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Study on the role of physical science in the development of technology and Strengthening the Nation

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Abstract

Fundamental laws of nature and fundamental physical properties of matter are studied under the physics. On the basis of available information, scientific knowledge, analytical thought and experiences further unsolved problems existing in the nature are solved. In this way physicists contribute to enhance the knowledge which is utilized by the further generations for welfare of society. Using available knowledge to convert it into beneficial products requires training of manpower in this direction. The skill development programs can play important role to develop small-small useful products based on scientific knowledge.

Contribution of physical science in major fields like research, disaster management, power generation, industry, transportation, communication, agriculture, medical, civil work, space etc. are given here. This paper gives an overview about technologies used in different sectors which are strengthening the nation.

Keywords: Research, Technology, energy, transportation, communication.

1. Introduction

Physicists have discovered various natural phenomena which were unknown to mankind. Physicists are trying to sort-out all confusions by giving scientific analytical explanation of most of the happenings in the nature. They also generated the process by which these phenomena can be used in the welfare of mankind. The use of these techniques shall definitely develop the nation. Sir Chandrasekhara Venkata Raman was awarded the Noble prize for the discovery^[1] of scattering of light by molecules. He used tools of only around three hundred rupees, when the facilities for scientific work were not good. H.J. Bhaba, S.N. Bose, S Chandrashekar, M.N. Saha and J.C. Bose also contributed a lot in the field of physics.

At present, Indian scenario is changing in terms of increasing research facilities, but it is required to skill manpower and to use them in Indian development by providing best fit scientific environment. Many aspects of the Indian scientific development still require much attention^[2-3]. Indian contribution was lacking in both quality and quantity of research which at present seems to be increasing up. To solve this problem, Steps should be taken to attract good students for graduate and post graduate courses in the physics.

The great achievements of U.S.A. and U.S.S.R in the scientific field in last three-four decades are due to the cooperative research. Developed countries like America, Japan etc. are harnessing knowledge of modern physics to make lives of citizens comfortable. But we are still in the process of talking and discussing how to raise the standard of living of our citizens by harnessing knowledge of modern physics. Industries must use scientific achievements to develop new tools and techniques. This saves efforts, cost and time by which doing other work, one can strengthen our nation. Physics always provides these techniques following natural laws. For example, lever multiplies work output and reduces input work if it is used technically which requires skill of using it in proper way.

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2. Methodology and discussion

This paper deals with the application of the important physical principles and techniques used in the various fields. For which literature related to past research has been reviewed and role of physical sciences extracted therefrom which is presented through this paper. Various branches of physics like atomic and molecular physics, nuclear physics, condensed matter physics, spectroscopy, astrophysics, thermal physics, quantum physics, optics, electrical and electronics etc are contributing to fundamental research. Fundamental research is important because it provides knowledge of laws and principles. Development of nation depends on the capacity of harnessing these laws and transforming laws in techniques. As the research of carbon nanotubes^[4] is fundamental research but applications of this will definitely revolutionize the structural material science.

3. Major fields influenced by physical science

Large number of devices have been manufactured by harnessing basic knowledge of physics. Role of physical science is reflected in following important fields (Figure-1) :-

3.1 In Research field

In research field, various sophisticated devices have been made using basic principles of physics. Each area of research requires measuring and data processing devices which is possible by the knowledge of physics. For example, Aeroqual is making sensor-based instruments. Production of such cheap devices at large scale is required which are easy to afford by common people. This is possible through the knowledge of technology^[5]. The new generation of tools, could revolutionize quality measures for city residents and government. Pollution is a global problem, especially in rapidly modernizing nations. But before countries can tackle it they have to be able to measure it. Otherwise, this simple seemingly task will turn out to be surprisingly difficult.

GIS and Remote Sensing is one of the most important techniques which is used to obtain data and then to actual picture of particular locality about the different aspects of life. This technique is best for government organizations which leads to future policy formulation on the basis of data received from these techniques. Satellite data are great for generating baseline to air quality measurements, but not so great for gauging real time fluctuation in local pattern. So many other sectors in research are experiencing advantage of physics.

3.2 In disaster management

So many disaster mitigation techniques are used which are developed on the basis of discoveries done in physical science. Different types of sensors are developed which gives real-time information about water level, atmosphere pressure, cloudbursts etc. New techniques are also helping us read the record of earthquakes with ever greater accuracy. Seismometer used to detect and measure earthquakes. Normally its value falls in the range 0 to 8 on Richer scale and sometimes more than this value. New ways of dating landscape features and by harnessing the rapidly growing power of computer simulation, shows historical ruptures and earthquakes correlation. Physical science provides basic frame work for satellite systems which are also helping to forecast and control the effect of natural calamities.

3.3 In agriculture

With the help of satellites, it is possible to forecast the weather very accurately. This is a great help to the farmers. Other technical tools are also manufactured using the principles of physics.

Physical science provides machinery to support the various sectors of agriculture. It is also helping in production of pesticides and fertilizers in agricultural sciences. Soil physics is the branch of physics which is used to improve soil quality. This leads to increased agricultural yields and making self-reliant India.

3.4 In medical

Chemistry of medicines has been benefited by the discovery of structure of atom, radioactivity, X-ray diffraction etc in the physics. Mass spectrograph helps not only in the discovery of new isotopes and isobars but also helps to identify new elements having different masses. Optical microscope is found to be of immense use in the study of biological structures. The electron microscope has made it possible to see the structure of the cell. The X-Ray diffraction is helping in the study of the structure of nucleic acids, thereby helping to control the vital process of the life activities. Oximeter, blood pressure machine, glucometer for measuring blood sugar and many more common devices are examples of scientific achievements which are again improving quality of health facilities.

3.5 In industry

Fundamental research in physics is used in the industrial development. Government has established council of scientific and industrial research (CSIR) for this purpose. National Laboratories under CSIR are working to provide indigenous technologies to manufacture useful products to fulfill the need of the common people. Industrial growth has been increased by the efforts of CSIR but it requires to increase more rapidly. Energy efficient home appliances have been developed which are saving energy and hence contributing in the development of nation.

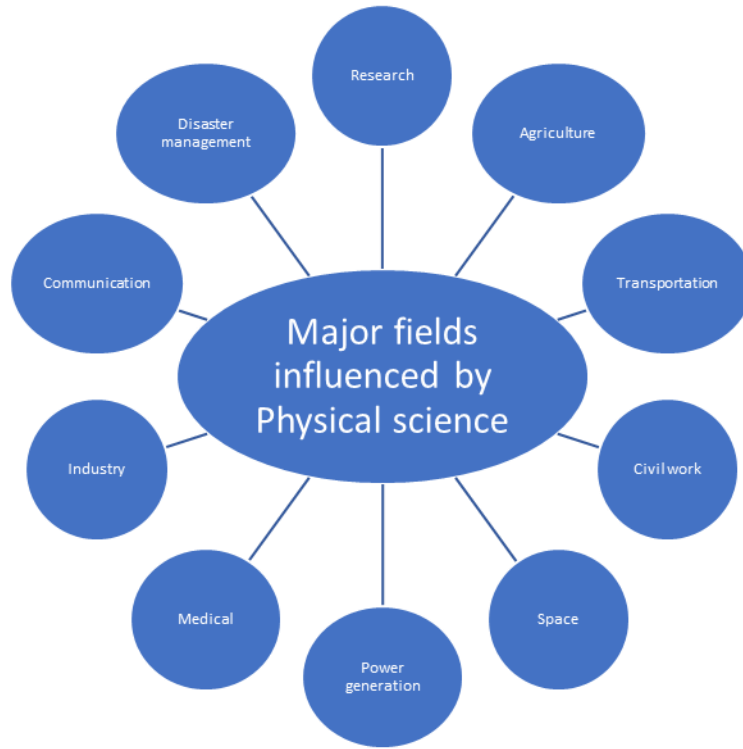


Fig. 1: Major fields influenced by physical science.

3.6 In Communication

Communication is a process of transmitting the information from one place to another place. Information may be data, voice, picture characters, code etc. and cannot be transmitted too far distances as such. Physicist have invented methods, processes using natural laws by which this became very easy using mobile, E-mail, fax, television broadcast, RADAR, sonar, radiobroadcast, telephony, telegraphy etc. These techniques are used to facilitate the human life. Increasing use of these techniques contributing to national development. Nobody was using mobile phones in India in 1993 but at present. Approx. 74 percentage of the Indian population is having mobile phones. Optical fibre made; remote sensing technique plays a significant role in the field of spying. The exact location and the movement of enemy's troops is assessed using remote sensing satellites. Optical fibre are now used in transatlantic services. Optical communication is fast replacing other types of communication. Computers and laptops are also helping in various sectors.

3.7 In power generation

The sun is radiating energy for several million years at the rate of about 10^{26} Joule per second. This energy is received by earth and stored in various natural forms^[6-7] which can be harnessed and used for the national development. Physicists have invented and used solar cell by which this energy can be converted in the form of electricity. The discovery of nuclear fission and fusion have proved to be a tremendous source of energy. In nuclear power stations and nuclear bombs, using nuclear fission, a large amount of heat energy is produced due to conversion of mass into energy. India has developed nuclear weapons for the national safety and security in which our former president Dr. A.P.J. Abdul Kalam contributed significantly. India is establishing various nuclear power stations to fulfill our energy needs.

3.8 In transportation

Automatic braking, infrared night visions, adaptive lamps, sensors to maintain required distance, advanced warning systems, electronic signal systems, electronic control systems are few examples in which automobiles are continuously experiencing dramatic improvement using inventions, discoveries and developments in the field of physics. Physicists have developed solar energy storing devices of various capacity which are continuously improving day by day with the progress of solar science. Lithium-ion-battery is also playing significant role in this field. Therefore, it seems that solar power vehicles will replace all the existing vehicles very soon in near future. New scientific advancements are influencing all the sectors of Indian railways and air transportation making it much comfortable and safe. In water transport buoyancy and Archimedes Principle play important role in designing and manufacturing the boats, ships and submarines.

3.9. In space

In the field of aerospace, wide variety of technical issues involving design, analysis and manufacturing of airplanes, rockets, missiles, space launch vehicles etc depends on the principles of physics. Aircraft engineering and aerospace technology are the branches of physics which deals with these issues. Rocket propulsion is based on Newton's second and third laws of motion. In future, more fuel efficient and safer airplanes can be manufactured. Solar power-based airplanes have been manufactured. Space agencies are also working for electric airplane that will consume energy less than half of their present capacities. Airbus is planning an airplane of the future that will run on the heat emanated by passengers. Human heat will be absorbed by cells fitted with seats and will be used for functions like fueling, electrifying, self-heating, charging computers and televisions. The long-standing mysteries of space can be solved by continuous efforts of astrophysicist. They also provide new insight about the energy output of

the sun and other stars. Now Scientists of educational institutions, government and private research establishments are collaborating by realizing that collaborative work gives better results in the development of new technologies.

3.10 Civil work

Civil engineer is required to have knowledge of physical properties of the material to be used during construction. Selection of the material depends on the physical properties and requirement like load bearing capacity, tensile strength, flexural strength, flexural modulus, durability. Elastic behavior is required to be studied in detail before selecting the material dimensions to construct the structure. Buildings, bridges, dams, ports, shipyards, water distribution canals and so many types of infrastructural development projects are not possible without the knowledge of proper understanding of physical sciences.

So many other sectors are there which have direct influence of physical science. Whatever is thought or discovered in physics, immediately affects the society as these give bases of technology development. Science and technology provide processes by which using minimum raw material, many fold products can be obtained. Awareness is required to use technology in proper manner to use it in true sense.

4. Conclusions

- There are opportunities to develop indigenous cheap technology by harnessing natural laws of physics. Awareness of technology is necessary to the common citizen due to which density of technology users increases. Therefore, awareness among the common people is required for which government establishments and educational institutions can play great role.
- Physics has the potentiality to develop the nation, to remove poverty and hunger completely from the India and to enter in an age of prosperity.
- It is our responsibility to use laws and discoveries of physics wisely otherwise it may be curse for the society if used in form of nuclear weapons.

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