

UNIT-II

1. SIR C.V.RAMAN (Text Book)

OBJECTIVES:

- Introduction to C.V.Raman's family background and education.
- C.V.Raman's avid interest in reading and research at a very young age.
- How C.V.Raman's life is a role model and motivation to younger generation
- C.V.Raman's educational achievements (Stood first in B.A., M.A. and FCS Exams, Publishing a research paper in British journal.)
- His fascination of waves and sounds – Research on musical instruments like Violin and Ektara, Veena etc.
- C.V.Raman's professional career as a palit professor of physics - research, supervision and teaching which enlightened many students.
- Establishment of Raman's Research Center at Bangalore.
- Awards and Honours (Nobel, professorships and honorary doctorates etc.) conferred on him

Question and Answers

1. How were the great men who Raman read about as a child reflected in the work he did later in life?

Ans: Right from the childhood, C.V.Raman is an avid reader of books. His interest of reading books has got further strengthened with his father's library at his home. He is both intelligent and voracious reader and pored eagerly over all the books in his father's collection. Some among these are the original writings of the outstanding scientists. He once said, "out of this welter of subjects and books, can I pick anything really mould my mental and spiritual outlook and determine my chosen path? Yes, I can and shall mention three books.

These three were Edwin Arnold's 'Light of Asia' which is the life story of Lord Gautama Buddha. Second one is titled 'The Elements of Euclid', is a treatise on Classical Geometry. 'The Sensations of Tone' is the last one and was authored by German scientist Helmholtz, on the properties of sound waves.

These books have had a profound influence on Raman's working style and problem solving nature in his later life. It began with his Masters' in Physics in Presidency college, Madras. When there was a discussion held on how light that fell on a screen placed in its path would get diffracted, or bent, when entering a narrow slit in it. While the entire class was pre occupied with it, Raman wondered what would happen if the light shone straight, not from an angle, on the screen. No student could display such alternative thinking as Raman. He not only studied it but also published a research paper on it in Philosophical Magazine, a British Journal. He was the first person from Presidency college to publish a research paper.

The mark of the great minds continued in his later research on musical instruments. Raman was fascinated by waves and sounds and is always carried in his mind the memory of reading Helmholtz's book on 'The Sensations of Tone' in his school days. He got a chance to study and experiment in the IACS, he chose to study musical instruments first. He used an idea found in Helmholtz's book, he explained the working of the Ektara, which is a simple instrument made of a

resonant box and a string stretched to lie across the cavity. Starting from his understanding of this simple object, he developed many ideas that he called 'remarkable resonances'. During this time, he took up the violin for study and developed a way of characterizing the quality of the instrument. It was the first time a scientific understanding was established, and it is employed even today. Raman's studies on the violin were extensive and published as a book entitled 'On the Mechanical Theory of Musical Instruments of the Violin Family with Experimental Results: Part I.

Raman's discovery, during the voyage across the Mediterranean sea, that water molecules could scatter light just like air molecules, was very important and radical in those days. It set him on the track to discovering the famous Raman's Effect. In 1922, he wrote a brilliant essay titled, "The Molecular Diffraction of Light", in which he speculated that light may exist in quanta, that is, massless particles of energy. This is an accepted theory till today but was most radical in those days.

Thus, the great minds whom Raman read during his childhood reflected on his academic and professional career.

2. Why did Raman fail to impress his teachers when he first joined Presidency College?

Ans: Raman finished his schooling at a very young age of 11. He spent the next two years studying in his father's college. When he was barely 13, he went to Madras to join the B.A. course in Presidency college. Raman was failed to win a word of praise initially from his teachers. Besides being young in his class, Raman was also quite unimpressive in his appearance. He could recall the incident occurred during his first English class that he attended. Observing Raman, his English Professor E.H.Elliot asked him whether he really belonged to the junior BA class. Raman immediately answered him 'yes' in affirmative tone. By the end of the course, he stunned all the skeptics and stood first in the BA Examinations.

3. What made Raman say of the Civil Surgeon of Madras, 'I shall ever be grateful to this man?'

Ans: Raman's exceptional performance in his academics brought him great admirations. Keeping profound belief in Raman, his teachers advised him to take up Indian Civil Services (ICS) examination. It was a very prestigious exam in those days and very rarely did non-Britishers get through it. Yet, Raman impressed his teachers so much that they urged him to take it up at a very early age. Despite of Raman's brilliance, the plan was not to work. Raman had to undergo a medical examination before he could qualify to take the ICS test, and the civil surgeon of Madras declared him medically unfit to travel to England. This was the only exam that Raman failed in his life. Later in his life, he marked in his characteristic style about the man who disqualified him, "I shall ever be grateful to this man", but at that time, he simply put the attempt behind him and went on to study Physics.

4. Why was the day when Raman walked into the Indian Association for the Cultivation of Science a historic moment?

Ans: After marriage, he attempted and topped the Financial Civil Services (FCS) examination. He began his career as an Assistant Accounts General. During this time, one day, when he was going to his work on a tram, he spotted a signboard with the words 'Indian Association for the Cultivation of Science'. His curiosity aroused, he got off the tram and, in what was his historic moment, walked into the building. That was later to become the laboratory where he and his team performed the legendary experiments on light.

5. Outline the subject of the first research Raman conducted in the IACS?

Ans: Ever since Raman was part of the IACS, he played a dual role. He would work efficiently as a finance officer all the day, and after office hours, move to the IACS, where he would immerse himself in research until late night. During these years, his papers appeared in International journals such as Nature and Philosophical Magazine, published in England, and the Physical Review, published

in the USA. He started communicating with the physicists round the world at this time. He also liked to teach and would give popular lectures in Calcutta. People loved his lectures as they would include live demonstrations that made even non-specialists understand his work.

Raman was fascinated by waves and sounds and is always carried in his mind the memory of reading Helmholtz's book on 'The Sensations of Tone' in his school days. He got a chance to study and experiment in the IACS, he chose to study musical instruments first. He used an idea found in Helmholtz's book, he explained the working of the Ektara, which is a simple instrument made of a resonant box and a string stretched to lie across the cavity. Starting from his understanding of this simple object, he developed many ideas that he called 'remarkable resonances'. During this time, he took up the violin for study and developed a way of characterizing the quality the instrument. It was the first time a scientific understanding was established, and it is employed even today. Raman's studies on the violin were extensive and published as a book entitled 'On the Mechanical Theory of Musical Instruments of the Violin Family with Experimental Results: Part I'.

The mechanical violin player devised by Raman in order to study its workings was assembled from the parts bought from cycle shop and other odds and ends found in the lab. It did not resemble the shapely instrument that we know, but it had all the essential features of the violin – the stretched string, the resonant box, the bow which can be moved at a desired speed and stroke-length by adjusting the mechanical wheel. This was the first time a mechanical violin player was designed for violin research, but it is a concept used even today.

Soon after publishing the first part of his book on violins, Raman, whose head was abuzz with lots of ideas, moved on to a different field of study and promised second part never came. He engrossed on acoustics until 1920. Besides the violin, Raman studied the Veena, Tambura, Mridangam and others. Around this time, he became interested in optics, and this led in the following decade to some discoveries that he is famous for.

6. What discovery did Raman make during his voyage across the Mediterranean and how did it prove to be important?

Ans: The University of Calcutta conferred on Raman an honorary doctorate in 1921. Soon after, he made his first visit to overseas. It was a formal visit to attend the University Congress at Oxford, where he represented Calcutta University. During his return journey to India, Raman spent hours watching the sea from the deck of his ship and was awe struck by its colour. According to Lord Rayleigh, who had explained the blue colour of the sea, 'The dark blue of the deep sea has nothing to do with the colour of water but is simply the blue of the sky seen in reflection'. Fascinated by it, Raman watched the sea intently and using the simple optical tools he usually carries. He did experiments to capture the colour of the sea. When ship finally docked at Bombay, Raman's paper explaining his observations on the Mediterranean Sea was on its way to the journal Nature.

During his return journey, Raman discovered that water molecules could scatter light just like air molecules. It was very important and radical in those days. It paves way for Raman to discovering the famous Raman Effect. He wrote a brilliant essay in 1922, titled, "The Molecular Diffraction of Light", in which he speculated that light may exist in quanta, that is, massless particles of energy. This is an accepted theory till today but considered as the most radical in those days.

This research further proved to be important in his later life and it brought laurels to his country. Raman had a hunch that if the light did not exist as particles, or quanta, then scattering experiments would show only a change in the light intensity and not in its frequency, or colour. On the other hand, if light did exist in particles, or quanta, then a scattering of the light could change its frequency as well as intensity. He moved forward, giving a deaf ear to what others say, directed all research at the institute towards finding evidence for the corpuscular theory of light through scattering experiments. However, in 1923, with the discovery of the Compton effect, the existence of light quanta was established beyond doubt. With this success, Raman directed his team to work on light scattering. Initially their

research findings were weak, some of his students named their initial finding as 'feeble fluorescence'.

Raman's team had to work rigorously four more years to be sure of what experiment they were doing. It was in 1927, they were able to say confidently that the new effect was not 'a type of fluorescence' but a modified scattering. This led to the discovery made on 28, February of the fact that light can undergo a scattering through a liquid resulting in a change in its frequency – the famous Raman Effect. To commemorate this historic event, this date is celebrated today as National Science Day.

7Q. Give a detailed description of Raman's educational and professional achievements?

Ans: Sir C.V.Raman is one of the world renowned scientists of India. He was a brilliant, industrious and disciplined student. He was also an original thinker. During his youth, India was not a free country, and there were hardly any institutions, libraries, to encourage for higher education. Despite these hurdles, Raman was able to contribute so greatly to Indian science. It was possible only because of his deep and genuine passion for physics and his commitment to finding answers to questions that puzzled him.

He was born in a village near Tiruchirappalli (known in his days as Trichinopoly) in southern India on 8 November, 1888. He was the second child of R.Chandrashekar Iyer and Parwathi Ammal. Raman's father was working as a lecturer in Mrs A.V.Narsimha Rao College. Raman's father was an athletic man and he took active interest in sports. His young son Raman was not physically very strong, but was very intelligent and he preferred to read books and work at his studies.

Raman is intelligent and voracious reader and pored eagerly over all the books in his father's collection. Some among these are the original writings of the outstanding scientists. He once said, "out of this welter of subjects and books, can

I pick anything really mould my mental and spiritual outlook and determine my chosen path? Yes, I can and shall mention three books.

They were Edwin Arnold's 'Light of Asia' which is the life story of Lord Gautama Buddha. Second is 'The Elements of Euclid', is a treatise on Classical Geometry. 'The Sensations of Tone' is the last one and was authored by German scientist Helmholtz, on the properties of sound waves.

Raman finished his schooling at a very young age of 11. When he was 13, he joined the B.A. course in Presidency college, Madras. Besides being young in his class, Raman was also quite unimpressive in his appearance. He could recall an incident occurred during his first year B.A., English class. Observing Raman, his English Professor E.H.Elliot asked him whether he really belonged to the junior BA class. Raman immediately answered him 'yes' in affirmative tone. By the end of the course, he stunned all the skeptics and stood first in the BA Examinations.

Keeping profound belief in Raman's exceptional performance, his teachers advised him to take up Indian Civil Services (ICS) examination. It was a very prestigious exam in those days and very rarely did non-Britishers get through it. Despite of Raman's brilliance, the plan was not to work. He had to undergo a medical examination before he could qualify to take the ICS test, and the civil surgeon of Madras declared him medically unfit to travel to England. This was the only exam that Raman failed in his life. Later in his life, he marked that surgeon, "I shall ever be grateful to this man",

Later, Raman joined M.A. Physics in Presidency college and topped the university. After marriage, he attempted and topped the Financial Civil Services (FCS) examination. He began his career as an Assistant Accounts General. During this time, he came across 'Indian Association for the Cultivation of Science'. His curiosity aroused and he walked into the building and it became a historic moment. That was later to become the laboratory where he and his team performed the legendary experiments on light.

Raman played a dual role in the IACS both as a finance officer and a scientist. During these years, his papers appeared in International journals such as Nature and Philosophical Magazine, published in England, and the Physical Review, published in the USA. He started communicating with the physicists round the world at this time. He also liked to teach and would give popular lectures in Calcutta. People loved his lectures as they would include live demonstrations that made even non-specialists understand his work.

Raman was fascinated by waves and sounds and is always carried in his mind the memory of reading Helmholtz's book on 'The Sensations of Tone' in his school days. During his experiment in the IACS, he chose to study musical instruments first. He used an idea found in Helmholtz's book, he explained the working of the Ektara. Soon, he took up the violin for study and developed a way of characterizing the quality the instrument. It was the first time a scientific understanding was established, and it is employed even today. Raman's studies on the violin were extensive and published as a book entitled 'On the Mechanical Theory of Musical Instruments of the Violin Family with Experimental Results: Part I'.

The mechanical violin player devised by Raman in order to study its workings was assembled from the parts bought from cycle shop and other odds and ends found in the lab. This was the first time a mechanical violin player was designed for violin research, but it is a concept used even today.

Soon, Raman was engrossed on acoustics until 1920. Besides the violin, Raman studied the Veena, Tambura, Mridangam and others. Around this time, he became interested in optics, and this led in the following decade to some discoveries that he is famous for.

Sir Ashutosh Mukherjee, the newly appointed Vice Chancellor of Calcutta, offered Raman the position of Palit Professor of Physics at the university around 1917.

During his tenure, he required to manage the labs and guide students in research. But he volunteered to teach courses. He guided and inspired many students and many young minds were attracted to this university from many parts of India.

The University of Calcutta conferred on Raman an honorary doctorate in 1921. Soon after, he made his first visit to overseas. It was a formal representing Calcutta University and to attend the University Congress at Oxford. During his return journey to India, Raman spent hours watching the sea and was awe struck by its colour. According to Lord Rayleigh, who had explained the blue colour of the sea, 'The dark blue of the deep sea has nothing to do with the colour of water but is simply the blue of the sky seen in reflection'. Fascinated by it, Raman watched the sea intently and using the simple optical tools. He did experiments to capture the colour of the sea. When ship finally docked at Bombay, Raman's paper explaining his observations on the Mediterranean Sea was on its way to the journal Nature.

This time, Raman discovered that water molecules could scatter light just like air molecules. It was very important and radical in those days. It paves way for Raman to discovering the famous Raman Effect. He wrote a brilliant essay in 1922, titled, "The Molecular Diffraction of Light", in which he speculated that light may exist in quanta, that is, massless particles of energy. This is an accepted theory till today but considered as the most radical in those days.

This research further proved to be important in his later life and it brought laurels to his country. However, in 1923, with the discovery of the Compton effect, the existence of light quanta was established beyond doubt. With this success, Raman directed his team to work on light scattering.

Raman's team had to work rigorously four more years to be sure of what experiment they were doing. It was in 1927, they were able to say confidently that the new effect was not 'a type of fluorescence' but a modified scattering. This led to the discovery made on 28, February of the fact that light can undergo a

scattering through a liquid resulting in a change in its frequency – the famous Raman Effect. To commemorate this historic event, this date is celebrated today as National Science Day.

Later, Raman took over Indian Institute of Science, Bangalore as a Director and he stayed there until 1948. He spent equal amount of time on research and organizational work. He not only conducted research but also mentored many students.

Raman dedicated his final years from 1946 to 1970, to set up of the Raman Research Institute in Bangalore and the running of the Indian Academy of Science. Despite his busy schedule, he edited journals 'Current Science' and the Proceedings of the Academy'. C.V.Raman died on 21 November, 1970. By a special arrangement, according to his wish, his mortal remains were consigned to flames in the institute campus itself, amidst the surroundings he loved, without any religious ceremonies. Today, a solitary tree is all that marks that spot in the grounds of the Raman Research Institute.

C.V.Raman exhibited remarkable independence in choosing to work in areas that excited his curiosity. Further, when faced with lack of infrastructure, he always improvised and built up whatever he needed from scratch. C.V.Raman's determination, spirit, and contributions indeed remain special within the context of the practice of science in India.

Fill in the blanks for Objective Exam

11. C.V.Raman was born in Tiruchurapalli (known as Trichinopoly) on 8th Nov, 1888.
12. Raman was the second child of R.Chandrashekara Iyer and Parvathi Ammal.

13. Raman's father worked as a Lecturer in Mrs. A.V.Narsimha Rao College, where he taught Physics, Mathematics, and Physical Geography.
14. Three significant books moulded Raman's mental and spiritual outlook.
15. Edwin Arnold wrote Light of Asia, which is the story of Guatham Buddha.
16. The book The Elements of Euclid, is a treatise on classical geometry.
17. The book The Sensations of Tone was written by German scientist Helmholtz on the properties of sound waves.
18. Raman was the first student of Presidency College to publish a research paper in the Philosophical Magazine, a British Journal.
19. Raman was declared medically unfit to travel to England by Civil Surgeon of Madras.
20. Raman passed his M.A Exam from Presidency College, Chennai, in Jan, 1907 and stood first in the University.
21. Raman married Lokasundari, who belonged to Madurai.
22. He took up the Financial Service Examination, a forerunner of the Indian Administrative and Audit Services (IACS) and topped the exam and joined as an Assistant Accounts Officer.
23. During his stay with Indian Association for the Cultivation of Science (IACS), he published his papers in international journals such as Philosophic Magazine, England and Physical Review, USA.
24. Raman introduced the practice of giving live demonstrations.
25. Raman was fascinated by waves and sounds and seems to carried in his mind the memory of reading Helmholtz's book 'The Sensations of Tone'
26. Raman's studies on Violin were extensive and were later published as a book 'On the Mechanical Theory of Vibrations of the Musical Instruments of the Violin Family with Experimental Results: Part I'.
27. After publishing book on Violin, he got interested in Acoustics until 1920 and later he became interested in Optics.
28. Ashutosh Mookerjee, the newly appointed V.C of University of Calcutta offered Raman the post of Palit Professor of Physics around 1917.

29. Some well-known and brilliant students of Raman were K.R.Ramanathan, K.S. Krisnan and Suri Bhagavantham.
30. In 1921, the University of Calcutta conferred on Raman an honorary doctorate and it was his first overseas trip.
31. He represented University of Calcutta when he attended University congress in Oxford in 1921.
32. When Raman's ship finally docked at Bombay, his paper on observation on Mediterranean sea was on its way to journal Nature.
33. Lord Rayleigh said about the blue colour of the sky 'the dark blue colour of the deep blue sea has nothing to do with the colour of water but is simply the blue of the sky seen in reflection'.
34. Raman discovered that water molecules could scatter just like air molecules.
35. In 1922, Raman wrote a brilliant essay titled 'The Molecular Diffraction of Light', in which he speculated the light may exist in quanta, that is, as massless particles of energy.
36. With the discovery of Compton Effect in 1923, the existence of light quanta was established beyond doubt.
37. In 1927, Raman's students were able to say confidently that the new effect was not 'a type of fluorescence' but a modified scattering and it led to the discovery made on 28, February, 1927.
38. The fact that the light can undergo a scattering through a liquid resulting in a change in its frequency – the famous Raman Effect – and the date is celebrated as National Science Day till date.
39. Raman was awarded Nobel Prize for Physics in 1930.
40. Raman took up chairmanship of Indian Institute of Science, Bangalore and stayed there until he retired in 1948.
41. Raman devoted his final years from 1946 to 1970 in setting up Raman Research Center in Bangalore besides running Indian Academy of Science.
42. He died on 21 November, 1970.

43. This piece of prose on C.V.Raman adapted from Vignettes in Physics, University Press.

Unit II

2. SAM PITRODA (Non-Detailed)

Objectives of the Lesson

1. Succinct sketch of Pitroda's background
2. Pitroda's philanthropic services and achievements in Information Technology
3. Bringing world attention to Indian Telecom services
4. Development of Indian telecommunication to great heights and enhancing the rate of employment.
5. Giving physical dimensions to the establishment of economical rural exchanges (REX).
6. Pitroda's invaluable contributions to the fields of e- governance and online transactions.

Question and Answers

1Q. Where and what kind of family was Sam Pitroda born in?

Ans: Sam Pitroda was born in Titlagarh, Orissa on 4th May, 1942. He was born in large family of seven brothers and sisters. His father had studied till just fourth grade, but he believed in educating his children and letting them do what they wanted to do.

2Q. What did Pitroda study in Baroda?

Ans: Sam Pitroda completed his Masters in Physics and Electronics from Baroda.

3Q. Where did he start his career in Digital Technology?

Ans: Soon after his first phone call, Sam Pitroda had an opportunity to work on digital switching technology at GTE Inc., Chicago, USA. It launched a successful and fruitful career for him in digital technology.

4Q. What did he do in 1974?

Ans: Having a decade successful career with GTE, he started a telephone exchange company called Wescom Switching in 1974. Later, he sold Wescom Switching to Rockwell for 10 million dollars.

5Q. When did Pitroda think of setting up cheap rural exchanges?

Ans: Pitroda's experience of working with digital technology has inspired him to wire up India. The same dream was crystallized later into his setting up cheap rural exchanges.

6Q. In what capacity did he approach the bank in Jeddah?

Ans: Pitroda visited Saudi American Bank (Citi Bank) in Jeddah in 1984. He introduced himself to the bank as a venture capitalist. The term Venture Capitalist meaning was understood by very few people at the time of his visit.

7Q. How did Rajiv Gandhi provide him the right opportunity?

Ans: Soon after his visit to Jeddah, Pitroda was given a valuable opportunity to realize his dreams. The then Indian Prime Minister Rajiv Gandhi made him his scientific advisor and requested him to start a new public-sector venture called Center for the Development of Telematics (C-Dot). This C-Dot found its true moorings and moved along the path of success. Later, it started exporting the telephonic equipment in bulk to countries such as Vietnam, Ethiopia, Bangladesh, Nepal, Ghana and Uganda. In the subsequent years, C-Dot sold its design licenses to about 20 different Indian equipment manufacturers.

8Q. What were the Rural Automatic Exchanges equipped with?

Ans: Sam Pitroda rendered his free services for a decade to connect his country. He successfully embarked upon the creation and launch of Rural Automatic Telephone Exchanges (RAX) designed and manufactured by him and his team of Indian engineers. As a result, 40,000 exchanges totaling about 20 million telephone lines were installed in India.

All these Rural Automatic Telephone Exchanges (RAX) were equipped with SS7 Intelligent Networking Signalling Systems. These systems are used to find out if a number is busy or available and to check up the database of telephone numbers. These exchanges will also provide toll-free information services and see it that the main telephone network does not get overloaded. These systems not only interconnect mobile and landline telephone numbers but also largely responsible for the rapid progress in the fields of administration, business, education, information, media etc. The unique feature of these new communication network systems is that, all the switches operate without air-conditioning even in warm environments.

9Q. How according to Pitroda can IT impact the nation?

Ans: According to Pitroda, IT has a tremendous and positive impact on our country. Today, as India begins to use IT for administration, it is the telecom network's reach and usage that it depends on. If not for Pitroda's vision and his

team's technology, this technology would have been much smaller, and the IT revolution would have been later in the coming. After taking over National Technology Mission in 1987, Pitroda gave a call that "Let's tap the developments in information technology and speed up the process of nation-building using these tools".

Pitroda opines that India has a huge pool of computer professionals but most often their energy is harnessed to solving other people's problems in the advanced countries of the world. Pitroda urged to employ their skills to solve the problems of our own country. The vision of Pitroda could be sensed in his own words, "IT solutions can help us tackle problems in core areas of governance, environment, legal issues and employment. From opening a bank account to getting admission to a university, we are forced to fill up innumerable forms and this puts bureaucratic hurdles in the way of people. He always says that let us use IT to simplify life and enable people to get things done with less hassles. He says that it is possible to believe Mahatma Gandhi's dream of a self-sufficient village community through IT applications by connecting every village in India with every other part of the country and the world. Our national agenda must reflect the multiple dreams and cultural diversity of India and every citizen must work towards the common agenda. We need to create a sense of urgency, hasten the process of development, build consensus by public debate, and create a climate for a new order and new ideas, and set priorities. He says we must encourage people to think differently and give wild ideas a hearing.

Thus, he opines that IT can bring revolutionary and fruitful transformations in India.

10Q. What was his idea of an electronic wallet?

Ans: Sam Pitroda is currently working on an "electronic wallet", which would have all kinds of cards – credit card, debit card, health card, insurance card, even the driving license. This would pave the way for electronic payment system, which would take over the existing payment systems. 'The future lies in the electronic payment systems'. The payment systems that exist are obsolete. It would make such sense for the Indian government to deposit of salaries of its employees in a

bank straight away. It is economical as it saves the logistics of writing cheques and waiting in long queues to deposit them. The same goes for the payment of electricity and telephone bills' said Sam Pitroda.

11Q. Give a detailed sketch of Sam Pitroda's contributions in the field of tele communication in India and abroad?

Ans: Sam Pitroda is one of the pioneering and world renowned persons. He is regarded as the father of Indian telecom revolution. He is the brain child of simple and economic Rural Automatic Telephone Exchanges (RAX) in India. He is the recipient of many distinguished honours and awards in India and abroad. Pitroda received India's National Citizen's award for his tremendous innovations and contributions in Telecom. He was also awarded the IIT Alumni Medal in 1993. He was also recipient of International Distinguished Leadership in 1995, besides being honoured with IT Lifetime achievement in 2002 by Dataquest.

Pitroda was born in Titlagarh, Orissa on 4th May, 1942. He was born in large family of seven brothers and sisters. His father had had education till just fourth grade, but he strongly believed in educating his children and letting them do what they wanted to do. Pitroda did his Masters in Physics and Electronics from Baroda.

Though Pitroda is regarded as the father of Indian telecom revolution, he made his first phone call only after moving to United States of America. He did his Electrical Engineering in the U.S. Expressing his dream, he says "since the fascination of the first call, my dream was to set up small rural exchanges and connect my country".

Pitroda soon got an invaluable opportunity to work on digital technology at GTE Inc., Chicago, USA. Later, it launched him in a successful and fruitful career in digital technology. After working a decade with GTE Inc., he started a telephone exchange company called Wescom Switching in 1974. Later, he sold his Wescom Switching company to Rockwell company for 10 million dollars. Pitroda's rich

experience of working with digital technology inspired him to wire up India. The same dream was crystallized later into his setting up cheap rural exchanges.

Pitroda visited Saudi American Bank (Citi Bank) in Jeddah in 1984. He introduced himself to the bank as a venture capitalist. The term Venture Capitalist meaning was understood by very few people at the time of his visit. Soon after his visit to Jeddah, Pitroda was given a precious opportunity to realize his cherished dreams. The then Indian Prime Minister Rajiv Gandhi made him his scientific advisor and requested him to initiate a new public-sector venture called Center for the Development of Telematics (C-Dot). This C-Dot found its true moorings and moved along the path of success. Later, it started exporting the telephonic equipment in bulk to countries such as Vietnam, Ethiopia, Bangladesh, Nepal, Ghana and Uganda. In the subsequent years, C-Dot sold its design licenses to about 20 different Indian equipment manufacturers. In the process of realizing his dreams, Pitroda rendered his free services for a decade to connect his country.

He successfully created and launched Rural Automatic Telephone Exchanges (RAX) which were also designed and manufactured by him and his team of Indian engineers. As a result, 40,000 exchanges totaling about 20 million telephone lines were installed in India. All these Rural Automatic Telephone Exchanges (RAX) were equipped with SS7 Intelligent Networking Signalling Systems. The unique feature of these new communication network systems is that, all the switches operate without air-conditioning even in warm environments. Shortly, he became the first Chairman of India's Tele Commission during Rajiv Gandhi's government.

With his altruistic vision, he connected some of the world's most isolated regions. He also made the case that that accessibility, not density, should be the focus of the implementation. He is a firm believer in substantial food, clean water, adequate shelter and communication are the fundamental components in the process of modernization. Pitroda stood against all the odds and criticisms while realizing his dreams. Responding to all the queries the intelligentsia had posed, Pitroda said,

“we need to exploit IT to fulfill basic human needs related to food, water, sanitation, literacy and health. We can not hope for development if only a small percentage of the population is empowered with basic needs and the rest is left out of the picture. We must work towards cent percent literacy, ten million new jobs every year, and ensuring that the economy grows at ten percent a year”. He said that we should tap the young minds and channelise their energies to solve the society’s problems creatively.

The telecommunication system introduced by Pitroda is unique and unparalleled in the world to this date. The basic technology used in it is not only simple but also provided employment opportunities to millions of people especially to physically challenged ones. Pitroda model has been a sensational success of telecom in India and abroad. He was largely responsible for shaping India’s telecom policy and for all aspects of telecom legislation and development in the country. “Let’s tap the developments in information technology and expedite the process of nation-building using these tools” was the call given by Pitroda when he took over the National Technology Mission in 1987.

Commenting on Indian manpower, he said that we have a huge pool of computer professionals. If they employ their skills to solve our country problems, rather than developed countries, we could solve the problems of India. He says IT helps in core areas of governance, environment, legal issues and employment. He always says that let us use IT to simplify life and enable people to get things done with less hassles. Sharing the dream of Mahatma Gandhi, he says a self-sufficient village community is possible through IT applications by connecting every village in India with every other part of the country and the world. We need to create a sense of urgency, hasten the process of development, build consensus by public debate, and create a climate for a new order and new ideas, and set priorities. He says we must encourage people to think differently and give wild ideas a hearing.

Sam Pitroda is currently working on an “electronic wallet”, which would have all kinds of cards – credit card, debit card, health card, insurance card, even the driving license. ‘The future lies in the electronic payment systems’. This would pave the way for electronic payment system, which would take over the existing payment systems.

He opines that IT and Internet can bring revolutionary and fruitful transformations in India. Thus, Pitroda has been a part of the developments of Indian telecommunication.

Fill in the blanks for the Objective paper

1. Sam Pitroda was born in Titlagarh, Orissa, on 4th May, 1942.
2. Pitroda was born in a large family of seven brothers and sisters.
3. Pitroda completed his Masters in Physics and Electronics from Baroda.
4. Pitroda is regarded as the father of the Indian Telecom Revolution.
5. Pitroda dream was to set up small, rural exchanges ever since he made his first call.
6. After his first call, Pitroda got an opportunity to work on digital switching technology at GTE Inc., Chicago, USA.
7. GTE Inc., Chicago, USA, launched Pitroda in a successful career in digital technology.
8. After working for ten years in GTE, Pitroda started a telephone exchange company called Wescon Switching in 1974.
9. Pitroda’s successful experience with digital technology inspired him to wire up India.
10. In1984, Sam Pitroda visited Saudi American Bank in Jeddah and introduced himself as a venture capitalist.
11. Pitroda successfully embarked upon the creation and launch of the Rural Automatic Telephone exchanges (RAX) which is also designed and manufactured by him.

12. Pitroda was the first chairman of India's Telecom Commission in Rajiv Gandhi's Govt.
13. Pitroda believed that substantial food, clean water, adequate shelter and communication are the fundamentals components in the process of modernization.
14. Pitroda's tenacity helped create the concept and technology behind the network of STD/PCO phone calls in every nook and corner of the country.
15. Pitroda founded Center for Development of Telematics (C-Dot) in 1984.
16. "Let's tap the developments in information technology and expedite the process of nation-building using these tools" was the call given by Pitroda when he took over the National Technology Mission in 1987.
17. TEL- GLOBAL Organization was founded by Pitroda in 1995 to develop Telecom Infrastructure in third world countries.
18. Through the backbones and the Internet Community Centres (ICC) the vision of developed India.
19. Pitroda was also a advisor of Kofi Annan, the United Nations General Secretary on the ICT Advisory Committee.
20. Pitroda received India's National Citizen's award for his tremendous innovations and contributions in Telecom.
21. Pitroda was awarded the IIT Alumni Medal in 1993.
22. Pitroda was also recipient of International Distinguished Leadership in 1995.
23. Sam Pitroda was given the IT Lifetime achievement award for 2002 by Dataquest.