

# MODULE - 4

## AI, ROBOTICS, NANO-TECHNOLOGY, IT

### # NET NEUTRALITY

- In news for freebasics.org → FB + Reliance + 17 Infotainment sites came together and the plan was any subscriber of Reliance visiting these Infotainment sites will not be charged for Data
- " " " zero Rating Plan of Airtel
- Airtel and Flipkart had a tie up and " subscribers were not charged for data if they visit Flipkart.

• Both these plans were criticised by civil society

### → WHAT IS NET NEUTRALITY?

- Internet should be neutral.
- Same speed → No Data Throttling, no Data Blocking.
- Equal access to all sites
- Same cost. e.g. JIO (free for all)
- In the debate of Net Neutrality there are 4 stakeholders.

- 1) Government
- 2) Customer/ consumer
- 3) Telecom Service Provider
- 4) OTT (over the top) → e.g. Ecommerce, social media, sites video streaming etc  
Anything dependent on internet.

- Argument of Telecom service provider was that they should be allowed to have to share profit of OTTs, b/c they are investing in infrastructure, paying the tax, buying spectrum.  
Govt refused to accept the proposal on the ground that it will reduce the options of customer.

### PROS

- In access to masses, reduce digital divide
- as aspirations will increase, people will move from free to paid internet

### CONS

- Fragmentation of internet  
3 classes → haves, have nots, limited access.
- It will kill competition.
- Detrimental to emerging culture of startups.

- Mark Zuckerberg, Free Basics → Some internet is better than no internet
- India is one of the least connected countries and we are here to provide internet connectivity to bridge internet divide
- TRAI asked people what they want and overwhelming no. of respondents said no to freebasics.org.

## → TRAI GUIDELINES

1. No paid prioritisation.
2. No Data blocking
3. No Data throttling.

Exception → Emergency services, closed electronic communication group (INTRANET)

4. If there is any violation, penalty = ₹ 50000/- per day (upto ₹ 50 lakh in total)

→ There is no universal benchmark for net neutrality.

→ US, UK, paid prioritisation is legal - Not in India.

→ In order to push internet taxes the options for India are:-

- ① NoFN → Bharat-Net (National Optical fibre Net)
- ② Universal Service Obligation fund should be utilized.
- ③ Corporate Social Obligation.

→ Is it a good thing for India to use paid prioritisation?

- No. It will create fragmentation of internet
- Split-Internet / Splinternet.

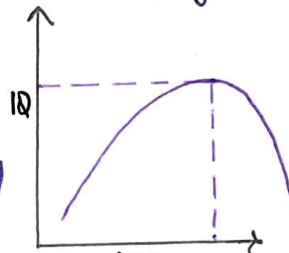
## ## ARTIFICIAL INTELLIGENCE (AI)

→ **INTELLIGENCE** - Ability of an individual to adjust in its environment, (social, physical, psychological).

It is being measured with help of IQ (Intelligence Quotient).

$$IQ = \frac{\text{Mental Age}}{\text{Chronological Age}} \times 100$$

- **IQ** → With age IQ level decreases.  
→ It is not a true reflector of the potential that is why EQ has replaced IQ.



• [Crystallised IQ] → Calculations etc. (declines with age) - information

• [Fluid IQ] → Opinion etc. (increases with age) - Knowledge.

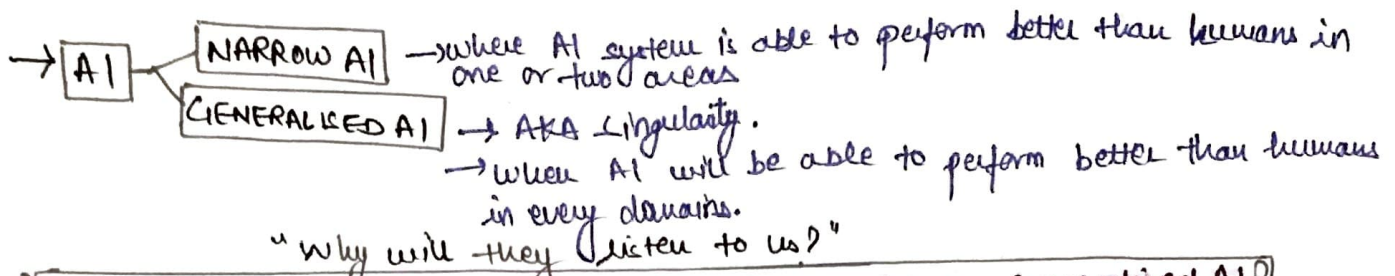
→ **EMOTIONAL QUOTIENT (EQ)** → e.g. Empathy, Communication, listening, understanding emotion.  
→ Emotional Intelligence.

⇒ **ARTIFICIAL INTELLIGENCE** → Depiction of human behaviour, like **speech recognition**, **voice recognition**, **pattern recognition** by the machines.

• **Human Behaviour** → most complex thing to understand, → eg Concept formation, memory, perception, emotion, motivation.  
• all this put together is human behaviour/personality.

→ The term 'Artificial Intelligence' was given by British mathematician Alan Turing "Computers are only machine capable of elements of human behaviours"





Why haven't been able to move from Narrow AI to Generalised AI?

Why do we need Generalised AI?

① Associated with the ultimate objective of Robotics AI i.e. to have artificial persons in form of humanoid / Android Robot.  
[GOAL OF ROBOTICS]

Reasons | Impediments in development of Generalised AI

① Lack of natural language ability, it is the attribute of human beings to take decisions, draw inference, critical thinking, understanding social context etc.

② They have not yet passed Turing Test.

Turing Test → When human beings will fail to distinguish b/w the work of human and work of a robot, they will pass Turing Test.

③ They (AI system) cannot transfer from one Architecture to another architecture.

④ The information processing capacity of AI system is very high as compared to human beings.  
e.g. Watson → defeats everyone in chess, scans 8mm moves in 1 second.

⇒ WHY WE NEED GENERALISED AI

① Transhumanism → taking humanity to the next level.

→ Outsourcing routine activities to AI machines.

→ But in a country like India, before introducing such technology we have to enhance the skills of the people, otherwise it will lead to massive unemployment.

e.g. Pradhan Mantri Kausal Vikas Yojna (PMKVY)

→ Acc to FICCI etc, 6mm jobs will be gone.

→ Acc to experts, there will be "polarisation of skill set" → where very few individuals with advanced skill sets will control the organisation.

- Two classes of students (private, public colleges)

- we need public sector education only.

- Check reckless privatisation, assessment of teachers should be done.

develop aptitude in school

→ students doing courses without aptitude

→ middle level jobs will cur and such a situation will be completely unstable (big population without skills at the bottom)

→ Acc to world economic forum, "only technologically updated people will survive."

→ only Infosys, Wipro decided to train their mid-level executives.

② AI systems should use same tools as used by humans.

③ AI " " " have non-verbal communication skills which is a hallmark of human behaviour.  
e.g. ERICA.



# → EVOLUTION OF AI

## ① ARTIFICIAL NEURAL NETWORK

Structure will resemble the functioning of neurons, like neurons they also have input and output. Sensory (takes info to brain); motor (bring instruction from brain)

## ② MACHINE LEARNING

- ① It is defined as making machines to perform the task which comes naturally to human beings.
- ② Application in healthcare, education, e-commerce etc
- ③ In machine learning data is being used by algorithm to develop the programme.

### • Key Process Involved

eg. Driverless car,  
NITI Aayog AI  
Cancer treatment  
(Smart healthcare)

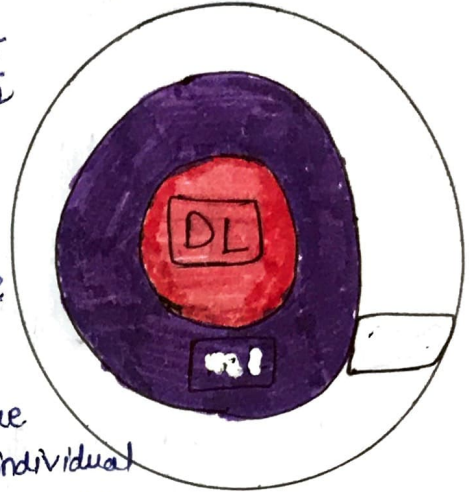
(i) **Data Mining** - It is about arranging the unstructured data in a meaningful manner.

(ii) **Data Analysis** - Drawing the inferences from structured data.

(iii) **Data Visualization** - selecting the right tools and analyse the complex data like GDP

(iv) **Recommendation system** - On the basis of previous history of an individual suggesting the likes and dislikes e.g. Youtube

(v) **Predictive modeling** - It is the further evolution of the recommendation system where how much overlapping the current issues having with previous history also depicted.



## ③ DEEP LEARNING

(Deep Neural Network → Input | ..... | Output)

- AI efforts are on ~~the~~ to input critical thinking abilities to the AI system.
- Related with neuromorphic computing (resembles functioning of human brain)
- Neuromorphic computers are analogue, efficient, faster.
- Developed by University of Manchester named SPINAKER (Spiking Neural Network Architecture)
- was used in SPOMINBOT.
- BLUE BRAIN PROJECT - Computer model of functioning of rat's brain.
- upgraded to Human Brain Project - Virtual model of working of human brain.



## ⇒ KAMAKOTI PANEL AND NITI AAYOG PAPER ON AI

- Kamakoti Panel was constituted by Ministry of Commerce.
- V. Kamakoti is from IIT-Madras

### → MANDATE OF KAMAKOTI PANEL

Q What should be the role of govt?

Q How to improve quality of life and solve problems of Indian citizens?

Q What are the ~~setting~~ sectors that can generate employment growth by AI?

### → GUIDELINES

- ① Inter-ministerial National AI Mission for 5 years with corpus of 1200 Crores.
- ② Set up centres of excellence, creation of inter-disciplinary data centres, AI based ~~AI based~~ curriculum for education and skilling.
- ③ Identified 10 imp. domains:-
  - Manufacturing, financial technology, healthcare, edu, Retail, Hospitality,

### → NITI AAYOG PAPER ON AI (#AIforall)

→ 5/yr 5 Areas of application of AI

- ① Agriculture | precision agriculture → Smart agriculture, Soil Health Card, Soil Health Card → Nano Sensors in field, blockchain technology.
- ② Healthcare → Imaging Bio Bank programme → Initiative of NITI Aayog, health history in centralised system.
- ③ Education.
- ④ Transportation - Smart mobility
- ⑤ Smart cities and infrastructure.

### → ROADMAP SUGGESTED BY NITI AAYOG

- ① Create Institutions → CORE (Centre of Research excellence) → basic Research  
→ ICTAI (International Centre for Transformational AI)  
→ applied Research.
- ② Scholarships to attract talent.
- ③ Innovation → IPR related to AI
- ④ Laws to protect IPR.
- ⑤ Courts to adjudicate
- ⑥ Assess the changing Nature of jobs and joblessness (Essay in Mains 2018)

### → Impediments

- ① Lack of AI Research
- ② u u Enabling Data Ecosystem
- ③ Inadequate availability of AI Expertise
- ④ Lack of clarity on privacy and security issues.
- ⑤ Unattractive IPR regime.



"Data will be the most viable part of 4th Industrial revolution"

## # DATA LOCALISATION

- Keeping data within the boundaries of a country.
- "Data is the new oil"
- C.J. → Circular issued by RBI - If you are MNCs (~~HSBC~~ HSBC, VISA), it is mandatory to keep data copy in India.
- E-Pharmacovigilance → Amd. Drugs and Cosmetic Act, 1945
  - They have to keep their portal in India.
- DISHA (Digital Information Security Healthcare Act)
  - Details of pathological data cannot be shared outside India.
- E-commerce Policy has incentivised the storage of data within India.
- ~~RBI circular for data mirroring.~~
- US came with cloud act (CLOUD ACT) - Clarifying Lawful Overseas Use of Data Act
- EU → GDPR (General Data Protection Rule) - PRE 2019
- China → allows but pass security check
- Russia → No data of any Russian will go out.

## POSITIVES

- ① Job of investigating agencies will become easy.  
FBI v. APPLE → didn't unlock phone of users (murders and deceased)
- ② Cost of law enforcement will come down → easy
- ③ NSA Buzin → Barack Obama time → US was carrying out electronic surveillance of leaders of world. (Concerns related to surveillance)
  - Violation of Privacy
  - Data localisation will prevent this
- ④ Digitization of Economy and Digital Information.
- ⑤ Next Generation Jobs, Data analytics
- ⑥ Research in ~~data~~ healthcare.
- ⑦ Privacy.

## NEGATIVES

- ① If we apply data localisation laws on MNCs they will do same, survival in competition variable
- ② It will turn away the investor.
- ③ In globalisation we need flow of data. Data ~~localisation~~ <sup>localisation</sup> will hinder this.
- ④ CEO across the globe, data here. (Impractical!)

→ PERSONAL DATA PROTECTION BILL, 2019

- DATA PRINCIPAL → Giving Data
- DATA FIDUCIARY → processing data of Data principal. e.g. Cambridge Analytica
- RIGHT TO BE FORGOTTEN
  - Right to Erase, Right to correct information
  - Bought in backdrop of "Petruwany case"
- PERSONAL DATA - Name, mob no., email ID, UID etc
- SENSITIVE PERSONAL DATA - Political Belief, Religious Belief, sexual orientation, Financial Data, health Data.
- CRITICAL " " - Defined by govt: from time to time.
- NON-PERSONAL DATA - Search history etc
- Personal Data, except critical, can be shared abroad with consent of individual, Sensitive Personal Data → govt exempted from consent.
- Right to be forgotten - Individual may ask not to reveal data, which hurts their image. → goes against freedom of media.
  - Concept imbedded in EU not USA.
- This bill introduced Data Portability - the data fiduciary have to give info in machine readable form to the Data Principle
- Right to correction and erase i.e., to get the things rectified and the removal of the information.
- Authorises social media networking sites to carry out user verification. This has been objected by many civil right groups as it will lead to another Cambridge analytics type of scandal.
- Violation → Penalty → 4% of global turnover / 15 crores (major)
  - Penalty - 2% of " " / 5 crore (minor)

# COMPUTING

- Quantum Phy.
- Heisenberg principle of Uncertainty
- Schrödinger's wave equation.

⇒ QUANTUM COMPUTING

- Based on Quantum mechanical mode of the atom where individual atoms, ions, molecules are being used for the storage and the retrieval of information.
- we're looking for supercooled atoms (Bose-Einstein Condensate) - just above state of matter multiple atoms | absolute behavior. like one unit
- Objective is to replace present days super computer with the desktop sized computers.
- India has started national mission on Quantum Computing.
- 3 principles of QUANTUM COMPUTERS
  - ① Entanglement
  - ② Superposition
  - ③ Qubit / Quantum Bit

- Quantum Phy. is probabilistic  
- Newtonian Phy. deterministic



## → QUANTUM ENTANGLEMENT

- Demonstrated by S. Haroche, David Wineland.
- They isolate a lead **ion**. Then they isolated a single **photon**.
- **ion (lead)** and photon brought close to each other.
- A parity got established b/w the lead ion and photon.
- Once a parity is connection / ~~linkage~~ linkage is made.
- By knowing the state of one, the state of another can be predicted. Influence of one will be reflected off in the influence of other.
- Entanglement has massive implications in Cyber security
- Quantum key distribution
- QUES China → entanglement is used.



Pb ion - Photon  
become one  
bond

## → SUPERPOSITION

- Probability of a particle existing in two states simultaneously is called superposition.
- To explain this, Schrodinger <sup>used</sup> gave "cat in box paradox"



→ Till the time box is closed, both possibilities exist (cat could be alive or dead)

→ one of the biggest challenge in the development of Quantum computer is that how to sustain the state of superposition.

## → QUBITS | QUANTUM BITS

- Capacity of
- Capacity of a Quantum computer is expressed in Qubits.
- Possibility where all the ~~comp~~ combinations can exist simultaneously.
- e.g. 0-0, 1-0, 0-1, 1-1

- \* Computer's power will increase exponentially ( $2^n$ )
- \* Google demonstrated Quantum supremacy - Quantum computer performed calculation which can be done by machine of IBM in 10000 years.
- \* D-Wave of Canada → one of the front runner to develop Quantum computers. These will be used for Drug discovery, big data analyses.
- \* Building a Quantum computer is one of the dimension under digital India as well.

## → NATIONAL MISSION ON QUANTUM COMPUTING

- 5 years, budget ₹8,000 crore

→ USA → passed National Quantum Initiative Act.



## ⇒ CHALLENGES

- Duplication of Research
- Lack of Ecosystem for research, in Quantum Tech.
- Lack of Expertise in Quantum Tech.
- 43% of patents related to Quantum Tech is with China.
- Private sector participation and investment is on lower side.
- Lack of co-ordination.

⇒ QUEST - QUANTUM ENABLED SCIENCE & TECHNOLOGY, Hyderabad.  
⇒ TIFR started QuMAC → QUANTUM MEASUREMENT & CONTROL  
⇒ IBM → Quantum Computing Initiative  
[Named after Eagle, Osprey, Condor]

## ⇒ APPLICATIONS OF QUANTUM COMPUTING

- ① Healthcare
- ② Defence
- ③ Telecom
- ④ ~~Telecom~~ Aerospace
- ⑤ Big Data

## ⇒ QUANTUM START-UPS IN INDIA

- ① Y2Q - Years to Quantum
- ② Qune Labs
- ③ Atomaski
- ④ Entanglement Partners.

## # OPTICAL COMPUTING

- These computers will use photonics for storing and retrieving the information.
- only light will be used.
- Binary computers - 0 or 1
  - ↳ optical transistors → will work on the principle of optical interference.
    - ① Constructive Interference
    - ② Destructive Interference.

## ADVANTAGES

- speed of light is 10x speed of current → 10 times faster than conventional computers.

→ Light does not require any medium to travel → computers will be compact.

→ No heating effect → more efficient.

### → CHALLENGE

→ There are no pure optical device — no programme in India.

→ As of now there are hybrid system

→

## # DNA COMPUTING / LIQUID COMPUTING / ORGANIC COMPUTING / BIOLOGICAL COMPUTING / MOLECULAR COMPUTING

→ DNA used for storage.

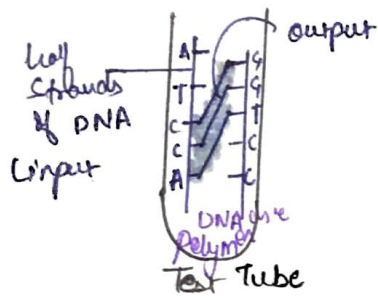
→ DNA is best example of programming

- Energy efficient

- massive data storage capacity → 1gm DNA will store upto  $10^{14}$  MB of data.

→ DNA computer works on the principle of complementarity → A-T

C-G



- Test tube taken

- Release half strands of DNA in test tube (input)

- Add enzyme → DNA polymerase

- strands will pair → output

→ DNA computing has been <sup>used for</sup> proof of concept

① To solve the Hamiltonian Path Problem AKA Travelling salesman problem.

- A network of cities

A B C D E

C<sub>1</sub> D<sub>3</sub> E F G

A<sub>2</sub> A<sub>4</sub> D<sub>2</sub> H I

} no. of solution increase as no. of cities increase → exponentially.

② Calculated square root of certain figures.

③ Diagnosing infection and prescribing treatment.



"India is a 3<sup>rd</sup> most PhD awardee country"  
- China - no. 1

# # NANO-TECHNOLOGY

→ Richard Feynman → during of lecture he said, "there is plenty of space at the bottom"

- We are manipulating the matter at macro ~~scale~~ scale.

- If we manipulate the matter at fundamental scale, we will be able to manipulate matter at higher level, and properties of matter will be drastically different.

e.g. Concept was explained by experiment like -

e.g. Peacock feathers  
colour due to nano pores → scatter colour

- Nano Gold particles showing change in colour.
- Nano Aluminium particle (explosion) - as soon as they come into contact with oxygen.
- Silver nano particles → socks, soap, deodorant → kills sweat bacteria.

→ German Scientist Eric Drexler popularised the concept by book "Engines of Creation"

→ The term "Nano Technology" was used by Japanese Scientist - Norio Taniguchi

→ Nano-technology is the manipulation of matter at the fundamental scale.

→ CNR Rao Bharat Rama 2013 →

**AFM**, **STM** - microscopes by which we can observe atoms and molecules.

- If we can observe them, we can understand them,
- If we can understand them, then we can control them → use → nanotechnology.

- 1nm to 10 nm → nanoparticle.

## → Two APPROACHES

① **Top Down** → from macro to fundamental

→ reducing size of object

→ But laws of Physics will not allow us to reduce size beyond a point.

② **Bottom Up** → "Future Renaissance"

→ Nano technology has been defined as future/renaissance/revolution - b/c of its interdisciplinary nature. b/c of which new technological concepts will develop.

→ Providing convergence of Physics, Bio-tech, Chemistry, Computer.

→ Imp. pillar of 4<sup>th</sup> Industrial revolution.

→ E.g. Cyborg (Internet of things), Driver less cars, Apple watch, DNA Computing.

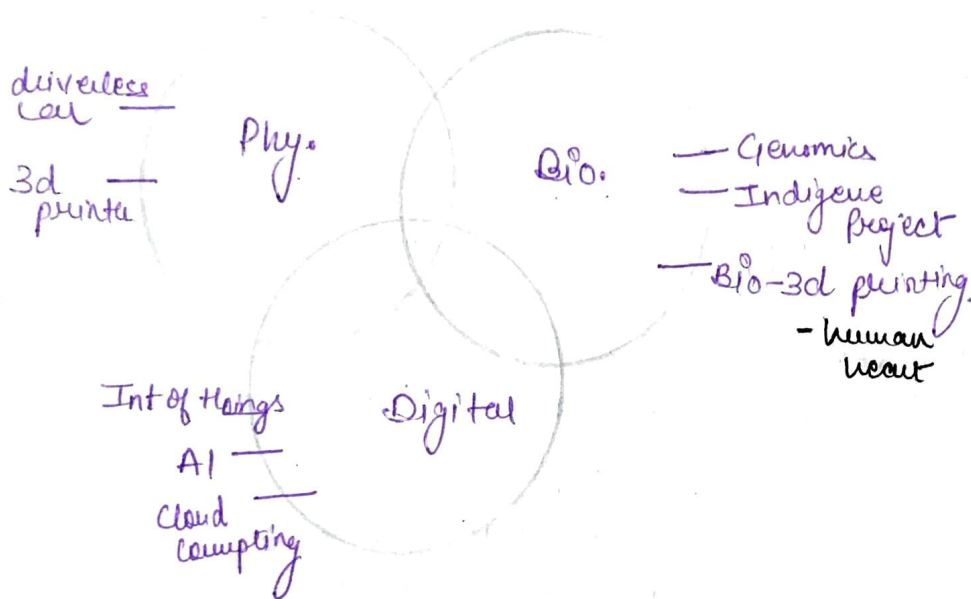
↳ blood sugar testing (glucometer) → chip inside body.  
↳ cyborg → challenge → change chip

# ⇒ 4<sup>th</sup> INDUSTRIAL REVOLUTION AKA INDUSTRY 4.0

→ This term was used by Klaus Schwab, founder of World Economic Forum.

- 1<sup>st</sup> Industrial Revolution - Steam Engine
- 2<sup>nd</sup> " " - Electricity → mass production.
- 3<sup>rd</sup> " " - Digital
- 4<sup>th</sup> " " - will be built upon the 3<sup>rd</sup> Industrial Revolution but in its case → lines which segregate Physical | Biological | Digital are getting blurred.

→ Defined as convergence of physical, biological, digital.



## ⇒ WHY IS IT KNOWN AS INDUSTRY 4.0

- ① Velocity → Rate @ which technology is increasing/growing  
 e.g. → Exponential innovation, data consumption, touch screen, vaccines
- ② Scope → going to disrupt every industry
- ③ Impact → Production, Management, Governance  
 → e.g. Fastag, Agra Metro ←

note: Gains of 3<sup>rd</sup> Industrial Revolution to be applied  
 - AI, Robotics, 3d-printing, Biotech, Nano tech, Autonomous vehicle, Quantum Computing.

→ Max. gains of Industry 4.0 → to people who will bring intellectual capital  
 ↳ " " " " " " ↳ physical capital.

→ Those will not be able to invest will face loss.

- Massive Jobloss
  - Societal Tensions will increase
  - Class Divide
- Low skill - low pay # High skills - High pay



- **World Economic Forum** - Set up a centre for Industry 4.0 @ Maharashtra.
- "Govt and Business leaders are supposed to make policies together."
  - Coordinate with USA (Capitalist), China, Japan (Capitalist)
  - This is dangerous for a country like India.
  - We should upgrade skills of the people before adopting technology.
  - Without skill it will hollow out the middle class.

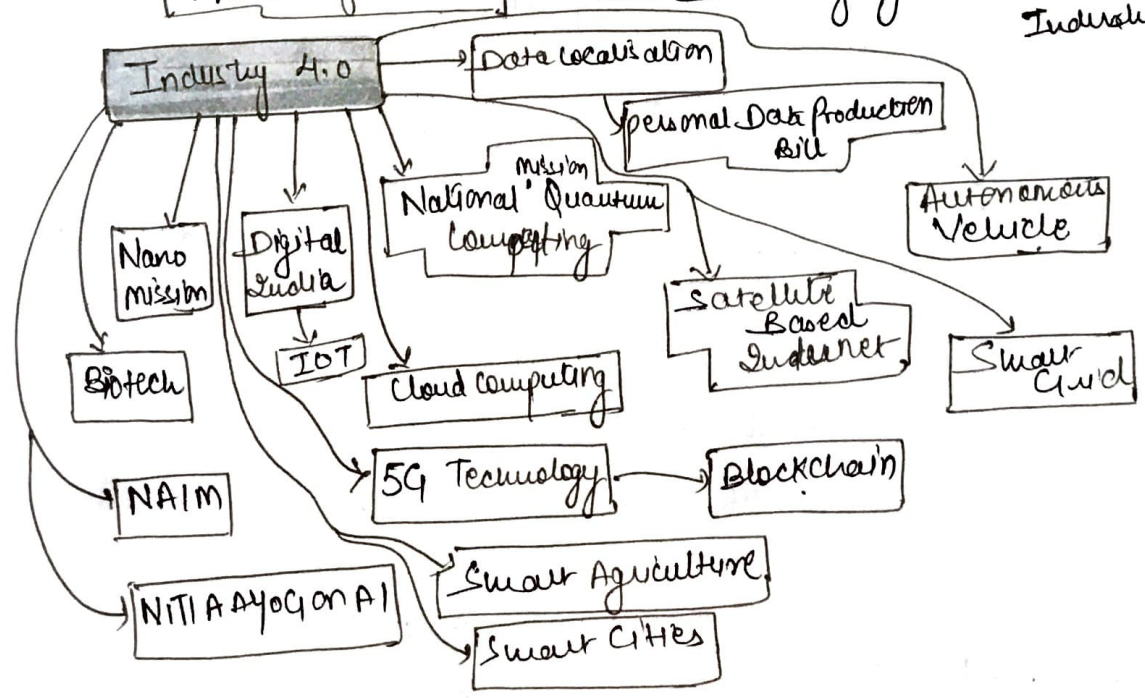
**Impact of Industry 4.0 (How bad it can be?)**

- ① **Government** - Anna Movement, Farmer's protest reached international news b/c of social media.
- These things demonstrate the people want accountability.
  - APJ Abdul Kalam asked for "concurrent Audit"
  - Transparency → but will depend on countrywise Policy
  - Faster grievance redressal
- ② **Business** - New players will emerge and established one's will die down.
- It will multiply the gains of 3rd Industrial Revolution
  - But → middle class jobs will be vanished.
  - Class divide.
  - It will be a huge business. AI alone will be a sector of 15.7 Bn USD by

**Logo**

**Frame of Answer**

→ "Data is going to be the base for Industry 4.0"



# # 5G TECHNOLOGY

## → EVOLUTION OF MOBILE TECHNOLOGY

**1G** → Analog → Didn't come to India

**2G** → Digital → Allowed voice and non-voice data

**2.5G** → Started the era of digital convergence in India.

→ mobile became a multimedia platform b/c of Internet due to **GPRS**

→ Max. Internet speed → **956 Kbps**

→ GPRS → General Packet Radio Service.

**2.75G** → Internet speed was faster.

→ EDGE (Enhanced Data rate for GSM evolution)

→ EGPRS (Enhanced GPRS)

**3G** → Distinguishing feature was video calling.

→ VoIP → Voice over Internet Protocol.

**4G/LTE** → Long Term Evolution (LTE)

→ VoLTE → Voice over LTE

→ mobile Revolution in India, Data became so cheap.

Jio → Telecom has become cheap

### **2G** **Scam**

- Cheap spectrum was to allow penetration tech. to grass root level.

- If this was bought @ 10% rate govt would've earned 10% amount of the

**CAI**

counter agreement → isn't it expensive?

### ① TIME DIVISION DUPLEX

- Operator only uses only one band for **uplinking & downlinking**.

"Unpaired spectrum"

same frequency band

info. is going to base tower

to avoid interference there is time gap b/w the two

### ② FREQUENCY DIVISION DUPLEX

- operator uses **paired spectrum** → 2 bands for uplinking and downlinking.

• **5G** → Transformative technology projected @ as a general purpose Tech. for Ind. 4.0.  
→ Not only internet speed, IoT also. @ max. 100 Mbps

• Low Frequency Bands upto 3GHz → Low, Already busy

• medium " " upto 3.2 - 3.67 GHz - faster

• High " " upto 4.25 - 28.5 GHz.

① Attenuation rate is faster

② Costliest Spectrum

→ Base price → DOT → 492 crore per MHz

→ An operator will require 100 MHz ⇒ 492 × 100 = ₹49200 crore

Challenges



- ③ Challenge → Involvement of Huawei → bc Proximity with Chinese govt  
 they can ask for data from Huawei whenever they like
- ④ → 80% of optical fibre needed.

→ O-RAN → Open Radio Access Network.

### CHARACTERISTICS OF 5G

- ① Enhanced mobile Broadband - Rural Area - 1Gbps  
 - Urban Area - 10 Gbps
- ② Ultra low latency → the time gap will be less than one millisecond.
- ③ Ultra high reliability
- ④ 80% fibrisation. needed
- ⑤ O-RAN.

→ Recently Dept of Telecommunication has constituted 8 working groups to suggest roadmap for 5G in Edu, FinTech, Agri, Smart Grid, Healthcare, Water treatment, Transportation, Industry 4.0.

→ 7/8 are done → then smart city will be made.

→ ~~Here~~ Spectrum can be made available easily but the attenuation of frequency will be very high. Even leaves absorb them. therefore, base station have to be at a very close distance to each other.

→ Indian Department of Telecom has initiated a process of 5G Trial, which includes Huawei as participant. USA, Jap, S-Korea banned Huawei from 5G service.

→ 5G will be such a deeply embedded technology where all types of data can be collected in a centralised manner.

→ For India, 5G will give long term dividends if there is indigenization of technology.

Dept of Telecom funded \$34 million large scale 5G demonstrator @ IIT Madras in that order IITs along with Indian Institute of Science participate.

→ They developed the equipment's for both the frequency ranges. Most of them were indigenous for e.g. IIT Hyderabad developed the chip but for some reason it was not scaled up.

→ Another issue w.r.t. spectrum pricing and spectrum availability, acc. to TRAI for 1MHz frequency the price is 492 crore. of an operator requires 100 MHz they have to shell around 49000 crore. 2 out 3 operators → massive losses.

→ Compared to S-Korea, Britain, the price of spectrum is 6-times in India.

# # NANO ETHICS

→ Emergence of ethical issues which are social, economic, environmental in nature due to increased proliferation of Nano Technology.

decomposition stopped

Impact on Environment

- [Silver nano particle on domestic waste & water → it killed bacteria.]
- It can disturb bio-geo-chemical cycle → Nitrogen, Carbon etc
- When silver nano particle soap use → it will enter sewage and then to food chain/food web.
- Nano particles will ~~assume~~ exhibit bio-accumulation / bio magnification.
- Once their concentration crosses the threshold then they will form free radicals. (most reactive species)
- These will disturb the cell physiology cycles → causes health issue
- An M.P. ~~from~~ from Vijaywada Mr. Sunivasan presented private member bill in the parliament that certain pesticides were mixed with silver nano particles.
- Most of the Nano products are of general consumption therefore they will ~~easy~~ make it very easy to enter into market and the chance of damage to the health and environment will further increase.
- Inhalation of nano-particles damage lungs and cause increase in the indicators of stress.
- Silicosis → accumulation of nano-particles in lungs.
- Israel was one of the first country to allow GM crops.
- A fungus has emerged and wiped out endemic crops.

## → Social Aspect

- Surveillance monitoring → violation of privacy
- Nano UAV (Drones) is of size of mosquito can be used easily to carry out surveillance.

## → Economic Aspect

Industrialised ——— C A P ——— developing  
↓  
Nano tech → IPR → gap increased.

## → Defence

- Nano tech + AI → Autonomous weapons → prohibited by International law but USA has developed ATLAS Robot defined as killer robot by Amnesty International.
- UAV Harop → autonomous weapon.
- Around 100 CEOs signed a pledge paper on International Joint-conference on AI that they will not develop Autonomous weapons.
- Acc. to UN chief such weapons are politically unacceptable and



Morally repugnant.

- As the international conventions, only those weapons which are wounded by human beings are permitted then only accountability can be fixed.
- These autonomous weapons can become an existential threat if they are hacked by ~~any~~ enemy of the state.

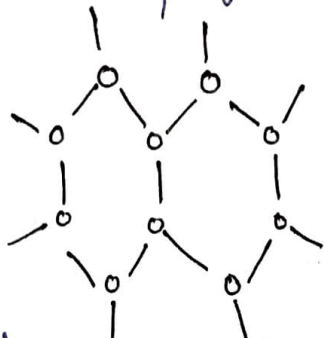
## # GRAPHENE & CARBON NANO TUBE

→ Carbon has Amorphous and Crystalline allotrop

↓  
Smoke

↓  
Diamond Graphite

→ Graphite is allotrope of carbon.



- Multiple layers in this fashion form Graphite
- Single layer of C-atoms taken out from graphite → Graphene.
- Graphene has 6-10 Carbon atoms.
- Lightest (one of the), strongest and most conducting material known to the mankind.
- Graphene is known as 'wonder material'.

### → Application

- ① Nano Electronics → Nano transistors  
↳ Rice university developed.
- ② Used in LED, OLED, touch screen.
- ③ Used in solar cells to increase efficiency.
- ④ Used in energy storage systems - ultra capacitors.
- ⑤ One of the source for Carbon Nano Tubes.

## # CARBON NANO TUBES

- Made of Graphite and Bucky Balls → both conductors.
- Lightest and strongest. w to s ratio is very low.
- Composite material → light and strong → space vehicle, space capsules,  
→ made by mixing two. → satellite
- Nano-sensors → can pick up harmful substances
- R.O. system → Hard water to soft drinking water. (desalination of water)
- TIFAC → Tech. Info. forecasting Assessment Council

→ To grow blood vessels

## ⇒ NANOTECH IN HEALTHCARE

→ Diagnosis ; Drug Delivery ; Neuroplasticity

E-Nose

TDDS  
DNA Based  
Nanoshell

Neuroelectronics

Bionics

↳ Prosthetics/Orthotic

## → DIAGNOSIS

→ E-NOSE developed by Israel Institute of Technology.

→ E-NOSE (Electronic Nano Olfactory sensors)

Two principles

① Whenever there is an onset of disease in human body, specific bio-markers are produced which are not only present in blood but also come out along with breath → stuck on ENOSE

② Gold Nano particles are also quite sensitive towards change environment as soon as they come in contact with some substance bio marker conductivity change which is enough to identify the signature chemical to diagnose a disease.

## → NEUROPLASTICITY

→ Changes in structure of brain etc of learning

→ Hippocampus → spatial memory

↳ activity — Bus/Cab driver

↳ Injury

where to ~~play~~ intervene and how to intervene to minimise the impact.

→ It is closely linked with neuro electronics when

transistor was connected to neuron to establish bi-directional flow of current.

→ It will lead to development of [Bionics] or biomimicry → which is defined as an artificial system trying to copy natural one.

E.g. ~~Bionic~~ Bionic Eye, Prosthetics, Orthotics

↳ Artificial limbs

↳ is science of artificial exoskeleton.

## → DRUG DELIVERY

→ Types → Nano shell, TDDS

① NANO SHELL → for cancer treatment

→ A layer of gold was coated on silica particles (1-100nm)



and injected a **rat** having tumour in neck.

↳ Injected **Nano shell**

↳ got accumulated in neck region.

→ The neck of rat was exposed to infra-red which were absorbed by nanoshell.

→ Temp. increased from  $38^{\circ}\text{C}$  to  $45^{\circ}\text{C}$  → enough to kill cancer cells.

→ Nanoshell is in phase of clinical trial.

### ② **TDDS (Targeted Drug Delivery System)**

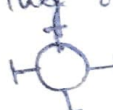
→ Smart Drugs.

→ Used for Gene therapy, cancer treatment.

→ A carrier molecule is fabricated by using nano-tech → **CNT**.

→ On the surface of this molecule, some chemical were attached.

→ They only react with surface which has cancer tissue.

→  → **Monoclonal Antibody** → to be injected in body of patient.

### ③ **DNA Based drug Delivery**

e.g. Moderna Pfizer → vaccine → m-RNA

→ also proposed for cancer treatment.

→ DNA helix are densely packaged in 3D cages structured to prevent against DNA-degrading enzymes.

### ⇒ **GENERATIONS OF NANO PRODUCTS**

→ Gen ① → Simple Nano particles.

→ Gen ② → TDDS

→ Gen ③ → Nanobot / Nanorobot → for carrying our surgeries @ the cellular level, gene therapy etc.

→ Gen ④ → modelled on living systems but there is lack of clarity which particular feature of living system they will copy, in present time xenobot comes close to that classification.