

REPORT  
ON  
RADIATION PHYSICS  
ADDON COURSE  
DEPARTMENT OF PHYSICS  
(2019-2020)

# SUMMARY

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# INAUGURATION



Department of Physics launched a newly introduced add-on course 'Radiation Physics' on 22nd August, 2019. Ms Bindhu Christopher selected as the co-ordinator of add-on course. Ms Vimala V (H.O.D) be the convener of the course. The program was launched by Rev Fr Dr Rolden Jacob. Mr Niju Thankachan, Assistant Professor, Department of Radiotherapy, Govt. Medical College, Thrissur,

gave a talk on the relevance of the subject and its application to the present day life.

Admission started on the same date. Applications from different departments were invited. More than 100 students approached for the admission. From this 56 students were selected who shows strong enthusiasm for the relevant topics. 7 students are from the department of zoology and the remaining belongs to the department of Physics. Amitha Teresa (1st MSc Physics) is selected as the class coordinator. A whatsapp group of students and the teachers was created. The information about the classes is communicated through the group.

Dr Jojo P J, Ms Bindhu Christopher, Dr Ben Byju, Dr Benzon K B, Dr Shyma Mary Y and Mr Patric V Lobo are the resource persons in this course. DR Jojo P J handles the overall introduction of radiation physics. Dr Ben Byju, Dr Benzon K B and Dr Shyma Mary Y handle



the fundamentals of radiation and nuclear physics. Ms Bindhu Christopher and MrPatric V Lobo handles the advanced topics in radiation physics such as radiological diagnosis, nuclear medicines, therapy technologies. Bindhu Christopher also handle the topics about the awareness of biological effects of mobile phone radiation to the students.

Classes are conducted every Thursday and Friday morning, from 9am to 10am. It is decided that the students will be sent for a one-week internship at Trivandrum medical college along with an industrial visit to Cancer Research Centre.

# SYLLABUS

## **Radiation (5 hours)**

Definition, Types of radiation, Ionizing and non-ionizing radiation, Atomic structure of matter. Electron energy loss by collision and bremsstrahlung. Coherent scattering, Compton scattering, photoelectric effect and pair production in x and gamma photons. Attenuation coefficients. Radioactivity: Radioactivity decay, Half-life. Units of activity.

## **Awareness about Mobile phone radiation(5 hours)**

Radiation rate, Exposure criteria, physics behind the interactive mechanism of electromagnetic waves with living cells, biological effect of mobile phone radiation include cancer, electromagnetic hypersensitivity, tumor ,hereditary disorders, Autism etc.

## **Radiation Quantities and Units: (5 hours)**

Radiation quantities and units -Absorbed dose- Radiation and tissue weighting factors, equivalent dose, effective dose, committed equivalent dose, committed effective dose – Concepts of collective dose ,Specific absorption rate.

Radiation Dose: Absorbed dose, equivalent dose and effective dose. Units of radiation dose. Effects of ionising radiation on living organisms. Hazards and risks. Background radiation.

## **Introduction to medical techniques (10 hours)**

Digital Medical Imaging: Introduction to modern medical imaging modalities. Tomography: Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET):Magnetic Resonance Imaging (MRI): Nuclear Medicine: Natural and artificial radionuclides and their properties. Medical ultrasound, Overview of therapeutic applications of radiation in medicine Radiation Protection In Radiotherapy,

### **Practical (5 hours)**

1. Calculation of power densities from different mobile phone with same frequency range and different frequency range using hand held microwave leakage detector.
2. Calculation of ionizing radiation rate of artificial radiation sources with different voltage using GM counter.
3. Calculation of temperature variation and SAR values of Brain tissues (demo) using Lutron thermometer.
4. Comparison of radiation rate from natural source of radiation and artificial source of radiation by using survey meter.

# **RADIATION PHYSICS –ADD-ON COURSE**

## **OBJECTIVES**

- Introduce the fundamentals in radiation physics.
- Introduce the radiation dose rate and the international limit of radiation.
- This course introduce the protective techniques about radiation.
- Outline the biological effects of both ionizing and non-ionizing radiation.
- Give awareness to young generation about the silent killer –the mobile phone radiation, and thereby save the incoming generation from hereditary disorders.

## **OUTCOMES**

- Students will aware about the radiation dosimetry and international limit for ionizing and non-ionizing radiation.
- Students will understand the biological effects of radiation.
- Students will aware about the radiation protective measurements.
- Most significantly this course contain the biological effects of mobile phone radiation and its dosimetry.
- The knowledge about mobile phone radiation will save our young generation from the deep addiction of mobile phone.

# RECOURSE PERSONS

Sl No	Resource Person	Topic Covered	Total hours
1.	Dr Jojo P J	<p><b>Radiation</b></p> <p>Introduction to the course</p> <p>Electromagnetic radiation, classification and its properties</p>	<b>1</b>
2.	Ms Bindhu Christopher	<p><b>Awareness about Mobile phone radiation</b></p> <p>Radiation rate, Exposure criteria, physics behind the interactive mechanism of electromagnetic waves with living cells, biological effect of mobile phone radiation include cancer, electromagnetic hypersensitivity, tumor ,hereditary disorders, Autism etc.</p> <p><b>Radiation Quantities and Units</b></p> <p>Radiation quantities and units -Absorbed dose- Radiation and tissue weighting factors, equivalent dose, effective dose, committed equivalent dose, committed effected dose – Concepts of collective dose ,Specific absorption rate.</p> <p>Radiation Dose: Absorbed dose, equivalent dose and effective dose. Units of radiation dose. Effects of ionising radiation on living organisms. Hazards and risks. Background radiation</p>	<b>10</b>



3.	Dr Shyma Mary Y	<p><b>Radiation</b></p> <p>Atomic structure of matter. Electron energy loss by collision and bremsstrahlung. Coherent scattering, Compton scattering, photoelectric effect and pair production in x and gamma photons. Attenuation coefficients. Radioactivity: Radioactivity decay, Half-life. Units of activity</p>	<b>3</b>
4.	Dr Ben Byju	Definition, Types of radiation, Ionizing and non-ionizing radiation,	<b>1</b>
5.	MrPatric V Lobo	<p>Introduction to medical techniques</p> <p>Nuclear Medicine: Natural and artificial radionuclides and their properties. Medical ultrasound, Overview of therapeutic applications of radiation in medicine Radiation Protection In Radiotherapy,</p>	<b>4</b>
6.	Ms Parvathy Dethan	<p>Introduction to medical techniques Digital Medical Imaging: Introduction to modern medical imaging modalities. Tomography: Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET):Magnetic Resonance Imaging (MRI):</p>	<b>6</b>

# TUTORIALS

About 56 students from various departments were selected for the course. Six teachers from the department of Physics were the resource persons for the course. Dr Jojo P. J. introduced the fundamental ideas of electromagnetic rays and radiation physics and enlightened the students with his inspiring class. About 25 theory classes and 5 practical classes were arranged.

Details of each sections are given below

SI No	Date	Time	Resource Person	Topic
1.	3/10/2019	8.45 AM-9.45 AM	Dr P J Jojo	Electromagnetic rays
2.	4/10/2019	8.45 AM-9.45 AM	Ms Bindhu Christopher	Radiation rate, Exposure criteria, physics behind the interactive mechanism of electromagnetic waves with living cells
3.	6/12/2019	8.45 AM-9.45 AM	Dr Shyma Mary Y	Atomic structure of matter. Electron energy loss by collision and bremsstrahlung.
4.	13/12/2019	8.45 AM-9.45 AM	Ms Bindhu Christopher	biological effect of mobile phone radiation
5.	16/12/2019	8.45 AM-9.45 AM	MrPatric V Lobo	Introduction to medical techniques  Nuclear Medicine
6.	18/12/2019	8.45 AM-9.45 AM	Dr Shyma Mary Y	Attenuation coefficients. Radioactivity: Radioactivity decay, Half-life. Units of activity
7.	10/1/2020	8.45 AM-9.45 AM	Ms Parvathy Dathan	Introduction to medical techniques Digital Medical Imaging:
8.	10/1/2020	3.45 PM-4.45 PM	MrPatric V Lobo	Natural and artificial radionuclides
9.	13/1/2020	8.45 AM-9.45 AM	MrPatric V Lobo	Medical ultrasound
10.	16/1/2020	8.45 AM-9.45 AM	Ms Parvathy Dathan	Introduction to modern medical imaging modalities.
11.	17/1/2020	8.45 AM-9.45 AM	Ms Parvathy Dathan	Tomography: Single Photon Emission Computed Tomography (SPECT)
12.	3/2/2020	8.45 AM-9.45 AM	Ms Parvathy Dathan	Positron Emission Tomography (PET):
13.	4/2/2020	8.45 AM-9.45 AM	Ms Parvathy Dathan	Positron Emission Tomography (PET):
14.	5/2/2020	8.45 AM-9.45 AM	Ms Bindhu Christopher	biological effect of mobile phone radiation include cancer, electromagnetic hypersensitivity, tumor ,hereditary disorders, Autism etc.
15.	7/2/2020	8.45 AM-9.45 AM	Ms Bindhu Christopher	Radiation quantities and units

16.	11/2/2020	8.45 AM-9.45 AM	Ms Bindhu Christopher	Absorbed dose- Radiation and tissue weighting factors,
17.	12/2/2020	8.45 AM-9.45 AM	Ms Parvathy Dathan	Magnetic Resonance Imaging (MRI):
18.	12/2/2020	3.45 PM-4.45 PM	Ms Bindhu Christopher	effective dose, committed equivalent dose, committed effected dose
19.	13/2/2020	8.45 AM-9.45 AM	MrPatric V Lobo	Overview of therapeutic applications of radiation in medicine Radiation Protection In Radiotherapy,
20.	13/2/2020	3.45 PM-4.45 PM	Ms Bindhu Christopher	– Concepts of collective dose ,Specific absorption rate.
21.	14/2/2020	8.45 AM-9.45 AM	Ms Bindhu Christopher	Effects of ionising radiation on living organisms. Hazards and risks.
22.	14/2/2020	3.45 PM-4.45 PM	Ms Bindhu Christopher	Background radiation
23.	17/2/2020	8.45 AM-9.45 AM	Ms Bindhu Christopher	Case Study -Experimental demonstration
24.	18/2/2020	8.45 AM-9.45 AM	Ms Bindhu Christopher	Case Study- result and interpretation
25.	19/2/2020	8.45 AM-9.45 AM	Dr Shyma Mary Y	Coherent scattering, Compton scattering, photoelectric effect and pair production in x and gamma photons.
26.	19/2/2020	3.45 PM-4.45 PM	Ms Bindhu Christopher Ms Parvathy Dathan	Practical
27.	20/2/2020	8.45 AM-9.45 AM	Ms Bindhu Christopher Ms Parvathy Dathan	Practical
28.	3/3/2020	8.45 AM-9.45 AM	Ms Bindhu Christopher Ms Parvathy Dathan	Practical
29.	4/3/2020	8.45 AM-9.45 AM	Ms Bindhu Christopher Ms Parvathy Dathan	Practical
30.	5/3/2020	8.45 AM-9.45 AM	Ms Bindhu Christopher Ms Parvathy Dathan	Practical

## ➤ PRACTICAL TUTORIALS

As part of the course, practical sections were also provided to the students. by Ms Bindhu Christopher and Parvathy Dathan. The main experimental arrangements were,



1. Calculation of power densities from different mobile phone with same frequency range and different frequency range using hand held microwave



leakage detector.



2. Calculation of ionizing radiation rate of artificial radiation sources with different voltage using GM counter.

3. Calculation of temperature variation and SAR values of Brain tissues (demo) using Lutron thermometer.



4. Comparison of radiation rate from natural source of radiation and artificial source of radiation by using survey meter.

An industrial visit was also conducted by the department. Innovative teaching methods like Case Study, Group discussions using audio- visual tools etc were carried out.

# CASE STUDY REPORT

During the first week of January a Case Study was conducted for the students. The Case Study was mainly focused on calculation of SAR values of brain eye and skin tissues of freshly collected samples of Goat due to mobile phone radiation. Students showed keen interest and each one submitted a brilliant case study report with great effort. Reports of and Aleena A, II DC Physics and NicymolShaji, II DC Zoology were selected as the best case study reports. One of the best case study report from Aleena A, 2<sup>nd</sup> dc Physics is specified here.

**ALEENA.A**

**II DC PHYSICS**



## **Introduction**

The growth in the use of cellular phone has raised the concerns about the possible interaction between the Electro Magnetic Fields (EMF) radiation and the biological effects on human tissues, particularly the brain and the human immune system. These concerns have induced a large volume of research studies. A study was conducted on the effect of mobile phone radiation and its after effects on human body. With the help of Lutron Thermometer, the rise of temperature on the tissue of brain, eyes and skin are noted. The specific absorption value of brain, skin and eye is obtained from the study and from the obtained value mobile phone radiation is noted. Our conclusions show that long-

term exposure to EMF radiation from a cell phone could cause health effects, such as brain cancer.

It is just to say that we live in a modern world with advanced technology. Requiring access to information and communications everywhere has created a new world. A device such as a cell phone has been used extensively due to having supreme communicative technology, but a cell phone is the main source of electromagnetic waves which can influence human tissues. The World Health Organization has reported dispersion of radio frequency waves as one of the most polluting sources, which are hazardous for human beings. Cell phones are considered as an important invention that has changed communication ways in this modern world. However, using cell phones had irregular growing rate in recent years. This rapid increase of using cell phones has provided worries about radiated frequency waves resulted from cell phones is increasing the temperature of body issues. Using cell phones near the head has provided general worries about damaging effects on the central nervous system confronting with radio frequency waves during conversation with the phone. In a study, after a 30 min confrontation of a cell phone with brain tissue, the brain temperature increased by  $4.5^{\circ}\text{C}$ . Cell phones users often complain about warming of their ears due to having contact with cell phones. This temperature increase may be due to radio frequency and electromagnetic waves absorbed by the user's head. Since the cell phone antenna is placed near the ear and head during contacts, the head is necessarily facing radio frequency waves and this has caused anxieties in this regard. Lindholm stated that the temperature of ear canals in users increased up to  $1.5^{\circ}\text{C}$  in confronting with the radio frequency waves of cell phone for 35min.

Since during contacts, cell phones are placed near the ear and head and also because the sensitivity of brain tissue to changing of the temperature, the aim of this study is to determine the effect of mobile phone radiation.

## **Methods**

This study was an experimental study. A goat's brain was used to evaluate the effect of cell phone radiation. A mobile phone was used to investigate the thermal effect of mobile phone radio frequency, as if a person is talking on a cell phone. Temperature increase in eye, skin is also measured.

## Laboratory Equipment

Lutron thermometer (Model: TM-917) with precision of 0.01 was used for measuring the tissue temperatures. It is made of platinum sensor. Lutron thermometer could measure in both Fahrenheit and Celsius units, Celsius unit was used for this study. The temperature changes were measured and recorded in a momentary basis. Thermocouple consist of two wire legs made from different metals. The wire legs are welded together at one end, creating a junction. This junction is where the temperature is measured. The operating principle of the thermocouple is based on the Peltier effect. The thermocouple circuit consists of two metals joined together to form two junctions of different temperatures. A Peltier emf is generated due to the difference in temperatures of the two junction of circuit.



**Figure -1 Precision 0.01° Thermometer**

Fig.1 represents precision 0.01<sup>0</sup> Thermometer Model: TM- 917

- Professional thermometer with high accuracy & 0.01 resolution.
- Accept multi type temperature probe input: Platinum PT 100-ohm, thermocouple type K/J/T/E/R
- With 0.01 high resolution for both platinum and thermocouple probe input.
- PT 100 probe input cooperate with an 0.000385 alpha co-efficient meet DIN IEC 751.
- Cooperate with 4 wires Pt- 100  $\Omega$  probe, high precision.

- Wide range display from – 100 to 1370<sup>0</sup>c. (Type K)
- Build in <sup>0</sup>C & <sup>0</sup>F select button on the front panel.
- Super large LCD with unit display, easy read out.
- Memory function to record the maximum & minimum reading with recall.
- Data hold function for stored the desired value on display.
- Built in low battery indication.
- Build in REL button useful for relative measurement.
- Optional heavy duty & compact housing case, designed for easy carry out.

## PREPARATION

The Goat's brain tissue was placed in the skull. A cell phone was used to investigate the thermal effect of mobile phone radio frequency placed on a distance on the left of the brain tissue, as if a person is talking on a phone. After adjustments, the thermometer was turned on and connected and the related software was operated.

The temperature balance between the environment inside the compartment and the tissue for reducing the errors regarding the contact between the tissues and the cell phone was not fulfilled at the beginning, until the temperature of the tissue and the compartment became similar and the thermometer showed a fixed temperature, the stable temperature was recorded and this temperature was called the base temperature (i.e. tissue



temperature before confronting with the mobile phone). Then the contact was made between the tissues and the cell phone, as if a person was talking on the phone. The confrontation time, the contact time was considered 15 min. After finishing the confrontation time, the contact (temperature) was cut off. For the next stage, the tissue was kept for 15 min for its temperature to be reduced without confrontation and the presence of radio frequency waves.

After attaining base temperature, the thermometer is connected to goat's brain. The Lutron thermometer contains a very sensitive thermocouple (model TM – 917) Fig. 1) to



measure the temperature. The goat's brain has an initial temperature of 0.8<sup>0</sup>c. The thermometer has a precision of 0.01<sup>0</sup>c. The mobile phone is brought in calling mode and placed near the brain which is placed inside a human skull. For every minute the rise in temperature is noted.

Similarly, the thermocouple is placed in skin and eye, closed to the eye socket and the corresponding change in temperature is noted. The temperature measurements for each 600 seconds are noted for different positions. From the specific Absorption Rate (SAR) value, the effect of mobile radiation on human body can be studied.

The SAR value for brain, skin and eye was calculated using the equation.

$$SAR = \frac{\text{Increase in temperature} \times \text{Specific Heat Capacity}}{\text{Time}}$$

Table 1. Specific Heat Capacities

Body Tissue	Heat capacity	
	Average(J/kg/ <sup>0</sup> c)	Maximum(J/kg/ <sup>0</sup> c)
Brain	3630	3682
Skin	3391	3662
Eye (Cornea)	3615	3615
Eye (Iris)	3421	3799
Eye (Lens)	3133	3644
Eye (Retina)	3696	3753

For microwaves the dosimetry quantity of interest is given by the specific absorption rate SAR, which is defined by the absorbed power per unit mass. The SAR is difficult to determine and may be estimated for example by measurements of the electric field strength of the radiation, the temperature increase or by numerical stimulations. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has recommended limits. These limits are based on the knowledge, that an exposure of the whole body with an average SAR of 4 W/kg will lead to a temperature rise of 1<sup>0</sup>c.

## RESULT

Temperature measurements for each 600 seconds are noted for different positions with same power conditions. The SAR value for brain, skin and eye were calculated using equation.

$$\text{SAR} = \frac{\text{Increase in temperature} \times \text{Specific Heat Capacity}}{\text{Time}}$$

RADIATION SOURCE	TIME (SECOND)	TISSUE	SPECIFIC HEAT CAPACITY Jk <sup>-1</sup> kg <sup>-1</sup>	RISE IN TEMPERATURE	SAR VALUES Wkg <sup>-1</sup>
HAND SETs	600	BRAIN	3696	0.08	0.49
		EYE	3615	0.02	0.13
		SKIN	3391	0.10	0.56

The observed instantaneous values of temperature at various points and the SAR values calculated are presented in the Table 2.

TABLE 2: Observed Average values of temperature variation and estimated SAR values for eye, skin and brain tissues for positions from different hand set.

## DISCUSSION & BIOLOGICAL EFFECTS

The present study evaluated the effect of increasing the distance of cell phones to brain tissue on temperature change in brain, skin, eye, due to the heat generated by radio frequency waves. The distance of brain tissue to the cell phone had more relations with the increasing rate of tissue temperature and by increasing the distance, less amount of increase in the tissues was observed.

Most of the hazardous biologic effects about the cell phone waves on humans are considered to be due to the effects of temperature increase, such that some of the all phone waves are transferred to human body as heat by current activated hyper polarization induced by the electric field and vibration of polar molecules, in going through an environment. Temperature is higher in brain tissue as compared to other tissues with low metabolic aspects in generating heat.

By increasing the temperature of the brain, the blood circulation is rapidly increased and the thermal self-adjusting reactions are activated. Measuring heart automatic responses and evaluation of brain blood flow are used as the indirect wideness of the interactions of blood circulation and adjusting the temperature during confrontation with radio frequency waves. Thus, separating confrontation and high temperature of the brain tissue even after some time from the confrontation would make undesirable effects on brain health after a passage of time. In the

studies by Beason, about the electromagnetic effects on brain, they showed that the similar waves to cell phone tele communication system could lead in 52% of case in increasing brain neuron activities. The results obtained from some epidemiologic studies show that even with lower densities than the permissible limits, all phone waves can cause signs and symptoms such as headache, feeling high temperature in ears, weakness of memory and fatigue. In a study regarding the effects of waves due to radiation generated by cell phones on vital signs in users. Mortazavi and Atefiobtained significant relations between using cell phones and disorder in paying attention, learning and concentration in users. Negative effects of waves resulted from cell phones and disorders in paying attention, learning and concentration in users. Negative effects of waves resulted from cell phones on the brain activities, and capabilities are confirmed in some studies. It was reported in a study that cell phone waves provide considerable changes in the density of dopamine, norepinephrine and serotonin in hippocampus, cerebellum, medulla in the brains of mature mice. The change in the rate of the densities of neural intermediaries can be effective in creating anxiety and problems regarding memory and learning.

- $\text{Ca}^{2+}$  efflux nervous tissue
- Permeability of the blood – brain – barrier
- Changes in metabolic level
- Changes in ECG – and sleep parameters
- Behavior changes
- Influence on blood pressure
- Evidence for non-thermal effects in experimental systems.
- Subjective symptoms
- Genotoxic effects
- Cell proliferation
- Tumor promotion and progression
- Incident rate for leukemia and solid tumors.

## **REPORTS**

- In 1984, Dulata et al. uses a frequency of 915 MHZ for 30 min. The SAR value founded was 0.05 and there is an increase in calcium efflux in brain etc.

- In 1997, Stagg uses a frequency of 836 MHz for 24h. The SAR value formed was 0.0059 and Glioma cells show significant increase in thymidine incorporation, which may be an indicator of increase in cell division.
- In 2001, Kuree uses a frequency of 960MHz for 20min. The SAR value was found to be 0.002. There is increased stress protein in human epithelial amnion cells.
- In 2010, Campuzano uses a frequency of 900MHz for 14 days 20 min per day. The SAR value was found to be 0.045. A DNA damage in human glial cell is found.
- On 28 March of 2019, the scientific peer review of a landmark United States government study conducted that there is 'clear evidence' that radiation from mobile phones causes cancer, specifically, a heart tissue cancer in rates that is too rare to be explained as random occurrence.

## **CONCLUSION**

The temperature difference could be related to one side to heterogeneity of brain tissue during movement from the brain membrane to its depth. Which is due to changing of grey matter of brain to white matter. From another point of view, the differences in building and temperature in various depths could be related to the aspect of generating optimum induced temperature in different depths, with regards to different variables such as frequency of waves and the direction of radiations, all of which should be considered in the future studies. This study shows that the temperature of brain tissue is incorrect after contacts with electromagnetic waves generated by all phones. The fact that the effects of these waves could be observed and recorded is an introductory for predicting the mentioned effects and the probable effects due to them.

# INDUSTRIAL VISIT REPORT

Another remarkable day of the course was the industrial visit day. On 14<sup>th</sup> February 2020, about 35 students were selected for the industrial visit based on the attendance percentage and quality of case study report.

Quilon Scan Centre, one of the leading scan centres in Kollam granted permission for the industrial visit. Facilities provided by the management team of the scan centre was amazing. They gave a detailed explanation about various medical imaging techniques. Industrial visit report competition carried out as group activity. Students of zoology department won the first position. Detailed review of their explanations are as follows:

The industrial visit was conducted on 14 Feb,2020 under the supervision of Ms Bindhu Christopher, Dr Sheena Mary Y ,and Ms Parvathy Dathan of Physics department. The purpose of the industrial visit was to know about the different diagnostics tools used for scanning and its mechanisms.



## Ultrasound

An ultrasound scan is a medical test that uses high frequency sound waves to capture live images from inside of our body. It is also called sonography. It allows doctor to see problems with organs, vessels and tissues without needing to make an incision.



Ultrasound uses no radiation. So, it is a preferred method for viewing a developing foetus during pregnancy. These scans can provide an expectant mother with the first view of her unborn child. An Ultrasound can provide view of the bladder, brain, kidney, liver etc.

An Ultrasound technician will apply special lubricating gel to skin so as to rub ultrasound transducer on skin. Gel transmit the sound waves, transducers sends ultrasound waves in to the

body. These waves get reflected and echoed back in to the computer. They form a picture that can be examine by the doctor. All procedure last less than 30 minutes.

After an ultrasound Doctor will review image and check for any abnormalities. If anything, abnormal turns up one need to undergo other diagnostic techniques such as CT scan, MRI etc. It can operate with frequencies from 20KHz up to several Gigahertz. Ultrasound is sound waves with frequencies higher than upper audible limits of human hearing.

## **X-rays**

X- rays are parts of electromagnetic spectrums with wavelengths shorter than visible light. They are high energy EM waves. An X-ray machine uses an X-ray generator and X-ray detector. It is used to detect bone fractures.

Grids: A bucky potter grid may be placed between the patient and detector to reduce the quantity of scattered X-rays that reach the detectors. This improves contrast resolution of the image, but also increases radiation exposure for patients.

Detectors: It can be divided in to major categories -Imaging detectors and X-ray films replaced by digitalizing devices like image plates and dose measurements devices used to measure local radiation.

Shielding: Lead is the main material used by radiography personnel for shielding against scattered X-rays.



Bone X-ray uses a very small dose of ionizing radiation to produce pictures of any bone. It is used to diagnose fractured bones/joint dislocations. Bone X-rays are used to assess bone fractures, injuries and joint abnormalities. Patients are made to lie down either on anatomical /lateral position. In case of bone and tissue different dosage of radiation are used.

### **X-ray working**

A small amount of ionizing radiation is passed through the body. X-rays examination are more likely to use a device that will capture transmitted X-rays to create an electronic image.

The calcium in bones block the passage of radiation, so healthy bones show up white or grey. Radiation easily passes through air spaces so lungs that are healthy appear black.

- The radiographer will instruct in positioning for X-ray.
- Patient placed between X-ray machine and imaging devices to transmit rays through the body.
- Radiographer will shield parts of body with lead apron.
- Radiographer will need patient to position correctly.
- Radiographer operates control while each image taken.
- Patients are asked to hold breathe for preventing blurring image.
- A straightforward X-ray taken a few minutes or may take longer.

### **Medical Issues with X-ray exam**

- Pregnant patient should never take X-ray.
- Conventional X-ray required hospital gown.
- Some involve use of iodinated contrast agent which improve details of images.
- Frequencies of X-rays range from 30 petahertz to 30 exahertz and energy is range 100 eV to 1000 eV.
- Exposure to high radiation can have a range of effects such as vomiting, bleeding, fainting, hair loss and loss of skin.

### **Mammogram**

A mammogram is an X ray picture of the breast. Doctors use a mammogram to look for early signs of breast cancer. For taking a mammogram patient will stand in front of an X-ray machine.





A technologist will place their breast on a clear plastic plate. Another plate will firmly press the breast from above. The plates will flatten the breast holding it while X-ray is taken. The steps are repeated to get side view of breast. The other breast X-rayed in same way. The technologist checks the four X-rays to make sure they do not need to redone. Technologist cannot tell the patient about results of mammogram. A radiologist reads the mammogram and reports the results to patient and doctor.

### **If Mammogram is abnormal**

Additional test shall be taken before confirming that there is cancer patients may also be referred to a breast specialist or surgeon.

Main risks and adverse consequences from screening mammography include discomfort from screening mammography include discomfort form breast compression, patient recall for additional imaging and false positive biopsies.

### **CT Scan**

CT Scan or Computed tomography scan makes use of computer processed combination of many X-ray measurements taken from different angles to produce cross-sectional images of specific areas of scanned objects allowing user to see inside the objects without cutting. These images provide more detailed information than normal X-rays images. They can show soft tissues blood vessels, bones etc. A CT scan can be used to visualize the head, shoulder, spine etc.



CT can diagnose infection, muscle disorders, bone fractures etc. It can pinpoint the location of masses and tumours, study blood vessels, guide surgeries, monitor the effectiveness of treatment etc.

### **CT Scan Procedures**

Patient is asked to take a special dye called contrast material that help internal structure to see. Depending on the part that being inspected one may need to drink a liquid that contain contrast. After changing into the hospital gown without any jewellerys, patient will lie face up on a table that slides into the scanner. The technician will leave the control room and they will communicate with patient with intercom.

Once the table is into the scanner, X-ray machine will rotate and each rotation produces numerous images of thin slices of our body. Entire procedure takes 20 minutes to 1 hour.

### **Risk with CT Scan**

The risk for cancer may increase over time if multiple X-ray or CT scan. The risk of cancer is increased in children receiving CT scans. Some



people are allergic to contrast material. Though the radiation from the CT scan is unlikely harm our body, then the doctor may recommend another diagnosis such as ultrasound, MRA scan etc.

CT scans are taken within 24 hours after an accident. Nowadays machine are designed to give more precision with less time and lesser radiation. Cooling in the room is a must for proper functioning of CT scan machine.

### **OPG (Orthopantomogram)**

- An OPG is a scan that gives a panoramic view of jaw and teeth. Scan can provide information on wisdom teeth, bone loss, orthodontic assessment. OPG unit is specially designed to rotate around patient's head during scan. It can take approximately 20 seconds. This can be used for surgical planning. Patient need to bite on mouthpiece and rest chin on plastic rest. Head is kept still and part of machine rotates around head as images are taken.



### **EEG (Electroencephalogram), ECG(Electrocardiogram)**

EEG is a non-invasive test that records electrical patterns in or brain. It is used to diagnose seizure, epilepsy, dizziness, headache, brain tumour etc. It can be used to confirm brain death. ECG is the test that measures the electrical activity of heart beat. It is used for assessing cardiovascular diseases. It is also used for detection of myocardial ischemia and infarction. ECG records heart's activity on a strip of paper.

# ATTENDANCE REPORT

Sl No	Name of The Student	Percentage of attendance(%)
1.	Ajaylal Krishna T	100
2.	Bibin Danial	60
3.	Varija S	73
4.	AabiAnilan	86
5.	Chinthalekshmi P S	93
6.	NicymolShaji	100
7.	T G Malavika	53
8.	AncyOuseph	80
9.	Joji Joseph	80
10.	Teena Thomas	80
11.	Amitha Teresa	53
12.	Rini Raj	56
13.	Asha S Raj	73
14.	Ramoon A	80
15.	Kiran Thomas Mathew	73
16.	Ameena S	66
17.	Ashna S R	46
18.	Anu S Murali	73
19.	Archana S	60
20.	SwathyLekshmi S	93
21.	Anju Varghese	80
22.	Nayana J	93
23.	Gopika Prasanth	46
24.	Anjali J nair	73
25.	Sneha Varghese	60

26.	Lima Felix	73
27.	Thasni S	53
28.	Aleena A	66
29.	Agin Das	46
30.	Ancy Christopher	60
31.	Aleena Joseph	100
32.	Devika Omanakuttan	93
33.	Dona B Fernandez	93
34.	Muhusina S	86
35.	Preveena P S	80
36.	Ramya Joseph	73
37.	Vinidhya Das	80
38.	Adithya A	60
39.	Meenu Krishnan	100
40.	Sneha Saji	80
41.	Sandrine jess johnson	43
42.	Hariram M	60
43.	Gopika V	44
44.	DeepthyKenphine Kenny	50
45.	Aishwarya Christopher	51
46.	Aleena Kalistus	51
47.	Haritha Clement	49
48.	Sree Parvathy R	43
49.	Emakulate Mary J	44
50.	Aneetta Antony	47
51.	Aneeta	40
52.	Sooraj Jose	50
53.	Simi Saji	50
54.	Nithya John	47
55.	Amritha A. S	47
56.	Sangeetha E	48

# FEEDBACK FROM THE STUDENTS



I feel very proud to complete this add on course on "Radiation Physics" organized by the department of physics, FMN college Kollam during the year 2019-20. This course was very helpful and I came to know more about radiation and its various aspects. The classes taken were very much understandable. As a part of this course we conducted a case study based on 'The Effect of Radiation on Human Tissues'. It was very much knowledge acquiring. We had an industrial visit to Quilon Scan Centre. We came to know about the working of different machines and the various effects of radiation. We had also conducted some experiments based on radiation. These all were very much helpful in enhancing our knowledge. Hearty thanks to the department of Physics, FMNC and the course coordinator Bindhu miss for giving me this valuable opportunity.

**Anjali J Nair**  
**1<sup>st</sup>DC Physics**

The industrial visit conducted regarding the study was very helpful. All the practical classes were done well. Teachers were very friendly and gave a clear picture of the study. Case study report submitted regarding radiation exposure on human brain was a different experience. Overall those classes was effective and hope it should be experienced by the coming students.

**NicymolShaji**  
**2<sup>nd</sup> DC Zoology**

This course gave us a wonderful experience and opened a new stream that is the various aspects of radiation. Radiation plays an important role in our various aspects. Quilon scan centre radiation and their relating to radiation proves the danger of importance in many course.



This course gave us a wonderful experience and opened a new stream that is the various aspects of radiation. Radiation plays an important role in our various aspects. Quilon scan centre radiation and their relating to radiation proves the danger of importance in many course.

**Dona B Fernandez**  
**2<sup>nd</sup> DC Physics**





The classes were gud , gave more information on radiation , it's application and effects on human lives both gud and bad , the IV was really gud . Enabled me to understand more on latest diagnostic equipment

**Kiran Thomas Mathew**  
**2<sup>nd</sup> DC Zoology**



The course is quite helpful to clear many myths related to the impact of radiation on the human body.It included theory, practical, project and industrial visit sessions . The most important part of the course was industrial visit.That helped all of us in gaining so many information about scanning,MRI,X\_ Ray,etc....There was a case study to analyse the effects of mobile phone radiations on human body.We are now capable of understanding the effects of radiations.We were handled by experienced faculty members of the campus.I would recommend this course to other students as it is quite interesting and very helpful for our future studies.

**Praveena.P S**  
**2<sup>nd</sup> DC Physics**



The classes started on September. It was a very good experience as a whole. It included theory, practical, project and field visit sessions which were given equal weightage for the evaluation.During the field visit session we got a hand on experience to the most modern equipment related to the course. The laboratory sessions allowed us to understand the various equipment used elsewhere in this field. Individual attention was received to each and everyone of us and the lecturers were handled by experienced faculty members of the campus and all study hours were engaged. I would personally recommend this course to other students, who are still unaware.

**Sooraj Jose S R**  
**2<sup>nd</sup> DC Physics**



The radiation physics course was very informative. With this course we got a clear picture on how the various medical devices work, their principle etc..like CT scan, MRI scan, X ray machine.Moreover, the industrial visit in one of the scanning centers at Kollam was very educational. Overall taking this course was worthwhile.

**Ajaylal Krishna T**  
**2<sup>nd</sup> DC Zoology**



A very engaging & thought-provoking course providing the insights from atomic structure to Electromagnetic Radiations, how they interact with matter and associated health effects. The course is quite helpful in particular to clear many myths related to the impact of radiation on the human body, while also explaining working of many medical imaging & examination techniques (like MRI, PET, etc.) Overall, a well-presented content in a lucid & entertaining manner, aptly complemented by noteworthy graphics & videos. The most helpful part of this course was industrial visit. That helped all of us in gaining so many information about scanning , MRI etc. There was a case study to analyse the effect of mobile phone radiation's on human body . We have done that experiment with the help of a goat brain and recorded our observations . We all have prepared a report based on the case study. It was concluded that the mobile phone radiations will increase the temperature of our brain and body . We are now capable of understanding the harmful effects of radiations as well as their usefulness. Thanks to all instructors and contributors. I'd say the course is simple to follow and worthy of binge-watching and one can finish earlier than prescribed duration.

**Devika Omanakuttan**

**II D.C. Physics**

Radiation physics class was a good experience.. I was able to gain more information ..Teachers conveyed ideas in a good manner.The classes conducted was very informative.The practical classes helped very much in understanding ideas. We had an industrial visit to a scanningcenter . It was a very good experience. We also did assignments based on radiation physics..overall it was a good experience and informative.



**Varija S**

**2<sup>nd</sup> DC Zoology**

Radiation physics class was so stress free that i was able to gain more information.. Teachers were so friendly. i was made aware of many new things. We had an industrial visit to a scanning center in kollam . It was a very good experience. Overall i loved being a part of this course.



**Chinthalekshmi P S**

**2<sup>nd</sup> DC Zoology**





I have opted for radiation physics add on course. It was helpful for me to gain knowledge about the subject. The industrial visit to quilon scans to learn more of what we have learnt was useful. All the teachers made it easy to understand the concept. It was a pleasure to be part of the course.

**Aabi Anilal**  
**2<sup>nd</sup> DC Zoology**



The six months course on "Radiation Physics" conducted by our department is a venture of victory as far I am concerned. The different sessions conducted as its part including industrial visit and case study could make a fine impact in us. That, the course with its ultimate aim of providing us an awareness on the health hazards caused by radiations mainly though there are good effects, both the case study and industrial visit could give us visual aid on the contents. Course enabled us to get clarified the myths related to radiation. Industrial visit provided us the opportunity to get an account of medical imaging techniques like MRI, PET etc... The case study enabled us to get an awareness on the effect of mobile radiation as the used specimen was goat brain which has an appropriateness to human brain. We prepared and submitted a report on it too. The lab sessions conducted also gave us a fine result in practical field. Now we are well-equipped on the contents discussed. Thanks to all instructors in charge. **Meenu Krishnan,**

**2<sup>nd</sup> DC Physics**



I 'm feeling very happy to complete this course on "Radiation Physics". This course is very useful in our life. This give us more ideas about the radiation and its different aspects. We had conducted experiment based on this. And case study also on the topic 'The effect of Radiation on Human Tissues'. Through this course i can understand that how much damage is causing our brain tissues while using mobile phones. Like that i get so many information from this course. We also had a Industrial visit. I am thanking the Department of Physics, FMNC and the teachers for giving me the wonderful opportunity.

**Gopika Prasanth**  
**1<sup>st</sup> DC Physics**