

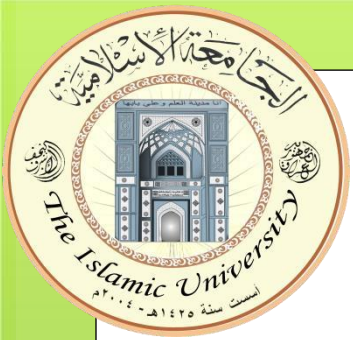
Medical Physics



Lecture 1

by:

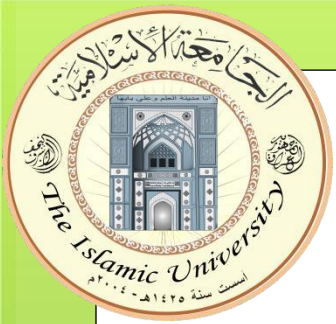
Dr. Fatima Abbas



What is Medical Physics?

- **defined** as a field in which applied **physics** techniques are used in **medicine**.

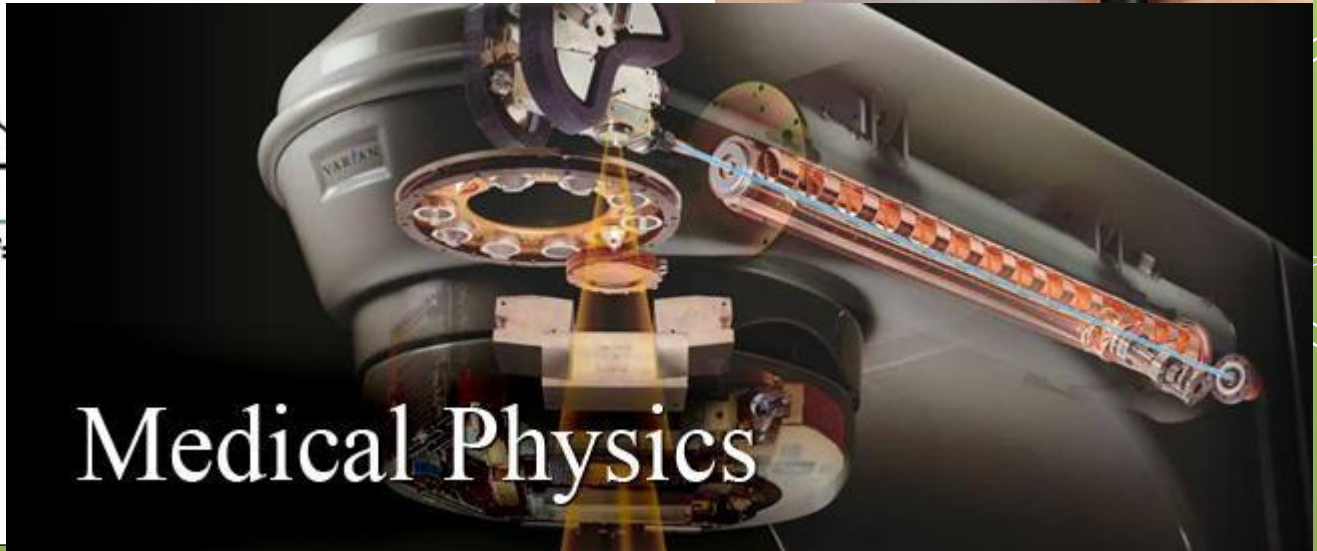
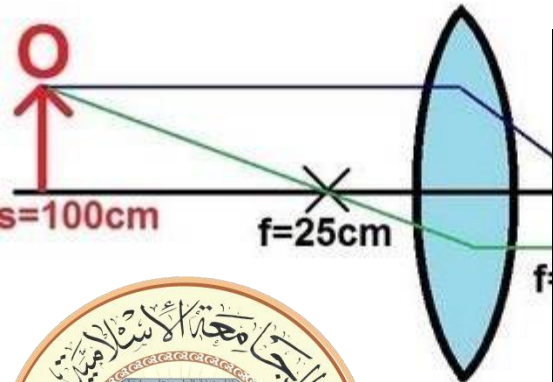




What is Medical Physics?

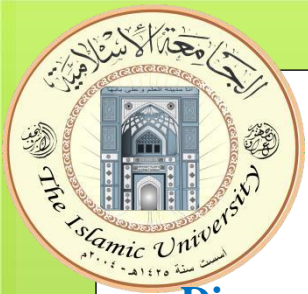
Medical physics deals chiefly with the use of Physics in the diagnosis and treatment of disease.

Medical physics is the application of the principles of physics to medicine or healthcare. It's basically a way to use our physics knowledge to develop tools and treatments that help humans live longer and be healthier.



Medical Physics





The three branches of medical physics.

Diagnostic radiology is primarily a form of medical imaging. All of our medical imaging modalities, including x-rays, mammograms, computed tomography, ultrasound, and magnetic resonance imaging (MRI), among others, require an on-site physician or consultant.

These technologies are complex and can only be fixed by those who understand them.

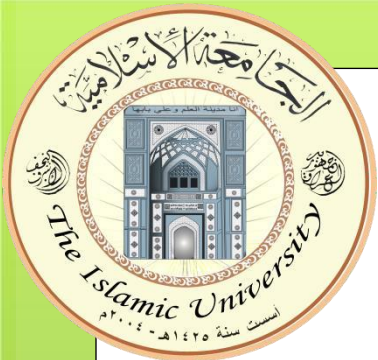
MRI machines use the principles of magnetism to take high-quality images of the inside of the human body, particularly the brain. They mainly work by observing the nuclear spin and distribution of hydrogen molecules. Since humans are about 70% water, we have a lot of hydrogen molecules to watch.

X-rays are a method of taking pictures of the skeletal system of the body. Ultrasound uses high-frequency sound waves that humans can tolerate, and bounces them off the inside of the body to create images of soft tissues. These images in particular are used to create images of babies inside the womb.

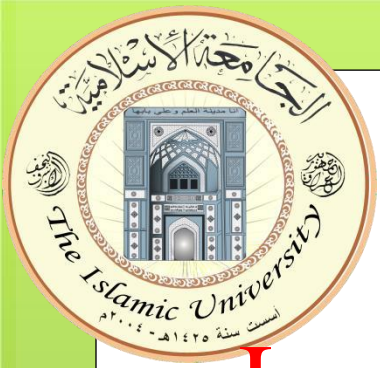
Why is Physics Necessary in Medicine?

Ever wonder why physics is important in the field of medicine? Well, there are numerous reasons why it is very vital to this field. In fact, this is a deceptively simple question because Physics is present in everything, from the workings of accurate medical scales, to the imaging equipment like X-rays, MRI, ultrasound..... this is why it is actually pretty hard to give a simple answer because there is so much of Physics in Medicine it's hard to know where to start! A simple answer is that physics is **useful across many aspects** of medicine both in treatment but especially in diagnostic medicine, such as X-Rays, CT, Ultrasound etc. One reason why a knowledge of

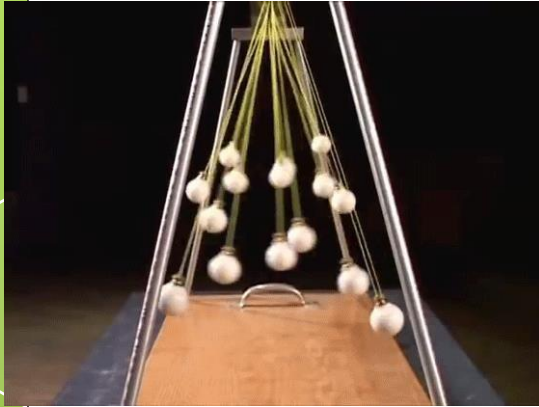




It generally concerns physics as applied to medical imaging and radiotherapy. Medical imaging refers to the techniques and processes used to create images of the human body (or parts thereof) for clinical purposes (medical procedures seeking to reveal, diagnose or examine disease) or medical science (including the study of normal anatomy and function. Under this are the following: An MRI scan diagnostic radiology, including x-rays, fluoroscopy, mammography, Dual-energy X-ray absorptiometry, angiography, and Computed tomography ultrasound. One of the most important factors you ought to consider is the fact that the study of **modern medicine is complemented with technology**. Your knowledge of Physics can be useful to understand the underlying science behind these technologies, what makes them work and the applications. You see physics is a great help in the field of medicine without it, we are not able to enjoy what we are enjoying today in terms of



In physics forces include:



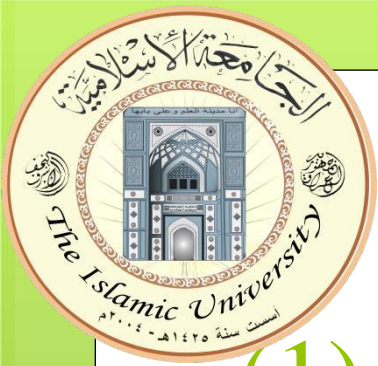
Gravitational



Electrical



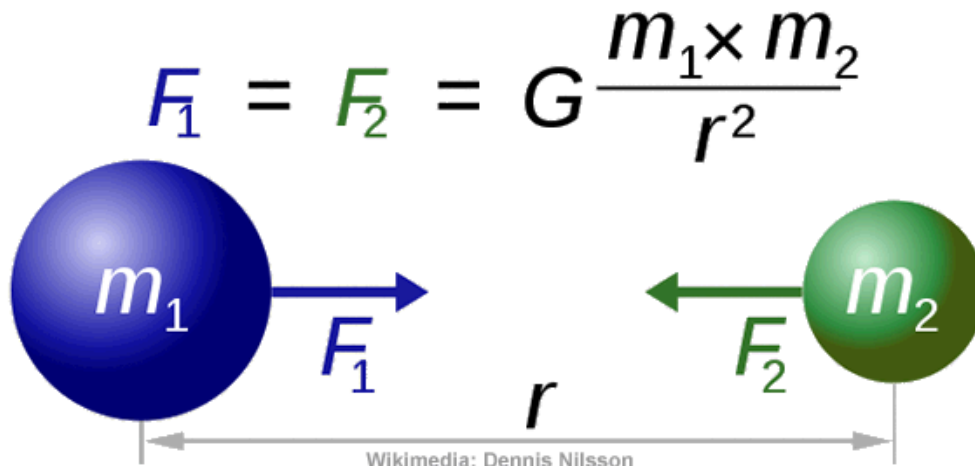
Nuclear



(1) Gravitational force:

- Law of universal gravitation:
 - “there is a force of attraction between any two objects which is proportional to the product of their masses and inversely proportional to the square of the distance

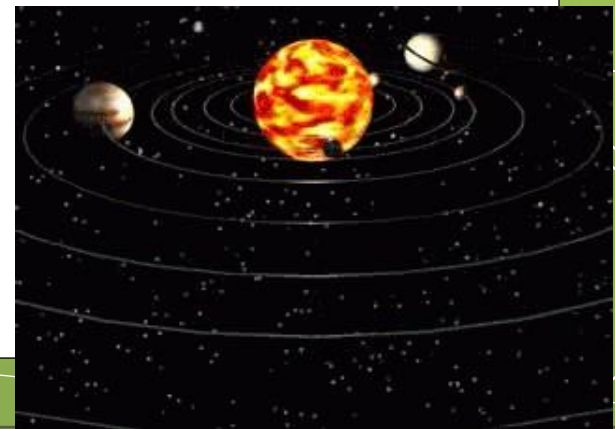
Newton's Law of Universal Gravitation





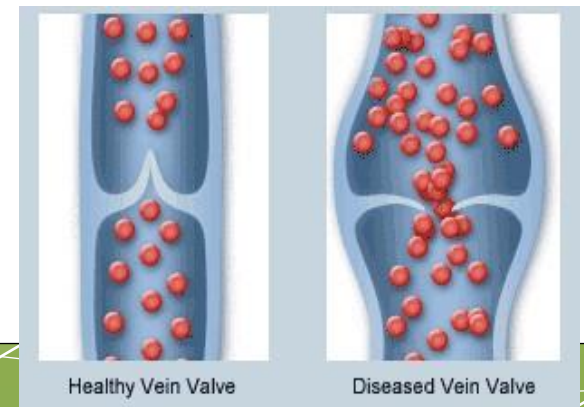
For example;

- our weight is due to the attraction Between the earth and our bodies.
- The gravitational force is smaller on the moon than on the earth in proportion to their respective masses.



Effects of the gravitational force on the body:

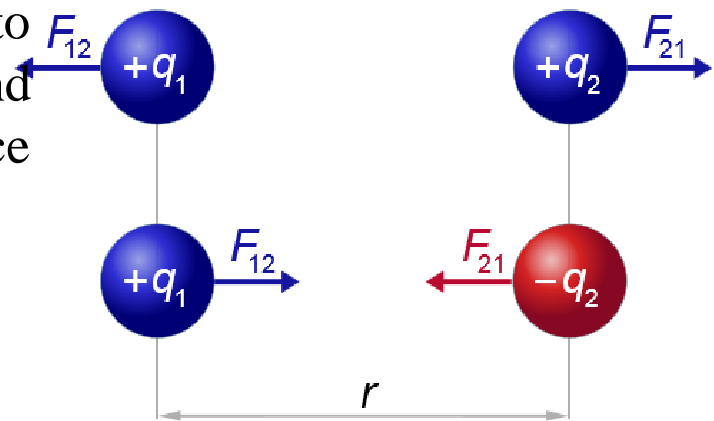
- The **formation of varicose veins** in the legs: This happens because of the **attraction of the earth** to the blood resisting the up flow of the venous blood which travels against the force of gravity on its way to the heart. As a result, **pooling of blood occurs especially in the legs.**



(2) Electrical force:

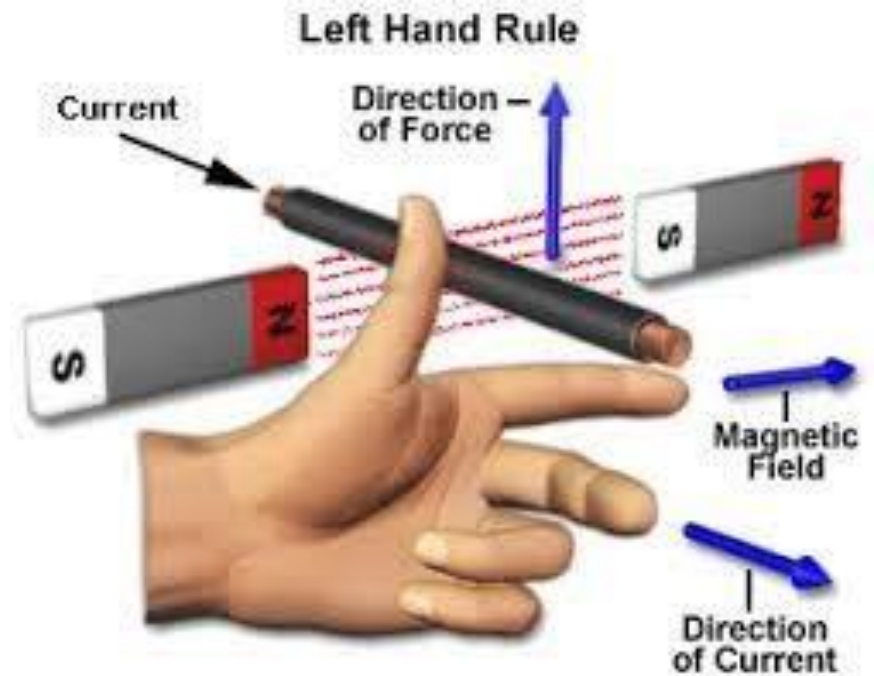
- The repulsive or attractive interaction between any two charged bodies is called as an electric force.
- (Coulomb's law):

Electric force is directly proportional to the amount of charge (q_1 and q_2) and inversely proportional to the distance between the charges r .



$$F_{12} = F_{21} = k \frac{q_1 q_2}{r^2}$$

- Magnetic forces are produced by moving electrical charges, (currents) that generate North and South poles.



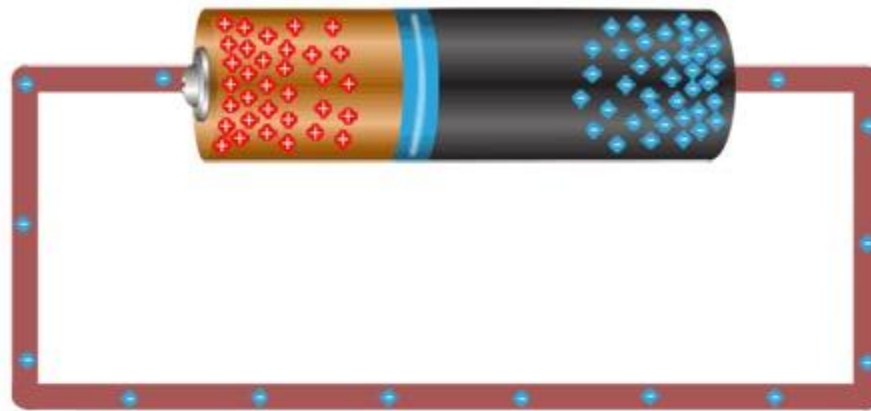
- Electrical forces are **immense** as compared to the weak gravitational forces.
- For example; the electrical force between an electron and a proton in H atom is about (10^{39} times) greater than the **gravitational force** between them.



Electrical current:

- Is moving electrical charges, (moving electrons).

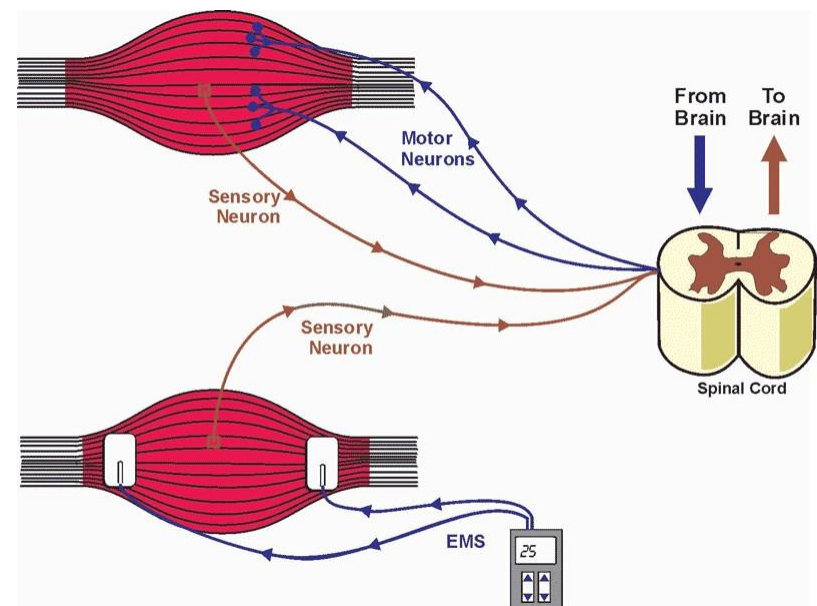
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← Direction of electron flow

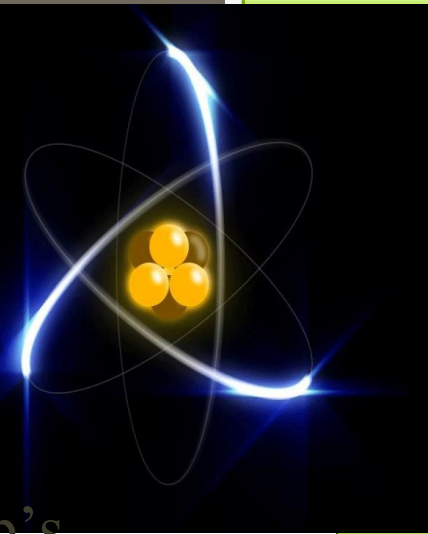
(Conventionally, direction of current is shown from positive to negative)

- Most of the forces dealt with in mechanics are of electromagnetic origin, but they produce the mechanical effects of acceleration, torque, and deformation.
- Our bodies are basically electrical machines in which the muscular forces are produced by electrical charges attracting or repelling other electrical charges.



(2) Nuclear forces:

- these forces counteract the enormous Coulomb's repulsion of the positively charged “protons” and hold them together inside the nucleus.
- There are two types of nuclear forces:
 - **Strong nuclear forces:** (as defined above)
 - **Weak nuclear forces:** associated with electron decay from the nucleus



Thank you