. ULTRA HIGH DEFINITION TELEVISION-

- Ultra HDTV, also known as “Super Hi-Vision” or “Ultra HD”, is an experimental broadcast format proposed by BBC, Japan’s NHK, and Italy’s RAI. The UHDTV format is 16 times larger than the current “Full HDTV” format. At this time, no television is capable of displaying the 7680x4320 pixel Super Hi-Vision signal, though such screens available for the 2012 Olympics.



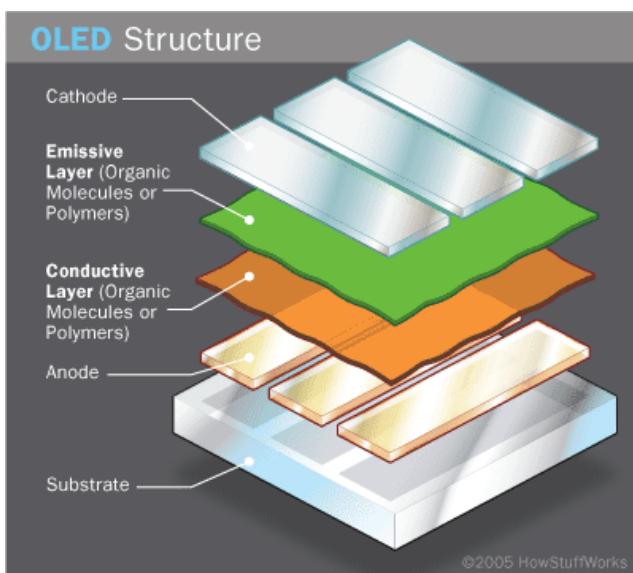


- Ultra High Definition is the real defining characteristic of this TV. Although the format is still in experimental stages of development, Ultra HD will eventually take over from 'standard' HD (around 2020, one would guess) and pushes a resolution of 16 times the pixels of existing HDTV's. This particular 145-inch Ultra HD television with its some 34 million pixels rivals IMAX in its detail; all the while being 60 frames per second and having an aspect ratio of 16:9.

39. OLED-

- An OLED (organic light-emitting diode) is a light-emitting diode (LED) in which the emissive electroluminescent layer is a film of organic compound which emits light in response to an electric current. This layer of organic semiconductor material is situated between two electrodes. Generally, at least one of these electrodes is transparent. OLEDs are used to create digital displays in devices such as television screens, computer monitors, portable systems such as mobile phones, handheld games consoles and PDAs.
- There are two main families of OLEDs: those based on small molecules and those employing polymers. Adding mobile ions to an OLED creates a light-emitting electrochemical cell or LEC, which has a slightly different mode of operation. OLED displays can use either passive-matrix (PMOLED) or active-matrix addressing schemes. Active-matrix OLEDs (AMOLED) require a thin-film transistor backplane to switch each individual pixel on or off, but allow for higher resolution and larger display sizes.
- An OLED display works without a backlight. Thus, it can display deep black levels and can be thinner and lighter than a liquid crystal display (LCD). In low ambient light conditions such as a dark room an OLED screen can achieve a higher contrast ratio than an LCD, whether the LCD uses cold cathode fluorescent lamps or LED backlight. Due to its low thermal conductivity, an OLED typically emits less light per area than an inorganic LED.
- In simple terms, OLED is a whole new large-screen technology. The flat panel is made up of millions of tiny LEDs. The "O" in OLED stands for "organic" which means there is carbon within the molecules of the emissive (light producing) layer of the panel. Large-screen OLED panels need no lamps -- they are self illuminating. OLED HDTVs can be thinner and lighter than the skinniest LED LCDs, and have several other advantages over LCD TVs, regardless of whether the LCD is lit by LED or CCFL.

- For instance, they provide very wide and consistent color no matter where you are seated in the room. LED LCDs tend to get significantly dimmer as you move away from the centre, and many exhibit color shift.



VISION IAS

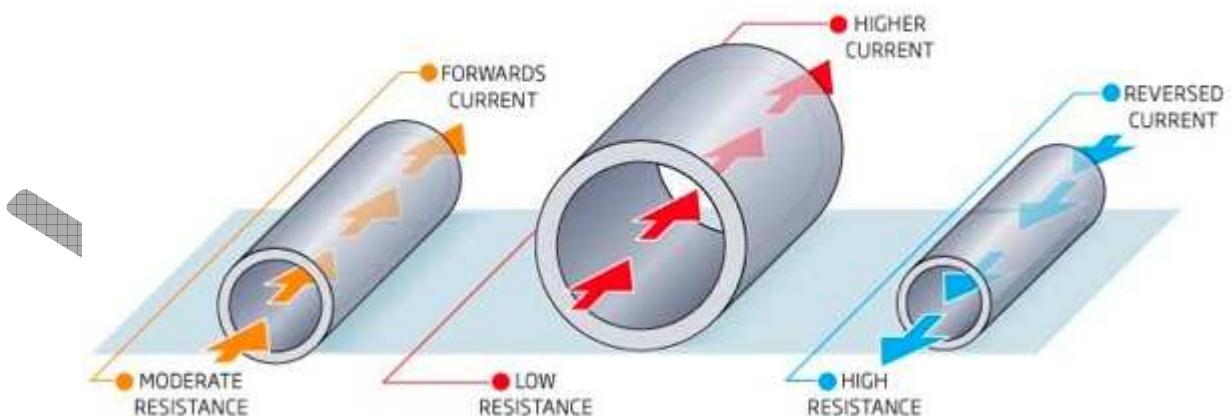
40. MEMRISTOR-

- It is the long theorized basic circuit element that can generate voltage from a current (like a resistor), but in a more complex, dynamic manner -- with the ability to "remember" previous current.

A memristor never forgets

©NewScientist

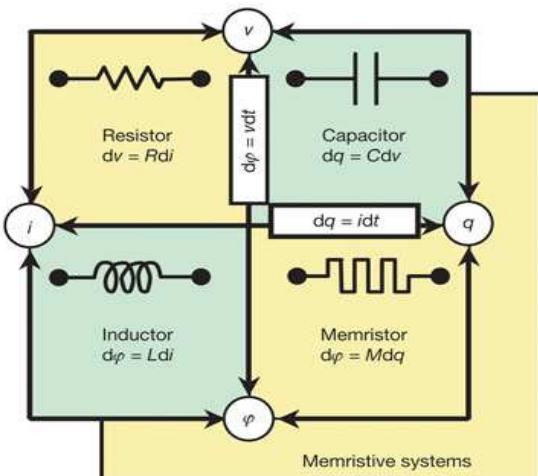
The "resistor with memory" that Leon Chua described behaves like a pipe whose diameter varies according to the amount and direction of the current passing through it



● IF THE CURRENT IS TURNED OFF, THE PIPE'S DIAMETER STAYS THE SAME UNTIL IT IS SWITCHED ON AGAIN - IT "REMEMBERS" WHAT CURRENT HAS FLOWED THROUGH IT

- Memristors are basically a fourth class of electrical circuit, joining the resistor, the capacitor, and the inductor, that exhibit their unique properties primarily at the nanoscale. Theoretically, Memristors, a concatenation of "memory resistors", are a type of passive circuit elements that maintain a relationship between the time integrals of current and voltage across a two terminal element. Thus, a memristors

resistance varies according to a device's memristance function, allowing, via tiny read charges, access to a "history" of applied voltage.



- The memristor was originally envisioned in 1971 by circuit theorist Leon Chua as a missing non-linear passive two-terminal electrical component relating electric charge and magnetic flux linkage.
- In March 2012, a team of researchers from HRL Laboratories and the University of Michigan announced the first functioning memristor array built on a CMOS chip for applications in neuromorphic computer architectures.

41. ELECTRONIC NOSE-

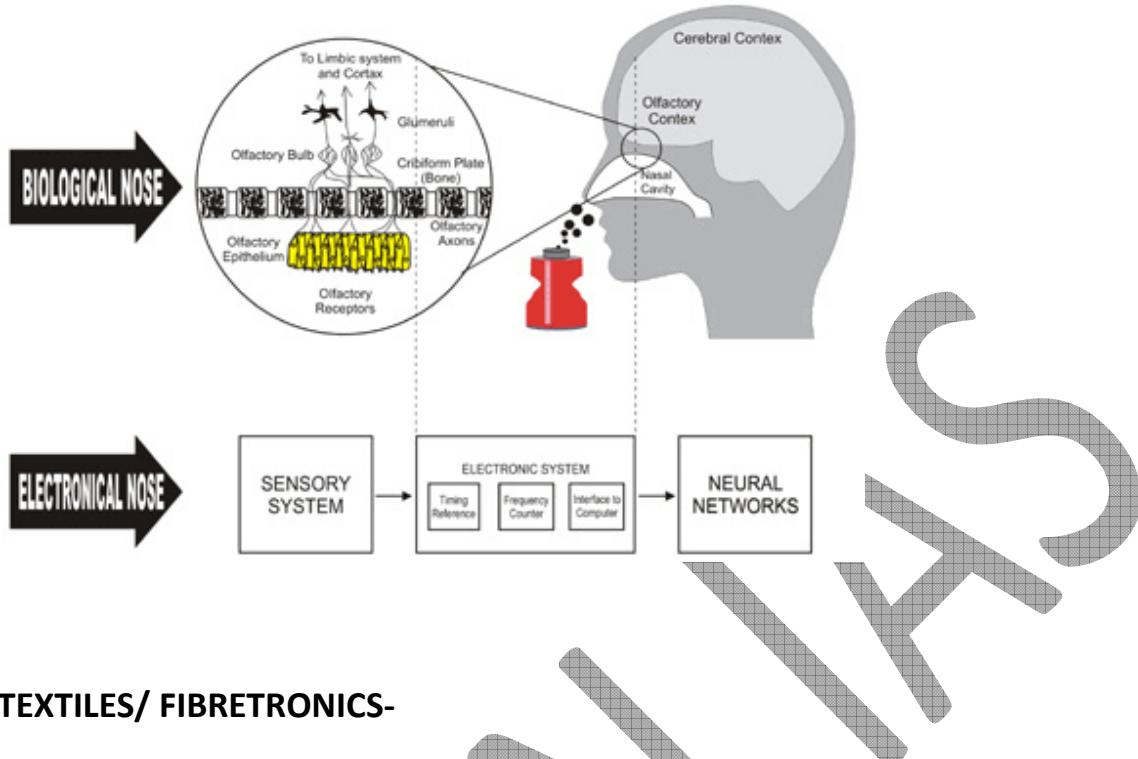
- An electronic nose (e-nose) is a device that identifies the specific components of an odor and analyzes its chemical makeup to identify it. An electronic nose consists of a mechanism for chemical detection, such as an array of electronic sensors, and a mechanism for pattern recognition, such as a neural network. Electronic noses have been around for several years but have typically been large and expensive. Current research is focused on making the devices smaller, less expensive, and more sensitive. The smallest version, a nose-on-a-chip is a single computer chip containing both the sensors and the processing components.
- Electronic Noses include three major parts: a sample delivery system, a detection system, a computing system.
- To perform analysis, an electronic nose needs to be trained with qualified samples so as to build a database of reference. Then the instrument can recognize new samples by comparing volatile compounds fingerprint to those contained in its database. Thus they can perform qualitative or quantitative analysis.

Recent Advances

- Detection of perineal odors associated with oestrus in cows.
- Detection of lung cancer in humans.
- NASA uses enose for detecting ammonia leakage in spacecrafts.

ELECTRONIC NOSE CONCEPT

4to40



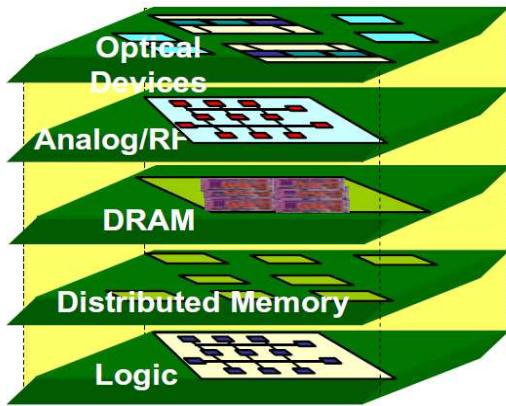
42. E- TEXTILES/ FIBRETRONICS-

- E-textiles, also known as electronic textiles or smart textiles, are fabrics that enable computing, digital components, and electronics to be embedded in them. Part of the development of wearable technology, they are known as intelligent clothing or smart clothing because they allow for the incorporation of built-in technological elements in everyday textiles and clothes. Electronic textiles do not strictly encompass wearable computing because emphasis is placed on the seamless integration between the fabric and the electronic elements, such as cables, microcontrollers, sensors and actuators. The field of embedding advanced electronic components onto textile fibers is sometimes called fibertronics.
- The field of e-textiles can be divided into two main categories:
 - E-textiles with classical electronic devices such as conducting wires, integrated circuits, LEDs, and conventional batteries embedded into garments. This is the common type of e-textile.
 - E-textiles with modern electronics directly on the textile fibers. This can include either passive electronics such as pure wires, conducting textile fibers, or more advanced electronics such as transistors, diodes, and solar cells.



43. 3D IC-

- In electronics, a three-dimensional integrated circuit (3D IC, 3D-IC, or 3-D IC) is a chip in which two or more layers of active electronic components are integrated both vertically and horizontally into a single circuit. The semiconductor industry is pursuing this promising technology in many different forms, but it is not yet widely used; consequently, the definition is still somewhat fluid.



3D IC

- Traditional scaling of semiconductor chips also improves signal propagation speed. However, scaling from current manufacturing and chip-design technologies has become more difficult, in part because of power-density constraints, and in part because interconnects do not become faster while transistors do. 3-D integrated circuits were proposed invented to address the scaling challenge by stacking 2-D dies and connecting them in the 3rd dimension. This promises to speed up communication between layered chips, compared to planar layout.

44. QUANTUM CRYPTOGRAPHY-

- Quantum cryptography uses our current knowledge of physics to develop a cryptosystem that is not able to be defeated - that is, one that is completely secure against being compromised without knowledge of the sender or the receiver of the messages. The word quantum itself refers to the most fundamental behaviour of the smallest particles of matter and energy: quantum theory explains everything that exists and nothing can be in violation of it.
- Quantum cryptography is different from traditional cryptographic systems in that it relies more on physics, rather than mathematics, as a key aspect of its security model.
- Essentially, quantum cryptography is based on the usage of individual particles/waves of light (photon) and their intrinsic quantum properties to develop an unbreakable cryptosystem - essentially because it is impossible to measure the quantum state of any system without disturbing that system. It is theoretically possible that other particles could be used, but photons offer all the necessary qualities needed, their behaviour is comparatively well-understood, and they are the information carriers in optical fibre cables, the most promising medium for extremely high-bandwidth communications.
- The advantage of quantum cryptography lies in the fact that it allows the completion of various cryptographic tasks that are proven or conjectured to be impossible using only classical (i.e., non-quantum) communication.

45. QUANTUM COMPUTER-

- A quantum computer is a computer design which uses the principles of quantum physics to increase the computational power beyond what is attainable by a traditional computer. Quantum computers have been built on the small scale and work continues to upgrade them to more practical models.

- Computers function by storing data in a binary number format, which result in a series of 1s & 0s retained in electronic components such as transistors. Each component of computer memory is called a bit and can be manipulated through the steps of Boolean logic so that the bits change, based upon the algorithms applied by the computer program, between the 1 and 0 modes.
- A quantum computer, on the other hand, would store information as either a 1, 0, or a quantum superposition of the two states. Such a "quantum bit," called a qubit, allows for far greater flexibility than the binary system.

46. OPTICAL COMPUTING-

- An optical computer (also called a photonic computer) is a device that uses the photons in visible light or infrared (IR) beams, rather than electric current, to perform digital computations. An electric current flows at only about 10 per cent of the speed of light. This limits the rate at which data can be exchanged over long distances, and is one of the factors that led to the evolution of optical fibre. By applying some of the advantages of visible and/or IR networks at the device and component scale, a computer might someday be developed that can perform operations 10 or more times faster than a conventional electronic computer.
- Optical technology has made its most significant inroads in digital communications, where fibre optic data transmission has become commonplace. The ultimate goal is the so-called photonic network, which uses visible and IR energy exclusively between each source and destination. Optical technology is employed in CD-ROM drives and their relatives, laser printers, and most photocopiers and scanners. However, none of these devices are fully optical; all rely to some extent on conventional electronic circuits and components.

47. PROTEIN COATED DISC-

- Protein-Coated Disc (PCD) is a theoretical optical disc technology currently being developed by Professor Venkatesan Renugopalakrishnan, formerly of Harvard Medical School and Florida International University. PCD would greatly increase storage over Holographic Versatile Disc optical disc systems. It involves coating a normal DVD with a special light-sensitive protein made from a genetically altered microbe, which would in principle allow storage of up to 50 Terabytes on one disc. Working with the Japanese NEC Corporation, Renugopalakrishnan's team created a prototype device and estimated in July, 2006 that a USB disk would be commercialised in 12 months and a DVD in 18 to 24 months.
- The technology uses the photosynthetic pigment (bacteriorhodopsin) created from bacteria.
- The information in such discs would be highly dense, due to being stored in proteins that are only a few nanometres across. However, a method to address individual protein molecules to read and write information to and from them would have to be developed in order to achieve the theoretical 50 TB capacity. Practically, capacity would probably be limited by the size that addressing light can be focused to, so a DVD-sized disc might be able to hold ~50 GB, or perhaps ~240 GB if near-field optics were used.

48. LS-R DISC-

- LS-R, or the Layer-Selection-Type Recordable Optical Disk, is the term coined by Hitachi in 2003 for a next-generation optical disc technology which allows much larger data storage densities than DVD, HD DVD or Blu-ray Disc, by allowing the use of a large number of data layers in a single disc. In previous optical disc technologies, only a relatively small number of data layers can be incorporated in a single

disc, since the reflections from the different layers interfere with each other. However, in LS-R, only the layer of interest generates a reflection, meaning that a very large number of layers can theoretically be stacked in the same disc. This feat is accomplished by an electronic "selection" mechanism, whereby each data layer is coated with electrodes and only the electrodes associated with the layer of interest are activated. This activation changes the "selected" data layer from being transparent to being reflective or opaque, thus it can be addressed.

- LS-R technology utilizes an electrochromic film, for example of tungsten oxide or an organic material to accomplish the optical change. A two-layer feasibility prototype has been demonstrated, and it was estimated that a 20-layer CD-sized disc could provide 1 terabyte of data capacity.

49. HVD-

- Holographic versatile disc (HVD) is a holographic storage format that looks like a DVD but is capable of storing far more data. Prototype HVD devices have been created with a capacity of 3.9 terabytes (TB) and a transfer rate of 1 gigabit per second (1 Gbps). At that capacity, an HVD could store as much information as 830 DVDs or 160 Blu-Ray discs.
- To increase capacity, holographic storage uses laser beams to store digital data in three dimensions, rather than in two dimensions as in CD and DVD media. HVD is, essentially, a holographic layer built on top of a conventional disc. The HVD process uses a blue-green laser beam, used for reading and writing data, collimated (made parallel) with a red laser beam, which is used for servo and tracking.
- In the recording process, the initial laser is split into two beams. One of the beams passes through a device called a spatial light modulator (SLM) and combines with the direct beam to produce a hologram in the physical medium. To recover the data, another 532-nm laser is directed into the hologram, which diffracts the laser beam. The resulting image constitutes an optical reproduction of the original recorded data. A photosensitive semiconductor device converts this optical data into the original digital files.

50. EXOCORTEX-

- An exocortex is a theoretical artificial external information processing system that would augment a brain's biological high-level cognitive processes.
- An individual's exocortex would be composed of external memory modules, processors, IO devices and software systems that would interact with, and augment, a person's biological brain. Typically this interaction is described as being conducted through a direct brain-computer interface, making these extensions functionally part of the individual's mind. Individuals with significant exocortices could be classified as cyborgs or transhumans.
- The noun exocortex is composed of the Greek-derived prefix *exo*-, meaning external or outside, and the Latin noun *cortex*, which originally meant bark but is used in neuroscience for the outer bark-like layer of the brain that is the site of most sophisticated cognitive information processing. It was coined in allusion to the neocortex (literally 'new bark'), the newest part of the mammalian brain (in evolutionary history), believed to be responsible for the highest human cognitive abilities including conscious thought, spatial reasoning, and sensory perception. Thus the terminology suggests a progression from reptilian thought (the older parts of the brain) through human (neocortex) to high-level human or even supra-human cognitive processing capabilities (exocortex).

51. SEMANTIC WEB-

- The Semantic Web is a web that is able to describe things in a way that computers can understand.

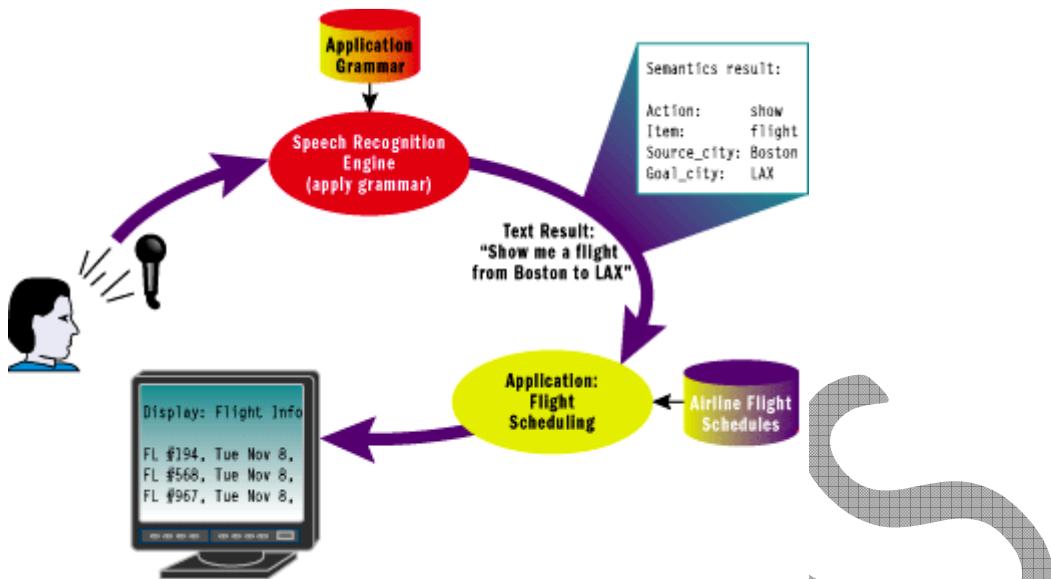
- It is a mesh of information linked up in such a way as to be easily processable by machines, on a global scale. You can think of it as being an efficient way of representing data on the World Wide Web, or as a globally linked database.
- The Semantic Web was thought up by Tim Berners-Lee, inventor of the WWW, URIs, HTTP, and HTML. There is a dedicated team of people at the World Wide Web consortium (W3C) working to improve, extend and standardize the system, and many languages, publications, tools and so on have already been developed. However, Semantic Web technologies are still very much in their infancies, and although the future of the project in general appears to be bright, there seems to be little consensus about the likely direction and characteristics of the early Semantic Web.
- While its critics have questioned its feasibility, proponents argue that applications in industry, biology and human sciences research have already proven the validity of the original concept. Scholars have explored the social potential of the semantic web in the business and health sectors, and for social networking. The original 2001 Scientific American article by Berners-Lee described an expected evolution of the existing Web to a Semantic Web, but this has yet to happen. In 2006, Berners-Lee and colleagues stated that: "This simple idea... remains largely unrealized."

52. CYBERMETHODOLOGY-

- Cybermethodology is a newly emergent field that focuses on the creative development and use of computational and technological research methodologies for the analysis of next-generation data sources such as the Internet.
- Cybermethodology is an outgrowth of two relatively new academic fields. The first is Technology and society, and the second is internet studies.
- Cybermethodology is the component of internet and technology studies that is specifically concerned with the use of innovative technology-based methods of analysis, new sources of data, and conceptualizations in order to gain a better understanding of human behavior. It is characterized by the use, as primary data sources, of emergent entities such as virtual worlds, blogs, texting, on-line gaming (mmorpgs), social networking sites, video sharing, wikis, search engines, and numerous other innovative tools and activities available on the web.

53. SPEECH RECOGNITION-

- In computer science, speech recognition (SR) is the translation of spoken words into text. It is also known as "automatic speech recognition", "ASR", "computer speech recognition", "speech to text", or just "STT". Some SR systems use "training" where an individual speaker reads sections of text into the SR system. These systems analyze the person's specific voice and use it to fine tune the recognition of that person's speech, resulting in more accurate transcription. Systems that do not use training are called "Speaker Independent" systems. Systems that use training are called "Speaker Dependent" systems.



- Speech recognition applications include voice user interfaces such as voice dialing, call routing, domotic appliance control, search , simple data entry (e.g., entering a credit card number), preparation of structured documents (e.g., a radiology report), speech-to-text processing (e.g., word processors or emails), and aircraft (usually termed Direct Voice Input).
- The term voice recognition refers to finding the identity of "who" is speaking, rather than what they are saying. Recognizing the speaker can simplify the task of translating speech in systems that have been trained on specific person's voices or it can be used to authenticate or verify the identity of a speaker as part of a security process.
- Speech recognition has many applications in Health care, military, telephony, robotics, video games, aerospace, telematics, etc.

54. 5G

- 5G technology is under research and it would have some good features along with the features of 4G.
- It is said that this will give high bit rate transfer with low costs.
- 1. High bit transfer rate2. Near about 1 GBPS speed3. Low traffic rates4. Better coverage5. Better security for users6. High resolution7. Remote Diagnostic8. Larger bandwidth
- Status of 4G in India: TRAI has released a consultation paper on 19-08-2011.

55. 4G-

- 4G is short for Fourth (4th) Generation Technology. 4G Technology is basically the extension in the 3G technology with more bandwidth and services offers in the 3G.
- In telecommunications, 4G is the fourth generation of cell phone mobile communications standards. It is a successor of the third generation (3G) standards. A 4G system provides mobile ultra-broadband Internet access, for example to laptops with USB wireless modems, to smartphones, and to other mobile devices. Conceivable applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing and 3D television.
- Two 4G candidate systems are commercially deployed: The Mobile WiMAX standard (at first in South Korea in 2006), and the first-release Long term evolution (LTE) standard (in Scandinavia since 2009). It has however been debated if these first-release versions should be considered as 4G or not.

- 4G Technology offers high data rates that will generate new trends for the market and prospects for established as well as for new telecommunication businesses. 4G networks, when tied together with mobile phones with in-built higher resolution digital cameras and also High Definition capabilities will facilitate video blogs.

56. VIRTUAL REALITY-

- Virtual reality is an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment. On a computer, virtual reality is primarily experienced through two of the five senses: sight and sound.
- The simplest form of virtual reality is a 3-D image that can be explored interactively at a personal computer, usually by manipulating keys or the mouse so that the content of the image moves in some direction or zooms in or out. More sophisticated efforts involve such approaches as wrap-around display screens, actual rooms augmented with wearable computers, and haptics devices that let you feel the display images.
- Virtual reality can be divided into:
 - The simulation of a real environment for training and education.
 - The development of an imagined environment for a game or interactive story.
- Popular products for creating virtual reality effects on personal computers include Bryce, Extreme 3D, Ray Dream Studio, trueSpace, 3D Studio MAX, and Visual Reality. The Virtual Reality Modelling Language (VRML) allows the creator to specify images and the rules for their display and interaction using textual language statements.

57. ARTIFICIAL BRAIN-

- Artificial brains are man-made machines that are just as intelligent, creative, and self-aware as humans. It is a term commonly used in the media to describe research that aims to develop software and hardware with cognitive abilities similar to those of the animal or human brain. Research investigating "artificial brains" plays three important roles in science:
 - 1) An ongoing attempt by neuroscientists to understand how the human brain works, known as cognitive neuroscience.
 - 2) A thought experiment in the philosophy of artificial intelligence, demonstrating that it is possible, in theory, to create a machine that has all the capabilities of a human being.
 - 3) A serious long term project to create machines capable of general intelligent action or Artificial General Intelligence. This idea has been popularised by Ray Kurzweil as strong AI (taken to mean a machine as intelligent as a human being).
- No such machine has yet been built, but it is only a matter of time. Given current trends in neuroscience, computing, and nanotechnology, we estimate that artificial general intelligence will emerge sometime in the 21st century, maybe even by the year 2050.

58. 3D PRINTING-

- 3D printing is a method of manufacturing everything from shoes to jewelery, to guns and aerospace parts, using a computer-controlled printer. The fundamental rule of 3D printing is that it's an additive manufacturing technique, unlike machining, turning, milling, and sawing which are subtractive.
- While there are different kinds of 3D printing, all 3D objects are generally built out of layers. A 3D printer starts with the bottom layer, waits for it to dry or solidify, and then works its way up. This layering

process differs depending on the printer and the material it works with — metal, plaster, polymer, resin — but it also depends on whether it's an industrial or commercial 3D printer.

- 3D printers can be used to create titanium aircraft parts, human bones, complex, nano-scale machines, and more. In the future, it's fairly safe to assume that we'll be able to manufacture almost anything with a 3D printer — and everything we can't make with a printer (clothes, textiles), automated CNC machines, or something like them, will take care of. Ultimately, 3D printers might also be the key to matter replicators, just like in Star Trek. It's important to note that we already have very accurate tools for creating 3D models of existing objects; we have the ability to scan a cup, and then create an exact copy using a 3D printer.

59. CLAYTRONICS-

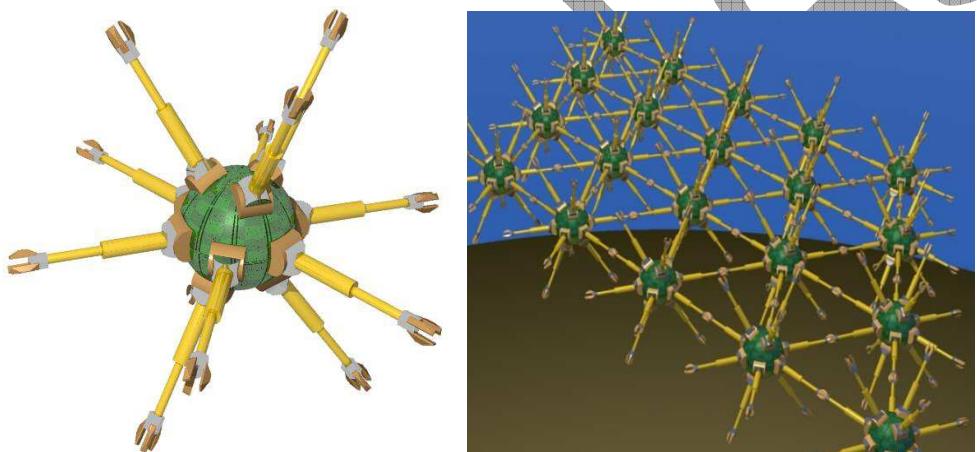
- Claytronics is an abstract future concept that combines nanoscale robotics and computer science to create individual nanometer-scale computers called claytronic atoms, or catoms, which can interact with each other to form tangible 3-D objects that a user can interact with. This idea is more broadly referred to as programmable matter. Claytronics has the potential to greatly affect many areas of daily life, such as telecommunication, human-computer interfaces, and entertainment.
- Catoms—for claytronic atoms—that can move in three dimensions (in relation to other catoms), adhere to other catoms to maintain a 3D shape, and compute state information (with possible assistance from other catoms in the ensemble). Each catom contains a CPU, an energy store, a network device, a video output device, one or more sensors, a means of locomotion, and a mechanism for adhering to other catoms.
- The power and flexibility that will arise from being able to "program" the world around us should influence every aspect of the human experience. Claytronics is a technology which can serve as the means of implementing a new communication medium, which we call pario. The idea behind pario is to reproduce moving, physical 3D objects. Similar to audio and video, we are neither transporting the original phenomena nor recreating an exact replica: instead, the idea is to create a physical artefact that can do a good enough job of reproducing the shape, appearance, motion, etc., of the original object that our senses will accept it as being close enough.
- As of 2006 researchers have already created a prototype catom that is 44 millimeters in diameter. The goal is to eventually produce catoms that are one or two millimeters in diameter—small enough to produce convincing replicas.

60. MOLECULAR ASSEMBLER-

- A molecular assembler is a molecular machine capable of assembling other molecules given instructions, energy, and a supply of smaller "building block" molecules to work from. They can work individually as tiny stand-alone systems, or potentially be organized in large numbers to form a desktop-scale nanofactory able to build macroscopic products. Distinction is sometimes made between synthetic and naturally occurring molecular assemblers.
- In cellular biology, the ribosome demonstrates the essential principles of a molecular assembler. Working within a cell's environment, it reads strands of mRNA as its instructions and assembles specific large protein molecules out of more fundamental parts.
- Synthetic assemblers have not yet been constructed, and some controversy exists as to whether they are possible or what their ecological impact might be. The potential uses of synthetic assemblers could be more general, and are thought to be especially applicable to materials science.

61. UTILITY FOG-

- Utility Fog is a swarm of invisibly small molecular robots, programmable to rearrange into virtually any configuration, almost instantly. Utility Fog is basically a 'Fractal Robot', made up of trillions of smaller bots. As such, it is a form of self-reconfiguring modular robotics.
- Coined by Dr. John Storrs Hall in 1993, Hall thought of it as a nanotechnological replacement for car seatbelts. The robots would be microscopic, with extending arms reaching in several different directions, and could perform three-dimensional lattice reconfiguration. Grabbers at the ends of the arms would allow the robots (or foglets) to mechanically link to one another and share both information and energy, enabling them to act as a continuous substance with mechanical and optical properties that could be varied over a wide range. Each foglet would have substantial computing power, and would be able to communicate with its neighbors.
- Some of the basic properties of Utility Fog would be invisibility (when desired), strength, and enormous computing power. Molecular size means too small to see, and in low density formations (arms extended to maximum) it would flow easily as air. Speed. At molecular sizes, robots would move interactively at about the speed of sound, almost faster than we could see. The strength of a swarm of molecular sized robots would be amazing... if desired as hard as cement, and in unison could lift a truck with ease!



62. AEROGEL-

- Aerogel is a synthetic porous material derived from a gel, in which the liquid component of the gel has been replaced with a gas. The result is a solid with extremely low density and thermal conductivity. It is nicknamed frozen smoke, solid smoke, solid air or blue smoke owing to its translucent nature and the way light scatters in the material; however, it feels like expanded polystyrene (styrofoam) to the touch.
- Aerogels are produced by extracting the liquid component of a gel through supercritical drying. This allows the liquid to be slowly drawn off without causing the solid matrix in the gel to collapse from capillary action, as would happen with conventional evaporation. The first aerogels were produced from silica gels.
- Despite their name, aerogels are rigid, dry materials and do not resemble a gel in their physical properties; the name comes from the fact that they are derived from gels. Aerogels are good thermal insulators. Owing to its hygroscopic nature, aerogel feels dry and acts as a strong desiccant. The slight color it does have is due to Rayleigh scattering of the shorter wavelengths of visible light by the nanosized dendritic structure. This causes it to appear smoky blue against dark backgrounds and yellowish against bright backgrounds. Aerogels by themselves are hydrophilic, but chemical treatment can make them hydrophobic.



63. SILICENE-

- Silicene is the thinnest possible form of silicon, and if the material can be commercialised, it could mean even smaller electronics. It is the silicon equivalent of graphene, the two-dimensional carbon lattice that has gripped the world of materials science since it was isolated in 2004.
- Graphene has a long list of astonishing properties: it has better intrinsic electron mobility than silicon, is so strong you can actually pick up a sheet of single atoms, and has a current density more than a million times that of copper, at room temperature.

Silicene vs graphene

- But silicene is potentially even more exciting because it could be more easily compatible with existing silicon-based electronics, which means its benefits could be exploited quicker. Since carbon is right next to silicon on the periodic table, scientists began to wonder if a single layer of silicon atoms might be similarly revolutionary, and so the race to make some was on.
- The European research team reported that their silicene behaved just like graphene in a key respect: its electrons behave in a very particular way. They are capable of moving like massless particles, travelling through the lattice at the speed of light, on a range of energy levels that are continuous, rather than discrete. When plotted, this energy continuum is known as a Dirac cone.
- Where graphene has no band gap, the sample of silicene (if that is what it is) produced in Japan, does. This makes it immediately more suitable for use in developing nano-scale transistors, for example.

64. HIGH TEMPERATURE SUPERCONDUCTORS-

- High-temperature superconductors (high-T_c or HTS) are materials that behave as superconductors at unusually high temperatures. The first high-T_c superconductor was discovered in 1986 by IBM researchers Karl Müller and Johannes Bednorz, who were awarded the 1987 Nobel Prize in Physics "for their important break-through in the discovery of superconductivity in ceramic materials".
- Whereas "ordinary" or metallic superconductors usually have transition temperatures (temperatures below which they superconduct) of about 30 K (-243.2 °C), HTS superconductors have been observed with transition temperatures as high as 138 K (-135 °C). Until recently, only certain compounds of copper and oxygen (so-called "cuprates") were believed to have HTS properties, and the term high-temperature superconductor was used interchangeably with cuprate superconductor. However, several Iron based compounds are now known to be superconducting at high temperatures.
- The high temperature superconductors represent a new class of materials which bear extraordinary superconducting and magnetic properties and great potential for wide-ranging technological applications. The importance of understanding the transport and magnetic behaviors of these novel materials is two-fold. First, it could lead to a better understanding of the basic phenomena of

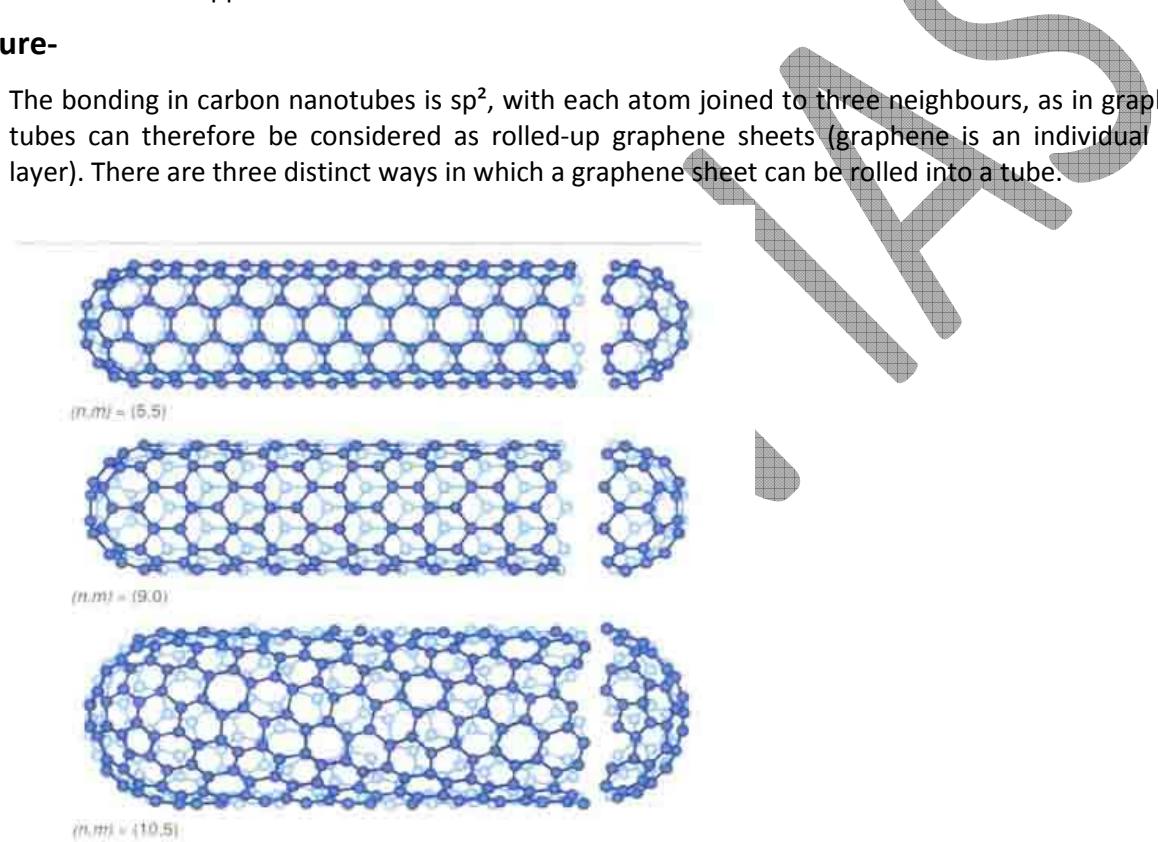
superconductivity in these materials. Second, it could provide ways to improve the magnetic quality of the presently known materials by enhancing flux pinning in a controllable manner.

65. CARBON NANOTUBES(CNT)-

- Carbon nanotubes (CNTs) are allotropes of carbon with a cylindrical nanostructure. Nanotubes have been constructed with length-to-diameter ratio of up to 132,000,000:1, significantly larger than for any other material. These cylindrical carbon molecules have unusual properties, which are valuable for nanotechnology, electronics, optics and other fields of materials science and technology. In particular, owing to their extraordinary thermal conductivity and mechanical and electrical properties, carbon nanotubes find applications as additives to various structural materials.

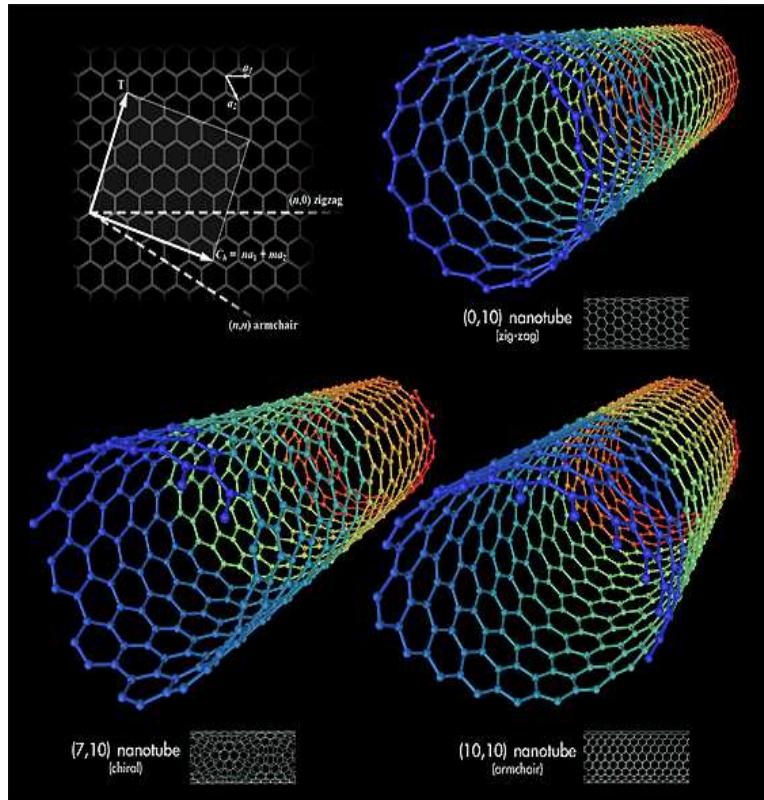
Structure-

- The bonding in carbon nanotubes is sp^2 , with each atom joined to three neighbours, as in graphite. The tubes can therefore be considered as rolled-up graphene sheets (graphene is an individual graphite layer). There are three distinct ways in which a graphene sheet can be rolled into a tube.



- Carbon nanotubes are long chains of carbon held together by the strongest bond in all chemistry, the sacred sp^2 bond, even stronger than the sp^3 bonds that hold together diamond. Carbon nanotubes have numerous remarkable physical properties, including ballistic electron transport (making them ideal for electronics) and so much tensile strength that they are the only substance that could be used to build a space elevator. The specific strength of carbon nanotubes is 48,000 kN·m/kg, the best of known materials, compared to high-carbon steel's 154 kN·m/kg. That's 300 times stronger than steel. You could build towers hundreds of kilometers high with it.
- Carbon Nanotube Technology can be used for a wide range of new and existing applications:
 - Conductive plastics
 - Structural composite materials
 - Flat-panel displays
 - Gas storage
 - Antifouling paint
 - Micro- and nano-electronics
 - Radar-absorbing coating

- Technical textiles
- Ultra-capacitors
- Atomic Force Microscope (AFM) tips
- Batteries with improved lifetime
- Biosensors for harmful gases
- Extra strong fibers



66. METAMATERIALS-

- “Metamaterial” refers to any material that gains its properties from structure rather than composition. Metamaterials have been used to create microwave invisibility cloaks, 2D invisibility cloaks, and materials with other unusual optical properties. Mother-of-pearl gets its rainbow color from metamaterials of biological origin. Some metamaterials have a negative refractive index, an optical property that may be used to create “Superlenses” which resolve features smaller than the wavelength of light used to image them! This technology is called subwavelength imaging.



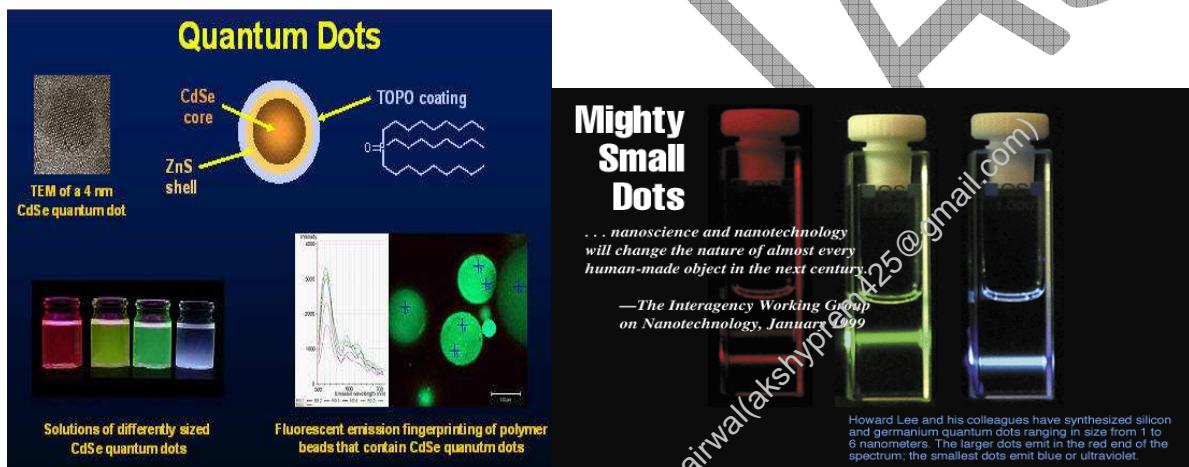
- Thus, Metamaterials are artificial materials engineered to have properties that may not be found in nature. Metamaterials usually gain their properties from structure rather than composition, using small inhomogeneities to create effective macroscopic behavior.
- Negative refractive index of the metamaterials appear to permit the creation of superlenses which can have a spatial resolution below that of the wavelength.
- Potential applications of metamaterials are diverse and include remote aerospace applications, sensor detection and infrastructure monitoring, smart solar power management, public safety, radomes, high-frequency battlefield communication and lenses for high-gain antennas, improving ultrasonic sensors, and even shielding structures from earthquakes.
- The research in metamaterials is interdisciplinary and involves such fields as electrical engineering, electromagnetics, solid state physics, microwave and antennae engineering, optoelectronics, classic optics, material sciences, semiconductor engineering, nanoscience and others.

67. PROGRAMMABLE MATTER-

- Programmable matter refers to matter which has the ability to change its physical properties (shape, density, moduli, optical properties, etc.) in a programmable fashion, based upon user input or autonomous sensing. Programmable matter is thus linked to the concept of a material which inherently has the ability to perform information processing.
- In one school of thought the programming could be external to the material and might be achieved by the "application of light, voltage, electric or magnetic fields, etc." For example, in this school of thought, a liquid crystal display is a form of programmable matter. A second school of thought is that the individual units of the ensemble can compute and the result of their computation is a change in the ensemble's physical properties. An example of this more ambitious form of programmable matter is claytronics, where the units in the ensemble "compute" and the result is a change in the shape of the ensemble.
- Metamaterials, Claytronics, cellular automata, quantum wells are all examples of programmable matter.

68. QUANTUM DOT-

- Quantum dots are tiny particles, or “nanoparticles”, of a semiconductor material, traditionally chalcogenides (selenides or sulfides) of metals like cadmium or zinc (CdSe or ZnS, for example), which range from 2 to 10 nanometers in diameter (about the width of 50 atoms).
- Because of their small size, quantum dots display unique optical and electrical properties that are different in character to those of the corresponding bulk material. The most immediately apparent of these is the emission of photons under excitation, which are visible to the human eye as light. Moreover, the wavelength of these photon emissions depends not on the material from which the quantum dot is made, but its size.
- The ability to precisely control the size of a quantum dot enables the manufacturer to determine the wavelength of the emission, which in turn determines the colour of light the human eye perceives. Quantum dots can therefore be “tuned” during production to emit any colour of light desired. The ability to control, or “tune” the emission from the quantum dot by changing its core size is called the “size quantisation effect”.
- The smaller the dot, the closer it is to the blue end of the spectrum, and the larger the dot, the closer to the red end. Dots can even be tuned beyond visible light, into the infra-red or into the ultra-violet.



- Quantum dots are particularly significant for optical applications due to their high extinction coefficient. In electronic applications they have been proven to operate like a single electron transistor and show the Coulomb blockade effect. Quantum dots have also been suggested as implementations of qubits for quantum information processing.
- The ability to tune the size of quantum dots is advantageous for many applications. For instance, larger quantum dots have a greater spectrum-shift towards red compared to smaller dots, and exhibit less pronounced quantum properties. Conversely, the smaller particles allow one to take advantage of more subtle quantum effects.

69. AUTONOMOUS ROBOTS-

- Autonomous robots are robots that can perform desired tasks in unstructured environments without continuous human guidance. Many kinds of robots have some degree of autonomy. Different robots can be autonomous in different ways. A high degree of autonomy is particularly desirable in fields such as space exploration, cleaning floors, mowing lawns, and waste water treatment.
- A fully autonomous robot has the ability to
 - Gain information about the environment (Rule #1)
 - Work for an extended period without human intervention (Rule #2)

- Move either all or part of itself throughout its operating environment without human assistance (Rule #3)
- Avoid situations that are harmful to people, property, or itself unless those are part of its design specifications (Rule #4)
- An autonomous robot may also learn or gain new capabilities like adjusting strategies for accomplishing its task(s) or adapting to changing surroundings.
- Autonomous robots still require regular maintenance, as do other machines.

70. PROPRIOCEPTIVE SENSORS-

Self – Monitoring

- The robot measures a signal originating from within using proprioceptive sensors. These sensors are responsible for monitoring self maintenance and controlling internal status.
- Common uses of proprioceptive measurements are for battery monitoring, current sensing, and heat monitoring.

Examples of Proprioceptive Sensors:

- Global Positioning System (GPS) - The drawbacks of GPS sensors include a slow refresh rate and sensitivity to blackouts.
- Inertial Navigation System (INS) - The drawbacks of INS include the tendency to drift over time and with temperature.
- Shaft Encoders - A shaft encoder, also known as a rotary encoder, is an electro-magnetic device that works as a transducer to convert the angular position of a shaft or axle to an analog or digital code.
- Compass - A compass sensor is used to detect direction and accurately correct motion.
- Inclinometer - An inclinometer sensor measures the tilt or angle of an axis.

71. MOLECULAR NANOTECHNOLOGY-

- Molecular nanotechnology (MNT) is a technology based on the ability to build structures to complex, atomic specifications by means of mechanosynthesis. This is distinct from nanoscale materials.
- MNT would involve combining physical principles demonstrated by chemistry, other nanotechnologies, and the molecular machinery of life with the systems engineering principles found in modern macroscale factories.
- It is an anticipated manufacturing technology that would allow precise control and positional assembly of molecule-sized building blocks through the use of nano-scale manipulator arms. Molecular nanotechnology is usually considered distinct from the more inclusive term "nanotechnology", which is now used to refer to a wide range of scientific or technological projects that focus on phenomena or properties of the nanometer scale (around 0.1-100nm). Nanotechnology is already a blossoming field, but molecular nanotechnology — the goal of productive, molecular-scale machine systems — is still in the preliminary research stage.
- Its projected applications are- Smart materials and nanosensors, Replicating nanorobots, Medical nanorobots, Utility frog, Phased array optics.
- Molecular nanotechnology will let us continue the historical trends in manufacturing right up to the fundamental limits imposed by physical law. It will let us make remarkably powerful molecular computers. It will let us make materials over fifty times lighter than steel or aluminium alloy but with the

same strength. We'll be able to make jets, rockets, cars or even chairs that, by today's standards, would be remarkably light, strong, and inexpensive. Molecular surgical tools, guided by molecular computers and injected into the blood stream could find and destroy cancer cells or invading bacteria, unclog arteries, or provide oxygen when the circulation is impaired.

72. LS3-LEGGED SQUAD SUPPORT SYSTEMS

- LS3 is a dynamic robot designed to go anywhere Soldiers and Marines go on foot. Each LS3 will carry up to 400 lbs of gear and enough fuel for missions covering 20 miles and lasting 24 hours. LS3 will not need a driver, because it will automatically follow a leader using computer vision or travel to designated locations using sensing and GPS. The development of LS3 will take 30 months, with first walk out scheduled for 2012. The development of LS3 is being funded by DARPA and the US Marine Corps.



73. SYNTHETIC APERTURE RADAR(SAR)-

- Synthetic-aperture radar (SAR) is a form of radar whose defining characteristic is its use of relative motion, between an antenna and its target region, to provide distinctive long-term coherent-signal variations, that are exploited to obtain finer spatial resolution than is possible with conventional beam-scanning means. It originated as an advanced form of side-looking airborne radar (SLAR).
- SAR is usually implemented by mounting, on a moving platform such as an aircraft or spacecraft, a single beam-forming antenna from which a target scene is repeatedly illuminated with pulses of radio waves at wavelengths anywhere from a meter down to millimeters. The many echo waveforms received successively at the different antenna positions are coherently detected and stored and then post-processed together to resolve elements in an image of the target region.
- Current (2010) airborne systems provide resolutions to about 10 cm, ultra-wideband systems provide resolutions of a few millimeters, and experimental terahertz SAR has provided sub-millimeter resolution in the laboratory.
- SAR images have wide applications in remote sensing and mapping of the surfaces of both the Earth and other planets. SAR can also be implemented as "inverse SAR" by observing a moving target over a substantial time with a stationary antenna.

74. SPACE-BASED SOLAR POWER

- Space-based solar power (SBSP) is an idea of collecting solar power in space for use on Earth.
- SBSP would differ from current solar collection methods in that the means used to collect energy would reside on an orbiting satellite instead of on Earth's surface.
- Part of the solar energy is lost on its way through the atmosphere by the effects of reflection and absorption. Space-based solar power systems convert sunlight to microwaves outside the atmosphere, avoiding these losses, and the downtime (and cosine losses, for fixed flat-plate collectors) due to the Earth's rotation.

Advantages

- The SBSP concept is attractive because space has several major advantages over the Earth's surface for the collection of solar power.
- There is no air in space, so the collecting surfaces could receive much more intense sunlight, unobstructed by the filtering effects of atmospheric gasses, cloud cover, and other weather events. Consequently, collection in orbit is approximately 144% of the maximum attainable on Earth's surface.
- A satellite could be illuminated over 99% of the time, and be in Earth's shadow on only 75 minutes per night at the spring and fall equinoxes. Orbiting satellites can be exposed to a consistently high degree of solar radiation, generally for 24 hours per day, whereas surface panels can collect for 12 hours per day at most.
- Relatively quick redirecting of power directly to areas that need it most. A collecting satellite could possibly direct power on demand to different surface locations based on geographical baseload or peak load power needs.
- Elimination of plant and wildlife interference.

Disadvantages

- The SBSP concept also has a number of problems.
- The large cost of launching a satellite into space
- Inaccessibility: Maintenance of an earth-based solar panel is relatively simple, but performing maintenance on a solar panel in space incurs the extra cost of transporting a team of astronauts into space.
- The space environment is hostile; panels suffer about 8 times the degradation they would on Earth. System lifetimes on the order of a decade would be expected, which makes it difficult to produce enough power to be economical.
- Space debris is a major hazard to large objects in space, and all large structures such as SBSP systems have been mentioned as potential sources of orbital debris.
- The broadcast frequency of the microwave downlink (if used) would require isolating the SBSP systems away from other satellites. GEO space is already well used and it is considered unlikely the ITU would allow an SPS to be launched.

75. Chemical Computer

- A chemical computer, also called reaction-diffusion computer, BZ computer (stands for Belousov–Zhabotinsky computer) or goware computer is an unconventional computer based on a semi-solid chemical "soup" where data are represented by varying concentrations of chemicals.
- The computations are performed by naturally occurring chemical reactions.
- The simplicity of this technology is one of the main reasons why it in the future could turn into a serious competitor to machines based on conventional hardware.
- A modern microprocessor is an incredibly complicated device that can be destroyed during production by no more than a single airborne microscopic particle.

76. DNA Computer

- DNA computing is a form of computing which uses DNA, biochemistry and molecular biology, instead of the traditional silicon-based computer technologies.
- DNA computing, or, more generally, biomolecular computing, is a fast developing interdisciplinary area.
- DNA computing is fundamentally similar to parallel computing in that it takes advantage of the many different molecules of DNA to try many different possibilities at once.

77. SOLAR PHOTOVOLTAIC TECHNOLOGIES

Solar photovoltaic technologies convert solar energy into useful energy forms by directly absorbing solar photons—particles of light that act as individual units of energy—and either converting part of the energy to electricity (as in a photovoltaic (PV) cell) or storing part of the energy in a chemical reaction (as in the conversion of water to hydrogen and oxygen).

Solar Cells

- Solar cells are devices that convert sunlight directly into electricity.
- Solar cells are made of layers of semiconductor materials similar to those used in computer chips.
- When sunlight is absorbed by these materials, the solar energy knocks electrons loose from their atoms, allowing the electrons to flow through the material to produce electricity.

Solar Arrays

- Solar cells are generally very small, and each one may only be capable of generating a few watts of electricity.
- They are typically combined into modules of about 40 cells; the modules are in turn assembled into PV arrays up to several meters on a side.
- These flat-plate PV arrays can be mounted at a fixed angle facing south, or they can be mounted on a tracking device that follows the sun, allowing them to capture more sunlight.
- For utility-scale electricity generating applications, hundreds of arrays are interconnected to form a single, large system.

Concentrated PV (CPV) Systems

- Concentrated PV (CPV) systems concentrate sunlight on solar cells, greatly increasing the efficiency of the cells.
- The PV cells in a CPV system are built into concentrating collectors that use a lens or mirrors to focus the sunlight onto the cells.
- CPV systems must track the sun to keep the light focused on the PV cells.
- The primary advantages of CPV systems are high efficiency, low system cost, and low capital investment to facilitate rapid scale-up; the systems use less expensive semiconducting PV material to achieve a specified electrical output.
- Reliability, however, is an important technical challenge for this emerging technological approach; the systems generally require highly sophisticated tracking devices.

78. BIO-DIGESTER

- A biodigester is an anaerobic tank (oxygen-free), which digests organic material biologically.
- It is used to treat black water (human waste) on site, eliminating pathogens and malignant bacteria, so the treated water can be used for irrigation.

Benefits of using a Biogester:

- It digests organic solids in an ecological way;
- It prevents human waste and untreated water from contaminating groundwater;
- It offers an alternative to dumping sewage into rivers, lakes and fields in rural and semi-rural areas where there are no city sewage systems;
- The effluent of water can be used as fertilizer for soil, to water plants, or for fish ponds;
- It's cleaner, more effective and easier to use than a septic tank because it doesn't need to be cleaned or emptied and doesn't create leakage problems;
- It is odorless, as opposed to composting toilets and septic tanks;
- It doesn't require the work and energy involved in relocating composting toilets every year.

79. INDUCED PLURIPOTENT STEM CELLS (iPSC)

- iPSCs are body (somatic) cells which have been reprogrammed to function like embryonic stem cells, thereby sidestepping the controversial use of killing the embryos while harvesting the stem cells.
- This is done by introducing four regulatory factors (pieces of DNA) into the cells.
- Scientists at the Guangzhou Institutes of Biomedicine and Health, China have claimed that they have improved the efficiency of Shinya Yamanaka's invention of producing induced Pluripotent Stem Cells (iPSC) which won Nobel Prize in Medicine.

80. BIO-INSPIRED TECHNOLOGY

- It is new branch of science and technology has emerged in recent years.
- It learns from the properties and behaviour of plants and animals, particularly their modes of defence and offence, and attempts to produce new technological products, inspired by these properties.
- For example about 10 years ago that scientists understood how the household lizard can run effortlessly on the ceiling, defying gravity and without dropping off to the floor. Based on an understanding of this phenomenon, scientists have been able to make tape-based adhesives. Likewise the flowers of the plant cocklebur inspired the Swiss engineer George de Mestral to invent Velcro. Latest in the series is the development of mechanically interlocking tissue adhesives or needles, trocars and surgical staples, inspired by porcupine.

81. ENCODE PROJECT

- The Encyclopedia of DNA Elements(ENCODE) Project was planned as a **follow-up to the Human Genome Project.**
- The Human Genome Project sequenced the DNA that makes up the human genome; the ENCODE Project seeks to interpret this sequence.
- The approximately 20,000 genes that provide instructions for making proteins account for only about 1 percent of the human genome. Researchers embarked on the ENCODE Project to figure out the purpose of the remaining 99 percent of the genome.
- Scientists discovered that more than 80 percent of this non-gene component of the genome, which was once considered “**junk DNA**,” actually has a role in regulating the activity of particular genes (gene expression).
- Researchers think that changes in the regulation of gene activity may disrupt protein production and cell processes and result in disease.

- A goal of the ENCODE Project is to link variations in the expression of certain genes to the development of disease.
- The ENCODE Project has given researchers insight into how the human genome functions.
- As researchers learn more about the regulation of gene activity and how genes are expressed, the scientific community will be able to better understand how the entire genome can affect human health.

82. COMPACT FLUORESCENT LIGHTS (CFLs)

- A compact fluorescent lamp (CFL) is a fluorescent lamp designed to replace an incandescent lamp; some types fit into light fixtures formerly used for incandescent lamps.
- The lamps use a tube which is curved or folded to fit into the space of an incandescent bulb, and a compact electronic ballast in the base of the lamp.

Pros

- CFLs use 75% less energy, produce 75% less heat and last up to ten times longer than the average incandescent bulb.
- They save electricity costs.
- Bulbs are available at most retailers, including supermarkets and drug stores.
- They are relatively inexpensive.
- One bulb can help reduce greenhouse gas emissions by hundreds of pounds.

Cons

- Data showed that some CFLs dimmed over a short period of time.
- CFLs contain about 4 to 5 mg of toxic mercury, which can be harmful to humans and the environment if bulbs are not disposed of properly.
- Depending on the type of bulb, CFLs require a warm-up period between one minute to three minutes before they achieve full brightness.

83. MAGLEV BULLET TRAIN

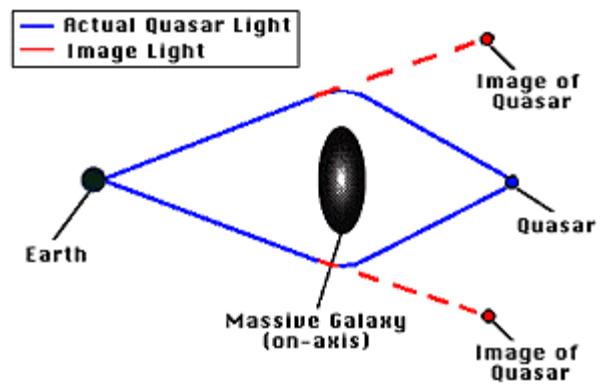
- Also called ‘floating’ trains as there is lack of friction due to the new maglev technology which makes acceleration and deceleration faster and they are unaffected by weather conditions.
- Japan has successfully performed the first successful test of new generation L0 Series Trains (maglev bullet trains) designed to travel at speeds of 311 mph.
- These trains have latest Magnetic levitation technology (maglev) instead of the conventional wheels.

Magnetic levitation technology (maglev)

- Maglev (derived from magnetic levitation) is a method of propulsion that uses magnetic levitation to propel vehicles with magnets rather than with wheels, axles and bearings.
- With maglev, a vehicle is levitated a short distance away from a guide way using magnets to create both lift and thrust.

84. GRAVITATIONAL LENSING

Imagine a bright object such as a star, a galaxy, or a quasar, that is very far away from Earth (say...10 billion light years). For our discussion, let us imagine we have a quasar. If there is nothing between it and us, we see one image of the quasar. Yet, if a massive galaxy (or cluster of galaxies) is blocking the direct view to the quasar, the light will be bent by the gravitational field around the galaxy [see figure below]. This is called "gravitational lensing," since the gravity of the intervening galaxy acts like a lens to redirect the light rays. But rather than creating a single image of the quasar, the gravitational lens creates multiple images. We follow the light rays from the Earth to the apparent locations of the quasar. If the galaxy were perfectly symmetric with respect to the line between the quasar and the Earth, then we would see a ring of quasars!



85. LETHAL AUTONOMOUS ROBOTS (LARs)

- LARs are weapon systems that, once activated, can select and engage targets without further human intervention.
- They have not yet been deployed in wars or other conflicts, but the technology to produce them is very much in reach.
- It's just a matter of taking the human decision-maker out of the hurly-burly of the immediate "kill loop" and leaving the firing decision to algorithms.
- A lethal autonomous robot can aim better, target better, select better, and in general be a better asset with the linked ISR [intelligence, surveillance, and reconnaissance] packages it can run.
- According to United Nations "**Killer robots**" that could attack targets autonomously without a human pulling the trigger pose a threat to international stability and should be banned before they come into existence.
- Machines lack morality and as a result should not have life and death powers over humans.

86. 3D BUMP

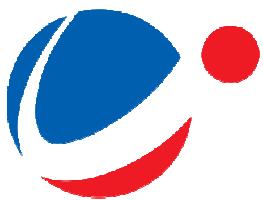
- Engineers at Disney Research, Pittsburgh, have developed a new technique that allows us to feel the texture of objects seen on a flat touchscreen.
- The algorithm enables a person sliding a finger across a topographic map displayed on a touchscreen to feel the bumps and curves of hills and valleys, despite the screen's smooth surface.
- The technique is based on the fact that when a person slides a finger over a real physical bump, he perceives the bump largely because lateral friction forces stretch and compress skin on the sliding finger.
- By altering the friction encountered as a person's fingertip glides across a surface, the Disney algorithm can create a perception of a 3D bump on a touch surface.

87. DEEP WEB

- The Deep Web is the part of the Internet that search engines do not reach.
- There is a lot of information hidden in the form of websites that standard search engines do not find because those pages do not exist until they are created dynamically through a specific search.
- It makes use of some anonymity network like 'Tor' which encrypts the data and then distributes the small packets of data across multiple relays set-ups by users across the world.
- These websites with the help of Tor are launched on onion network i.e. they make use of onion URL.
- One needs to install Tor Browser Bundle, if one wants to access those websites which uses a special DNS server.
- The Tor browser guides the route and in due course hops many times so as to keep the identity of website and the user anonymous i.e. they keep the IP address unknown.

88. NEED FOR DEEP WEB

- With news of intelligence agencies' surveillance practices, it has become crucial to keep critical and important documents private.
- It can also be the solution for research of sensitive topics, facilitator for hidden military communication and safe submission of sensitive documents to governments, police etc.
- The journalist community should make maximum use of the Deep Web because it is safer than any other privacy measure.
- But, before using Deep Web frequently, a good cyber security infrastructure has to be put in place.
- Deep Web exists in order to provide incredible services to people and organisations that require anonymity to release information or communicate without fear.



Part 3 : SCIENCE & TECHNOLOGY

Contents

Achievements of Indians in science & technology	5
RTS,S /Mosquirix	5
First indigenous rotavirus vaccine	5
Indigenization of technology and developing new technology	6
KIRAN scheme:	6
Right to Research Foundation	6
IT and Computers	6
NeGP2.0	6
MyGov.in	6
'digital cloud' for every Indian	6
MeghRaj	6
Bharat Bill Payment System	7
e-Pramaan	8
Centralized Monitoring System(CMS)	9
SandeshPathak:	10
VISHING FRAUD	10
Mobile Seva	10
Digital Divide	10
M-Pesa	11
Space	11
Significance of MOM/Mangalyaan	11
Mars 2020 Rover Mission	12
Space Vision 2025	13
Liquid Apogee Motor	14

Recent flights of PSLV	14
MAVEN(Mars Atmosphere and Volatile Evolution Mission)	15
Manned space mission	15
Geo imaging Satellite (GISAT)	16
ASTROSAT-1	16
ADITYA-1	16
Space Commerce/Antrix	17
Antimatter	17
SAARC Satellite	18
Problem of Waste Deposits in Space	18
Dark Matter	19
Kepler-186f:	20
Graveyard Orbit	20
The Atlast	20
Robotics	20
Velocirobot	20
Defence	20
k-4	20
Netra	21
Bio-Technology	21
Genetic Testing:	21
Genetic Blueprint	22
Genetic blueprint of bread wheat genome unveiled, last step before full genome sequence	22
Energy	22
Fast Breeder Reactor	22
Chaibagaan time	23
One Nation-One Grid	23
World's first solar jet fuel	24
Applications of FLOW BATTERY:	24
SnT developments and their applications and effects in everyday life	25
Innovation Hub	25
Mass spectrometry	25
Health	26
ZMapp:	26
Magnivisualizer:	26
PaMZ – TB	27
Environment Technology	27

Polar Vertex:	27
COMAPS(Coastal Ocean Monitoring and Prediction System)	27
Articles from Science Reporter Part 2	28
C V Raman	28
Energy Efficient Vehicles	29
Turning off Aging Genes	29
RoboBee: An insect Drone	30
Human ID cards	30
Mercury and Minamata Convention	31
Cyber Rain Sprinkler Controller	31
3D Bio-pen	31
Super Lithium Ion Batteries	32
Disposable Paper Cups	32
International Space Station	32
Weightlessness in Space	33
Active and Adaptive optics and Creating an Artificial Star	33
Wheat Stem Rust UG99	34
Water Footprint	34
Solid Waste Management and Energy from Wastage	35
Persistent Organic Pollutants (POPs)	37
Growth Promoting Antibiotics	37
Finger Reader	38
Emerging and Significant Technologies (Part C)	38
Precision agriculture	38
Biosphere 2	39
The Virgin Earth Challenge	39
5 technologies for CO ₂ removal (current CO ₂ level 400 ppm)	39
3. Direct air capture	40
Amorphous metal	40
Bioplastics	41
Conductive Polymers	41
Femtotechnology	42
Magnetic refrigeration	42
Scramjet (supersonic combusting ramjet) Technology	43
Superalloy	43
Sovaldi (sofosbuvir)/Olysio (simeprevir)	44
Reinvent the Toilet Challenge	44

RapiDot Diagnostic Kit:	44
Earclip-type Wearable PC:	44
Welspun Solar MP Project:	45
“Digital Holographic Microscopy” technique:	45
Theatre Level Operational Readiness Exercise (TROPEX) :	45
Charkilo:	45
Olive Riddley Conservation Programme:	45
Bacillus pumilus SAFR-032:	46
Putnisite:	46
KrishiShakti	46
INS Kamorta	46
101 st science congress	47
National Technology Day	47
SindhuSadhana	47
SCAR Medal 2014 for Excellence in Science and International Coordination	47
‘Jammu Kashmir Arogya Gram Yojana’	47
First Indigenously Developed Diagnostic Test Kit for Intestinal Disorder “Celiac Disease”	48
CARPEDIEM (Cardio-Renal Pediatric Dialysis Emergency Machine)	48
RhoDIS	48
Promotion of Science	48

VISION IAS

Design of Science and Tech Notes: Where to find what!!!!

Basic Books	Emerging and Significant Technologies	Current Affairs
Basic understanding of Topics and Traditional questions.	<p>In last 3-4 years, many questions are asked from this section.</p> <p>This is equivalent to last 5 years current affairs.</p>	Last one year's current affairs from Science Reporter+TheHindu+IndianExpress+Times of India etc.
	<ul style="list-style-type: none"> • Science and tech Part 1 • Science and Tech Part 3 (Sub Part C) 	<ul style="list-style-type: none"> • Monthly Current affairs Notes(Combined Soft copy on student Zone) • Science and tech Part 2 • Science and Tech Part 3 (Sub Part A, B and D)

Part A: Current Affairs

Achievements of Indians in science & technology

RTS,S /Mosquirix

- This is a new Malaria vaccine , created by the Indian Institute of Science (IISc).
- It contains live malaria sporozoites (an immature stage of the parasite Plasmodium berghei) with an important genetic modification.
- The vaccine targets the pathogen as it enters the liver, the first destination in the host.
- RTS,S will be exclusively used against the Plasmodium falciparum malaria parasite, which is most prevalent in sub-Saharan Africa (SSA).

First indigenous rotavirus vaccine

- Rotavirus is the most common cause of severe **diarrhea** among infants and young children. It is a double-stranded **RNA virus**.
- Diarrhea caused by rotavirus kills nearly 80 thousand children each year, results in up to 10 lakh hospitalizations, pushing many Indian families below the poverty line. It also imposes an economic burden of over 300 crore rupees each year to the country.
- **India has developed and licensed its first indigenous rotavirus vaccine**, developed under a public-private partnership by the Ministry of Science and the Ministry of Health and Family Welfare. India will introduce this vaccine in a phased manner.

Indigenization of technology and developing new technology

KIRAN scheme:

- KIRAN-Knowledge Involvement Research Advancement through Nurturing, the Department of Science and Technology will provide research grants especially to those female researchers and technologists who had to take a break due to family reasons.
- The purpose is to bring back these female researchers back so as to bring gender parity in Indian R&D sector.
- The scholarships will be provided under three categories- associated in research work in basic or applied sciences with any central or state level organisation or university; women scientists involved in research and application of innovative solutions for various societal issues, and lastly for those researchers who are self-employed

Right to Research Foundation

A group of scientists and academicians have started the Right to Research (R2R) Foundation to support foreign-educated and trained Indian researchers to help them find suitable jobs, upon their return to the country.

IT and Computers

NeGP2.0

- In order to upscale and ramp up e-Governance initiatives across the country, National e-Governance Plan 2.0 titled “e-Kranti” is formulated by DeitY with a focus on transforming e-Governance for transforming Governance.

(Note: e-Kranti is subsumed in Digital India mission Read more about Digital India Mission from Science and Tech part 2)

MyGov.in

MyGov is an innovative platform to build a partnership between Citizens and Government with the help of technology for growth and development of India.

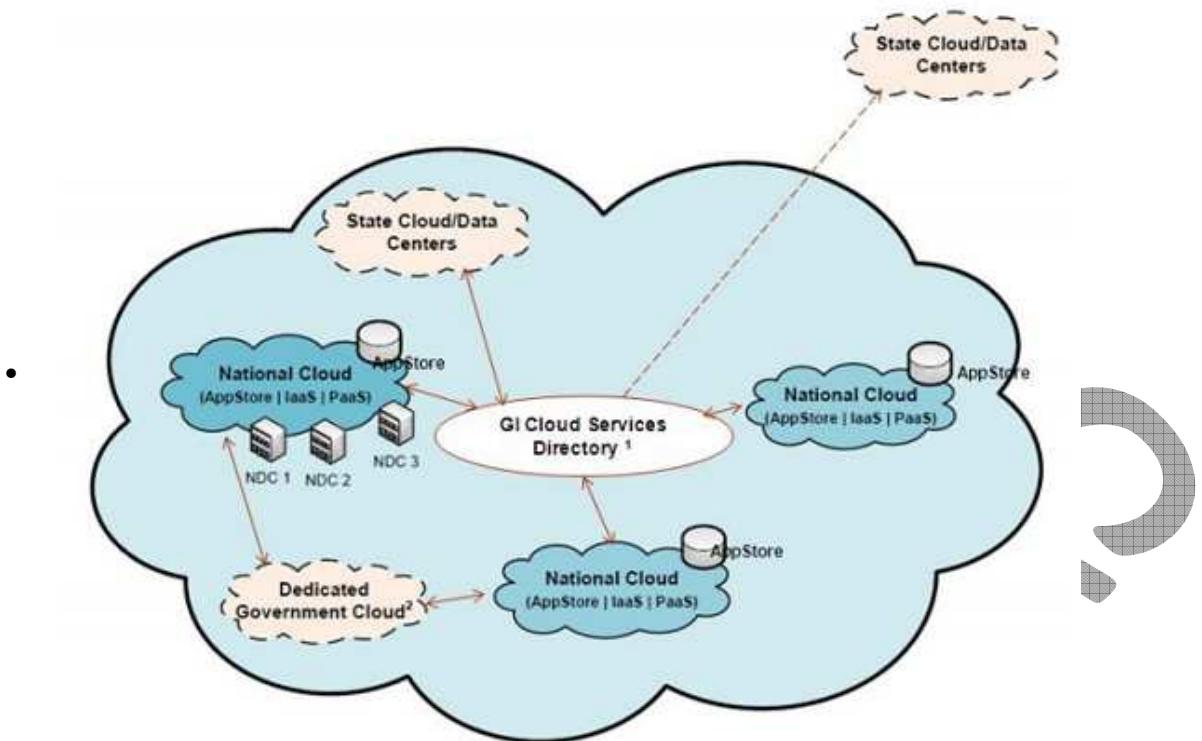
'digital cloud' for every Indian

- Prime Minister Narendra Modi's next big push to free up service delivery from the hold of the lower bureaucracy will be in the form of a 'digital cloud' for every Indian.
- Certificates issued by the government — education, residential, medical records, birth certificates etc — are to be stored in individual 'digital lockers' and a communication protocol established for government departments to access them without physically having to see the hard copy.
- For example, if a student is applying for a government college and has studied in a government-aided school, his birth certificate, identity details and educational certificates, school-leaving details etc should be accessible by organisations where he is applying.

MeghRaj

- In order to utilise and harness the benefits of Cloud Computing, Government of India has embarked upon an ambitious initiative – ‘GI Cloud’ which has been named as ‘MeghRaj’. The focus of this initiative is to accelerate delivery of e-services in the country while optimizing ICT spending of the Government. This will ensure optimum utilization of the infrastructure and speed up the development and deployment of eGov applications. The architectural vision of GI Cloud encompasses a set of discrete cloud computing environments spread across multiple locations, built on existing or new (augmented)

infrastructure, following a set of common protocols, guidelines and standards issued by the Government of India.



- The National Cloud will help the departments to procure ICT services on demand in the OPEX model rather than investing upfront on the CAPEX. The Cloud Services available are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) and Storage as a Service (STaaS). Some of the features of the National Cloud include self-service portal, multiple Cloud solutions, secured VPN access and multi-location Cloud. NIC is providing Cloud services under the umbrella of 'MeghRaj'.

Bharat Bill Payment System

- Reserve Bank of India has proposed setting up of a **national integrated platform for bill payment**: Bharat Bill Payment System, a service through which consumers can pay their bills from anytime, anywhere.
- Within this ambitious plan, nation-wide service providers would be integrated into one single platform of billing.

The Problem

Currently, more than 3080 crore bills are generated from India's top 20 cities, amounting to roughly Rs 600,000 crore annually. The problem is that the bill payment system is very scattered and de-centralized. Cash and cheques are still top modes of payment, and fearing that their payment will not materialize, majority of consumers visit the service provider directly to make the payment.

The consumer is left to figure out himself how to make bill payments for municipality taxes, phone usage and water connection among hundreds of other bill payments.

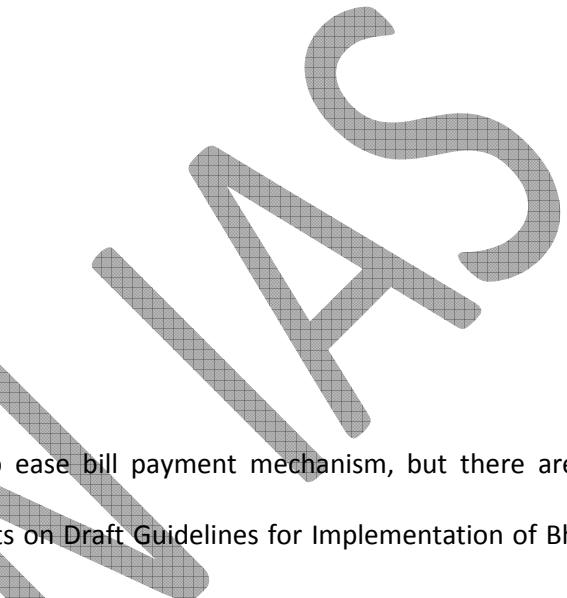
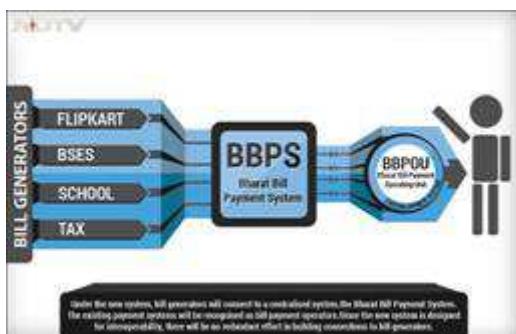
The Solution

- The whole concept of Bharat Bill Payment System (BBPS) is based on providing customers one unified location where he can pay all of his bills easily. As per the plan by RBI, BBPS will "offer interoperable and accessible bill payment service to customers through a network of agents, enabling multiple payment modes, and providing instant confirmation of payment."

- The whole model of BBPS has been divided into two parts: a) the entity which will operate BBPS, which will be a '**standard setting body**' and b) **Bharat Bill Payment Operating Units** (BBPOUs), which would be authorized operational unit set up in urban and rural areas to make the process easier.
- RBI has made it clear that any entity wishing to operate as BBPS for consumers should be a 'section 25 company under the Companies Act 1956' and having net worth of atleast Rs 100 crore.

Participants

The participants in the BBPS will include authorised entities, such as, the entity operating the BBPS itself, the BBPOUs as well as their agents, payment gateways, banks, billers and service providers, and other entities as required under the BBPS.



Road Ahead

- BPS certainly sounds like an awesome plan to ease bill payment mechanism, but there are lots of clarifications which are required from the RBI.
- RBI is currently seeking general public comments on Draft Guidelines for Implementation of Bharat Bill Payment System.

e-Pramaan

e-Pramaan is a National e-Authentication service offered by DeitY.

e-Pramaan provides a simple, convenient and secure way for the users to access government services via internet/mobile as well as for the government to assess the authenticity of the users. e-Pramaan builds up confidence and trust in online transactions and encourages the use of the e-services as a channel for service delivery.

Major Components of e-Pramaan includes:

- Identity Management (including Credential Registration)
- e-Authentication (including Step-up Authentication)
- Single Sign-on
- Aadhaar based credential verification

e-Pramaan offers authentication as a service by verifying the credentials of a person who is wishing to access any e-Governance service.

What is e-Authentication?

Electronic Authentication (or e-Authentication) is the process of electronic verification of the identity of a user. e-Authentication provides a simple, convenient and secure way for the users to access government services via internet/mobile as well as for the government to assess the authenticity of the users. e-Authentication helps to build up confidence and trust in online transactions and encourages the use of the electronic environment as a channel for service delivery.

Why e-Pramaan?

e-Pramaan provides guidelines that will help in the selection and implementation of the appropriate e-authentication approaches. Having a standardised e-Authentication framework has the following benefits:

- Transparency- E-authentication decisions will be made in an open and transparent manner
- Cost-effectiveness Government departments and agencies will not have to implement cumbersome and expensive e-authentication processes for simple or low-risk transactions
- **Risk management:** The selection of e-authentication mechanisms will be guided by the likelihood and impact of identified risks
- **Consistency:** Government departments and agencies will apply a consistent approach to selecting the appropriate e-authentication mechanism
- **Trust:** The mechanisms used will support online and mobile based services and enhance security, safety, and trust in such transactions
- **Improved privacy:** Personally identifiable information will be collected only where necessary as per the sensitivity level of the application or service
- **Efficiency:** The time to deploy an e-Authentication capability for any government application will be greatly reduced

The framework provides various levels of authentication based on the sensitivity requirement of an e-Governance service.

- Level 0: No Authentication required for publicly available information.
- Level 1: User Id and Password based authentication. This is meant for basic public services with low sensitivity service.
- Level 2: Two factor authentication (User Id and Password AND OTP). Meant for personally identifiable information and services with moderate levels of security.
- Level 3: User Id and password PLUS Digital Certificate (soft/hard). Meant for services which requires high security and any or all of PAIN properties.
- Level 4: User Id and password PLUS Biometric based authentication. Meant for services requiring the highest levels of security.

The level 4 of Authentication in e-Pramaan supports UIDAI biometric authentication in which Aadhaar holders can get authenticated by giving their fingerprint which will be verified in the background through Aadhaar Authentication Server. The services of e-Pramaan will be provided through NSDG, SSDG. Central government department or state government department services registered with various service delivery gateways will call e-Pramaan services for authentication before the actual service is invoked.

Centralized Monitoring System(CMS)

- The Central Monitoring System, abbreviated to CMS, is a **secret mass electronic surveillance programme** installed by the C-DOT to monitor communications on mobile phones, landlines and the internet in the country.
- It aims to **strengthen the security environment** by providing Call Data Records (CDR) analysis, location details etc. of the target numbers.
- It may act as a single window from where government arms such as the National Investigation agency or the tax authorities will be able to monitor every byte of communication.
- Prior to CMS, agencies had to seek court orders for surveillance, and had to send in an individual request to a telecom target.
- Now Ministry of home affair has the sole power to decide who to monitor.
- Human rights and civil-liberties groups have expressed concerns that the CMS is prone to abuse, and is an infringement of privacy and civil liberties, especially because the government has repeatedly used the Information Technology Act to arrest people for posting comments ,on social media that are critical of the government, as well as to put pressure on websites such as Facebook and Google to filter or block content.

SandeshPathak:

- It is a new mobile phone app that reads out the content of any SMS. It will primarily help illiterate farmers.
- The app supports five Indian languages — Hindi, Tamil, Marathi, Gujarathi and Telugu with options to select language.
- This application has been jointly developed by C-DAC Thiruvananthapuram , C-DAC Mumbai, IIT Kharagpur, IIT-Madras and IIIT Hyderabad.
- The app is available at Appstore of the Mobile Seva Project of government of India.

VISHING FRAUD

- Voice phishing is the criminal practice of phone calling to gain access to private personal and financial information from the public for the purpose of financial gain, identity theft.
- Voice phishing is typically used to steal bank details such as credit card numbers, passwords, pins, expiry date, Date of birth.
- Some fraudsters use features facilitated by Voice over IP (VoIP). Features such as caller ID spoofing (to display a number of their choosing on the recipient's phone line) and automated systems (IVR).
- It is difficult for legal authorities to monitor or trace.
- Eg. According to police sources in Chennai, the gang which targeted many people in Chennai, suspected to be operating from Delhi, has access to bank accounts and card details of numerous customers mainly of private sector banks which they use to prove that they are calling from bank.

Mobile Seva

- Mobile Seva is an UN award-winning e-governance initiative by government of India. This programme was launched in 2011, by Department of Electronics and Information Technology, Government of India. This programme includes a Mobile Applications Store that by December, 2013, contained 240 applications available free. The programme takes benefit of ubiquitous mobile phone use all over India, to enable interaction between the Indian government and its citizens

Digital Divide

- The term Digital divide describes a gap between those who have ready access to information and communication technology and the skills to make use of those technology and those who do not have the access or skills to use those same technologies within a geographic area, society or community.
- The Internet users account for only 40% of world's population and most of them live in developed countries.
- **India's status:** Only 20% population using internet which is very less, compared to China(46%), USA(86%). The country is ranked 119th in the world in the ICT Development Index, below Zimbabwe, Bhutan and Ghana
- **Efforts made towards bridging the gap:**
- **Digital India Programme:** A programme to transform India into digital empowered society and knowledge economy.
- Other programs are National Mission on Education through ICT, National Knowledge Network, Kisan Call centre, Life Line India, Gyandoot Project, TDIL (Technology Development for Indian Languages), National Science Digital Library (NSDL) and VidyaVahini, digital mobile libraries and library networks and community information centers etc.
- **Challenges and Barriers to Bridging the Digital Divide:**

- **IT Infrastructural and Electricity barriers:** India still lacks a robust telecommunication infrastructure with sufficient reliable bandwidth for Internet connection. Over one third of India's rural population lacked electricity, as did 6% of the urban population which is essential for computers, internet use.
- **Literacy and skill barriers :** IT literacy is very important to allow access to digital information. Generally, online content and information have been designed for an audience that reads at an average or advanced literacy level. In a country like India where roughly 50 percent of people do not have reading and writing skills for functioning in everyday life, IT literacy is out of the question.
- **Economic barriers:** In India (30% people below poverty line) the ability to purchase or rent the tool for access to digital information is less among the masses. The lower income group does not have discretionary money to spend on cyber-cafes or to get Internet connectivity on their own to access digital information.
- **Language barriers:** India is a country having a multicultural and multilingual population. Today a large percentage of information content on the Internet is in English, which is a barrier for the people whose primary language is not English.
- **Benefits of Bridging Digital Divide**
- There are immense benefits of bridging digital divide in the fields of economy, governance like Employment, economic growth, education, health, building social capital, efficient implementation of government schemes, agriculture sector

M-Pesa

- **In News:** ICICI Bank, India's largest private sector bank and Vodafone India's wholly-owned subsidiary Mobile Commerce Solutions (MCSL) announced the launch of mobile-based transfer of health care subsidies directly to the beneficiaries under Janani Suraksha Yojna Scheme in Ranchi. This scheme is operated under National Rural Health Mission (NRHM) of Government of India. ICICI Bank and Vodafone M-Pesa has started the pilot project in Namkum block in Ranchi district, Jharkhand.
- In 2007, M-Pesa started in Kenya as a CSR pilot project by Safaricom, a Vodafone subsidiary, to transfer money over mobile because it was unsafe to carry cash. But soon it changed into a financial service and became a big hit.
- Vodafone brought the platform to India in 2010 as a pilot in Rajasthan, and launched it in April 2013.
- **What is M-pesa:** M-Pesa is a mobile-phone based money transfer and microfinancing service, launched in 2007 by Vodafone for Safaricom and Vodacom, the largest mobile network operators in Kenya and Tanzania. It has since expanded to Afghanistan, South Africa, India and in 2014 to Eastern Europe. M-Pesa allows users with a national ID card or passport to deposit, withdraw, and transfer money easily with a mobile device.
- It gives the "power of money" on mobile phone. It transforms the existing Vodafone mobile phone into a bank account and gives a user the freedom to transact and stay in control 24x7.
- M-Pesa is an SMS-based service that does not need Internet technology.
- MCSL has been authorized by Reserve Bank of India (RBI) under Payment and Settlement Systems Act, 2007 for Setting up and Operating a Payment System in India. MCSL is also a business correspondent of ICICI Bank.
- m-pesa™ is a registered trademark of Vodafone and is now available across India

Space

n for Mars orbit insertion.

Significance of MOM/Mangalyaan

- It is the most **cost-effective** interplanetary mission (only 450 crore) NASA spent 4000 crore of rupees on MAVEN.

- The technology used in this mission has potential application in **weather forecast, computer tech, health-medicine** etc. in future
- Space research is not waste of time and money. (For eg. 1999 Odisha cyclone killed >10000 people. But 2013 cyclone Phalin killed very few, because Indian satellite gave accurate weather prediction about where and when the storm would hit. Space research has given immense benefits to Agriculture, education, fisheries and defence)
- **No country** has ever reached Mars on its **first attempt** and too in such a short time (only 2 years). A successful mission will be a source for **national pride** and would force the world to take note of our technological prowess.
- As ISRO establishes reputation, gets more contracts from foreign countries and more foreign exchange. It can be used as a tool to exercise soft power by sending space missions of third world countries and SAARC countries.
- Above all, such an achievement works as an **inspiration and catalyst for innovation** in the country and bringing more youth into the field of science.

Cons

- Some critics says that Crores of rupee wasted- could be used to remove hunger, malnutrition, improve sanitation.
- This is a **costly “me-too”** mission and would **merely be a duplication of other Mars probes**
- **Non-readiness of the larger GSLV** had **forced India to use** a light-lift, low-cost rocket such as the liquid-engine-powered PSLV for propulsion.

Mars 2020 Rover Mission

- The Mars 2020 rover mission (announced on December 2012) is a Mars planetary rover mission under study by NASA with a proposed launch in 2020, will make landing on the red planet after an eight to nine month journey in 2021.
- The mission rover will be based on the design of the successful rover, Curiosity that is functioning since it landed on the Mars in August 2012 and is a part of the NASA’s Mars Exploration Program.
- **Aims**
- 1) To find out the potential habitability 2) directly search for signs of prehistoric Martian life 3) to facilitate future manned missions.
- **Functions**
- 1) The rover will perform geological and atmospheric survey that is expected to enhance our understanding of both the present and the past of Mar’s geological landscape.
- 2) The rover is also designed to store rock and soil samples for future retrieval by a manned mission.
- **3) Producing oxygen from MARS abundant CO₂ (96% mars of atmosphere)and its benefits:** NASA will put MOXIE – Mars Oxygen ISRU Experiment as one of the payloads on the Mars 2020 rover mission. MOXIE will produce oxygen on MARS using the Martian atmospheric Carbon Dioxide (CO₂).
- The conversion of CO₂ into Oxygen will be beneficial for **human respiration**. The oxygen can be used as an **oxidizer for rocket fuel** for return mission. If this experiment is successful it will make future manned missions easier.
- **The Seven Payloads are:-**
- **Mastcam-Z** : It is an advanced camera system with panoramic view, zoom and stereoscopic vision. The zoom in particular is expected to be useful for target selection and rover navigation. These cameras will function as main eyes of the rover.

- **SuperCam:** From France, it is an imaging sensor that will analyze chemical compounds and minerals. It has a laser to determine the elemental composition of any compound from 20 feet distance.
- **MEDA or Mars Environmental Dynamics Analyzer:** From Spain, it is a pack of sensors to measure atmospheric conditions. The sensors will measure temperature, wind speed, pressure, relative humidity and dust size and shape. It will also measure solar radiation cycles.
- **RIMFAX or Radar Imager for Mars' Subsurface Exploration:** From Norway, it is a radar system that will plow into the ground and provide subsurface structure data.
- **PIXL or Planetary Instrument for X-ray Lithochemistry:** From NASA, it is an X-ray fluorescence spectrometer and hi-res imager for determining elemental composition of the surface of Mars.
- **MOXIE or The Mars Oxygen ISRU Experiment:** From Massachusetts Institute of Technology, it is an experiment with an objective to produce oxygen from Martian carbon dioxide. The Martian atmosphere comprises about 96% carbon dioxide, and the MOXIE device can turn it into pure oxygen and carbon monoxide. Data from this experiment will help researchers design instruments capable of generating oxygen on Mars.
- **SHERLOC or Scanning Habitable Environments with Raman & Luminescence for Organics and Chemicals:** From NASA, it is a spectrometer equipped with a UV laser for finding organic compounds and other minerals. This is the first time a Raman spectrometer will be sent to the Martian surface.

Space Vision 2025

The Space Vision 2025 was unveiled at the Indian Science Congress – 2003, in Bangalore. The vision document spells out the steps to take our space programme to greater heights.

The emphasis is on achieving self-reliance in launching capabilities and end dependence on foreign agencies for the same. Of course, self-sufficiency has been achieved in the fabrication of satellites. Mission to moon also forms part of the vision.

The seven-point ‘Space Vision India 2025,’ is future roadmap for ISRO

1. Satellite based communication and navigation systems for rural connectivity, security needs and mobile services
2. Enhanced imaging capability for natural resource management, weather and climate change studies
3. Space science missions for better understanding of solar system and universe
4. Planetary exploration:
5. Development of Heavy lift launcher:
6. Reusable Launch Vehicles - Technology demonstrator missions leading to Two Stage To Orbit (TSTO): has been approved by the National Review Committee in 2012 and is expected to bring down cost significantly.
7. Human Space Flight:

Work done according to vision 2025 (Success)

- Reached to Moon (Chandrayan 1), Chandrayan 2 in design phase
- Mars (MoM) reached on 24 September 2014, 2nd Mission on mars might be sent in 2020
- Launch of experimental flight of GSLV MK III with indigenous cryogenic engine is planned in December 2014.
- Human Space Flight (**HSF**)programme will be taken after successful launch of GSLV.
- Reusable Launch Vehicles - Technology demonstrator missions leading to Two Stage To Orbit (TSTO): has been approved by the National Review Committee in 2012 and is expected to bring down cost significantly.

Liquid Apogee Motor

An Liquid Apogee motor (LAM) refers to a rocket motor which is used to provide thrust to bring the satellite or spacecraft into desired orbit.

It is regularly employed on artificial satellites or space crafts destined for a geostationary orbit or Moon's orbit (Chandrayan 1) or Mars (MoM) orbit.

How it works: The carrier rocket would only be able to launch the satellite into an elliptical orbit after that the satellite must then provide thrust to reach a geostationary orbit (or Moons orbit, Mars orbit). This is typically done with a fixed onboard Liquid Apogee Motor (LAM).

When the satellite reaches its orbit's apogee position, the LAM is ignited, transforming the elliptical orbit into a circular orbit, while at the same time bringing the inclination to around zero degrees, thereby accomplishing the insertion into the desired orbit. This process is called an "apogee kick".

ISRO's first liquid rocket motor (LAM), developed in the early eighties

Fuel: LAM develops 45-kg thrust and uses monomethyl hydrazine and a nitrogen tetroxide as propellants and pressurized helium gas is used to force the propellants into the combustion chamber.

Uses: The LAM has since been used in over two dozen missions to boost communication, weather and navigation satellites into geo-synchronous orbit.

The LAM-thruster combination was also adopted for the Chandrayaan-1 lunar orbiter mission and the Mars Orbiter Mission (MOM).

Eg. Liquid Motor (LM) on MOM: MOM features a modified version of the LAM called the Liquid Motor (LM), or the 440-Newton Liquid Engine. It was used to raise the orbit of the MOM and propel it on a Trans-Mars trajectory. It has been fired seven times so far and will next be used to slow MOM down.

Recent flights of PSLV

PSLV C23

- ANTRIX (ISRO's commercial arm) successfully launched 5 foreign satellites from four countries on board PSLV-C23 rocket which placed them in orbit.
- 5 foreign satellites
- SPOT 7: French satellite, it will be part of the existing Earth observation satellite. It has been built by European space technology company Airbus Defence and Space.
- AISAT: German nano-satellite, to focus on the global sea-traffic monitoring system with special emphasis on high traffic zones using AIS signals.
- NLS 7.1 and NLS 7.2: Canadian satellite, they will perform Two-spacecraft precision formation flying using differential GPS with centimetre-level relative position and sub-metre level accurate position control system.
- VELOX-1: Singaporean satellite, it is a technology demonstrator for in-house design of image sensor, MEMS-based attitude determination and control system and inter-satellite RF link

Significance of PSLV

- The PSLV has launched 71 spacecraft (31 Indian and 40 foreign satellites) into a variety of orbits.
- The reliability rate of PSLV has been superb. There had been 27 continuously successful flights of PSLV, till October 2014

- Some notable payloads launched by PSLV include India's Chandrayaan-1 lunar probe and the Mars Orbiter Mission, IRNSS which are of great significance.
- It can be used to send satellites for SAARC countries (as said by PM of India), will help India to exercise its soft power in neighborhood which is becoming more and more important for growth and security

PSLV C25	PSLV-XL	5 November 2013	Mars Orbiter Mission	India's first Mars mission.
PSLV C24	PSLV-XL	4 April 2014	IRNSS-1B	India's second regional navigation satellite
PSLV C23	PSLV-CA	30 June 2014	SPOT-7 Can-X4 Can-X5 AISAT VELOX-1	ISRO's fourth commercial launch (foreign satellite as the main payload).
PSLV C26	PSLV-XL	15 October 2014	IRNSS-1C	Seventh PSLV XL and third Navigation Satellite launch.

- PSLV C27 is planned for December 2014 to launch India IRNSS-1D

MAVEN(Mars Atmosphere and Volatile Evolution Mission)

- Mars Atmosphere and Volatile Evolution Mission (MAVEN) is a space probe designed by NASA to study the Martian atmosphere while orbiting Mars
- MAVEN was successfully launched aboard an Atlas V launch vehicle at the beginning of the first launch window on November 18, 2013 (about same time of launch of Mangalyan) and reached on 22 September.
- Mission most important goal is determining how the Martian atmosphere and water, presumed to have once been substantial, were lost over time.
- It will also give clues about Martian climate, geologic, and geochemical conditions over time.

Manned space mission

- Human spaceflight (also referred to as manned spaceflight) is space travel with a crew aboard the space craft. When a spacecraft is crewed, it can be operated directly, as opposed to being remotely operated or autonomous.
- The first human spaceflight was launched by the Soviet Union on 12 April 1961 as a part of the Vostok program, with cosmonaut Yuri Gagarin aboard. Humans have been continually present in space for 14 years and 12 days on the International Space Station.

The Indian human spaceflight programme:

- The Indian human spaceflight programme is a proposal by the Indian Space Research Organisation (ISRO) to develop and launch the ISRO Orbital Vehicle, which is to carry a two-member crew to Low Earth Orbit. Recent reports indicate that human spaceflight will occur after 2017 as the mission is not included in the government's 12th five-year plan (2012–2017).
- The ISRO does not have a human-rated launch vehicle yet. A full-scale, unmanned crew module is getting ready to be flown onboard the experimental flight of GSLV Mk-III, to understand its ballistic re-entry characteristics.

- Under the MoU ISRO and Russian space agency Roscosmos have revealed that they will jointly build the spacecraft for the Indian manned mission.
- Having considered several terms for Indian astronauts, **Vyomanaut** has been finalised by ISRO. The term Vyomanaut stands for Vyoma which means space or sky in Sanskrit.
- In 1984, Rakesh Sharma became the first Indian citizen to go into space, flying aboard a Soviet mission.

Geo imaging Satellite (GISAT)

- Indian Space Research Organisation (ISRO) is designing a **GEO Imaging Satellite (GISAT) to be launched during 2016-17.**
- GISAT will carry a GEO Imager with multi-spectral (visible, near infra-red and thermal), multi-resolution (50m to 1.5 km) imaging instruments. GISAT will be placed in geostationary orbit of 36,000 km.
- The remote sensing satellites launched by ISRO revisit the same area once in every 2 to 24 days and acquire images of a geographical strip (swath) at different spatial resolution (360 meter to better than 1 meter). GISAT will provide near real time pictures of large areas of the country, under cloud free conditions, at frequent intervals. That is, selected Sector-wise image every 5 minutes and entire Indian landmass image every 30 minutes at 50m spatial resolution.
- **Purpose:** It is designed to act as a special 'eye' up in the sky to constantly watch over the country and alert authorities below of trouble spots, natural disasters, floods and forest. More importantly it will also keep a watch over our sensitive borders. It would complement the advanced meteorology and remote-sensing satellite, Insat-3D, due to be launched in December this year.

ASTROSAT-1

- Astrosat is India's first dedicated astronomy satellite and is scheduled to launch on board the PSLV in 2015.
- A large number of leading astronomy research institutions in India and abroad are jointly building various instruments for the satellite.
- Astrosat will be a proposal-driven general purpose observatory, with main scientific focus on:
 - Simultaneous multi-wavelength monitoring of intensity variations in a broad range of cosmic sources
 - Monitoring the X-ray sky for new transients
 - Sky surveys in the hard X-ray and UV bands
 - Broadband spectroscopic studies of X-ray binaries, AGN, SNRs, clusters of galaxies and stellar coronae
 - Studies of periodic and non-periodic variability of X-ray sources
- In particular, the mission will train its instruments at active galactic nuclei at the core of the Milky Way that is believed to have a super massive black hole.

ADITYA-1

- Aditya-I is India's first dedicated scientific mission to study the sun. This is a low-earth orbit (LEO) mission at an altitude of 800 km.
- These studies will enhance our current understanding of the Solar Corona and also provide vital data for space weather studies.
- The satellite will carry as its payload an advanced solar coronagraph.

- The other payloads will include an ultraviolet imager telescope to observe the entire solar disc for solar storms, a high energy x-ray imager to scan smaller region of the solar disc to study flares, a wind particle detector to sample the solar wind, a soft x-ray spectrometer and a variable emission coronagraph.

Space Commerce/Antrix

India's Space capability is being marketed globally by Antrix Corporation Limited. As the commercial and marketing arm of ISRO, Antrix is engaged in providing Space products and services to international customers worldwide. By using the launch services of ISRO's workhorse launch vehicle, PSLV, 31 satellites belonging to 17 countries have been launched on commercial terms during the last 10 years. An important achievement of the last decade is realising two high power communication satellites, viz. W2M and HYLAS for European customers – contracts bagged by Antrix against tough competition. Additionally, the data from Indian Remote sensing satellites are commercially disseminated to users globally. Antrix launched SPOT-7 satellite of France on board PSLV C23 during 2014. Definite agreements have been entered for launching NLS 7.1, NLS 7.2, AISAT, LAPAN-A2, LAPAN ORARI and EnMap satellites.

Antrix leases transponders of the INSAT system for commercial purpose. In the transponder provisioning services, Antrix is supporting the ever increasing requirement of Indian users for supporting the Direct-to-Home, TV Broadcasting, Very Small Aperture Terminal and Digital Satellite News Gathering Services.

Antimatter

Every elementary particle in the Universe appears to have a partner particle called its antiparticle that shares many of the same characteristics, but many other characteristics are the opposite of those for the particle. For example, the electron has as its antiparticle the antielectron(also called positron). The electron and the antielectron have exactly the same masses, but they have exactly opposite electrical charges.

The common stuff around us appears to be "matter", but we routinely produce antimatter in small quantities in high energy accelerator experiments. When a matter particle meets its antimatter particle they destroy each other completely (the technical term is "annihilation"), releasing the equivalent of their rest masses in the form of pure energy (according to the Einstein $E=mc^2$ relation). For example, when an electron meets an antielectron, the two annihilate and produce a burst of light having the energy corresponding to the masses of the two particles.

Because the properties of matter and antimatter parallel each other, we believe that the physics and chemistry of a galaxy made entirely from antimatter would closely parallel that of our our matter galaxy. Thus, it is conceivable that life built on antimatter could have evolved at other places in the Universe, just as life based on matter has evolved here. However, we have no evidence thus far for large concentrations of antimatter anywhere in the Universe. Everything that we see so far seems to be matter. If true, this is something of a mystery, because naively there are reasons from fundamental physics to believe that the Universe should have produced about as much matter as antimatter.

WHY IN NEWS?– Scientists have come closer in understanding why the universe contains more matter than antimatter. Physicists have made important discoveries regarding Bs meson particles — something that may explain why the universe contains more matter than antimatter(Bs meson oscillates between a matter particle and an antimatter particle). But the uncertainties of their results were too high to make any solid conclusions.

Could the Dark Matter be Antimatter?

- It is conceivable that the dark matter (or at least part of it) could be antimatter, but there are very strong experimental reasons to doubt this. For example, if the dark matter out there were antimatter, we

would expect it to annihilate with matter whenever it meets up with it, releasing bursts of energy primarily in the form of light. We see no evidence in careful observations for that, which leads most scientists to believe that whatever the dark matter is, it is not antimatter.

SAARC Satellite

Proposing satellite diplomacy with a view to playing a key role in the development of the region, Prime Minister Narendra Modi called upon the Indian Space community to develop a SAARC satellite which can be dedicated as a "gift" to the neighbours. India is already sharing disaster management data with over 30 countries and provides benefits of tele-medicines to Afghanistan and African countries.

Prime Minister has also asked the Space Community to enlarge the footprint of India's satellite-based navigation system, to cover all of South Asia.

The concept of SAARC satellite is quite old and was first discussed at length by SAARC information ministers in Dhaka way back on 26 April, 1998.

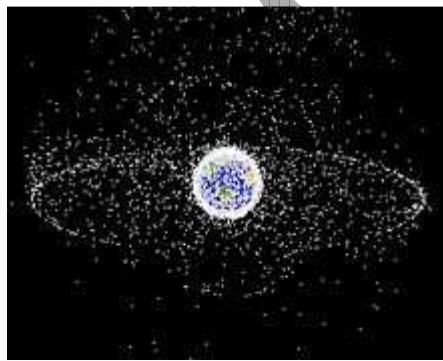
However, the idea could never be implemented, largely because of the India-Pakistan tensions as the Kargil War broke out one year later

Modi has revived the good old concept of a SAARC satellite. This augurs well for the grouping which has since expanded to eight members with Afghanistan as the new member in this interregnum.

SAARC region has got a fairly long coastline (12,000 kms) and real time scientific data are the need of the hour for preventing natural disasters. For centuries, the region has been ravaged by three major natural disasters: earthquakes, landslides and drought. A SAARC satellite will go a long way in addressing these needs.

Problem of Waste Deposits in Space

Space debris, also known as orbital debris, space junk, and space waste, is the collection of defunct objects in orbit around Earth. This includes everything from spent rocket stages, old satellites, fragments from disintegration, erosion, and collisions. Since orbits overlap with new spacecraft, debris may collide with operational spacecraft.



Space debris populations seen from outside geosynchronous orbit (GEO). Note the two primary debris fields, the ring of objects in GEO, and the cloud of objects in low earth orbit (LEO).

As the chance of collision is influenced by the number of objects in space, there is a critical density where the creation of new debris is theorized to occur faster than the various natural forces remove them. Beyond this point, a runaway chain reaction may occur that would rapidly increase the number of debris objects in orbit, and therefore greatly increase the risk to operational satellites. Called the "Kessler syndrome", there is debate if the critical density has already been reached in certain orbital bands. A runaway Kessler syndrome would render a

portion of the useful polar-orbiting bands difficult to use, and greatly increase cost of space launches and missions. Measurement, growth mitigation and active removal of space debris are activities within the space industry today.

India has done studies related to waste deposits in space referred as Space Debris and successfully developed methodologies and software tools. ISRO performs Space Object Proximity Analysis for its operational Low Orbit spacecrafts on a regular basis to assess the collision risk and determine risk mitigation strategies in advance. Collision Avoidance analysis is also carried out to identify the safe lift-off time for launching of satellites from Sriharikota. The growing space debris poses threat to present and future space activities, globally, in terms of collision risk. ISRO has taken mitigation measures like passivation of spent upper stage of launch vehicles and de-orbiting of non-functional satellites to avoid creation of space debris. ISRO has also undertaken collaborative studies with other space agencies to control and restrict this outer space contamination. India is a active member of Inter Agency Space Debris Co-ordination Committee (IADC) and played a key role in evolving space debris mitigation guidelines formulated by IADC and United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS).

Dark Matter

- In astronomy and cosmology, dark matter is a **type of matter hypothesized to account for a large part of the total mass in the universe.**
- Dark matter **cannot be seen directly** with telescopes; evidently it neither emits nor absorbs light or other electromagnetic radiation at any significant level.
- Its existence and properties are inferred from its gravitational effects on visible matter, radiation, and the large-scale structure of the universe.
- Dark matter is estimated to constitute 84% of the matter in the universe and 23% of the total energy density (with almost all the rest being dark energy).
- It is **called dark matter because it does not interact with light**. Dark matter **interacts with ordinary matter through gravity** and binds galaxies together like an **invisible glue**.
- While **dark matter pulls matter together, dark energy pushes the universe apart** at ever-increasing speeds. In terms of the total mass-energy content of the universe, **dark energy dominates**. Even less is known about dark energy than dark matter.

Why is it in news?

1. Dark matter experiments have increased in frequency around the world, as scientists have become more and more desperate to pin down this elusive substance. (ET)
2. An unusual signal picked up by a European space observatory(XMM-Newton observatory) could be the first direct detection of dark matter particles, astronomers say. The findings are tentative and could take several years to check, but if confirmed they would represent a dramatic advance in scientists' understanding of the universe. Astronomers noticed that the intensity of x-rays recorded by the spacecraft rose by about 10 per cent whenever it observed the boundary of Earth's magnetic field that faces towards the sun. (The Hindu)
3. The handful of unusual events observed in the underground experiments at the Kolar Gold Field (KGF) mines during the 1960-70s and the 1980s, which have remained unexplained to this day, may have been due to the decays of hitherto unseen Dark Matter (DM) particles. This interesting hypothesis has been put forward by Profs. G. Rajasekaran and M. V. N. Murthy of the Institute of Mathematical Sciences (IMSc), Chennai, in a paper published in the latest issue of the physics journal Pramana.(The Hindu)

Kepler-186f¹:

- It is the newest earth size planet discovered by astronomers at NASA.
- It is special because it is located in **habitable zone**. Habitable zone is defined as the range of the distance from the star where liquid water can be found. This is generally considered as primary qualifying criteria for a planet to host life as we know.
- This discovery proves that earth sized planets do exist in habitable zone of other stars. These planets are theoretically supposed to be most probable to have life.

Graveyard Orbit

- It is a orbit where space crafts are placed at the end of their operational life.
- The purpose of graveyard orbit is to avoid any collision between dead space crafts with currently operational one.
- It is a supersynchronous orbit , i.e. it lies significantly above synchronous orbit.
- ISRO is currently moving its communication satellite INSAT-3E to graveyard orbit.
- Communications satellite INSAT-3E has completed its life and gone out of service. It is a third-generation satellite which was launched in September 2003.

The Atlast

- The Atlast or Advanced Technology Large-Aperture Space Telescope ,is the most powerful telescope in the world .
- It will be able to analyse atmospheres-methane , ozone, oxygen and other gases of planets and solar systems up to 30 light years away which suggest the presence of life.
- To be able to analyse these planets, the telescope will have to be the largest of its kind ever to be built and up to four times bigger than the 44-feet Hubble Space Telescope(HST).
- If launched, ATLAST would be a replacement and successor for the HST

Robotics

Velocirobot

- It is a robotic dinosaur developed by Korea.
- It has two powerful legs that can propel it to speeds of 46km/h which is just fast enough to beat Usain Bolt in a race.

Defence

k-4

- K-4 is an intermediate-range nuclear-capable submarine-launched ballistic missile under development by DRDO of India to arm the Arihant class submarine and to complement K-15 Sagarika. The missile has an effective range of 3500 km

¹Gliese 581 g was asked in CSE Mains 2011. It was also suspected to be in habitable zone.

Netra

- It is a light-weight unmanned aerial vehicle for surveillance operations jointly by the Defence Research and Development Organisation and ideaForge
- The equipment is now used by army and paramilitary forces for operational requirement. The object has the capability to detect oil spills using its thermal camera.
- It has been designed to carry out surveillance in an area of 4 km from the location of its take-off. It could fly up to 400 metres.

Bio-Technology

Genetic Testing:

In News:

- “Angelina Jolie Effect” is creating awareness about Genetic Testing and its usefulness.
- Union Health Minister highlighted that the violation of Pre Conception and Pre Natal Diagnostic Techniques Act, 1994 (PC&PNDT Act) is in vogue as misuse of ultra sound machines is still prevalent because it is cheap, newer medical technologies are increasingly being used in the name of ‘genetic testing’.
- With nearly 17 lakh people in India born with genetic defects, the need for testing and counselling couples was highlighted at a seminar on *Essential Genetics Diagnosis in Advanced Medical Care*, at Osmania University.

What is Genetic Testing:

- Genetic testing is a detailed analysis of the DNA, the molecular structure of the chromosomes that carries the genes responsible for all body’s functions. The technology can detect gene alterations or mutations, which are associated with certain diseases or conditions in a person and his/her relatives.
- Genetic tests are performed on a sample of blood, hair, skin, amniotic fluid (the fluid that surrounds a fetus during pregnancy), or other tissue.
- In medical practice, genetic tests are requested for valid medical reasons such as to determine the possible genetic cause of a disease, predict possible future illness in a person with a family background of an inherited disorder, assess the risk of transmitting a genetic abnormality to children and predict the response to a given therapy.
- Genetic testing can tell you whether or not you are at a high risk for a disease like cancer, and then allow you to prevent it yet such results often lead to a quandary for both patients and doctors.
- These tests might provide a positive (disease is present) or a negative result (absence of the gene mutation) and also give an inconclusive result (test is not interpretable).
- For some illnesses, a positive or negative outcome is straightforward and irrefutably confirms or rules out the genetic abnormality. However, for many other genetic tests, the positive result indicates that while the individual has a higher risk of developing the disease, it does not mean that he/she will eventually get it.
- Likewise, the negative test stresses a low risk for the disorder but does not rule out development of the disease later in life.
- Without proper advice, the result can trigger important emotional issues, irrational behaviour (such as stopping screening when the result is negative) and/or social implications such as tense family relationships when a gene problem is diagnosed. In France, for example, generic testing is highly regulated.

Genetic Blueprint

The concept of inheritance has been known for long- the fact that traits are passed down from generation to generation. These traits get passed on through "genes."

Genetic Blueprint is a map of a living organism's genes or genomes. Every organism is born with a unique genetic blueprint, that define many of the characteristics it has throughout.

Genetic blueprint of bread wheat genome unveiled, last step before full genome sequence

- Scientists from ICAR's National Research Centre on Plant Biotechnology (NRCPB), New Delhi, Punjab Agricultural University (PAU), Ludhiana, and Delhi University South Campus (DU) in collaboration with International Wheat Genome Sequencing Consortium (IWGSC) have published a chromosome based draft sequence of the bread wheat genome .
- The genome's unusual size and form made the sequencing especially difficult for the team. India is entrusted with the responsibility of decoding wheat chromosome '2A', which alone has a genomic DNA code of about 900 million base pairs that is about two and a half times the size of whole rice genome, and about one third of the size of the human genome. The full wheat genome is about six times the size of human genome
- The draft provides new insight into the structure, organization, and evolution of the large, complex genome of the world's most widely grown cereal crop. Decoding the genome will afford ways to boost yield of this staple crop.
- The genetic blueprint is an invaluable resource to plant science researchers and breeders of tools enabling them to rapidly locate specific genes on individual wheat chromosomes throughout the genome.
- By identifying genes that control traits such as yield, pest resistance, quality, water stress, etc the researchers can produce new generations of wheat with desired qualities. As of today, researchers in the IWGSC estimate that the full genome sequence will be available within three years.

Energy

Fast Breeder Reactor

A breeder reactor is a nuclear reactor capable of generating more fissile material than it consumes.

FBR uses fast (unmoderated) neutrons to breed fissile plutonium from uranium-238. It can also breed fissile uranium-233 from thorium.

Fuel: FBRs usually use a mixed oxide fuel core of up to 20% plutonium dioxide (PuO_2) and at least 80% uranium (U-238) dioxide (UO_2).

Coolant is of 3 types gas cooled, sodium cooled, lead cooled

Most of the present fast neutron reactor designs use liquid metal as the primary coolant. Some experimental reactors use sodium potassium alloy. These are used because they are in liquid form at room temperature.

process of breeding: The core is surrounded in a blanket of tubes containing non-fissile uranium-238 which, by capturing fast neutrons from the reaction in the core, is converted to fissile plutonium-239 (as is some of the uranium in the core), which is then reprocessed and used as nuclear fuel.

Advantage:

Uranium deficient countries like India can use these for power generation as they produce more fuel than they consume. eg. Stage 2 of India's nuclear programme is based on FBRs.

Limitations

Interest in fast breeder reactors has declined after the 1960s as more uranium reserves were found and new methods of uranium enrichment reduced fuel costs.

India's status

India's first 40 MWt Fast Breeder Test Reactor (FBTR) attained criticality on 18 October 1985.

Construction (already in its final stages) of another FBR — the 500 MWe prototype fast breeder reactor - at Kalpakkam, near Chennai

Significance to India It has one of the world's largest reserves of thorium, which could provide power for more than 10,000 years. Thorium can be converted to usable fuel using FBRs.

Chaibagaan time

Why in news ?

- The state of Assam has decided to follow the 'chaibagaan' time instead of the Indian Standard Time, according to reports.

What is it ?

- The chaibagaan time or bagaan time refers to a daylight saving schedule introduced by the British for better energy savings on tea plantations more than 150 years ago. According to it Assam will turn its clock 1 hour ahead.

Why is it required?

- IST corresponds to the time schedule along 82.5 degrees East longitude, where Mirzapur in UP is located. States to the east of this longitude have less daylight hours in comparison to the rest. This is because even though rises earlier than rest of India they go to work at the same time.
- Thus turning clock one hour ahead helps utilize precious daylight.
- Obvious benefits are savings in electricity costs and increase in productivity. Additional daylight hours in the evenings would also be people-friendly, would help save power at home and in offices, reduce petty crimes among other gains.

One Nation-One Grid:

The Indian Power system for planning and operational purposes is divided into five regional grids. The integration of regional grids, and thereby establishment of National Grid, was conceptualised in early nineties. The integration of regional grids which began with asynchronous HVDC back-to-back inter-regional links facilitating limited exchange of regulated power was subsequently graduated to high capacity synchronous links between the regions.

The initial inter-regional links were planned for exchange of operational surpluses amongst the regions. However, later on when the planning philosophy had graduated from Regional self-sufficiency to National basis, the Inter-regional links were planned associated with the generation projects that had beneficiaries across the regional boundaries.

By the end of 11th plan the country has total inter-regional transmission capacity of about 28,000 MW which is expected to be enhanced to about 65000 MW at the end of XII plan.

Why one grid?

Synchronisation of all regional grids will help in optimal utilization of scarce natural resources by transfer of Power from Resource centric regions to Load centric regions. It provides relief to the power-short southern region, it will also improve transmission and facilitate better management of demand, ensuring the stability of the electricity grid. Easier availability of power could also lead to lower tariffs in Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Puducherry. Together with a proposal to separate the so-called carriage-and-content operations of existing power distribution companies, the move has the potential to bring about a structural transformation of the power sector

Further, this shall pave way for establishment of vibrant Electricity market facilitating trading of power across regions. One Nation One Grid shall synchronously connect all the regional grids and there will be one national frequency

Evolution of National Grid:

- Grid management on regional basis started in sixties.
- Initially, State grids were inter-connected to form regional grid and India was demarcated into 5 regions namely Northern, Eastern, Western, North Eastern and Southern region.
- In October 1991 North Eastern and Eastern grids were connected.
- In March 2003 WR and ER-NER were interconnected .
- August 2006 North and East grids were interconnected thereby 4 regional grids Northern, Eastern, Western and North Eastern grids are synchronously connected forming central grid operating at one frequency.
- On 31st December 2013, Southern Region was connected to Central Grid in Synchronous mode with the commissioning of 765kV Raichur-Solapur Transmission line thereby achieving 'ONE NATION'- 'ONE GRID'- 'ONE FREQUENCY'.

World's first solar jet fuel

- An EU-funded research project called Solar Jet has produced the world's first 'solar' jet fuel from water and carbon dioxide. Researchers have successfully demonstrated the entire production chain for renewable kerosene using concentrated light as a hightemperature energy source.
- The idea is to extract carbon dioxide from the atmosphere and converting it into fuel. At high temperatures carbon dioxide and water dissociate into hydrogen, carbon monoxide and oxygen. The hydrogen and carbon monoxide mixture, known as synthesis gas or 'syngas', can then be converted into liquid hydrocarbons such as petrol or kerosene.
- The project is still at an experimental stage and just a glassful of jet fuel was produced in lab conditions using simulated sunlight. This technology means we might one day produce cleaner and plentiful fuel for planes, cars and other forms of transport. This could greatly increase energy security and turn one of the main greenhouse gases responsible for global warming into a useful resource.

Applications of FLOW BATTERY:

- Load balancing - where the battery is connected to an electrical grid to store excess electrical power.
- UPS, where the battery is used if the main power fails to provide an uninterrupted supply.
- Electric vehicles - Because flow batteries can be rapidly "recharged" by replacing the electrolyte.
- Stand-alone power system - An example of this is the telecom industry for use in cellphone base stations where there is no grid power available.

SnT developments and their applications and effects in everyday life

Innovation Hub

- **In News:** Innovation Hub was inaugurated at the Nehru Science Centre.
- This new facility, the fifth in the chain of Innovation hubs developed by National Council of Science Museums (NCSM) and National Innovation Council, is aimed at fostering the creative faculty among students by emphasizing on inquiry-based learning and promoting crave for lifelong learning.
- To encourage school children to explore scientific discoveries, 100 innovation hubs would be established throughout the country by 2017.
- Despite an apparent chaos that India is known for, there are several grassroot innovations which are impacting the society. Innovation Hubs would motivate and excite young minds, and provide a proper ambience to promote grassroot innovations.
- The Innovation Hub includes:
 - **Hall of Fame: Inventions and Inventors** — Includes several multimedia kiosks bring the stories of major inventors and their inventions in various fields.
 - **Innovation Resource Centre** — Equipped with a broadband Internet connection, it provides online access to innovation-centric resources, e-journals, books and grass-root innovation portals.
 - **Innovative Laboratory**: Equipped to carry out innovative activities, experiments and projects in a multi-disciplinary set up.
 - **Tech Lab: Robotics & Microprocessor Programming, Electronics** — Facilitates creative and innovative projects in robotics, electronics and microprocessor programming, Apps development for mobiles etc for practical applications.
 - **TodFodJod (TFJ)*** — Place where students can creatively engage in learning to open gadgets and reassemble them on their own.
 - **Kabad Se Jugad (Build from Scraps)** — Students can use low-cost materials to develop interesting models or science toys and perform investigative experiments.
 - **Idea Box** — Students are encouraged to write down innovative ideas and submit them to idea bank. The best ideas are chosen for further development as project work.
 - **The Lab** — With facility for experimentation in Physics, Chemistry, Electronics, Biology, Robotics, etc also provides opportunity for students to work on innovative ideas and make a working model or kit on it and perform several investigative experiments.

Mass spectrometry

- **In News:** Mass spectrometry arguably the most important analytical spectroscopic tool of modern times, is in its centenary year in 2013 along with two other celebrated discoveries of science, the Bohr atom model and the chemical bond of G. N. Lewis.
- **Mass spectrometry (MS)** is an analytical chemistry technique to determine the mass of a molecule by measuring the mass-to-charge ratio of its ion.
- Sir J.J. Thomson, a Nobel Laureate, also known for the discovery of electrons, built the first rudimentary mass spectrometer in 1913. which identified the existence of isotopes — atoms differing in mass but having the same atomic number and therefore occupying the same position in the periodic table.
- There are many problems in Chemistry which could be solved with far greater ease by this method than by any other method. Mass spectrometry has both qualitative and quantitative uses. These include identifying unknown compounds, determining the isotopic composition of elements in a molecule, and determining the structure of a compound by observing its fragmentation.
- Other uses include quantifying the amount of a compound in a sample. MS is now in very common use in analytical laboratories that study physical, chemical, or biological properties of a great variety of compounds.

Health

MERS (Middle East Respiratory Syndrome)

- MERS (Middle East Respiratory Syndrome) is a severe pneumonia-like respiratory disease caused by a virus.
- MERS causes high fever, cough, and severe shortness of breath. The infection is thought to be spread by close contact with an infected person.
- MERS is different from severe acute respiratory syndrome (SARS). Most importantly, the MERS virus does not appear to be as easily spread between people, whereas the SARS virus spreads very easily.
- Why in News: After Ebola, medical practitioners are turning their attention to yet another disease called the Middle East Respiratory Syndrome (MERS) which was first reported in Saudi Arabia two years ago. It's like SARS, swine flu and avian influenza which has caused a global scare, resulting in several casualties.

ZMapp:

Z Mapp an experimental biopharmaceutical drug for treatment of Ebola virus. It is currently the only known treatment against the virus. The drug was first tested in humans during the 2014 West Africa Ebola virus outbreak, but has not been subjected to a randomized controlled trial to determine whether it works, and whether it is safe enough to allow on the market.

Magnivisualizer:

- In News: Government launched indigenous equipment that can detect early cervical cancer and be used even by healthcare workers with basic training.
- The device AV Magnivisualizer which was developed by the Institute of Cytology and Preventive Oncology under the Indian Council of Medical Research (ICMR).
- It has 95 per cent accuracy for detecting pre-cancerous lesions. Randomised clinical control trials have confirmed its efficacy in reducing incidence and mortality of the disease. It can be made available in remote rural areas.
- This is a user-friendly device which costs about Rs 10,000 as against the present devices which cost between Rs 8-10 lakh and are beyond the reach of most people.
- The device has a white light source with variable interchangeable magnification and can be operated on a 12-volt battery in rural and semi-urban areas where electric supply is not regular.
- Magnivisualizer has been found to pick up 1.5 times more high-grade pre-cancerous lesions than the ordinary tungsten light.
- Now, the ICMR is initiating studies to assess its applicability even for oral pre-cancerous and cancerous lesions.
- In the initial phase, the device would be available in the Community Health Centres (CHC); in the next phase it would be made available in the Primary Health Centres (PHC), where cervical cancer cases go undetected.
- Cervical cancer is the most common malignancy among Indian women, particularly those who marry early. Current estimates indicate that approximately 1.32 lakh new cases are diagnosed and 74,000 deaths occur annually in India, accounting for nearly one-third of global cervical cancer deaths.
- Cervical cancer takes about a decade to fully develop and is often detected when it has spread substantially. It starts from a pre-cancer stage called dysplasias and early detection and appropriate treatment at this stage can halt its progression, resulting in decreased incidence or mortality.

PaMZ – TB

- PaMZ – TB is new tuberculosis (TB) drug developed by Global Alliance for TB Drug Development (TB Alliance).
- PaMZ is a combination of three drugs, two of which have not been licensed for TB treatment before. If the trials are conclusive, it will only be the third new TB drug to be licensed in 60 years.
- PaMZ's development has been hailed as a breakthrough. It will be available for both drug-sensitive and some drug resistant TB patients (about a third of cases). In the case of the latter, it promises to reduce the treatment duration (from two years to six months) and its cost (from \$2,000 to \$100), simplify it (pills-only, no injection required) and improve cure rates.
- PaMZ will also be compatible with anti-retrovirals (ARV) for treating HIV offering a new solution for millions of co-infected HIV-TB patients. At least a third of the 35.3m people living with HIV are infected with TB and the disease is the leading cause of death among HIV-positive patients.

Environment Technology

Polar Vertex:

- **In News:** The U.S. is bracing itself for freezing temperatures and snow as a result of part of the polar vortex heading southwards sending temperatures spiralling 10 to 20 degrees below normal.
- A **polar vortex** is a persistent, large-scale cyclone that circles either of the planet's geographical poles. On Earth, the base of the polar vortices are located in the middle and upper troposphere and extend into the stratosphere.
- They surround the polar highs and lie in the wake of the polar front. These cold-core low-pressure areas strengthen in the winter and weaken in the summer due to their dependence upon the temperature differential between the equator and the poles.
- Occasionally, this very cold air can get dislodged farther south than normal, leading to cold outbreaks in Canada and the U.S.
- The cold air will be accompanied by gusty winds. Such cold will raise the risk of hypothermia and frostbite in the North and will make it uncomfortable for some outdoor activities in the South.
- Last winter in January 2014, temperatures plunged to life-threatening lows in some places, 60 degrees Fahrenheit below zero (minus 51 degrees Celsius) due to the polar vertex.
- The chemistry of the Antarctic polar vortex has created severe ozone depletion. The nitric acid in polar stratospheric clouds reacts with chlorofluorocarbons to form chlorine, which catalyzes the photochemical destruction of ozone. Chlorine concentrations build up during the polar winter, and the consequent ozone destruction is greatest when the sunlight returns in spring.

COMAPS(Coastal Ocean Monitoring and Prediction System)

The Government of India, in the Ministry of Earth Sciences (formerly Ministry of Ocean Development) have been monitoring the levels of marine pollution at about 80 locations along the coastline of the country. The programme is called COMAPS. The major objectives of this programme are to assess status and trend of coastal marine environmental quality on a long term basis and to alert government and public institutions, of their implications.

Coastal environments of India are under immense stress due to discharge and disposal of domestic and industrial wastes from point and nonpoint sources as a result of rapid growth of population and economic activities. Further, lack of proper sewer systems and discharge of untreated/semi-treated sewage and effluents from coastal towns/cities cause degradation of coastal environment.

The main objectives of the programme are as under:

- To detect radical changes in the bio-geochemical regimes of the marine system and to alert Government, public and social institutions of their implications.
- To set standards for the measurement of various pollution parameters and to ensure compatibility between the data acquired and processed by various monitoring agencies through definition of equipment specifications, periodic intercalibration exercises, planned cross-checks and training programmes.
- To provide advisory and technical services to Government, industry and public institutions aimed at evolving pollution containment measures.

Part B: Science Reporter

Articles from Science Reporter Part 2

C V Raman

- One of the most prominent Indian scientists in history, C.V. Raman was the first Indian person to win the Nobel Prize in physics in 1930 for his ground breaking work in the field of light scattering. It is now commonly known as the "Raman Effect".
- He discovered that, when light traverses a transparent material, some of the deflected light changes in wavelength.
- In 1954, he was honoured with the highest civilian award in India, **the Bharat Ratna**.
- He was passionate to discover the reason of the blue colour of sky and sea and performed many experiments regarding the scattering of light from water and transparent blocks of ice. According to the results, he established the scientific explanation for the blue colour of sea-water and sky.
- What is Raman Effect?
 - When a beam of light traverses a dust-free, transparent sample of a chemical compound, a small fraction of the light emerges in directions other than that of the incident (incoming) beam. Most of this scattered light is of unchanged wavelength (and frequencies).
 - A small part, however, has wavelengths different from that of the incident light; its presence is a result of the Raman Effect.
 - When the emitted photon has lower energy than incident photon it is known as Stokes Raman scattering and when it has higher energy than incident photon it is called Anti-Stokes scattering. This is called Raman Effect or Raman spectroscopy.
- Why is Raman spectroscopy important?
 - Raman spectroscopy is used to analyze a wide range of materials, including gases, liquids, and solids.
 - Highly complex materials such as biological organisms and human tissue can also be analyzed by Raman spectroscopy.
 - Raman spectroscopy can be used to determine the force constant and bond length for molecules which can't be determined with other spectroscopy techniques like rotational spectroscopy, vibrational spectroscopy or electronic spectroscopy.
 - It is also used in optical amplifiers to amplify an optical signal directly, without the need to first convert it to an electrical signal.

(The year 2013 was 125th birth anniversary of Dr. C V Raman.)

Energy Efficient Vehicles

- Scientists from South Korea have introduced the world's first road-powered electric vehicle network.
- This new technology is called **Shaped Magnetic Field in Resonance (SMFIR)** and it consists of special roads that have electrical cables buried just below the surface, which wirelessly transfer energy to electric vehicles (known as online electric vehicles, OLEV) via magnetic resonance while moving.
- The length of power strips installed under the road is generally 5%-15% of the entire road, requiring only few sections of the road to be rebuilt with the embedded cables.
- Road-powered electric vehicles only require small batteries, significantly reducing their overall weight and thus their energy consumption.
- Also, with an electrified roadway, the need of plugging vehicles in to recharge it is done away, removing most of the risk and range anxiety associated with electric vehicles (EVs).
- The power supply is only switched on when LEV buses pass along, but is switched off for other vehicles, thereby preventing electromagnetic fields exposure and standby power consumption.
- We can expect more research to reduce the complexities of technology and result in cheaper, lighter and more efficient vehicles.

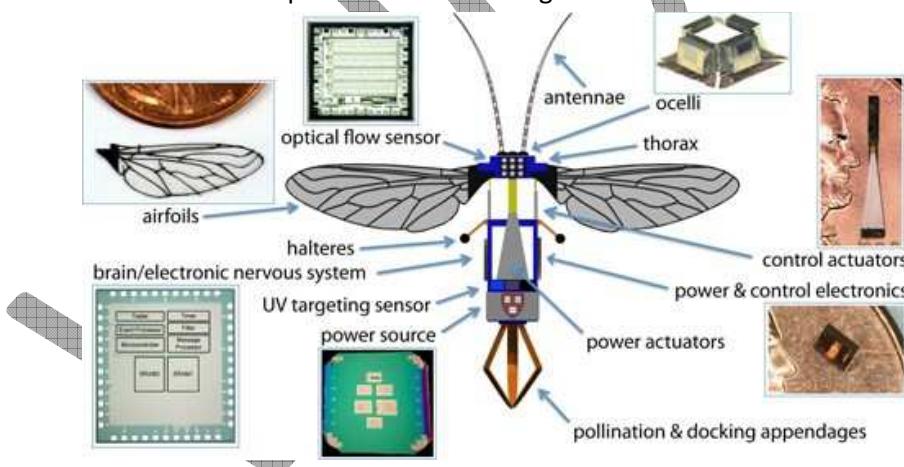


Turning off Aging Genes

- Calorie restriction can prolong lifespan in many species including Human. Using this hypothesis, researchers have developed an algorithm that predicts which genes can be turned off to create the same anti-aging effect as calories restriction.
- This algorithm (known as Metabolic Transformation Algorithm or MTA) could lead to development of new drugs which will not target to kill cell but to transform them from a diseased state into a healthy one.
- MTA can take information about two metabolic states and can predict the genetic or environment changes required to go from one state to another.
- Currently there is no way to verify the results produced by MTA in humans but the genes identified by this algorithm are known to extend lifespan in yeast, worms and mice.
- MTA could also be applied to finding drugs for disorders where metabolism plays a role like obesity, diabetes, neurodegenerative disorders and cancer.

RoboBee: An insect Drone

- RoboBee is a tiny robot capable of tethered flight, developed by a research robotics team at Harvard University.
- Inspired by the biology of a bee, scientists developed a tiny winged craft that could be used as a surveillance drone.
- Flying insects are small enough to get into any tight space and go unnoticed and this was the vision of these Nature-inspired researchers.
- The project envision that the Nature-inspired research could lead to a greater understanding of how to artificially mimic the collective behavior and “intelligence” of a bee colony; foster novel methods for designing and building an electronic surrogate nervous system able to deftly sense and adapt to changing environments; and advance work on the construction of small-scale flying mechanical devices.
- The devices will open up a wide range of discoveries and practical innovations, advancing fields ranging from entomology (the branch of Zoology concerned with the study of insects) and developmental biology to amorphous computing and electrical engineering.
- RoboBee's wingspan is 3 centimetres, which is believed to be the smallest man-made wingspan to achieve flight. The wings can flap 120 times per second and be controlled remotely in real time. Each RoboBee weighs 80 milligrams.
- Practical applications:
 - It can help in artificial pollination of a field of crops.
 - A group of RoboBees with their swarm intelligence can be very useful in search and rescue operations e.g., in the aftermath of a natural disaster.
 - Hazardous environment exploration can be done using RoboBee.
 - It can also help in Military surveillance.
 - High resolution weather and climate mapping can be done by these artificial Bees.
 - It can help in Traffic monitoring.



Human ID cards

- Humans have an inbuilt genetic card and it's possible to distinguish one individual from another at molecular level.
- This unique ID is due to Human Leukocyte Antigen (HLA), direct products of a group of genes found on the sixth chromosome of every human cell.
- The system of identification is very important in the body defence against disease. The nature of HLA antigens on the body's ID card can tell about susceptibility and resistance to score of diseases.

- The information on HLA typing is also critical before a patient receives a donor organ as only people with same HLA can be immunologically compatible.

Mercury and Minamata Convention

- The use of mercury due to anthropogenic activities such as mining and fossil fuel burning has posed a serious threat to the public health.
- Elemental and Methyl Mercury are toxic to the central and peripheral nervous system. Inorganic salts of mercury are corrosive to the skin, eyes and may induce kidney toxicity.
- Mercury is naturally used element in various industrial processes such as chor-alkali industry, cement, chemical units, cola based thermal power plants, CFLs, healthcare sectors etc.
- Minamata, a town in Japan** first gained the attention of world to the devastating effects of Mercury poisoning, when an outbreak of neurological disease occurred due to discharge of Methyl Mercury in wastewater.
- Minamata Convention on Mercury
 - In 1972, the United Nations conference on human environment initiated action on high priority marine pollutants including Mercury. In October 2013, a new international convention to control Mercury emissions was opened for signing in Japan.
 - The convention aims to protect human health and environment from anthropogenic emissions and releases of Mercury and its compounds.
 - The parties also agreed to control and reduce mercury and mercury compounds emissions.
 - The convention also called for additional research on issues related to Mercury.
- India participated in all meetings and played an important role in finalizing the text of the convention; however it hasn't ratified the convention yet.

Cyber Rain Sprinkler Controller

- Cyber rain is a way for automatic sprinkler owners to save water. This device is a sprinkler controller with a brain.
- The controller coordinates with a networked PC to check local weather forecast like precipitation, humidity, and temperature and adjust sprinkler schedule. It uses internet to check the weather and automatically adjust run times of sprinkler.

3D Bio-pen

- Researchers in Australia have developed a pen to deposit regenerative stem cells onto damaged bone and cartilage in a process similar to 3D printing.
- It combines principles from 3D printing with stem cell research to enable missing or diseased bone to be replaced faster and more accurately.
- The hand-held design provides both precision in the operating room and makes the device easy to transport.
- It is designed to let surgeons "draw" live cells and growth factors directly onto the site of an injury to help accelerate the regeneration of functional bone and cartilage.
- The device can also be used to seed growth factors or other drugs to promote regrowth and recovery.

Super Lithium Ion Batteries

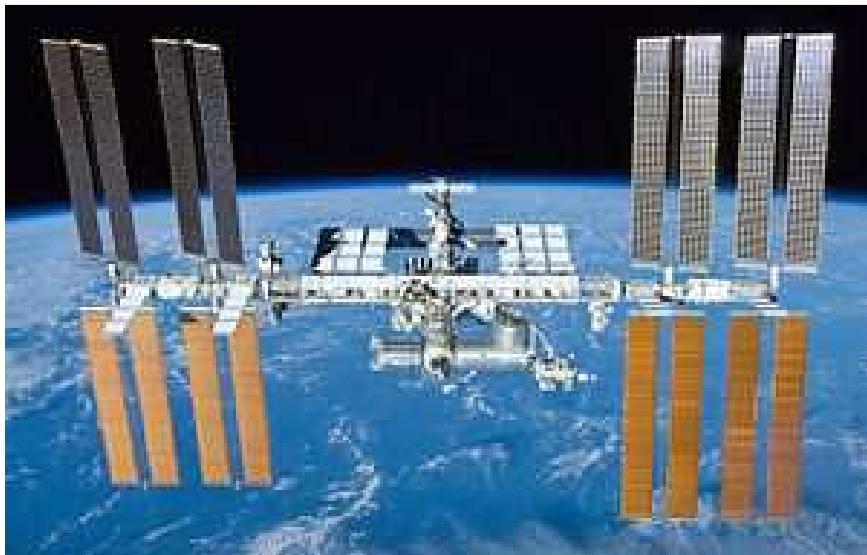
- Most batteries take a long time to charge and don't last more than a few years
 - German scientists are engineering a rechargeable Lithium-ion battery with a projected **lifespan of 28 years**.
 - This new battery will also be charged in shorter time and even 28 years of use will still retain 85% of its original charge capacity.
- A lithium-ion battery in general is a rechargeable battery. These batteries are common in consumer electronics. They are one of the most popular types of rechargeable batteries for portable electronics, with a high energy density, no memory effect, and only a slow loss of charge when not in use.
- Researchers across the world are trying to improve the efficiency of these batteries and the current innovation by German scientists is a breakthrough in electronics.

Disposable Paper Cups

- Abandoned disposable cups have become a serious threat for pollinating nectarivorous bees.
- Remnants of sugary residue attract these honey bees and once they fall into these cups, it becomes difficult for them to come out, which results in large scale death.
- A ban or safe way of disposing the cups is needed as nectarivorebees play an important role in livelihood for forest-dwelling communities as honey and wax are produced by these bees.
- These bees are also important for pollination for many floral species.

International Space Station

- The International Space Station (ISS) is a space station, or a **habitable artificial satellite**, in low Earth orbit (about 400km above us).
- It is the largest artificial body in orbit and can often be seen with the **naked eye** from Earth.
- Its first component was launched in 1988 and a **joint project among five participating space agencies** – NASA (US), Roscosmos (Russia), JAXA (Japan), ESA (Europe) and CSA (Canada).
- The size of ISS can be compared with a football field and it **orbits the earth approximately every 90 minutes** at the speed of about 27,700 kilometres per hour.
- The ISS serves as a **microgravity and space environment research laboratory** in which crew members conduct experiments in biology, human biology, physics, astronomy, meteorology and other fields.
- It Provides/controls elements such as atmospheric pressure, oxygen levels, water, fire extinguishing etc so that astronauts can live comfortably.
- Recent experiments on ISS showed that vegetables can be cultivated in micro-gravity conditions.
- India is currently not a partner in the ISS but **ISS has invited other countries including India to conduct experiments.**



Weightlessness in Space

- At the height of 400 km, gravitational force of space is not absent still astronauts feel weightlessness.
- This is connected with the relative motion of astronauts with earth and spacecraft.
- All objects inside the spacecraft including the spacecraft itself is falling around the earth, thus every object inside the craft is in the same motion as the craft which produces a feeling of weightlessness.
- This is equivalent to feeling of weightlessness within a free falling elevator where both elevator and persons within the elevator are accelerated at the same rate towards earth.

Active and Adaptive optics and Creating an Artificial Star

- The radiations emitted by distant stars are analysed by astronomers to understand the complexities of universe.
- These radiations travel a long way through the thick atmosphere and thus get distorted which might not provide required data.
- Expensive telescopes like Hubble space telescope have been sent into space for better observation. Establishing a telescope in outer space is very costly and therefore scientists focused on mountaintops in Hawaii, Chile etc. to establish powerful telescopes and have adopted cheaper technologies like Active optics and Adaptive optics for sharp and steady images.
- **Active optics** corrects the changes in shape of primary mirror used in telescopes from phenomenon like uneven expansion (due to heat during day and cold during night) or distortion of mirror due to gravitational pull, violent rush of wind etc.
- **Adaptive Optics:**
 - Light is affected by the medium in which it propagates, so turbulence in the atmosphere distorts signals from astronomical objects. (A good example is twinkling stars).
 - Thus rapid changes in the orientation of mirrors are required with dynamic conditions of atmosphere, which might not be easy by using active optics techniques. Adaptive optics is used to correct these changes.
 - Adaptive optics uses a flexible mirror which adjusts its shape under computer control. However this method requires a special star called reference star. This reference star must be located in the same field of view as distant objects under study. Using this method results into sharp images as if the atmosphere were not present.

- **Why Artificial stars?**
 - Adaptive optics is a complicated process as it requires a nearby reference star for observation which might not be available for many astronomical objects under observation.
 - To overcome this limitation astronomers artificially create a suitable star according to the requirement.
 - **With the use of a powerful LASER a bright spot light can be created which is known as artificial star.**
 - With the help from this artificial star the mirrors of telescope can be adjusted accordingly and we can know about the true shape of the signal coming from the target star.

Wheat Stem Rust UG99

- Wheat is only second to rice as source of calories and protein to people across the globe; however there is a threat to the crop with stem rust UG99.
- What are Stem Rusts?
 - Stem rusts are a significant disease caused by the fungus *Pucciniagraminis* which affect cereal crops.
 - Ug99 is a lineage of wheat stem rust and can potentially cause a wheat production disaster that would affect food security worldwide.
 - Under the umbrella of Borlaug Global Rust Initiative many research projects to tackle UG99 threat.
 - In late 2013, **large areas of India** along with Eritrea and Ethiopia were on high alert after a rust-resistant cultivar became susceptible to UG99, eventually leading to localised severe rusts.
- Early warning of rust epidemics is very important as farmers can use measures like spraying of appropriate fungicides.
- Recently rust **resistant genes Sr35 and Sr33** have been cloned and combining these two either by **crossing or genetic engineering** might become beneficial to control this devastating wheat disease.

Water Footprint

- World water use has been growing rapidly in the last hundred years and it is estimated that by 2025, an estimated 1.8 billion people will live in areas plagued by water scarcity.
- Water usage has increased owing to increasing population, industrialization, demand for water intensive products etc. Change in precipitation pattern due to climate change has proved to be further deterrent.
- **What is Water Footprint?**
 - The water footprint of an individual, community or business is defined as the total volume of freshwater used to produce the goods and services consumed by the individual or community or produced by the business.
 - A water footprint can be calculated for any well-defined group of consumers (e.g., an individual, family, village, state or nation) or producers (e.g., a public organization, private enterprise or economic sector).

- It is a geographically explicit indicator, not only showing volumes of water use and pollution, but also the locations.
- The calculation for water footprint includes the total amount of freshwater consumed along the supply-chain of a product. For example, in a cup of coffee many will assume that only water in the cup is consumed however 140 litres of water is involved in growing, producing, packaging, and shipping the coffee beans.
- Agriculture is the largest consumer of freshwater and with increasing food demand it will use more and more water.
- Comparing water footprints of different management practises in agriculture can evaluate drought tolerance, water use efficiency, effective use of rainfall and the significance of irrigation.
- Population ecologists use it as an indicator to show the total water requirement of a nation and the impact of human consumption on the natural water environment.
- Simple water calculators have been designed by many agencies and comparing the data of water footprint shows that many countries are over-exploiting this resource.
- India's water footprint:
 - India uses 13% of global water resources and is the largest consumer after China (12%) and the USA (9%).
 - Huge population, water intensive consumption pattern, agricultural economy and high water requirement per unit of crop production are the main reasons behind high footprint.
- We must adopt production techniques that require less water per unit product to reduce our water footprint. This can be done in various ways:
 - In agriculture we can use water productive technique like rainwater harvesting and supplementary irrigation.
 - We need to shift our consumption pattern that requires less water. We can change our food basket and include indigenous and seasonal food.
 - Water is highly subsidised in our country; hence trends of over exploitation and wastage are prevalent. Reducing subsidy might help people to realise the importance of this precious resource.
 - Awareness campaigns on negative impact of increasing water footprint can be organised.
 - National targets on water footprint can be translated to specific reduction for products, producers, industry, goods etc.
- Reducing water footprint must be of utmost priority for nations otherwise in absence of water this planet will become uninhabitable.

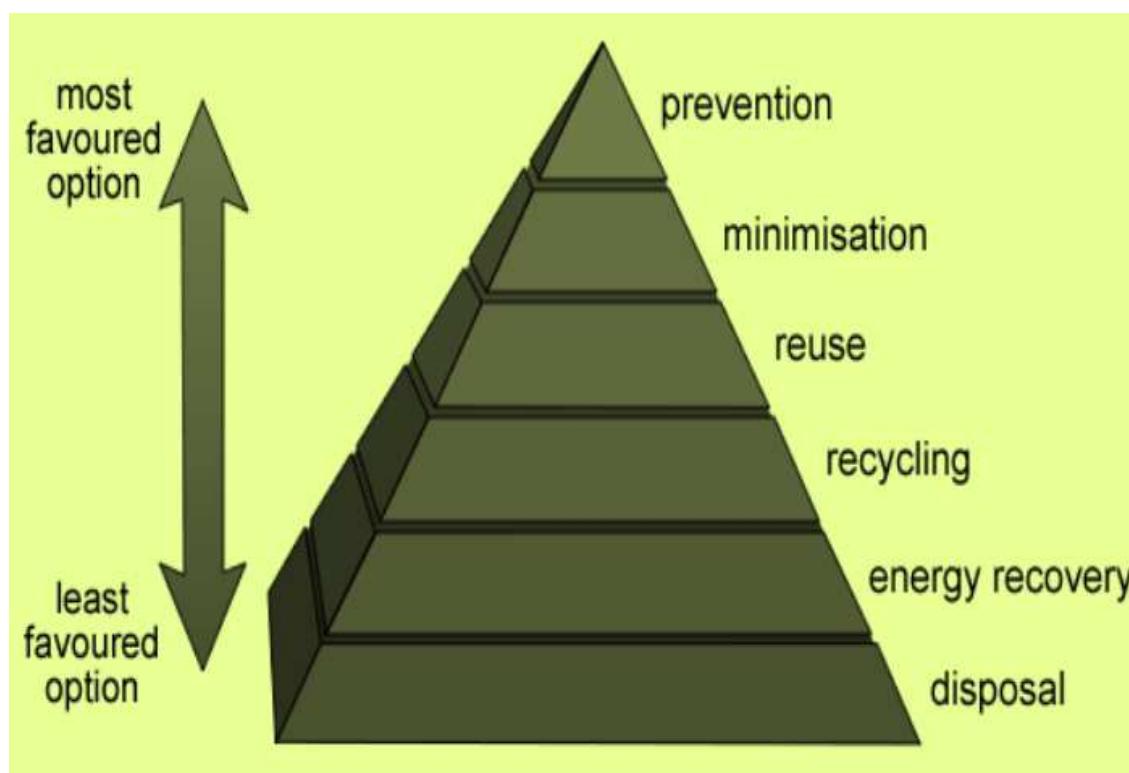
Solid Waste Management and Energy from Wastage

- About 55 million tonnes of waste is generated every year and expected to cross 125 million tonnes by 2030.
- Much of this waste is dumped on outskirts of cities with no compliance or regulation. Vehicles transporting these wastes are not totally covered up and littering of waste, causing breeding of waste and flies which affect public health.
- Municipal waste: It includes domestic waste either in solid or semi solid form. About 115,000 tonnes of municipal waste is generated every day with a yearly increase of 5%. It is broadly classified as:
 - Biodegradable Waste: Food and Kitchen waste, Green Waste
 - Recyclable Material: Paper, Glass, Bottles, Plastics, Fabrics etc.
 - Inset Waste: Soil, Pebbles, Dirt, and Ash etc.

- About 25% of municipal waste is not collected at all and the authorities don't have preparedness to set up waste processing and disposal facilities.

There are various methodologies available for the treatment of solid waste.

- Waste Management Hierarchy



- **Land Filling**
 - It is a technique for the disposal of waste into or onto the land.
 - In this method transportation costs are generally high as the landfill sites are far away from cities.
 - Two major green house gases Carbon Dioxide and Methane get emitted in this method.
- **Composting and Vermi Composting**
 - In the presence of microorganisms, degradation of organic matter occurs which lead to the formation of compost. This is known as composting.
 - It is a simple and cost effective method which increases the moisture holding capacity of the soil; however there are concerns like methane emission, flies, bad odour, requirement of large land with this method.
 - **Vermi Composting** is a less mechanised process where earthworms are fed on partially decomposed matter. This process casts out a fine, odourless and granular product used as biofertilizer in agriculture.
- **Waste to Energy (WtE)**
 - Waste-to-energy or energy-from-waste is the process of generating energy in the form of electricity and/or heat. WtE is a form of energy recovery.

- Most WtE processes produce electricity and/or heat directly through combustion, or produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuels.
- Some WtE technologies are:
 - **Incineration:** MSW can be directly combusted in incinerators which reduces the waste volume by 80-90%; however due to high organic material, moisture content and low calorific value of MSW in India, this method is not practised much.
 - **Pyrolysis:** Pyrolysis involves thermochemical decomposition of organic material at elevated temperatures in the absence of oxygen. It produces combustible tar/bio-oil and chars.
 - **Biomethanation:** In this process organic waste is acted upon by microorganisms which break down the material with the release of Carbon dioxide and Methane; however this method is only suitable for organic biodegradable part of MSW.
 - **Refuse Derived Fuel (RDF):** By shredding the solid waste or treating with steam pressure in an autoclave fuel can be produced. Burning RDF is more clean and efficient prior to incinerating MSW. This process is energy intensive and not suitable for wet MSW such as during rainy season.

Persistent Organic Pollutants (POPs)

- POPs are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes.
- These compounds are capable of long-range transport and bioaccumulate in human and animal tissue, bioaccumulate in food chains, and to have potential significant impacts on human health and the environment.
- Specific effects of POP include cancer, allergies, and hypersensitivity, damage to the central and peripheral nervous system, reproductive disorders, and disruption of the immune system.
- Sources of POPs:
 - Most POPs are created by humans in industrial processes, either intentionally or as by-products.
 - POPs are currently or were in the past used as pesticides.
 - In industrial processes and in the production of a range of goods such as solvents, polyvinyl chloride, and pharmaceuticals, POPs are used.
 - There are a few natural sources of POPs, such as volcanic activity and vegetational fires.
- As POPs are cross boundary pollution problem the United Nations Environment Programme adopted Stockholm Convention for POP regulation.
- The convention and its participants have recognized that POPs have the potential for long range transport and bioaccumulation and biomagnification. The convention seeks to study and then judge whether or not a number of chemicals that have been developed with advances in technology and science can be categorized as POPs or not.
- The initial meeting in 2001 made a preliminary list of 12 compounds termed as “**dirty dozen**,” of chemicals that are classified as POPs.
- India actively participated in the International Negotiation and ratified the convention in 2006.

Growth Promoting Antibiotics

- The use of antibiotics has become common in the livestock production around the world. Antibiotics increase the efficiency of animal growth by inhibiting the growth of microbes which triggers immune response.

- However, there is much concern regarding the indiscriminate use of antibiotics which could lead to resistance associated even in humans.
- Resistance to antibiotics is a major problem that can undo the beneficial effects of antibiotics.
- Remedial Measures
 - Use of friendly bacteria: Scientists are looking for non-antibiotic growth promoters like feed bacteria. Bacteria used for this purpose are known as probiotics.
 - Safe antibiotics like Flavophospholipol etc. can be a better alternative for growth of animals which don't lead to antibiotic resistance.
 - Governments can ban the use of antibiotics for animal growth.

Finger Reader

- Researchers from MIT have come up with a prototype device that straps itself around fingers and reads printed text out loud with a synthesized voice.
- It contains a camera which reads the text on the page and says it loud.
- It weighs no more than a regular ring and can also indicate if the user has reached the end of line or reader's finger is drifting from the line of text and provides cues to move the finger higher or lower on the page.
- A future version where the device can translate text into another language is envisaged by the researchers.
- Once launched in market this device will be very helpful for people with sight difficulties.

Part C: Emerging and Significant Technologies

Emerging and Significant Technologies

Precision agriculture

Precision agriculture (PA) is a farming technique based on observing, measuring and responding to inter and intra-field variability (spatial and temporal) in crops.

How it is done: This is done by measuring real-time data on weather, soil and air quality, crop maturity and even equipment and labor costs and availability. This data is analyzed to make smarter decisions.

In PA, precise spatial and temporal information and management of inputs (seeds, fertilizers, water, irrigation techniques, pesticides etc.) is used to increase farm productivity, profitability, sustainability, environmental protection, food safety.

Precision agriculture (PA) is a holistic new and developing agricultural system that is progressively changing agriculture in the U.S. and around the world.

India's Status: In India, currently 22 (PFDC) precision farming development centers collect and process data and advice farmers make the best decisions with regard to planting, fertilizing and harvesting crops. Also, they aim to promote research and extension activities in promotion of new technologies in agriculture.

At PFDC, the farmers are also provided an insight into fertilizers and weed management, drip irrigation, better harvesting practices, grading of produce and marketing tips.

Advantages: Precision agriculture management practices can significantly reduce the amount of nutrient and other crop inputs (water, pesticides, fertilizers, seeds etc.) used while boosting yields.

The techniques would boost yield and improve quality of the produce. Therefore, the farmers need not depend only on the local markets but could also send their produce to upcountry markets to get good prices.

Applying the right amount of inputs in the right place and at the right time benefits crops, soils and groundwater, and thus the entire crop cycle. Consequently, precision agriculture has become a cornerstone of sustainable agriculture.

Case study: Rajamani, a young farmer of Pullagoundanpudur village, Coimbatore district, Tamil Nadu tried precision farming in growing vegetable crops like onion, chilli and turmeric in the red sandy loam soil. He spent Rs. 3,35,400 for cultivation practices and got high profit of Rs. 9,66,000 per hectare from turmeric, onion, chillies, coriander and red gram. He got this huge profit since he shifted from conventional farming to precision farming.

Biosphere 2

Biosphere 2 is an Earth systems science research facility, owned by the University of Arizona since 2011. Its mission is to serve as a center for research, outreach, teaching, and lifelong learning about Earth, its living systems, and its place in the universe

It is a 3.14-acre structure originally built to be an artificial, materially closed ecological system. Constructed between 1987 and 1991, it is the largest closed system created.

Biosphere 2 contained representative biomes: a rainforest, an ocean with a coral reef, a mangrove wetlands, a savannah grassland, a fog desert, an agricultural system, a human habitat

Biosphere 2 had two closure experiments, Missions 1 and 2, during which the structure was sealed with researchers living inside. The first closed mission lasted from September 26, 1991 to September 26, 1993. The second mission began on March 6, 1994 but Mission 2 was ended prematurely on September 6, 1994.

The Virgin Earth Challenge

The prize was conceived and financed by Sir Richard Branson, a successful British entrepreneur, and was announced in London on 9 February 2007

The Prize will be awarded to "a commercially viable design which, achieves or appears capable of achieving the net removal of significant volumes of anthropogenic, atmospheric GHGs each year for at least 10 years.

The Virgin Earth Challenge is intended to inspire inventors to find ways of bringing GHGs back down again to avoid the dangerous levels of global warming and sea level rise.

Among more than 2600 applications, 11 finalists were announced on November 2, 2011.

5 technologies for CO₂ removal (current CO₂ level 400 ppm)

1. Biochar

Biochar, created by pyrolysis of biomass. Pyrolysis is a process where biomass is partially combusted in an oxygen-limited environment, which produces a char rich in carbon.

This char can be distributed in soil and this Biochar can store large amounts of greenhouse gases in the ground for centuries

At the same time its presence in the earth can improve water quality, increase soil fertility and raise agricultural productivity

Finalists competing with biochar designs are Biochar Solutions, US, Black Carbon, Denmark, Full Circle Biochar, US

2. BECCS (Bio-energy with carbon capture and storage)

It is a greenhouse gas mitigation technology which utilizes biomass to extract carbon dioxide from the atmosphere, and carbon capture and storage technologies to concentrate and permanently store it in deep geological formations.

It was pointed out in the IPCC Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) as a key technology for reaching low carbon dioxide atmospheric concentration targets

The negative emissions that can be produced by BECCS has been estimated by the Royal Society to be equivalent to a 50 to 150 ppm decrease in global atmospheric carbon dioxide concentrations

3. Direct air capture

Direct Air Capture is the process of capturing carbon dioxide directly from ambient air using solvents, filters or other methods.

Subsequent to being captured, the carbon dioxide would be stored with carbon capture and storage technologies to keep it permanently out of the atmosphere.

Finalists competing with direct air capture designs: Carbon Engineering, Canada Climeworks, Switzerland Coaway, US Global Thermostat, US Kilimanjaro Energy, US

4. Enhanced weathering

Enhanced weathering refers to geoengineering approaches that use the natural or artificially created minerals to remove carbon dioxide from the atmosphere. This is of 2 types

Terrestrial enhanced weathering: It is the spreading of crushed silicate minerals and other minerals on the land surface

Oceanic enhanced weathering: It is the spreading of crushed silicate minerals and other minerals on the ocean surface. It utilizes wave energy for natural spreading of sand particles, silicate minerals

But in this the higher pH of seawater may substantially decrease the rate of dissolution of atmospheric CO₂ with the silicates

Eg. **Olivine** a mineral used in enhanced weathering

5. Grassland restoration

- It refers to changed management methods for grasslands can significantly increase the uptake of carbon dioxide into the soil, creating a carbon sink.
- This and other land use change methods is not generally considered among negative emission technologies because it is uncertain and very long-time taking strategy.
- Finalist competing with grassland restoration design: The Savory Institute, US
- **Criticisms:** CO₂ removal is slow to act, and requires a long-term political and engineering program to effect.

Amorphous metal

- An amorphous metal (also known metallic glass or glassy metal) is a solid metallic material, usually

- an alloy, with a disordered atomic-scale structure (glass-like structure)
- Properties: Most metals are crystalline in their solid state, which means they have a highly ordered arrangement of atoms. Amorphous metals are non-crystalline, and have a glass-like structure.
- But unlike common glasses, such as window-glass, which are typically insulators Amorphous metals have good electrical conductivity
- They have better resistance to wear and corrosion than metals but thermal conductivity (ability to transfer heat) of amorphous materials is lower than that of crystalline metal.
- Applications:** Used to build highly efficient transformers - Amorphous metals have high electric resistance and low coercivity leads to low loss.leads to low losses by so used to build highly efficient transformers.
- The most useful property of bulk amorphous alloys is that they are true glasses, which means that they soften and flow upon heating. This allows for easy processing, such as by injection molding, in much the same way as polymers. As a result, amorphous alloys have been commercialized for use in sports equipment, medical devices, and as cases for electronic equipment
- Electronic article surveillance (such as theft control passive ID tags,) often uses metallic glasses because of these magnetic properties.
- They can be used as biomaterial for implantation into bones as screws, pins, or plates, to fix fractures

Bioplastics

- Bioplastics are plastics derived from renewable biomass sources, such as vegetable fats and oils, corn starch, pea starch or microbiota. Bioplastic can be made from agricultural byproducts and also from used plastic bottles and other containers using microorganisms
- Bioplastics can be composed of starches, cellulose, biopolymers, and a variety of other materials.
- Applications:** Bioplastics are used for disposable items, such as packaging, crockery, cutlery, pots, bowls, and straws. They are also often used for bags, trays, fruit and vegetable containers and blister foils, egg cartons, meat packaging, vegetables, and bottling for soft drinks and dairy products.
- These plastics are also used in non-disposable applications including mobile phone casings, carpet fibres, insulation car interiors, fuel lines, and plastic piping,
- New electroactivebioplastics are being developed that can be used to carry electrical current. Also, Medical implants made of bioplastics which dissolve in the body, can save patients a second operation.
- Advantages:** Bioplastics are designed to biodegrade and production of some of the bioplastics is cheaper than normal plastics.
- Common plastics, such as fossil-fuel plastics, are derived from petroleum. Production of common plastics requires more fossil fuels and produces more greenhouse gas so bioplastics are more environment friendly.
- Some of the normal plastics can be toxic in nature (eg. Poly-vinyl chloride (PVC) and formaldehyde-based laminate work surfaces). Bioplastics could solve the problem to an extent.
- Some States like Andhra Pradesh, Himachal Pradesh and Rajasthan have totally banned plastic bags and others are moving towards that but it is still miles to go, so bioplastics can be good environment friendly alternative.
- Shrimp shells which can be used for manufacturing bio-plastic products so Aqua farmers now can fetch good money from shrimp shell

Conductive Polymers

- Conductive polymers are organic polymers that conduct electricity. Such compounds may have metallic conductivity equal to metals or semiconductors.
- They can offer high electrical conductivity but do not show similar mechanical properties to other commercially available polymers.
- The biggest advantage of conductive polymers is their processability, mainly by dispersion

- An Indian scientist, Mrinal Thakur has been nominated for the 2003 Nobel Prize in Chemistry for his discovery of non-conjugated conductive polymers
- Two Americans — Alan Heeger and Alan MacDiarmid — and a Japanese, Hideki Shirakawa, won the Chemistry Nobel in 2000 for their discovery conductive polymers
- **Recent Development:** The new nanostructured forms of conducting polymers particularly, augment this field with their higher surface area and better dispersability.
- **Applications:** Specially designed organic polymer can emit light when electric current is passed through them so they have been incorporated into commercial displays and batteries eg. OLED TV. These photodiodes are more energy saving and generate less heat than light bulbs also flexible displays can be made using them.
- They are also promising in organic solar cells, printing electronic circuits, actuators, supercapacitors, chemical sensors and biosensors, flexible transparent displays, electromagnetic shielding and possibly replacement for the popular transparent conductor indium tin oxide.
- Eg. polyaniline is widely used for printed circuit board manufacturing – in the final finish, for protecting copper from corrosion and preventing its solderability
- It is also used on computer screens, protecting the user from electromagnetic radiation, and as a corrosion inhibitor
- Another use is for microwave-absorbent coatings, particularly radar-absorptive coatings on stealth aircraft.
- **Limitations:** There have had limitations due to the manufacturing costs, material inconsistencies, toxicity, poor solubility in solvents, and inability to directly melt process.

Femtotechnology

- Femtotechnology is a hypothetical term used in reference to structuring of matter on the scale of a femtometer, which is 10^{-15} m
- This is a smaller scale in comparison to nanotechnology and picotechnology which refer to 10^{-9} m and 10^{-12} m respectively
- Work in the femtometer range involves manipulation of excited energy states within atomic nuclei to produce metastable (stabilized) states with unusual properties.
- Metastable refers to the fact that these excited states have half-lives more than 100 to 1000 times the half-lives of the excited nuclear states that decay with a "prompt" half life (ordinarily on the order of 10^{-12} seconds)
- Practical applications of femtotechnology are currently considered to be unlikely. The hypothetical hafnium bomb can be considered a crude application of femtotechnology.

Magnetic refrigeration

- Magnetic refrigeration is a cooling technology based on the magnetocaloric effect (ME). This technique can be used to attain extremely low temperatures, as well as the ranges used in common refrigerators.
- ME refers to the warming and cooling of a magnetic material when a magnetic field is applied and removed.
- Gadolinium and its alloys are the best material known for magnetic refrigeration near room temperature
- As of 2013 this technology had proven commercially viable only for ultra-low temperature cryogenic applications which is used in space crafts but The discovery of giant magnetocaloric effect (GME) (some alloy of Gadolinium) materials will significantly accelerate the development of cost effective magnetic refrigeration appliances for small temperature spans, such as room and automotive air conditioners.
- **Advantage:** It is more energy efficient and environment friendly than conventional vapour cycle refrigeration as there is no compression/expansion and no use of HFCs, CFCs, hazardous ammonia.

- The magnetic refrigeration is already competitive compared to vapour cycle refrigeration in large scale applications such as gas liquefaction, super-market sized freezers, air-conditioning of large spaces, industrial chemical processing

Scramjet (supersonic combusting ramjet) Technology

- Scramjet is a variant of the ramjet that works at higher speeds. It uses atmospheric oxygen (hypersonic air flow) to burn its fuel. This reduces the amount of fuel that the rocket should carry at lift-off, resulting in considerable cost savings.
- How it works:** The scramjet is composed of three basic components: a converging inlet, where incoming air is compressed; a combustor, where gaseous fuel is burned with atmospheric oxygen to produce heat; and a diverging nozzle, where the heated air is accelerated to produce thrust. The speed of the aircraft moving through the atmosphere force the air to compress within the inlet.
- Theoretical projections place the top speed of a scramjet between Mach 12 (8,400 mph; 14,000 km/h) and Mach 24 (16,000 mph; 25,000 km/h) but practically Mach 9.68 has been achieved by NASA's X-43a experimental aircraft in 2010
- India's status:** The Vikram Sarabhai Space Centre (VSSC) is carrying out the ramjet combustor development programme in collaboration with the National Aerospace Laboratories (NAL), Bangalore.
- In 2006, ISRO had successfully tested the use of oxygen moving at a speed of Mach 6 - six times the speed of sound - in laboratory conditions to produce a stable supersonic combustion lasting for a few seconds.
- With this, India has joined the elite club comprising a handful of nations that are working on mastering the technology. The U.S., Japan, China, Russia, Australia, and some countries in Europe
- Advantages:** Using scramjet technology will enhance the payload capability and reduce the cost because it does not have to carry oxygen to burn its fuel and not need rotating parts to compress air (as used in conventional jets, all of which add weight, complexity, and a greater number of failure points to the engine).
- Higher speed could mean cheaper access to outer space in the future
- Challenges:** Hypersonic flight within the atmosphere generates immense drag
- Temperature found on the aircraft and within the engine can be much greater than that of the surrounding air so "active cooling" is required in which coolant circulating throughout the vehicle skin prevents it from disintegrating.
- Maintaining combustion in the supersonic flow presents additional technical challenges, as the fuel must be injected, mixed, ignited, and burned within milliseconds.
- Another limitation is the availability of oxygen. Oxygen is limited to the atmosphere and is dense in the 10-20 km region. So scramjet can be used optimally at this height.

Superalloy

- A superalloy (high-performance alloy) is an alloy that exhibits excellent mechanical strength and resistance to creep (tendency for solids to slowly move or deform under stress) at high temperatures; good surface stability; and corrosion and oxidation resistance
- A superalloy's base alloying element is usually nickel, cobalt, or nickel-iron
- Superalloys develop high temperature strength through solid solution strengthening. Oxidation or corrosion resistance is provided by elements such as aluminium and chromium.
- Applications** of superalloys include: gas turbines (commercial and military aircraft, power generation, and marine propulsion); space vehicles; submarines; nuclear reactors; military electric motors; racing and high-performance vehicles, chemical processing vessels, bomb casings. e.g. turbine blades for hot sections of jet engines, and bi-metallic engine valves for use in diesel and automotive applications
- Examples** of superalloys are Hastelloy, Inconel (e.g. IN100), Waspaloy, Rene alloys (e.g. Rene 41, Rene 80), Haynes alloys, Incoloy, MP98T, TMS alloys, and CMSX (e.g. CMSX-4) single crystal alloys.

Part D : Not So important Topics

Sovaldi (sofosbuvir)/Olysio (simeprevir)

- Sofosbuvir (brand name Sovaldi) is a **drug to treat hepatitis C** infection.
- The U.S. FDA has approved a breakthrough therapy for treatment of chronic hepatitis C that is expected to offer a **more palatable cure** to millions of people infected with the liver-destroying viral disease.
- Sovaldi (sofosbuvir) is the first drug that has demonstrated safety and efficacy to treat certain types of HCV infection without the need for co-administration of interferon.
- Olysio (simeprevir) a similar purpose drug was also approved recently.

Reinvent the Toilet Challenge

- "Reinvent the Toilet Challenge," is a Water, Sanitation & Hygiene program initiated by Bill & Melinda Gates Foundation.
- Under this program grant is provided to develop a next-generation toilet that can be used to disinfect liquid and solid waste while generating useful end products, both in developing and developed nations.
- In October 2013, the Department of Biotechnology (DBT) under the Ministry of Science and Technology of the Government of India and the Bill & Melinda Gates Foundation in collaboration with India's Biotechnology Industry Research Assistance Council (BIRAC) launched the Reinvent the Toilet Challenge:India. This partnership will support sanitation research and development projects conducted by Indian individuals and organizations to extend affordable sanitation services to poor communities.

In News: A revolutionary waterless toilet powered by the sun, developed to help some of the 2.5 billion people lacking safe and sustainable sanitation around the world, will be unveiled in India this month. Designed and built using a \$7,77,000 grant from the Bill & Melinda Gates Foundation, the self-contained, waterless toilet with its innovative technology converts human waste to **biochar***, a highly porous charcoal. (TOI March 2014)

RapiDot Diagnostic Kit:

- It is a diagnostic kit **to detect white spot virus in shrimps**.
- It has been developed by the Mangalore-based College of Fisheries.
- The new diagnostic kit is extremely cheap costing Rs 40-50 per test ,can detect the disease within 5 minutes and has long shelf life.
- Shrimp is a small shellfish that has a long body and legs and that is eaten as food .White spot diseases cause an estimated loss of Rs.500 crores to the shrimp culture industry in India

Earclip-type Wearable PC:

- It's a new prototype of wearable personal computer being developed by Japanese researcher.
- This tiny ear computer can be worn on the ear and can be controlled with the blink of an eye or the click of a tongue.
- The device is a battery-powered and comes with built-in storage that allows users to upload software, apps and files to their ear-worn clip.
- The computer uses infrared sensors that monitor tiny movements inside the ear and can recognize every time a wearer's eyes and mouth move.
- The new prototype can be useful for Useful for rock-climbers, hikers, cyclists, people with disabilities, etc.

Welspun Solar MP Project:

- It is the largest solar power plant of India. It is a 130 MW capacity plant coming up in Neemuch , MP.
- This Project will raise Indian solar capacity by 7 percent.
- The project is being developed by Welspun Energy Ltd. (WEL) is the biggest developer of solar photovoltaic projects of India.
- The Union Government launched the Jawaharlal Nehru National Solar Mission (JNNSM) in 2010. India currently has a grid-connected solar-power capacity of 2208 MW. The JNNSM aimed for India to reach an installed capacity of 20000 MW (or 20 gigawatts) of solar power by 2022.
- The production cost of solar power in India has fallen by more than half in recent years, from 17 rupees per kilowatt-hour (kWh) three years ago to 7.50 rupees per kWh now. But these costs are still high compared to coal (2.50 rupees per kWh), nuclear (3 rupees per kWh) or natural gas (5.5 rupees per kWh).

“Digital Holographic Microscopy” technique:

- This new technique has been used to develop first ever 3D film of a living sperm.
- The new technique gives morphology(form and structure) and motility (ability to move spontaneously and actively) data on sperm.
- The knowledge about sperm's form and structure can be used to detect potential infertility-causing anomalies, such as the “bent tail” that prevents the cells from swimming straight. This can possibly help doctors to select most viable sperm to improve odds during In Vitro Fertilization (IVF).
- Also data on motility is a key indicator of success of IVF technique.

Theatre Level Operational Readiness Exercise (TROPEX) :

- It is one of the largest war drills spread over Indian Ocean , Arabian Sea and Bay of Bengal region
- The drill involved large scale naval manoeuvres in all three dimensions surface, air and underwater like nuclear submarine INS Chakra
- Such war exercises helps to asses the operational readiness of naval units ,validate Navy's war doctrines and integrate newly included capabilities in its Concept of Operations
- One of the major focus was to validate Navy's network centric warfare capabilities. Recently launched GSAT-7 was utilized for this purpose.

Charkilo:

- It is the newest miniature planet to be discovered.
- It has been discovered by astronomers from Niels Bohr Institute.
- The unique thing about the miniature planet is its two rings of ice and pebbles. Till now, rings have only been observed around giant planets viz. Jupiter, Uranus, Neptune and especially Saturn. This is the first time that such a small celestial body with rings has been observed.
- It is located between Saturn and Uranus in the Kuiper Belt. Kuiper Belt is a collection of thousands of dwarf planets and comets in orbit beyond Neptune on the edge of our solar system

Olive Ridley Conservation Programme:

- The conservation programme was resumed after 25 years by Forest Department of Tamil Nadu government.

- Under the programme , a hatchery has been set up at Besant Nagar.The eggs were collected and deposited in the hatchery. The new born from the hatched eggs were then released into the sea.
- Olive Ridley is one of the smallest sea turtles,found only in warmer waters, including the southern Atlantic, Pacific and Indian Oceans.
- These turtles are solitary, preferring the open ocean. They migrate hundreds or even thousands of miles every year, and come together as a group only once a year for the *arribada*, when females return to the beaches where they hatched and lumber onshore, sometimes in the thousands, to nest.

Bacillus pumilus SAFR-032:

- It is a spore forming bacteria.
- It is being widely researched because of its observed ability to withstand harsh conditions.
- The significance of above bacteria needs to be understood in context of our effort to look for life on planets other than Earth.If the current space craft landing on such planets (eg Curiosity Rover on Mars) carries with it microbes ,it will contaminate the environment of the planet.Then even if any living organism is found later , it will be impossible to ascertain whether that living organism existed from before or was brought tp the planet by any man made space craft that landed on it.
- To prevent above scenario,every space craft landing on a planet is sanitized and allowed to carry only a bare minimum levels of living organisms.Of course , completely sanitiosing a space craft is impossible. The assumption is that this negligible amount of living organism will not survive the harsh conditions of space travels.
- However, as the research shows that microbes like SAFR-032 can survive longer than expected under harsh space like conditions. This means that there is a greater chance of a microbe being carried to a planet by a man made space craft.
- This latest research is hence expected to push more stringent rules and standards in the domain of biological load of such space crafts ,for the future missions to such planets.

In News: Bacteria from Earth can colonise Mars: NASA - The Hindu; Earth bugs may soon hike to Mars: Nasa - The Times of India

Putnisite:

- It is the newest mineral discovered. It has been discovered by scientists in West Australia.
- The new mineral exists as tiny crystals.
- It has unique structure and composition. It combines the elements strontium, calcium, chromium, sulphur, carbon, oxygen and hydrogen.The unusual combination of elements is the most unique thing about the new mineral.
- it is unclear whether Putnisite will have any practical applications.

KrishiShakti

- It is a small range (10-12 hp) tractor developed by CSIR to empower the Indian farmers for **mechanized agriculture**.

INS Kamorta

- INS Kamorta,is the “first Indian Naval warship ever built in the country with almost 90 per cent of indigenous content.

- The warship is being built with indigenously developed special grade high-tensile (DMR249A) steel produced by SAIL (Steel Authority of India)
- It is a super-sophisticated frontline warship first in series of anti-submarine corvettes built by Kolkata based Garden Reach Shipbuilders & Engineers Ltd. (GRSE).

101st science congress

- Indian Science Congress Association (ISCA) is a premier scientific organisation of India with headquarters at Kolkata, West Bengal. The association started in the year 1914 in Kolkata and it meets annually in the first week of January every year. Today, it has a membership strength of more than 30,000 scientists.
- The Prime Minister of India(at that time), Dr.Manmohan Singh inaugurated 101st Session of Indian Science Congress (3-7 February 2014) at Jammu University, Jammu. In his address, while emphasizing upon the need to eliminate unscientific prejudices he said, to ensure food security and to improve land and water productivity, we have to launch a national drive for an ever-green revolution.

National Technology Day

- On 11th May, 1998 India achieved a major technological breakthrough by successfully carrying out nuclear tests at **Pokhran**. Also first, indigenous aircraft "Hansa-3" was test flown at Bangalore on this day and India also performed successful test firing of the Trishul missile on the same day.
- Considering above technological achievements on a particular date i.e. **11th May**, the day of 11th May was chosen to be commemorated as National Technology Day.
- Technology Day is celebrated as a symbol of quest for scientific inquiry, technological creativity and the translation of that quest in the integration of Science, Society and Industry. This day is also celebrated to honour technological innovations and their successful commercialization which makes fruits of research reach people at large.

SindhuSadhana

- First ever indigenously built Research Vessel (Ship) " SindhuSadhana "
- Acquired recently by the CSIR-National Institute of Oceanography.
- SindhuSadhana is a multi-disciplinary research vessel equipped with a number of laboratories for data collection, echo sounders, acoustic doppler, profiler, autonomous weather station, air quality monitors and a host of other world-class latest equipments in the field of ocean technology and ocean research.

SCAR Medal 2014 for Excellence in Science and International Coordination

- The SCAR medal for 2014 for International Scientific Coordination is being jointly awarded to RasikRavindra (India) - Panikkar Professor, MoES and Mahlon "Chuck" Kennicutt (USA)- for their collaborative and coordination roles in the science community and the leadership and vision they have both shown to the community.
- The Scientific Committee on Antarctic Research (SCAR) is an interdisciplinary body of the International Council for Science (ICSU). It was established in February 1958 to continue the international coordination of Antarctic scientific activities.

'Jammu Kashmir Arogya Gram Yojana'

- Under this the CSIR (Council for Scientific & Industrial Research), affiliated with the Ministry of Science & Technology, will identify thousand villages in Jammu & Kashmir for the growth of aromatic plants with active participation of local farmers and owners of the land.
- The Government will initially spend over Rs.25 crores on this scheme in addition to technical support by a team of CSIR scientists.

First Indigenously Developed Diagnostic Test Kit for Intestinal Disorder “Celiac Disease”

- First Indigenously developed, cost-effective diagnostic test kit, the first of its kind in India, for the autoimmune “Celiac disease”, which is a lifelong intestinal disorder manifesting as intolerance to certain foods such as wheat, barley, etc. with symptoms like recurring abdominal pain, diarrhoea and weight loss was launched recently.
- It has been developed by Department of Biotechnology via PPP model.

CARPEDIEM (Cardio-Renal Pediatric Dialysis Emergency Machine)

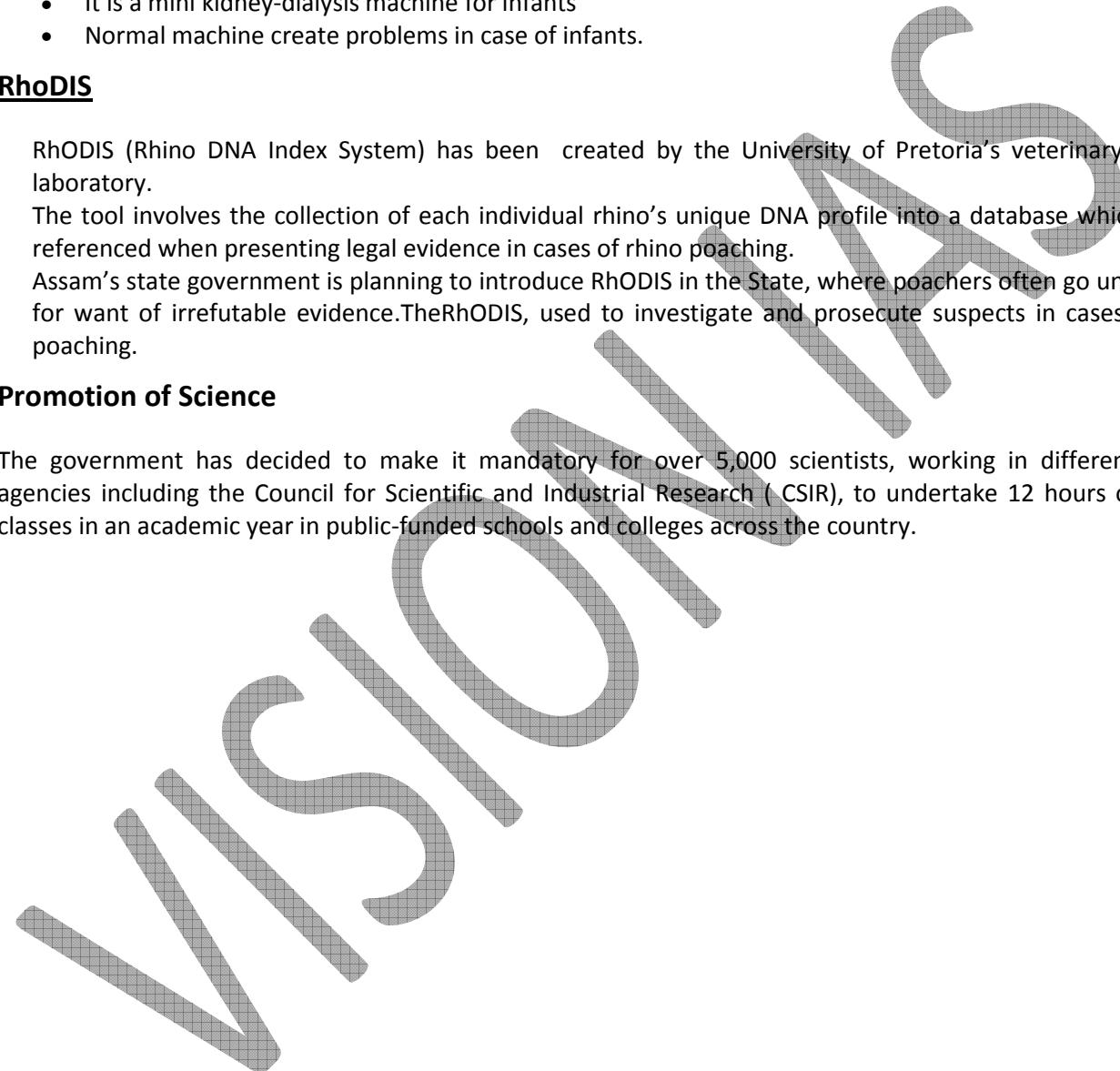
- It is a mini kidney-dialysis machine for infants
- Normal machine create problems in case of infants.

RhoDIS

- RhODIS (Rhino DNA Index System) has been created by the University of Pretoria's veterinary genetics laboratory.
- The tool involves the collection of each individual rhino's unique DNA profile into a database which can be referenced when presenting legal evidence in cases of rhino poaching.
- Assam's state government is planning to introduce RhODIS in the State, where poachers often go unpunished for want of irrefutable evidence. The RhODIS, used to investigate and prosecute suspects in cases of rhino poaching.

Promotion of Science

The government has decided to make it mandatory for over 5,000 scientists, working in different central agencies including the Council for Scientific and Industrial Research (CSIR), to undertake 12 hours of lecture classes in an academic year in public-funded schools and colleges across the country.



Copyright © by Vision IAS

All rights are reserved. No part of this document may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior permission of Vision IAS