BRITISH COLUMBIA INSTITUTE OF TECHNOLOGY

COURSE OUTLINE, PHYS 2272

COURSE NAME:	Physics of Medical Radiography		
COURSE NUMBER:	PHYS 2272		
PREPARED BY:	Richard Saunders	TAUGHT TO:	1st year
DIVISION:	Academic Support	SCHOOL:	Health
PROGRAM:	Physics	PROGRAM:	Radiography
DATE PREPARED:	September 1996	OPTION:	
LEVEL:	3	HOURS/WEEK:	2.3 average
TERM LENGTH:	15 Weeks	TOTAL HOURS:	31

INSTRUCTOR: Richard Saunders OFFICE: SW3 4083 LOCAL: 5314

OFFICE HOURS: Open or Make an Appointment

PREREQUISITES: PHYS 1272

COURSE OBJECTIVES:

Upon successful completion of this course the student will be able to;

a) define relevant physics terms with units,
b) explain or discuss relevant physics concepts with defined terminology.
c) draw and label diagrams of: EM waves, X-ray spectra, energy level diagrams, X-ray attenuation, Compton scatter and photoelectric attenuation,
d) demonstrate conceptual understanding of physics by solving numerical, subjective and objective problems,
e) explain the radiographic image formation process to a patient,
f) use physics concepts to understand new technological development.

EVALUATION:

Quiz	15%	
Test	25%	
Lab	10%	
Final examination	50%	(Includes questions on lab material)

REQUIRED TEXT:

Lecture notes

EQUIPMENT:

A calculator with logarithm and trigonometry functions.

COURSE SUMMARY: PHYS 1272 and PHYS 2272

Physics of Medical Radiography is an introductory level course which emphasizes the application of physical phenomena in medical radiography. It includes the structural and physical properties of matter, static electricity, direct and alternating current, magnetism, mechanics, energy, heat, wave motion, electromagnetic radiation, quantum concepts, production of X-rays and interaction of X-rays with matter. Where appropriate, the physics of devises such as X-ray tubes, photomultiplier tubes, TLDs, etc will be covered.

REFERENCE TEXTS

1. Ball, J.L. and A.D. Moore, *Essential Physics for Radiographers*, second edition, Blackwell, 1986.
2. Beiser, Arthur, *Modern Technical Physics*, fifth edition, Benjamin -Cummings, (1987). or any first year Physics text.
3. Bushong, Stewart C., *Radiologic Science for Technologists: Physics, Biology and Protection*, fifth edition, Mosby, 1993.
4. Carlton, R.R. and A.M. Adler, *Principles of Radiographic Imaging: an art and a science*, Delmar Publishers, 1992.
5. Currey, Downey and Murray, *Christensen's Introduction to the Physics of Diagnostic Radiology*, fourth edition, 1990.
6. Hay and Hughes, *First-Year Physics for Radiographers*, second, Bailliere Tindall, 1978.
7. Hill, D. R. (editor), *Principles of Diagnostic X-ray Apparatus*, Phillips, 1975.
8. Thompson, Hattaway, Hall and Dowd, *Principles of Imaging Science and Protection*, Saunders, 1994.
9. Wilks, *Principles of Radiological Physics*, Churchill Livingston, 1981.
10. Gray, J.E., N.T. Winkler, J. Stears, and E.D. Frank; *Quality Control in Diagnostic Imaging*, Aspen, 1983.

NOTE: Course content is subject to change by the instructor in charge. Time assigned to each section is a reasonable estimate only.

PHYSICS OF MEDICAL RADIOGRAPHY
COURSE OUTLINE, 1996

I. Electromagnetic Radiation — 5 periods

1. Wave motion

2. Wave equation

3. EM waves
   a) amplitude
   b) frequency, period
   c) velocity
   d) wavelength

4. Electromagnetic radiation
   a) sources
   b) wave nature
   c) particle nature (photon)
   d) wave particle duality
   e) photo diode and Photomultiplier tube

5. The electromagnetic spectrum

II. X-ray Production — 3 periods

1. Definitions

2. Stopping electrons
   a) small interactions, heat
   b) continuous spectrum
   c) characteristic spectrum
   d) spectral intensity vs photon energy

3. Energy level diagram

4. Relative importance of Brems & Characteristic

5. Production efficiency

6. Changing the X-ray intensity curve
    a) Ma
    b) Kv
    c) target material
    d) filtration
    e) voltage wave form

7. Xray quality and quantity

III. Interaction of X-rays with Matter — 9 periods

1. Attenuation
    a) absorption
    b) scattering
    c) divergence

2. Linear attenuation coefficient

3. Half value layer

4. Heterogeneous X-ray beams

5. X-ray beam filtration

6. Mass attenuation coefficient

7. Attenuation mechanisms
    a) unmodified scatter
    b) Compton scattering (modified)
        i. distribution of scatter
        ii. quantum nature of X-rays
        iii. probability of occurrence
    c) photoelectric attenuation
        i. probability of occurrence
    d) pair production (mention only)

8. Total mass attenuation coefficient

9. Relative importance of mechanisms
    a) by number
    a) by absorbed dose

10. Attenuation edges
    a) best attenuator for X-rays
    b) rare earth elements
    c) quantum mottle

11. Subject contrast

12. Measurement of radiation
    a) Coulomb/kilogram
    b) Gray
    c) Activity (count/second)

IV. Temperature and Heat — 3 periods

1. Temperature

2. Heat energy
    a) heat flow
    b) units of heat
    c) heat capacity
    d) specific heat

3. Thermal expansion

4. Heat transfer
    a) conduction
    b) convection
    c) radiation

5. Heating and cooling curves

V. Heat and the X-ray Tube — 2 periods

1. Fixed anode X-ray tube

2. Rotating anode X-ray tube

3. Radiological heat unit

4. Maximum power input curve