Dr J C Bose

- He was a polymath, physicist, biologist, botanist and archaeologist.
- He pioneered the study of radio and microwave optics, made important contributions to the study of plants and laid the foundation of experimental science in the Indian sub-continent.
- He was the first person to use semiconductor junctions to detect radio signals, thus demonstrating wireless communication for the first time.
- He was father of open technology, as he made his inventions and work freely available for others to further develop. His reluctance for patenting his work is legendary.
- Another of his well known inventions is the crescograph, through which he measured plant response to various stimuli and hypothesized that plants can feel pain, understand affection etc.
- Bose performed a comparative study of the fatigue response of various metals and organic tissue in plants.
- Wrote Science fiction in Bengali.

Dr Vikram Sarabhai

- Dr. Vikram Ambalal Sarabhai was an Indian astrophysicist who is considered as the Father of Indian Space Program.
- He worked on cosmic ray studies at the Indian Institute of Science in Bangalore, where he was mentored by Nobel Laureate Dr. C. V. Raman.

<u>Contributions in the development of space technology in India</u>

- **Establishment of ISRO**: His vision and commitment led to the establishment of Indian National Committee for Space Research (INSCOSPAR), which was later re-christened as the Indian Space Research Organisation (ISRO) in 1969.
- He was appointed as the **Chairman of the Atomic Energy Commission of India** and was largely responsible for the establishment and development of India's nuclear power plants.
- **Physical Research Laboratory** (PRL): In 1947, he returned to India and founded the Physical Research Laboratory (PRL) in Ahmedabad. PRL was one of the first research institutes in India to work in the field of space sciences.
- **India's first rocket launching station**: Along with Dr. Homi Bhabha, Dr. Sarabhai set up India's first rocket-launching station at Thumba near Thiruvananthapuram. It led to the development of present day indigenous rocket launchers like SLV, PSLV, GSLV.
- **Development of Satellite programme**: He started a project for the fabrication and launch of an Indian Satellite. As a result, the first Indian

satellite, Aryabhata, was put in orbit in 1975 from a Russian Cosmodrome.

- Further, the **Satellite Instructional Television Experiment (**SITE) was launched in 1976 based on his dialogue with NASA. The project helped India gain technical experience in the field of satellite communications and made available informational television programs to rural India.
- The lander of India's Chandrayaan-2, Vikram, was named after him, and so was the Vikram Sarabhai Space Centre (VSSC), ISRO's facility for rocket development in Thiruvananthapuram.

Dr Hargobind Khurana

- He was born in Raipur village of Multan district, In 1969, he was awarded Padma Vibhushan.
- 1968 Nobel Prize for Physiology or Medicine (shared with Nirenberg and Holley) for interpretation of genetic code and its function in protein synthesis.
- He proved that genetic code consists of 64 different three-letter words, which told the cell where to begin reading the code and where to stop.
- Constructed the **world's first synthetic gene** paving the way for further advancements in the field of genetic engineering and biotechnology.
- He investigated **mutations in rhodopsin** that are associated with retinitis pigmentosa, **which causes night blindness**. Rhodopsin is a light-sensitive protein found in the retina of the vertebrate eye.
- Contributed to the **science of polymerase chain reaction** (PCR) tests, used to detect genetic material from a specific organism, like a virus.
- Discovered structure of **transfer-RNA, or** tRNA (small RNA molecule that participates in protein synthesis)

Dr A P J Abdul Kalam

- He was an Indian scientist who also served as the 11th President of India from July 25, 2002 to July 25, 2007.
- Kalam and his team were successful in developing **India's first indigenous hovercraft which was named Nandi**. A hovercraft is an amphibious craft capable of travelling over land, water, mud, ice and other surfaces.
- The team of rocket engineers of which Kalam was a part, set up the **Thumba Equatorial Rocket Launching Station** (TERLS) in 1963.
- He was project **director of India's first Satellite Launch Vehicle**.
- He was given the responsibility to lead the **Integrated Guided Missile Development Program (IGMDP**). According to the instructions of then Defence Minister R. Venkataraman, four missiles were to be developed simultaneously as part of the program. After years of

consistent hard work and immense dedication, India got her first range of ballistic missiles, the Prithvi, the Agni, the Aakash, and the Nag.
- The **Pokhran-II nuclear** tests were conducted during this period and Kalam played an intensive political and technological role in their success.
- He served as **first principal scientific advisor to government of India**.
- He is author of best selling work Wings of Fire, which has inspired millions.
- He was awarded Bharat Ratna in 1997.

Homi Jehangir Bhabha

- He was the first person to become the Chairman of the Atomic Energy Commission of India.
- Bhabha is acknowledged as the father of Indian nuclear power.
- He envisaged the 3 staged nuclear program to effectively utilize thorium reserve of India.
- Bhabha was also the founding director of the Atomic Energy Establishment, Trombay (AEET) which is now named the Bhabha Atomic Research Centre
- He calculated the **cross section of electron-positron scattering**.
- He also helped in developing the **cosmic radiation's understanding**.
- He was instrumental in establishing the Tata Institute of Fundamental Research in Mumbai.
- Along with Dr. Homi Bhabha, Dr. Sarabhai set up India's first rocket-launching station at Thumba near Thiruvananthapuram.
- He promoted nuclear energy control and also advocated for the prohibition of atomic bombs worldwide.
- He was also nominated for the Nobel Prize for Physics in 1951 and 1953–1956.

Raja Ramanna

Raja Ramanna was an Indian physicist who made significant contributions to nuclear science and played a prominent role in India's nuclear program. Here are some key aspects of his work:

- **Nuclear Research**: Ramanna was involved in pioneering research in nuclear physics and played a crucial role in the development of India's first nuclear weapons. He worked on various aspects of nuclear technology, including nuclear reactor design, nuclear materials, and nuclear weapon testing.
- **Pokhran-I**: Ramanna was the director of the first nuclear test conducted by India, codenamed "Smiling Buddha" or Pokhran-I, which took place on May 18, 1974. The successful test established India as a nuclear-armed nation.
- **Nuclear Policy**: Ramanna was involved in formulating India's nuclear policy and advocating for peaceful uses of nuclear energy. He emphasized

the need for self-reliance in nuclear technology and worked to strengthen India's nuclear infrastructure.
- **Scientific Institutions**: Ramanna held various leadership positions in India's scientific institutions. He served as the Chairman of the Atomic Energy Commission of India and played a key role in the establishment of the Bhabha Atomic Research Centre (BARC) and the Indira Gandhi Centre for Atomic Research (IGCAR).
- **Science Education**: Ramanna was also dedicated to promoting science education and research in India. He actively participated in scientific conferences, seminars, and lectures, sharing his knowledge and inspiring young scientists.

Visvesvaraya

- Sir Mokshagundam Visvesvaraya was a civil engineer who also served as Diwan of Mysore (1912 to 1919).
- Sir MV was recognized for engineering the Krishna Raja Sagara Dam located in Mysore.
- Also, he was one of the Chief designing engineers for bringing up a system for flood protection in Hyderabad.
- He is credited for inventing 'automatic sluice gates' and 'block irrigation system' which are still considered to be marvels in engineering.
- He came up with an efficient way of filtering water through 'Collector Wells'
- In 1955, he was honored with Bharat Ratna.
- September 15 is celebrated as Engineers day in India, in his loving memory.

Meghnad Saha

- Meghnad Saha's best-known work concerned the thermal ionisation of elements, and it led him to formulate the Saha Equation.
- This equation is one of the basic tools for interpretation of the spectra of stars in astrophysics.
- By studying the spectra of various stars, one can find their temperature and from that, using Saha's equation, determine the ionisation state of the various elements making up the star.
- He also invented an instrument to measure the weight and pressure of solar rays.
- He was also the chief architect of river planning in India.

Praful Chandra Ray

- He established Bengal Chemical and Pharmaceutical Works Ltd, India's first pharmaceutical company in 1901.

- His research included organic compounds containing sulphur, double salt, homomorphism and fluorination.
- His research included the discovery of the stable compound mercurous nitrite in 1896 while studying nitrite and hyponitrite compounds and their compounds.

Shanti Swaroop Bhatnagar

- He was "father of research laboratories" in India.
- He was also the first Chairman of the University Grants Commission(India)
- In 1958, to honour his name and legacy, the Indian Council of Scientific and Industrial Research (CSIR) instituted the Shanti Swarup Bhatnagar Prize for Science and Technology for scientists who have made significant contributions in various branches of science.

- In 1940, the Board of Scientific and Industrial Research (BSIR) was formed for a period of two years and he was appointed as its Director. In 1941, he persuaded the government to set up an Industrial Research Utilisation Committee (IRUC) for further investment into industrial research.
- In 1942, the Council of Scientific and Industrial Research (CSIR) was formed and the BSIR and IRUC became its advisory bodies. In 1943, CSIR approved his proposal to establish five national laboratories.
- Post-independence, he was made the chairman of the CSIR and he became the first director general of the council. He established many laboratories and mentored many great minds during his tenure as the head of the CSIR.

Ramanujan

- With almost no formal training in pure mathematics, he made extraordinary contributions to mathematical analysis.
- Ramanujan was elected to the London Mathematical Society in 1917 and was elected a Fellow of the Royal Society for his excellent work on Elliptic Functions and the theory of numbers.
- Ramanujan made priceless contributions to several mathematical concepts like infinite series, continued fractions, number theory and mathematical analysis.
- He also made notable contributions like the hypergeometric series, the Riemann series, the elliptic integrals, the theory of divergent series, and the functional equations of the zeta function.
- He introduced a summation in 1918, now known as the Ramanujan sum which is currently used in signal processing, i.e., analysing, modifying and synthesising periodically repetitive signals such as speech, music, DNA sequences etc.
- He introduced the “mock theta functions” which are used today in ‘String Theory’ in theoretical physics.
- He is also credited for his work in ‘Modular functions’ which are used to reveal properties of Black Holes by astrophysicists.

- He discovered Hardy Ramanujan number i.e. 1729 which is the smallest number which can be expressed as the sum of two cubes in two different ways- 1729 = 13 + 123 = 93 + 103 .
- His birth anniversary 22 December is celebrated as National Mathematics day.

Women Scientists of India:

Anandibai Gopalrao Joshi (1865-1887) First Indian female to study and graduate with a degree in western medicine from the United States (1886). She is believed to be the first woman to set foot on American soil from India

Kadambini Ganguly (1861-1923) The first Indian woman to get admission to Calcutta Medical College (1884), becomes India's first female doctor & practitioner (1886) of western medicine in the whole South Asia.

Mary Poonen Lukose (1886-1976) The first female Surgeon General in India, (1938). She became the first woman obstetrician of India.

Bibha Chowdhary (1913-1991) First woman high energy physicist of India and the first woman scientist at the TIFR (1948). The International Astronomical Union honored her by naming a white yellow dwarf star after her name.

Edavaleth Kakkat Janaki Ammal (1897-1984) Renowned botanist & plant cytologist, made significant contributions to genetics, evolution, phytogeography and ethnobotany. First Director of the Central Botanical Laboratory at Allahabad, 1952

Kamala Sohonie (1911-1998) First Indian woman to receive a PhD in a scientific discipline. She discovered the enzyme 'Cytochrome C' which plays an essential role in the electron transport chain occurring in plants, human and animal cells for energy synthesis.

Asima Chatterjee (1917-2006) The first woman to be awarded a Doctor of Science by an Indian University (Calcutta) in 1944. She was the first woman to be elected as the General President of the Indian Science Congress.

Iravati Karve (1905-1970) First Indian female anthropologist. She founded the Department of Anthropology at the University of Pune in 1963. She also held the post of the Vice-Chancellor of SNDT University.

Debala Mitra (1925-2003) First Indian archaeologist served as Director General of the Archaeological Survey of India, 1981. She explored and excavated several Buddhist sites.

Purnima Sinha (1927-2015) An Indian physicist who received a doctorate in physics under the guidance of Prof Satyendra Nath Bose. She did tremendous work in the field of x-ray crystallography of clay minerals.

Rajeshwari Chatterjee (1922-2010) Woman Engineer who pioneered research in microwave engineering. She is the first woman engineer at IISc who joined the Department of Electrical Communication Engineering (ECE).

Anna Mani (1918-2001) First woman to join the Meteorological department in Pune, 1948. Her major contributions are in the field of solar radiation, ozone and wind energy instrumentation.

Kamal Ranadive (1917-2001) Established India's first tissue culture research laboratory at the Indian Cancer Research Centre in Mumbai, 1960. She was among the first to recognise the connection between cancer susceptibility and the interaction between hormones and tumour virus.

Tessy Thomas:
- known as the 'Missile Woman' of India is the Director General of Aeronautical Systems and the former Project Director for Agni-IV missile in Defence Research and Development Organisation (DRDO).
- She is the first woman scientist to head a missile project in India.
- She has contributed in guidance, trajectory simulation and mission design at the DRDO. She designed the guidance scheme for long-range missile systems, which is used in all Agni missiles.

Ritu Karidhal:
- As Mission Director of the Chandrayaan-2 mission, Ritu Karidhal was feted for role in helming one of India's most ambitious lunar projects.
- She was responsible for detailing and the execution of the craft's onward autonomy system, that independently operated the satellite's functions in space and responded appropriately to malfunctions.
- Dubbed as the 'Rocket Woman of India' Ritu joined ISRO in 2007 and was also the Deputy Operations Director to India's Mars Orbiter mission, Mangalyaan.

Muthayya Vanitha
- She is the Project Director of Chandrayaan-2. She is the first woman to lead the interplanetary mission at ISRO.
- She was promoted from Associate Director to Project Director of the mission.
- She has occupied several roles such as leading the Telemetry and Telecommand Divisions in the Digital Systems Group of ISRO Satellite Centre, and has been the Deputy Project Director for several satellites including Cartosat-1, Oceansat-2, and Megha-Tropiques.

Gagandeep Kang,
- a virologist and scientist, is known for her interdisciplinary research in transmission, development, and prevention of enteric infections and their sequelae in children in India.
- She has been elected as a Fellow of the Royal Society (FRS), the first Indian woman scientist to receive this honour.
- she also national rotavirus and typhoid surveillance networks, established laboratories to support vaccine trials, and conducted phase one-three-

clinical trials of vaccines, a comprehensive approach that has supported two WHO prequalified vaccines made by two Indian companies.
- She is also investigating the complex relationships between infection, gut function, and physical and cognitive development, and seeking to build a stronger human immunology research in India.

Mangala Mani

- The 'polar woman of ISRO', Mangala Mani is ISRO's first woman scientist to spend more than a year in the icy landscape of Antarctica.
- The 56-year-old had never experienced snowfall before she was selected for the mission. In November 2016, she was part of the 23-member team that went on an expedition to Bharati, India's research station in Antarctica.

Kamakshi Sivaramakrishnan

- She is responsible for building the algorithm and the chip that is responsible for bringing information from Pluto as part of New Horizon mission.
- The chip on board the spacecraft collects signals and sends them back to the space station which is three billion miles away.
- Based in San Mateo, California, she has been building a complex algorithm to be more intuitive about how users interact with ads online, as well as across different interfaces – smartphones, tablets, laptops, etc.

Chandrima Shaha

- Chandrima is a biologist and the first ever woman president of the Indian National Science Academy (INSA).
- She specialises in cell biology, and has conducted extensive research about the 'Leishmania' parasite which causes Kala Azar.