ABSTRACT

The thesis entitled “A study of effects of electromagnetic radiation (EMR) on health” is based on observing influence of electromagnetic fields around us. Electromagnetic radiation may have an effect on living things on earth and in space also. It is very difficult to imagine a world without electricity. Day by day we are becoming more and more dependent on electrical and communication technology making the globe to be flooded with electromagnetic radiation field in the frequency 50 Hz to 2 GHz. When electricity is used for various purposes, electrical circuits and electrical devices produce electromagnetic fields. Although magnetic fields are weak and invisible, their possible adverse effects on the human body have been the issue of extensive studies for the last 50 years.

Investigations concerning electromagnetic energy can be divided into three major categories based on the sources. First category is includes electromagnetic fields produced by electricity circulation system, electric circuits used in computers, television, microwave ovens, cell phones and wireless communication towers systems etc. These fields are can be called as technofields.

As well as the entire living beings are facing electromagnetic radiation from natural sources like sun and the rest of the universe. These fields are called as geofields. These fields exist in nature. They are unpredictable due to their characteristics of fluctuations like eruption during solar eclipse. They are cyclic in nature. They are as due to diurnal and seasonal changes. Also they are relatively stable like earth’s magnetic field. The ionosphere reflects all the radiation passing through it including radio waves which play a vital role in the communication.

Third field is related with human body. It is the field created by all living beings during metabolic activity in the body hence, is called as biofields. Electricity produced
within body bioelectricity is a biofield. It is due to concentration gradient generated across membrane of the cell.

In bioelectricity, the major part of the study is concentrated on electric and magnetic fields produced during functioning of nervous system, cardiovascular system, heart, brain and muscle. Biofields are comparatively weaker as compared with either geofields or technofields. If they are measured correctly, they provide useful information about functioning of various systems and hence useful in diagnosis and monitoring of the patients mostly. These fields have been used to observe changes in the metabolic activity of system and to detect sickness. The energies in the process are biological energies and can be used to restore energy imbalance. Also, these fields can be used in healing process like therapeutic touch, reiki, acupressure etc.

In the present thesis effect of technofields and geofields on human health parameters is discussed. The study presented in the thesis is mainly divided in to six topics.

First topic, introduction contains basic theory about electromagnetic radiation, electromagnetic spectrum and its historical background. It also contains information about ionizing and non ionizing radiation with examples. Working of the latest commonly used devices are based on concept of electrical and magnetic field. Cell phones, AM and FM radio, television broadcast stations, power transmission line and distribution cables, communication systems involve effects of electromagnetic field. The spectrum of electromagnetic waves involves an array of the waves increasing in frequency from low frequency to gamma ray of highest frequency. All these waves in the electromagnetic spectrum form electromagnetic radiation. Some people believe that electromagnetic radiation may affect the human body.

If the energy of radiation is sufficiently high, photons will have ample energy to ionize the atom. These radiations are called as ionizing radiations. Ionization will be possible if frequency of radiation is greater than frequency of waves in the visible region. Gamma radiation and X-rays have higher frequency and hence the power to ionize the matter. On the other hand, the radiation of low frequency is called as non-ionizing
radiation. Their energy levels are below the level that is required to cause ionization at atomic level. The Non ionizing radiations can be due to static electromagnetic fields, low-frequency waves and radio frequencies. The health hazards of this ionizing radiation are discussed in the topic. At the end of topic, objectives and importance of study is discussed.

Second topic, literature review contains review of various sources and effects of electromagnetic radiation. The role of the low frequency and high frequency radiation is discussed. The biophysical principle behind the radiation absorption and biological effects are discussed in detail. Major health effects like blood brain barrier, genotoxic effects, effects on fertility and reproduction, generation of cancer, problems in nervous system and brain functioning, sleep disturbance and variations in EEG pattern, variations in heart rate, stress response, effects on children, occupational health hazards, precaution taken during driving and uses of cell phone radiation in hospitals are discussed in detail.

In addition, impact of radiation on wild life including impact on birds, bees, farms animals, plants, mammals and wild life is discussed. Subjects residing near base transmission towers can have ill health due to radio frequency radiation emitted nearby mobile towers. The probable relation between exposure of radiation and symptoms of common diseases observed in the vicinity with possible effects are discussed in the literature survey. More over mobile towers emit radiation continuously and hence it is supposed to be major source of radiation than mobile handset and other radio frequency devices.

Topic two also contains reviews on effects of electrical powerline and geopathic stress. The worry about radiation emitted by high voltage transmission lines of frequency 50 Hz has extensive issue of discussions in property business and related in energy sector also. In this regards, controversial and inconsistent data is reported every year. In these research articles papers necessity of high voltage transmission line and effects due to interaction of human body with electric and magnetic field were discussed.

Geopathic stress is created by to low frequency waves due to underground flowing water, deposits of mineral and reservoir. This stress may arise due to man made
disturbance like mining in the ground. There are reports of problems caused by geopathic stress. The theories of origin of earth’s field, symptoms in people residing in the geopathic stress zone are discussed. Safety measures for exposure of electromagnetic radiation are discussed in the topic.

Third topic, data collection and analysis deals with information about the instruments used for the study reported in the thesis. It also contains the criterion used for selection of site and sample in various experiments described in the topic. Detailed information about ECG machine Cardiart 108 T DIGI, ECG electrodes used is explained. Other devices multipara monitor, Caddo 19 B and monitoring various functions, fat measurement using Fat monitor HBF 306, Mercury Sphygmomanometer and Omron BP monitor are discussed with theoretical background and methods of recording the measurements.

A survey of effect of mobile phone radiation was conducted on volunteers residing in diverse regions of cell phone tower areas. Analysis of survey and necessary measures to minimize radiation hazards are also discussed. Methodology used for study of effect of mobile phones in various tones on cardiovascular system along with exclusion and inclusion criteria for volunteers are explained. The data recorded and analyzed with statistical p value obtained using online students t test are presented. Details about study of an influence of the continuous communication using mobile phone on variations in heart rate and cardiovascular parameters when exposed to cell phone radiation, high tension electric powerline are discussed with experimental care. Recorded data with analysis of blood pressure, heart rate, respiration rate, temperature of body and percentage oxygen using multipara Caddo 19 B are also given in the topic.

The study of geopathic stress includes selection of site, subjects (volunteers) and method of recording observations. Four sites of geopathic stresses in Pune and Pimpri Chinchwad area were selected by well-known dowsing method. Forty male volunteers were selected for the study. The health parameters are recorded using multipara Caddo 19 B analyzed. Using online student’s t test analysis was done. Mean values with standard deviation, standard error and statistical p value are calculated for interpretation for all the four geopathic zone sites.
Fourth topic deals with results and discussion on the data obtained in the experiments explained in the data collection and analysis topic. It includes the detailed outcome of the survey of biological effects of mobile phones and towers (Appendix I) conducted. Health symptoms and health problems are reported by respondents during survey are explained by graph plotted by Origin 7 software.

Discussion of experiments of exposure of radiation due to various ring tone of mobile phone, effects of continuous communication on mobile phone for 20 minutes, effect of electric high tension power line and geopathic stress on cardiovascular parameters are included in the topic. The discussion is based on comparative tables and graphs. The probability value $p < 0.05$ is considered as significant for the effects. Effects are discussed gender wise and age group wise. More attention is given on youngster because they are addicted to mobile phones for diverse applications. Minimum, maximum values with standard deviation of studied variables for students before and after exposure to EMR from high voltage powerlines with p value are tabulated. Similarly p values for four geopathic sites are also tabulated indicating significance of each site.

Topic five deals with summary of the results of mobile phone, high voltage powerline and geopathic study. Due to remarkable growth in mobile users, more and more people will be exposed to radiation emitted from mobile phones in coming years. The most apparent effects of radio frequency radiation on living cells are due to heat emitted by radiation. There are other reasons to be worried about health effects of radiation exposure. The fear exists because the aerials and antennas of phones give out much of radiofrequency energy to user’s head directly for continuous 24 hours. The study presented in the thesis indicated that mobile phone affect some cardiovascular parameters also. The change in cardiovascular parameters at individual level is more prominent for some cases.

It has been observed that the long term communication on cell phone for period more than 20 minutes continuously affects blood pressure and heart rate. The study is useful for the people who are not aware about these radiations. It has been noted that electromagnetic radiation emitted by mobile phone and mobile phone towers are harmful for the people who are living nearby the transmission towers. So people should keep
away from the base transmission towers. They should oppose erection of mobile tower going to be put up in residential crowded area, hospitals, schools and colleges. It is recommended that people should use the mobile phone for very short time and in emergency only. The voltage powerline study indicated no harms to human health. The causes are discussed in the topic.

It has been noticed that geopathic stress of low frequency affects health. All the four geopathic sites showed change in health parameters but some sites showed more noteworthy changes. Geopathic stress lowers immune system and invites number of diseases. All the study presented in the thesis has certain limitations and these limitations are mentioned in the topic.

Topic sixth is about recommendation and future scope of the study. To avoid threats due to radiofrequency radiation emitted by cell phone and base transmission, precautionary measures should be taken to reduce the exposure. These precautionary measures are discussed in the topic. Suggestions and recommendations, which can be carried out on to reduce the effect of EMR from high voltage powerlines on student's health are also stated. Recommendations are suggested to protect from geopathic stress in the topic.