Lecture (1)

Medical Physics

Fourth Stage
Department of Physics
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Medical Physics

Syllabus of Medical Physics

Week	Subject
1	Terminology and Measurements
2	Force on and in the body
3	Energy, Work and Power of the Body
4	Heat and cold in medicine
5	Pressure in the body
6	Electricity in human body
7	Bio Potentials
8	Sound in medicine

Week	Subject
9	Physics of hearing and ear
10	Physics of eye and vision
11	Physics of eye and vision
12	Light and UV in medicine
13	x-ray in medicine
14	x-ray in medicine
15	Nuclear medicine

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Reference Books

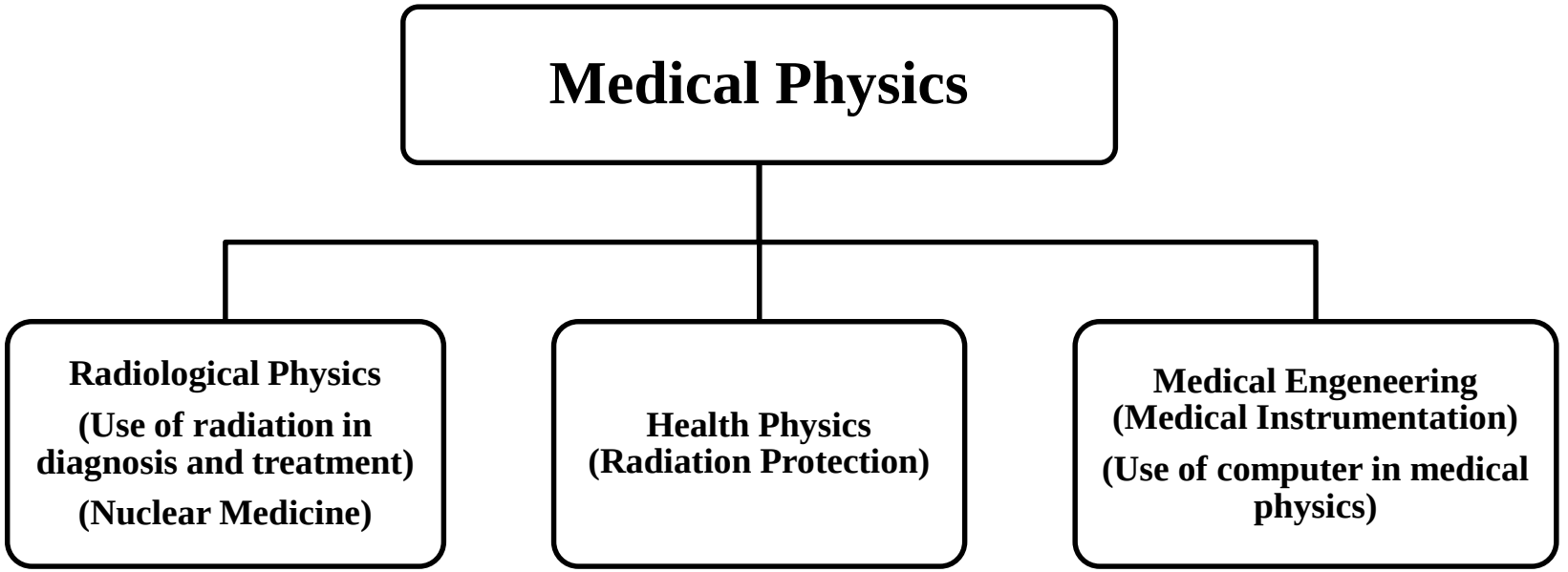
1. Medical Physics by John R. Cameron, International Publication.
2. Elements of Biophysics Randall 1998
3. Website

Introduction to Medical Physics

Medical physics is a branch where physics principle is applied for medical purpose. There are two important area of medical physics:

1- Physics of Physiology: Contain application of physics to function of human bodies in health and diseases.

2- Application of physics principle in practice of medicine such as blood pressure (B.P), x-ray, ultrasound, Laser and radiation.



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Scope of Medical Physics

1. Radiology (γ-ray)
2. Imaging (x-ray, Sonography)
3. Health
4. Diagnosis and Treatment
5. Instrumentation in Medicine
6. Telemedicine

- **Modelling**

Tear small paper and let it fall to floor. Then the motion of paper can be described by model. Knowledge and law of physics help in understanding physical aspect and diseases of body.

- **<u>There are few types of modeling:</u>**

1- Mechanical Model: Some models involve physical phenomena, which are completely unrelated to the subject being studied.

For example: **Flow of blood** ← − → **Flow of Electricity**

Model simulate phenomenon of cardiovascular system but this analogy have some limitation: Blood made of RBCs and 45 % of blood occupied by RBCs, and percentage changes as the blood flows towards extremities.

2- Mathematical Model: The nature and behavior of a particular phenomenon can be explain by using mathematical formula, that is called as mathematical model. It is useful to predict and describe physical behavior law of some systems.

Example $F = m\,a = m\,\frac{dv}{dt}$ *Newtons second Law*

$w = f(H)$ w *is weight as a function of hight*

$R = f(P)$ R *is hear rate and* P *is presure*

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- As body grows number of cells increases until it reaches adult size and then body remains more or less constant in size under some feedback control. Some cell don’t respond causing tumors.

3- Computer modeling: This modeling is used for simulation.

- **Measurements**

Characteristic of science ability to reproducibly measure quantity. Growth of science is depend on growth of ability to measure the quantity.

Some common measurement in the medicine.

1. Weight kg, 1kg=2.2 pound
2. Temperature
3. Blood pressure
4. x-ray radiation
5. Volume
6. Pulse

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S.I units

QUANTITY	UNIT	ABBREVIATION
Length	meter	m
Mass	kilogram	kg
Time	second	sec
Current	ampere	A
Temperature	kelvin	K
Luminous Intensity	candela	cd

Derived Units

Force	**N**
Pressure	**Pa, N/m^2**
Energy	**J**
Power	**W**
Electric Charge	**C**
Electric Potential	**V**
Inductance	**H**
Magnetic flux	**Wb**
Magnetic intensity	**T**
Frequency	**Hz**
Disintegration rate	**Bq**
Absorbed dose	**Gy**

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Large Unit Prefixes

Factor	Name	Symbol
10^{24}	yotta	Y
10^{21}	zetta	Z
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10^{1}	deka	da

Small Unit Prefixes

Factor	Name	Symbol
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a
10^{-21}	zepto	z
10^{-24}	yocto	y

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Physical Quantities

Quantity	Unit in m
Diameter of sun	$1.4 * 10^{9}$
Radius of earth	$6 * 10^{6}$
Average height of the man	1.65
Size of human hair	$1 * 10^{-4}$ to 10^{-5}
Diameter of RBC	$1* 10^{-5}$
Size of virus	$1* 10^{-6}$
Size of water molecule	$15 * 10^{-9}$
Radius of H atom	$5 * 10^{-11}$
Radius of proton	$1 * 10^{-15}$

- 1 light year = 365 *24*60*60*3*10^{8} m = 9.46 *10^{15} m
- 1 angstrom = 1 A^{o} = 10^{-10} m

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- 1 meter is a length of path travel by light in a vacuum during the time interval of 1/299792458 of a second.
- 1 kg is a mass of international prototype of the kilogram (a platinum iridium alloy cylinder) kept at international Bureau of weights and measures at severs, near Paris France.

- **Atomic mass unit (amu) or u =1.661 * 10^{-27} kg**

- A second is a S I unit of time it is duration of 9,192,631,770 vibrations of radiation corresponding to transition between two hyperfine level of the ground state of cesium 133 atom.
- S I unit of temperature is kelvin. The kelvin defined as 1/273.16 of the temperature of the triple point of water.
- Note that we do not use degree symbol in reporting the temperature on the kelvin scale. We say that the boiling point of water is look or 100 kelvin.

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