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**INTRODUCTION**

Advances in numerical analysis techniques, including the finite element method and high-speed, high-capacity analytical hardware such as the personal computer have made it possible to investigate numerically even the most complex electromagnetic phenomena. The frequencies involved in the operation of a product determine how the analysis must be carried out: in some cases, the electric field and magnetic field may be studied separately, as in electric field analysis and magnetic field analysis; while in other cases it is necessary to study both the electric and magnetic fields simultaneously, as in electromagnetic field analysis. This paper outlines and describes the purpose of electromagnetic field analysis, and presents examples of product design and development.

**ABSTRACT**

Understanding the connections between magnetism and electricity and exploiting that understanding for technological innovation dominated science in the nineteenth century, and yet no one saw it coming. In the index to Butter- field’s classic history of the scientific revolution which he locates roughly from 1300 to 1800, the word “electricity” does not appear. Electricity, as we now call it, was not completely unknown, of course. In the late sixteenth century, Gilbert, famous for his studies of magnetism, discovered that certain materials, mainly crystals, could be made attractive by rubbing them with a cloth. He called these materials electrics. Among Gilbert’s accomplishments was his overturning of the conventional wisdom about magnets, when he showed, experimentally, that magnets could still attract nails after being rubbed with garlic. Sometime after Gilbert, electrostatic repulsion and induction were discovered, making the analogy with magnetism obvious. However, until some way was found to study electricity in the laboratory, the mysteries of electricity would remain hidden and its importance unappreciated. Nobody in 1800 could have imagined that, within a hundred years or so, people would live in cities illuminated by electric light, work with machinery driven by electricity, in factories cooled by electric-powered refrigeration, and go home to listen to a radio and talk to neighbors on a telephone. How we got there is the subject of this note.

**HISTORY**

Early Greek science was entirely theoretical so the explanation, proposed circa BC 460, by Diogenes of Apollonia that there was: “...humidity in iron which the dryness of the magnet feeds upon” survived unchallenged for nearly 2000 years. William Gilbert (1544-1603) summarized the subject and its history in a book but although some of his theories were good ‘Unlike poles attract, like poles repel’.

Charles du Fay, who was Superintendent of the French Royal Botanical Gardens, recognized that there were two forms of electricity – either resinous or vitreous. He found that like forms repelled and unlike forms attracted. Benjamin Franklin explained the experiments in terms of an excess, or deficit, of vitreous fluid. The modern ideas of positive and negative charge appeared at about this time. Franklin also found that a cork ball inside a charged metal cup was not attracted to the inside surface. Joseph Priestly proposed that there was an analogy between the inverse square law of gravity and electricity. Coulomb concluded from his experiments that magnetic fluids were bound to molecules and could not flow and the same experiments were used as the basis for a mathematical theory by Poisson who developed the idea of a potential after starting work 1824.

**DEFINITION OF ELECTROMAGNETISM**

Electromagnetism is a branch of physics which deals with electricity and magnetism and the interaction between them. It was first discovered in the 19th century and has extensive application in today's world of physics.

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Electromagnetism is basically the science of electromagnetic fields. An electromagnetic field is the field produced by objects that are charged electrically. Radio waves, infrared waves, Ultraviolet waves and x-rays are all electromagnetic fields in a certain range of frequency. Electricity is produced by the *changing* of magnetic field.

**APPLICATIONS OF ELECTROMAGNETISM**

We can find enormous practical application of electromagnetism in everyday life from domestic appliances to research applications.

**1.Household Appliances**

Electromagnetism serves as a basic principle of working for many of the home appliances in household applications. These applications include lighting, kitchen appliances, air conditioning systems, etc.

* The most dominant use of power in homes as well as commercial buildings is lighting systems. These lighting systems used numerous fluorescent lighting fixtures. Ballasts used in the fluorescent lamps use electromagnetism principle so that at the time of turn ON of the light it produces a high voltage.
* Electric fans, blowers and other cooling systems use electric motors. These motors work on the principle of electromagnetic induction which is the branch of electromagnetism. In any electrical appliance, electric motor is moved by the magnetic field produced by the electric current according to the Lorenz force principle. These motors are vary in size, rating and cost based on the application.

**2.Industrial Applications**

Almost all of the instruments or devices used in industries are based on the electromagnetism. Materials used in constructing such devices include iron, cobalt, nickel, etc which naturally responds to the magnetic fields.

Starting from small control instruments to the large power equipment’s, the electromagnetism is used at least at one stage of their working.

* Generators and motors dominate in most of the industries which are the primary power source and driving systems respectively. Generators convert the mechanical to electrical energy whereas the motors convert electrical energy to mechanical energy.
* Generators supply the electrical energy in the time of mains power interruption and most of the cases, these are driven by the IC engines. There are different classes of motors which are employed in industries. These are used for cranes, hoists, lifts, conveyor systems, etc.
* Various sensors and actuating devices are works based on electromagnetism. Electromagnetic sensors include Hall-effect sensors, magneto resistive sensors, fluxgate sensors, etc. These sensors convert the physical quantity such as flow, pressure, level, proximity, etc. into an electrical signal.
* Actuators are the final control elements which drives the load at specific conditions. These actuator devices include solenoid valves, relays, motors, etc. and all these works on the principle of electromagnetism.

**3.Communication System**

It is the process of transmitting information from a source to a receiver. This transmission of energy over long distances is carried out through electromagnetic waves at high frequencies. These waves are also called as microwaves or high frequency radio waves.

Suppose in case of mobile phones, sound energy is converted into electromagnetic energy. By using radio transmitters, this electromagnetic energy is transferred to the receiver. At the receiver these electromagnetic waves are again transformed back into sound energy.

**4.Medical System**

Nowadays electromagnetic fields play a key role in advanced medical equipment’s such as hyperthermia treatments for cancer, implants and magnetic resonance imaging (MRI).

RF range frequencies are mostly used in medical applications. In MRI scans, sophisticated equipment works based on the electromagnetism can scan minute details of the human body. The electromagnetic therapy is an alternate form of medicine which claims to treat disease by applying pulsed electromagnetic fields or electromagnetic radiation to the body. This type of treatments is used for wide range of ailments such as nervous disorders, diabetes, spinal cord injuries, ulcers, asthma, etc.

Many of the medical equipment’s such as scanners, x-ray equipment’s and other equipment’s uses electromagnetism principle for their functioning.

**5.Magnetic Levitation Trains**

This is the modern technology of transportation systems that use the concept of electromagnetism. These are called as high speed trains which use powerful electromagnets to develop the speed. These trains will float over a guide way using the basic principles of magnets such as electromagnetic suspension (EMS) and electrodynamic suspension (EDS). In EMS, electromagnets employed on the train body are attracted to the iron rails. These magnets wrap around the guided rails and attractive force between the guideways and magnets lifts the train upwards. In EDS, train is levitated by the repulsive force in the conductive guideways by induced currents.

A guideway is nothing but an arrangement of specially designed magnetic coils and tracks at regular intervals. Along this guideway a maglev train is suspended by the phenomenon of the magnetic levitation with no supports other than magnetic fields.

**RESEARCH PAPER**

The report titled ‗MAGLEV TRAINS‘accomplishes a research on the developing discipline of magnetic levitation and its application to transportation through trains. It provides detailed information about the evolution of maglev science, its progression and improvisation till date. High-speed magnetically levitated ground transportation (maglev) is a new surface mode of transportation, in which vehicles glide above their guide ways, suspended, guided, and propelled by magnetic forces. This report tries to explain the complexities involved in this technology in a simple but precise manner, so that all the methods implemented in it are understood by the reader at prima facie. This report, tries to compare the conventional modes of transport with maglev trains in various aspects such as safety, durability, speed, comfort and so on. Thus, providing the advantages and disadvantages of the trains. Further, this report helps us to learn about the various cities around the world, where maglev trains currently run and also provides an overview of the proposals for such trains, which are being considered as a promising investment globally. Consecutively, it deals with the accidents that have occurred at places where maglev trains have been implemented and the reasons that triggered them. This data has been included so that such incidents may be avoided in the future and in order that certain necessary modifications are made to improve the safety measures of these trains. Capable of travelling at speeds of 250 to 300 miles-per-hour or higher, maglev would offer an attractive and convenient alternative for travelers between large urban areas for trips of up to 600 miles. It would also help relieve current and projected air and highway congestion by substituting for short-haul air trips, thus releasing capacity for more efficient long-haul service at crowded airports, and by diverting a portion of highway trips. Finally, our report gives a peek into the future expansions of maglev trains and thus undoubtedly assures its readers that maglev trains are no longer a science fiction, and are in fact the future of world transportation. III. BACKGROUND Transportation is the direct product of the social link and social relationship of the people. Revolutionary changes have taken place in the life of the mankind since human beings PRAYASH B BHATT, SUNITA R. YEWALE International Journal of Scientific Engineering and Technology Research Volume.04, IssueNo.17, June-2015, Pages: 3281-3287 acquired the capability of walking upright as a result of evolution from the ape. Human being‘s vision was widened to enable itself to better observe the surroundings and to be watchful against any possible crises. But due to the low productive forces and constraints on people by the conditions of the nature in the primitive times, usually they could not but live by hunting animals or gathering plants within a certain region to maintain the lease of life by making use of a few elements of the nature, let alone any act of transport for the commercial intercourse among the peasants, workers and merchants. Nevertheless, with the development of human society, people gradually widened their vision in the geographic space through several forms of lateral social contact in their production activities and injected active seeking factor into the passive man, environment relationship. Gradually, human being mastered the use of tools and other special at his service. Among others, the horse, an animal which changed the speed of human transportation, enabled a cart to run at some 10km/h, thus the region scoped varied and the link between city and city became closer, enhancing the progress of culture and civilization in various places.

**CONCLUSION**

Electromagnetism is responsible for practically all the phenomena encountered in daily life, with the exception of gravity. Ordinary matter takes its form as a result of intermolecular forces between individual molecules in matter. Electromagnetism is also the force which holds electrons and protons together inside atoms, which are the building blocks of molecules. This governs the processes involved in chemistry, which arise from interactions between the electrons inside and between atoms.

Electromagnetism manifests as both electric fields and magnetic fields. Both fields are simply different aspects of electromagnetism, and hence are intrinsically related. Thus, a changing electric field generates a magnetic field; conversely a changing magnetic field generates an electric field. This effect is called electromagnetic induction, and is the basis of operation for electrical generators, induction motors, and transformers. Mathematically speaking, magnetic fields and electric fields are convertible with relative motion as a four vector.

Electric fields are the cause of several common phenomena, such as electric potential (such as the voltage of a battery) and electric current (such as the flow of electricity through a flashlight). Magnetic fields are the cause of the force associated with magnets.

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