# Measurement of Magnetic Field Emitted from Electrical Appliances in CSE Labs and Classrooms of Southeast University, Bangladesh

Munima Haque, Md. Quamruzzaman, Shahina Haque

**Abstract**— The aim of this survey is to investigate whether the Electromagnetic Fields (EMF) emitted from various air conditioners and switch boards affect the students, faculties and employees. There is a standard threshold value recommended by WHO for both electric and magnetic fields. Electro-Magnetic Field also named Non Ionizing Radiation is emitted from high power transmission lines, computer monitor/video display unit, radio waves of different frequencies, telecommunication, satellite, radar etc. which causes health hazards to living system and environment. There has not been much study performed in Bangladesh. The data were collected from various Computer Science and Engineering (CSE) department labs and classrooms at Southeast University in Dhaka, Bangladesh. Both threshold values of Electric and Magnetic fields were measured for various air conditioners and switchboards. The maximum value of the magnetic field results showed that in many cases the magnetic field radiated from the different sources are greater than the threshold limit, which are the main point of our findings.

**Index Terms**— Air Conditioners, EMF, ELF, EF, MF, NIR, Switch Boards, WHO

## 1 INTRODUCTION

Ionizing radiation is the radiation of sufficiently high energy to cause ionization in the medium through which it passes. It may consist of a stream of high–energy particle (e.g. electron, protons, alpha particles) or short wavelength electromagnetic radiation (ultraviolet, X-rays, gamma-rays). Radiation, which does not cause any ionization of the media while passing through it, is known a non-ionizing radiation (NIR). Examples of non-ionizing radiation are ultraviolet, visible light, infrared, microwave and radiowave. Their energy is relatively low; it only manages to cause molecules to vibrate and induces heating effects.

Throughout the world, the general public is concerned that exposure to EMF from such sources as high voltage, power lines, radars, mobile telephones and their base stations could led to adverse health consequences ,especially in children. As a result, the construction of new power lines and mobile telephone networks has met with considerable application in some countries. Recent history has shown that lack of knowledge about health consequence of technological advances may not be the sole reason for social opposition to innovations. Disregard to difference among scientists, government, industry and the public is also to blame. It is for this reason that risks perception and risks communication in relation to EMF hove become a international issue. As a result World Health Organization (WHO) in response to these public concerns shared by many governments has established the International Commission on Non-Ionizing Radiation and Protection (ICNIRP) to evaluate the biological effects and asses public health risks from EMF exposure.

Naturally occurring 50/60 Hz magnetic field levels are extremely low of the order of 0.0001 V/M and 0.00001 μT respectively. Human exposure to ELF fields is primarily associated with the generation, transmission and use of electrical energy. Electrical energy from generating stations is distributed to communication via high voltage transmission lines. EM fields under health overhead transmission lines may be as high as 12Kv/m and 30 μT. Around generating stations and substations, EM fields up to 16 Kv/m and 270 μT may be found. EM fields at home depends on many factors including the distance from power lines the number and types of electrical appliances in use in home and the configuration and position of household electrical wiring. EMF in homes may be 500V/m and 150 μT. But they decrease rapidly with distance. Workers who maintain transmission and distribution lines may be exposed to 130 mT. Near Industrial furnace and electrolytic cells it may be higher than 50 mT.

In trying to understand people's perception of risks, it is important to distinguish between a health hazards and a health risks. A hazard can be an object or a set of circumstances that can potentially harm a person's health. Risks is the like hood (as probability) that a person will be harmed by a particular hazard. There is no such thing which could be considered as zero risk. The same is the true for EMF emitting sources. Under certain circumstance EMF can be potentially hazardous and risks to a person's health depends on the level exposure.

A number of factors influence a person's decision to take a risk or reject it. People usually perceive risks as negligible, acceptable, tolerable or unacceptable, and compare them with the benefits, which should outweigh the risks by a significant margin. These perceptions can depend on people's age, sex, cultural and educational backgrounds. The nature of risks can lead to different perceptions.eg. (i) Involuntary vs. voluntary exposure, Lack of personal control vs. feeling of control over a situation , familiar vs. unfamiliar, dread vs. not dreaded, and

unfairness vs. fairness.
In the case of people who do not own a mobile telephone but may be exposed to RF fields from mobile telephone base stations may be perceived as a high risk.

Lower animals are reported to very much sensitive to electromagnetic fields. It is observed that animals like rats make their living brooding holes away from the high electric field and bees block-up their hives in the chronic presence of NIR/EMF. As a consequence, scientists and health physicians in developed countries have become aware of the effects of NIR [3]. Their research and observations have brought out some remarkable results linking low level alternating electromagnetic fields with serious health hazards. There is also evidence that biological effect like immune deficiency, sensitive lymphocytes, disrupting DNA, cellular breakdown is being affected by NIR [4].

Everyone is exposed to a complex mix of electromagnetic fields (EMF) of different frequencies that permeate our environment. Exposure to many EMF frequencies are increasing significantly as technology advances unabated and new application are found every day.
Whle the enormous benefits of using electricity in everyday life and health care are unquestioned during the past 30 years the general public has become increasingly concerned about potential adverse health effects of exposure to electric and magnetic fields at extremely low frequencies of 50/60 Hz.

Much research has been performed in this regard. Most recently, Epidemiological survey of people working in EMF field exposed to high frequency have been investigated [5]. Also, research was performed for epidemiological survey on e\ffect of EMF emitted by photocopy machines generally used in Dhaka city Bangladesh [6]. Survey was done on EMF emitted by Lab equipments in various labs of Southeast University in Bangladesh for possible health hazards [7]. A case study was done on EMF near high voltage transmission line [8]. Also, a review was done on Non Ionizing Radiation (NIR), its harmful effects especially from Mobile/Cell Phone and Towers [9]. An epidemiological survey was performed on CRT monitors used in Dhaka city [10]. An investigation was performed in finding the magnetic field emitted from various Lab equipments in Textile Labs in Southeast University [11].

The only practical way that ELF fields interact with living tissues is by inducing electric fields and currents in them. However, the magnitude of these induced currents normally found in our environment is less than the current occurring naturally in the body.

There have been various papers published on EMF of radio, TV etc. but not much on Air Conditioners (AC). Since the invention of modern electrical air conditioning unit in 1902 by Willis Carrier, Buffalo, New York [12] there has been tremendous increase in use of air conditioning in the world. In some cases it has been used in cooling the building, theatres, and for commercial purposes. Since air conditioner has been used for comfort, its demand has increased. After the invention of portable air conditioners, it has been easier to purchase one. Especially in tropical countries like Bangladesh, it is in high demand not only at offices, but at homes also. With the increase in the efficiency of the modern air conditioners as well as the attractive decrease in its price, offices and private homes have their own air conditioner systems. At Southeast University, all the offices, labs and classrooms have air conditioners due to very hot and humid weather during the summer. Each office, labs and classrooms have one or multiple switchboards. The students spend around 7-8 hours each day in these classrooms and labs while the faculties and employees also do the same. The aim of this research is to investigate whether the EMF emitted from these air conditioners and switchboards are within threshold values and also if the students and employees are safe from these equipments.

## 2 MATERIALS AND METHODS

A Cornet ED78S EMF RF Meter ElectroMagnetic Detector [13] was used for measuring the magnetic field values for the various air conditioners and switch board equipments. A Coghill Field Mouse for Biohazard Awareness was used for measuring the threshold values for both electric field (EF) and magnetic field (MF) around the instrument. The threshold voltage setup inside the Coghill Field Mouse is according to ICNIRP. The readings were taken to cover all around the equipment. The method followed was: at the center of the equipment (front side), upper backside, at $45^{O}$ both front side and back.

Fig. 1: Electrosmog RF/LF Field Strength power meter Dual mode RF power meter & LF gauss meter ED-78S measuring magnetic field in front of air conditioner (left image) and the COGHILL FIELD MOUSE measuring the EF and MF threshold values (see the red and green lights). Green lights indicate the EF and MF both threshold have reached. (right image)

## 3 RESULTS

Findings at different EMF sources: All the readings were taken from different labs of Electrical and Electronic Engineering (EEE) department, Southeast University Tejgaon Permanent campus. Readings were taken from air conditioning units and the switchboards of each classroom.

**Table 1:** EMF values measured for Air Conditioner equipments in various Labs in Southeast University (SEU)

| Serial No. | Equipment info. (Machine #, Machine Model, made country, year made, Date of installation) | Threshold dis. in front of the equipment measured from the centre of the equipment (cm) | | Magnetic Field (mG) in front of the eqpt. | Threshold dis. at right side of the equipment (cm) | | Magnetic Field (mG) at right side of the equipment | Threshold distance at the left side of the equipment (cm) | | Magnetic Field (mG) at left side of the equipment | Magnetic Field maximum (mG) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EF | MF | | EF | MF | | EF | MF | | |
| 1a | Air conditioner Model: Carrier 42CSR018-703 1 ton/2009 | 28.1 | 101.5 | 30.6 μT | 13 | 17 | 17 μT | 21 | 30 | 1.1 μT | 30.6 μT |
| 1b | Air conditioner Model: Carrier 42CSR018-703 1 ton/2009 | 29 | 103 | 31.3 μT | 12 | 19 | 18 μT | 23 | 31 | 1.1 μT | 31.3 μT |
| 2 | Air conditioner Model: Mitsu 42CSR018-703 2 ton/2002 | 70 | * | 65.1 μT | 31 | 49 | 31 μT | 28 | 36 | 11.1 μT | 65.1 μT |
| 3 | Air conditioner Model: National 42CS-4TV21 2 ton/2002 | 33 | * | 57 μT | 29 | 43 | 29 μT | 23 | 31 | 9.6 μT | 57 μT |
| 4a | Air conditioner Model: National 42CS-4TV21 2 ton/2002 | 41 | * | 39.5 μT | 23 | 29 | 27.2 μT | 11 | 15 | 0.7 μT | 39.5 μT |
| 4b | Air conditioner Model: National 42CS-4TV21 2 ton/2002 | 38 | * | 33.2 μT | 21 | 31 | 23.5 μT | 13 | 17 | 0.6 μT | 33.2 μT |
| 5a | Air conditioner Model: National 42CS-4TV21 2 ton/2002 | 44 | * | 38.5 μT | 23 | 33 | 29.3 μT | 11 | 16 | 0.6 μT | 38.3 μT |
| 5b | Air conditioner Model: National 42CS-4TV21 | 45 | * | 41.6 μT | 21 | 31 | 28.5 μT | 9 | 16 | 0.9 μT | 41.6 μT |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 ton/2002 | | | | | | | | | | |
| 6 | Air conditioner Model: National 42CS-4TV21 2 ton/2002 | 37 | * | 31.5 µT | 22 | 29 | 22.4 µT | 10 | 15 | 0.7 µT | 31.5 µT |

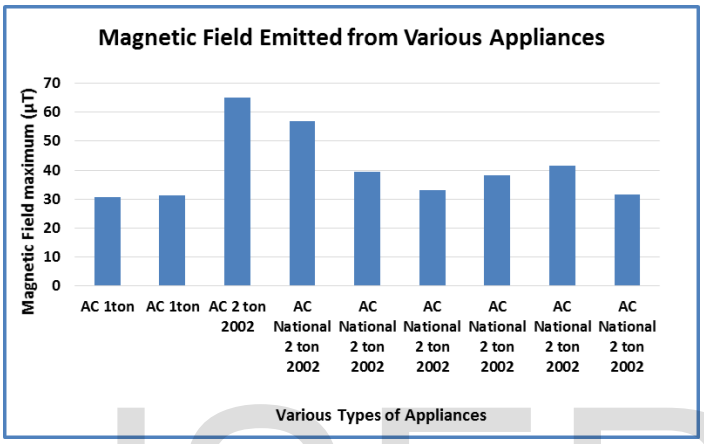


Fig. 2: Graphical representation of Table 1

**Table 2:** EMF values measured for Air Conditioner equipments in various CSE classrooms in Southeast University (SEU), April 2016. Air conditioners location address: (1) Classroom AR 901, (2) classroom AR 902, (3) Classroom AR 701, (4) classroom AR 702, (5) Classroom AR 705, (6) classroom AR 1201, (7) Classroom AR 1202, (8) classroom AR 1206.

| Serial No. | Equipment info. (Machine #, Machine Model, made country, year made, Date of installation) | Threshold dis. in front of the equipment measured from the centre of the equipment (cm) | | Magnetic Field (mG) in front of the eqpt. | Threshold dis. at right side of the equipment (cm) | | Magnetic Field (mG) at right side of the equipment | Threshold distance at the left side of the equipment (cm) | | Magnetic Field (mG) at left side of the equip ment | Magnetic Field maximum (mG) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EF | MF | | EF | MF | | EF | MF | | |
| 1a | Air conditioner Model: Carrier 42CSR018-703 1 ton/2014 | 18.2 | 75 | 19.6 µT | 11 | 18 | 13 µT | 9 | 15 | 0.6 µT | 19.6 µT |
| 1b | Air conditioner Model: Carrier 42CSR018-703 1 ton/2014 | 16.5 | 65 | 17.2 µT | 12 | 16 | 13.1 µT | 11 | 16 | 0.6 µT | 17.2 µT |
| 2a | Air conditioner Model: Mitsu 42CSR018-703 | 17 | 95 | 21.3 µT | 15 | 19 | 11.3 µT | 10 | 15 | 0.7 µT | 21.3 µT |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 ton/2014 | | | | | | | | | | |
| 2b | Air conditioner Model: National 42CS-4TV21 1 ton/2014 | 19 | 91 | 18.5 μT | 13 | 19 | 14.2 μT | 9 | 17 | 0.9 μT | 18.5 μT |
| 3 | Air conditioner Model: National 42CS-4TV21 2 ton/2002 | 45 | * | 51 μT | 28 | 37 | 29.6 μT | 23 | 33 | 7.5 μT | 51 μT |
| 4 | Air conditioner Model: National 42CS-4TV21 2 ton/2002 | 31 | * | 47 μT | 29 | 38 | 21.5 μT | 13 | 17 | 8.3 μT | 47 μT |
| 5 | Air conditioner Model: National 42CS-4TV21 2 ton/2002 | 37 | * | 49.2 μT | 27 | 33 | 19.6 μT | 11 | 16 | 8.1 μT | 49.2 μT |
| 6a | Air conditioner Model: Carrier 42CSR018-703 1 ton/2009 | 29 | 125 | 32.1 μT | 10 | 13 | 19 μT | 31 | 37 | 0.9 μT | 32.1 μT |
| 6b | Air conditioner Model: Carrier 42CSR018-703 1 ton/2009 | 31 | 130 | 19 μT | 10 | 12 | 18.5 μT | 19 | 30 | 0.7 μT | 19 μT |
| 7a | Air conditioner Model: Carrier 42CSR018-703 1 ton/2009 | 29.5 | 100 | 32.7 μT | 13 | 17 | 18 μT | 21 | 32 | 1.1 μT | 32.7 μT |
| 7b | Air conditioner Model: Carrier 42CSR018-703 1 ton/2009 | 27 | 101 | 29.6 μT | 17 | 30 | 17 μT | 23 | 33 | 0.9 μT | 29.6 μT |
| 8a | Air conditioner Model: Carrier 42CSR018-703 1 ton/2009 | 28.7 | 111 | 33.1 μT | 15 | 32.3 | 8.2 μT | 22 | 33 | 1.1 μT | 33.1 μT |
| 8b | Air conditioner Model: Carrier 42CSR018-703 1 ton/2009 | 27.1 | 107 | 31.2 μT | 13 | 19 | 18.1 μT | 21.5 | 31 | 1.0 μT | 31.2 μT |

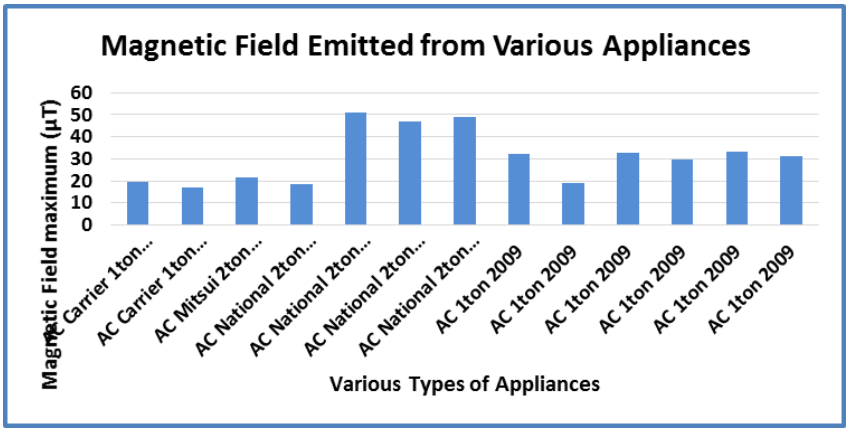


Fig. 3: Graphical representation of Table 2

**Table 3:** EMF values measured for switchboards in various CSE labs in Southeast University (SEU), March 2016. Switchboards location address: (1) Physics Lab AR 1205 (2) DLD Lab AR 802 (3) Computer Lab-3 (4) Computer Lab-2 and (5) Computer Lab-5.

| Serial No. | Equipment info. (Machine #, Machine Model, made country, year made, Date of installation) | Threshold dis. in front of the screen measured from the center of the equipment (cm) | | Magnetic Field. In front of the equipment (μT) | Threshold dis. at right side of the equipment (cm) | | Magnetic Field at right side of the equipment (μT) | Threshold distance at the at left side of the equipment (cm) | | Magnetic Field at left side of the equipment (μT) | Magnetic Field maximum (μT) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EF | MF | | EF | MF | | EF | MF | | |
| 1a | Plug Board 13A | 3.5 cm | * | 0.2 μT | 1.4 cm | * | 0.1 μT | 1 cm | * | 0.1 μT | 0.2 μT |
| 1b | Switchboard 13A | 30.5 cm | 4 | 1.2 μT | 18 cm | 2.5 | 0.6 μT | 15.5 cm | 6.5 | 0.6 μT | 1.2 μT |
| 1c | Plug Board 13A | 5.5 cm | 0 | 0.3 μT | 8 cm | 0 | 0.4 μT | 3.5 cm | 0 | 0.5 μT | 0.5 μT |
| 1d | Plug Board 13A | 8 cm | 0 | 0.2 μT | 11 cm | 0 | 0.1 μT | 3.5 cm | 0 | 0.06 μT | 0.2 μT |
| 1e | Plug Board 13A | 10 cm | 0 | 0.4 μT | 13 cm | 0 | 0.3 μT | 11.5 cm | 0 | 0.3 μT | 0.4 μT |
| 1f | Plug Board 13A | 6 cm | * | 0.3 μT | 11 cm | * | 0.2 μT | 3 cm | * | 0.1 μT | 0.3 μT |
| 1g | Plug Board 13A | 9 cm | 0 | 0.1 μT | 10 cm | 0 | 0.1 μT | 4 cm | 0 | 0.04 μT | 0.1 μT |
| 1h | Switchboard 13A | 20 cm | * | 1.4 μT | * | * | 0.8 μT | 14 cm | 7 | 0.7 μT | 1.4 μT |
| 2a | Plug Board 13A | 3.8 cm | * | 0.3 μT | 1.4 cm | * | 0.1 μT | 1.2 cm | * | 0.1 μT | 0.3 μT |
| 2b | Plug Board 13A | 5 cm | 0 | 0.3 μT | 8 cm | * | 0.4 μT | 4 cm | 0 | 0.4 μT | 0.4 μT |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2c | Plug Board 13A | 8 cm | 0 | 0.2 µT | 12 cm | * | 0.2 µT | 3.5 cm | 0 | 0.08 µT | 0.2 µT |
| 2d | Switchboard 13A | 30 cm | 6 | 1.2 µT | 17.5 cm | * | 0.5 µT | 16 cm | 5 | 0.6 µT | 1.2 µT |
| 2e | Switchboard 13A | 20 cm | 4.5 | 1.4 µT | * | * | 0.8 µT | 14 cm | 7.5 | 0.8 µT | 1.4 µT |
| 2f | Plug Board 13A | 9 cm | 0 | 0.2 µT | 13 cm | * | 0.2 µT | 4 cm | 0 | 0.06 µT | 0.2 µT |
| 2g | Switchboard 13A | 33 cm | 5 | 1.2 µT | 16 cm | * | 0.6 µT | 15 cm | 6.5 | 0.7 µT | 1.2 µT |
| 3a | Switchboard 13A | 31 cm | 7 | 1.3 µT | 14 cm | 5 | 0.6 µT | 13 cm | 5 | 0.4 µT | 1.3 µT |
| 3b | Switchboard 13A | 32 cm | 5 | 1.2 µT | 15 cm | 6 | 0.5 µT | 12 cm | 3 | 0.4 µT | 1.2 µT |
| 3c | Plug Board 13A | 4 cm | * | 0.2 µT | 15 cm | * | 0.1 µT | 1 cm | * | 0.2 µT | 0.2 µT |
| 3d | Plug Board 13A | 5 cm | 0 | 0.2 µT | 5 cm | 0 | 0.2 µT | 3.5 cm | 0 | 0.1 µT | 0.2 µT |
| 3e | Plug Board 13A | 8 cm | 0 | 0.3 µT | 3.5 cm | 0 | 0.2 µT | 3 cm | 0 | 0.2 µT | 0.3 µT |
| 3f | Plug Board 13A | 11 cm | 0 | 0.3 µT | 6 cm | 0 | 0.2 µT | 5 cm | 0 | 0.2 µT | 0.3 µT |
| 4a | Switchboard 13A | 32 cm | 5 | 1.2 µT | 13 cm | 6 | 0.5 µT | 11 cm | 6 | 0.5 µT | 1.2 µT |
| 4b | Plug Board 13A | 5 | 0 | 0.3 µT | 4 cm | 0 | 0.1 µT | 2 | 0 | 0.1 µT | 0.3 µT |
| 4c | Plug Board 13A | 3.5 | 0 | 0.1 µT | 3 cm | 0 | 0.1 µT | 1.5 | 0 | 0.1 µT | 0.1 µT |
| 4d | Plug Board 13A | 4 | 0 | 0.2 µT | 3.5 cm | 0 | 0.1 µT | 1 | 0 | 0.1 µT | 0.2 µT |
| 4e | Plug Board 13A | 5.5 | 0 | 0.2 µT | 3.5 cm | 0 | 0.1 µT | 1.5 | 0 | 0.1 µT | 0.2 µT |
| 4f | Switchboard 13A | 28 | 3 | 1.1 µT | 14 cm | 6 | 0.6 µT | 10 | 5 | 0.3 µT | 1.1 µT |
| 5 | Switchboard 13A | 31 | 6 | 1.2µT | 15 cm | 6 | 0.6 µT | 8 | 3 | 0.2 µT | 1.2 µT |

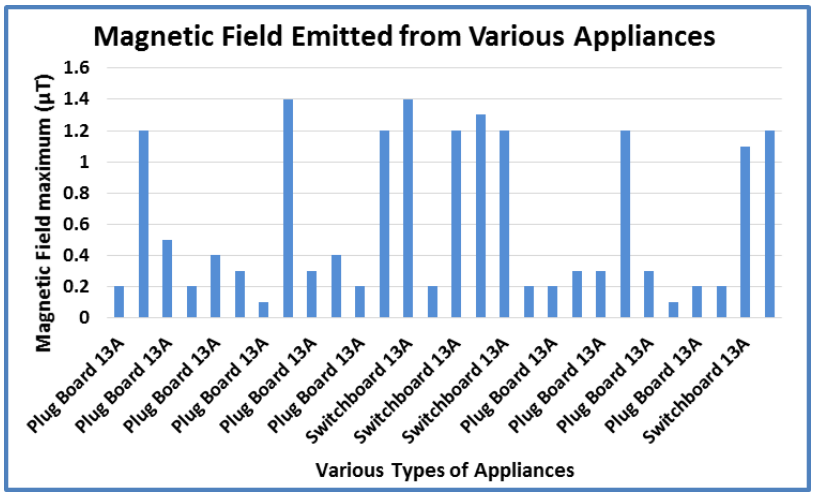


Fig. 4: Graphical representation of Table 3

**Table 4:** EMF values measured for switchboards in various CSE labs in Southeast University (SEU), March 2016. Switchboards location address: (1) Classroom AR 901, (2) classroom AR 902, (3) Classroom AR 1201, (4) classroom AR 1202, (5) Classroom AR 1206, (6) classroom AR 701, (7) Classroom AR 702, (8) classroom AR 705, and (9) classroom AR 706.

| Serial No. | Equipment info. (Machine #, Machine Model, made country, year made, Date of installation) | Threshold dis. in front of the screen measured from the center of the equipment (cm) | | Magnetic Field. In front of the equipment (μT) | Threshold dis. at right side of the equipment (cm) | | Magnetic Field at right side of the equipment (μT) | Threshold distance at the at left side of the equipment (cm) | | Magnetic Field at left side of the equipment (μT) | Magnetic Field maximum (μT) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EF | MF | | EF | MF | | EF | MF | | |
| 1 | Switchboard 13A | 31 cm | 6 | 1.3 μT | 14 cm | 5 | 0.6 μT | 15 cm | 3.5 | 0.6 μT | 1.3 μT |
| 2 | Switchboard 13A | 25 cm | 5 | 1.1 μT | 13 cm | 6 | 0.7 μT | 13 cm | 7 | 0.6 μT | 1.1 μT |
| 3 | Switchboard 13A | 32 cm | 6 | 1.2 μT | 15 cm | 3 | 0.6 μT | 16 cm | 3.5 | 0.6 μT | 1.2 μT |
| 4 | Switchboard 13A | 30.5 cm | 6 | 1.2 μT | 16 cm | 2.5 | 0.6 μT | 16.5 cm | 3.5 | 0.06 μT | 1.2 μT |
| 5 | Switchboard 13A | 29 cm | 5 | 1.1 μT | 14 cm | 3 | 0.5 μT | 16 cm | 3.5 | 0.5 μT | 1.1 μT |
| 6 | Switchboard 13A | 33 cm | 6 | 1.3 μT | 17 cm | 2.5 | 0.6 μT | 16 cm | 5 | 0.4 μT | 1.3 μT |
| 7 | Switchboard 13A | 30 cm | 5 | 1.2 μT | 15 cm | 3.5 | 0.5 μT | 16 cm | 4.5 | 0.5 μT | 1.2 μT |
| 8 | Switchboard 13A | 25 cm | 3.5 | 1.1 μT | 10 | 2.5 | 0.3 μT | 11 cm | 3 | 0.3 μT | 1.1 μT |
| 9 | Switchboard 13A | 35 cm | 6.5 | 1.4 μT | 16 cm | 4 | 0.6 μT | 13 cm | 5 | 0.6 μT | 1.4 μT |

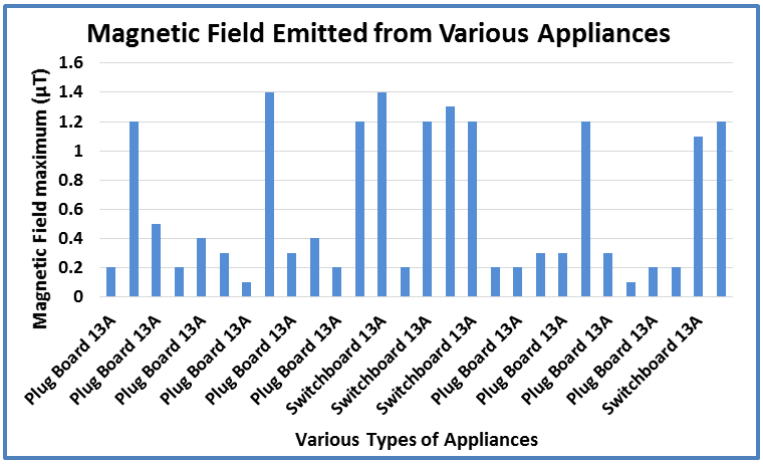


Fig. 5: Graphical representation of Table 4

### 3.1 EMF Measurements from air conditioners

In Table 1, experimental data of EMF values measured for Air Conditioner equipments were collected from the following labs: serial nos. (1) 1a-1b from Physics Lab AR 1205 (2) 2 from DLD Lab AR 802 (3) 3 from Chemistry Lab, (4) 4a-4b from Computer Lab-2, (5) 5a-5b from Computer Lab-3, and (6) 6 from Computer Lab-5. Air conditioners (AC) brand "Carrier" - having 1 and 2 tons of various models were measured for their Electric field and Magnetic field threshold distances as well as the magnetic field values for (i) in front of the equipment measured from the center of the equipment (ii) at right side of the equipment and (iii) at left side of the equipment. Also, the maximum magnetic fields were measured for each AC of this lab. The "*" sign indicates that the threshold distance was above recommended level and out of range.

### 3.2 EMF Measurements from air conditioners

In Table 1, experimental data of EMF values measured for Air Conditioner equipments were collected from the following classrooms: serial nos. (1) 1a-1b from Classroom AR 901, (2) 2a-2b from classroom AR 902, (3) 3 from Classroom AR 701, (4) 4 from classroom AR 702, (5) 5 from Classroom AR 705, (6) 6a-6b from classroom AR 1201, (7) 7a-7b from Classroom AR 1202, and (8) 8a-8b from classroom AR 1206. Air conditioners (AC) brand "Carrier" - having 1 and 2 tons of various models were measured for their Electric field and Magnetic field threshold distances as well as the magnetic field values for (i) in front of the equipment measured from the center of the equipment (ii) at right side of the equipment and (iii) at left side of the equipment. Also, the maximum magnetic fields were measured for each AC of this lab. The "*" sign indicates that the threshold distance was above recommended level and out of range.

### 3.3 EMF Measurements from switch boards in labs

In Table 3, experimental data were collected from the following CSE labs in Southeast University (SEU), March 2016. Serial numbers and switchboards location address: (1) 1a-1h from Physics Lab AR 1205 (2) 2a-2g from DLD Lab AR 802 (3) 3a-3f from Computer Lab-3 (4) 4a-4f from Computer Lab-2 and (5) 5 from Computer Lab-5. Switch board, plug board were measured for their Electric field and Magnetic field threshold distances as well as the magnetic field values for (i) in front of the equipment measured from the center of the equipment (ii) at right side of the equipment and (iii) at left side of the equipment. Also, the maximum magnetic fields were measured for each switch/boards of these labs. The "*" sign indicates that the threshold distance was above recommended level and out of range.

### 3.4 EMF Measurements from switch boards in classrooms

In Table 4, experimental data were collected from the following classrooms: serial nos. (1) 1 from Classroom AR 901, (2) 2 from classroom AR 902, (3) 3 from classroom AR 1201, (4) 4 from classroom AR 1202, (5) 5 from classroom AR 1206, (6) 6 from classroom AR 701, (7) 7 from classroom AR 702, (8) 8 from classroom AR 705, and (9) 9 from classroom AR 706. Switch board, socket points were measured for their Electric field and Magnetic field threshold distances as well as the magnetic field values for (i) in front of the equipment measured from the center of the equipment (ii) at right side of the equipment and (iii) at left side of the equipment. Also, the maximum magnetic fields were measured for each switch/boards of these labs. The "*" sign indicates that the threshold distance was above recommended level and out of range.

In Physics lab, there were enough space between two ACs. So, readings of EF and MF were taken without any problem. In DLD and Chemistry lab, there were only one AC. These ACs were very old, and so the MF readings were not been able to collect. National ACs from computer Labs-2, 3 and 5 were much older. So, the MF reading could not be taken in front of the equipment. Also, from classrooms 901, 902, 701, 702, and 705 the National ACs used were much older. So, the MF reading could not be taken in front of the equipments. In class-

rooms 1201, 1202 and 1206, there were enough space between two ACs. So, the EF and MF readings of ACs were taken without any problem.

In Physics lab, there were enough space to take EF and MF readings of the plug boards without any problem. It was difficult to measure the right side of the switch board because it was situated beside the pillar. In DLD lab also, it was difficult to measure the right side of the switch board because it was situated beside the pillar. In computer lab-3, there was enough space to take EF and MF reading of plug boards and switchboards without any problem. N computer lab-5, all plug boards were situated underneath the PC table. So, data could not be taken. In all classrooms, there were enough space to take EF and MF readings of switchboards without any problem.

## 4 Conclusion

It was found from the results that the magnetic field values are much higher than the threshold level. Because of the nature of the wiring both in the ceiling and floor, all the rooms had higher magnetic field than threshold value. Students work on an average of 7-8 hours a day in those classrooms. We have in mind to include classrooms from other departments of Southeast University for the study to continue.

There has been an increase of use of the air conditioners in Bangladesh for the last few years in various offices and organizations to increase the working efficiency of the employees. For this reason, the load shedding of electricity has increased tremendously for the last few years due to excessive air conditioner used in offices, organizations and private homes for comfort living.

From the above classroom and substation, generator results, it has been found that in most cases the magnetic field has crossed threshold value. The electric field also has a higher threshold value in some of the equipments. Also, the magnetic field maximum exposure was nearly 66 µT in one case. Wiring must be done according to the building code 2012. As the locations of air conditioners were on the wall near to the roof, therefore because of this height (distance) students they do not possess that much hazards as it should be. It is hoped that this survey will be helpful as a preventive health measure for students and employees of Southeast University.

## References

[1] N. Wertheimer, and E.D. Leeper, Electrical wiring configurations and childhood cancer. *American journal of Epidemiology,* **109**, 273-284, (1979).

[2] S. Milham, Mortality from leukaemia in workers exposed to electrical and magnetic fields. *New English J Med.*, **307**, 249, (1982).

[3] H. Repacholi, An Overview of WHO's EMF Project and the Health Effects of EMF Exposure. *Proceedings of the International Conference on Non-Ionizing Radiation at UNITEN (ICNIR 2003), Electromagnetic Fields and Our Health*, 1-13, (2003).

[4] I. Nordenson, K.H. Mild, G. Andersson and M. Sandström, Chromosomal aberrations in human amniotic cells after intermittent exposure to fifty hertz magnetic fields. *Bioelectromagnetics,* 15, 293–301 (1994).

[5] M. Quamruzzaman and M. Haque, Epidemiological Survey of People Working in EMF Field Exposed to High Frequency. *Proceedings of the Global Engineering, Science and Technology Conference* 2012, 28-29 December, Dhaka, Bangladesh.

[6] M. Quamruzzaman and M. Haque, Epidemiological survey on effect of EMF emitted by photocopy machines generally used in Dhaka city Bangladesh. *IJRET: International Journal of Research in Engineering and Technology,*4(4), 92-100 (2015).

[7] M. Quamruzzaman and M. Haque, Survey of EMF emitted by Lab equipments in various labs of Southeast University in Bangladesh for possible preventive health hazards. *IFRSA International Journal Of Electronics Circuits And Systems,* 4(1), 26-32 (2015).

[8] M. Quamruzzaman, M. Haque, F. *Ahmed and M.S. Zaman,* Effects of electromagnetic fields (EMF) near high voltage transmission line: a case study. *Bangladesh Journal of Medical Physics,* 7(1), 66-68 (2014).

[9] M. Quamruzzaman, M. Haque, Non Ionizing Radiation (NIR), its harmful effects especially from Mobile/Cell Phone and Towers. *Southeast University Journal of Science and Engineering* (In press)..

[10] M. Quamruzzaman, M. Haque, Survey on Effect of EMF Emitted by CRT Computer Monitors in Bangladesh. *Universal Journal of Electrical and Electronic Engineering*, 3(5), 149-158 (2015).

[11] M. Quamruzzaman, M. Haque, Survey of EMF Emitted from Lab Equipments and Air Conditioners in Textile Engineering Labs of Southeast University in BangladeshInternational Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, 4(3), March 2016.

[12] P. Lester, History of air conditioning. *US Department of Energy*. Retrieved March 21, 2016, from http://www.energy.gov/articles/history-air-conditioning.

[13] ED78S Meter ElectroMagnetic Detector. Retrieved March21, 2016, from http://www.radmeters.com/Cornet-ED78S-ep.html and http://www.amazon.com/Cornet-ED78S-Meter-ElectroMagnetic_Detector/dp/B00P67QLA0/ref=sr_1_1?s=industrial&ie=UTF8&qid=1458266517&sr=1-1&keywords=Cornet