Industrial revolution 4.0

Part of: GS Prelims and GS-III- Economy (PT-MAINS-PT)

Technology forms the subtext of human development. History is loaded with instances of technology serving as catalyst in the grand narrative of human development. From basic necessities like food, air, water, clothing and shelter, to structural requirements like security technology has played a tremendous role in every field of human growth and survival.

Invention of the transistor:

- Around the year 1948 the invention of the transistor, a device with potential to have numerous applications in radio technology by replacing the vacuum tube, took place.
- The transistor is a resistor or semi-conductor device which helps amplify electoral signals as they get transferred through it.
- The presence of the transistor enables all kinds of binary logic operations and has brought a revolution to the field of electronics and computing.

Historical Perspective:

- Manifestations of various technological developments have resulted in various industrial revolutions since 17th/18th century onwards.
- However, during the last few decades, one country that has shown remarkable progress towards industrialization is China. Countries like Israel and India are known to have made some contributions too, with Israel playing a major role in the realm of technology development.
- The main features of these industrial revolutions are as follows:
  - **The First Industrial Revolution:** 1760 – 1840. It was a period which witnessed the emergence of steam engine, textile industry and mechanical engineering.
  - **The Second Industrial Revolution:** 1870- 1914. The revolution was about emergence of railways and steel industry.
  - **The Third Industrial Revolution:** 1969 – 2000. Electric engine, heavy chemicals, automobiles and consumer durables made their presence felt during this period.

This is an ongoing phase of this industrial revolution which has also been called as Industry 4.0. Developments in the oil industry and the IT industry have led the initial phase of Industry 4.0. At the same time, there are various other S&T innovations which are leading the progression of this Industrial Revolution.

Innovations in the field of Medicine:

- Invention of Penicillin during 1928 by the Scottish scientist Alexander Fleming could be considered as the beginning of the modern era of medicine. It transformed the field of medicine by its ability to cure infectious bacterial diseases.
- The discovery of DNA has totally revolutionized field of biology and demonstrated that this discovery would help humans to resolve various challenges beyond medicine. DNA profiling helps the law enforcement agencies towards solving crimes.
- Apart from these important discoveries, the research on the stem cell is also an important innovation. Such cells have the unique ability to develop into specialized cell types in the body which could be used to replace cells and tissues that have been damaged or lost.
due to disease.

- In addition, various innovations in the organ donation field which assist to replace (repair) eyes, lung, heart, kidney, liver, pancreas or intestine have helped human race immensely.

Innovations in the Power Sector:

- In the power sector, from nuclear power to solar power to space based solar power to biofuels, various clean options have been made available.
- Another interesting technology/method for energy generation is by using nuclear fusion reactors.
- Presently, much work is happening in the arena of development of nuclear fusion reactors. In southern France, International Thermonuclear Experimental Reactor (ITER) is getting developed. This technology, when fully operationalized, is expected to change the global energy habits.
- A major innovation could happen when the current nuclear fusion reactors where the hydrogen isotopes tritium and deuterium are used as the fuel would be replaced by other technology.
- If helium-3 and deuterium could be used as fuels, then a major revolution in the energy sector is expected.
- The helium-3 is not available on the earth’s surface, hence at present few states are undertaking missions to Moon where helium-3 is available in abundance.

Innovation in Modern Technology:

- For many years one of the best approaches to industrial production was considered as CNC (Computer Numerical Control) machine.
- Today, with the developments taking place in the additive manufacturing (AM) sector it is expected that a major change is at the doorstep of global manufacturing processes.
- This technology which is commonly known as 3D printing is a mechanism of direct digital manufacturing. This would allow object creation by simply using a digital file which is having the design of the product.

Internet of Things:

- At the heart of various technological innovations over the years, lies the Internet. This is the single most technology which has helped to change the face of the world within a few years.
- Internet 2.0 is expected to bring in major changes in the present-day setup of doing various things.
- Development in multiple fields of science and engineering like nanoscience, electronics, and sensor technologies are offering new opportunities to relate with internet differently.
- The idea of using internet differently and by using diverse effects (normally “thing” or “objects” are viewed as any possible items in the real world that could join the communication chain) is expected to upswing to the model of Internet of Things (IoT).
- Generally, IoT is considered to be simply a means of connecting different sensors to a network. Ambient Intelligence and Cognitive Technologies are anticipated to have a major impact on the future of IT. Technologies like Fog computing, Distributed computing, Cloud
computing, Big Data and Block-chain are expected to impact the future of IoT.

Artificial Intelligence:

- Artificial Intelligence (AI) is another technology which has been there for many years and is presently found making a lot of impact on the development cycle in various disciplines.
- Issues of ethics do get raised in regard to the applicability of AI.
- However, even today, AI is still an evolving technology and the scope for AI is varied.
- Broadly, it could be argued that AI and Internet 2.0 could decide on the future of the world.

Innovations in Space Technology:

- Developments in the field of Outer Space have been fascinating.
- This is one technological field, which could be said to have made major contribution towards addressing various issues of socio-economic importance.
- Voice and data communication in real time and offering accurate inputs for various development aspects and managerial issues has been the key focus of space technologies.
- Today communication, navigational remote sensing (earth observational), weather and scientific satellites actually almost fully control humans lives.