Development of Medical Physics B.Sc. Curriculum

Key of tenth digits in Physics Department Courses:

Tens Digit	Delicate Specialty
0	General Physics
1	Electronics, Optics and Laser
2	Medical Imaging Ionizing & non-ionizing
3	Theory of Electromagnetism
4	Modern Physics
5	Theoretical Physics
6	Nuclear & Radiation Physics
7	Application of Radiation & Nuclear Physics in Medicine
8	Applications and Labs
9	Training and research courses, Special topics and occupational skills

1. Preparatory Year

Level 1

Course No.	Course Title	Unit			Prerequisites
		T	P	C	
CPIT 100	Computer Skills			**3**	---
ELI 101	English Language (1)			**0**	---
ELI 102	English Language (2)			**2**	---
PHYS 110	General Physics I	**3**	**0**	**3**	---
MATH 110	Calculus I	**3**	**0**	**3**	---
TOTAL CREDITS		**11**			

Level 2

Course No.	Course Title	Unit			Prerequisites
		T	P	C	
COMM 101	Communication Skills	**3**	**0**	**3**	---
ELI 103	English Language (3)			**2**	**ELI 102**
ELI 104	English Language (4)			**2**	**ELI 103**
BIO 110	Biology	**3**	**0**	**3**	---
CHEM 110	General Chemistry	**3**	**0**	**3**	---
STAT 110	Statistics	**3**	**0**	**3**	---
TOTAL CREDITS		**16**			

2. Other 3 Years

Level 3

Course No.	Course Title	Unit			Prerequisites
		T	P	C	
ARAB 101	Arabic Language (1)	**3**	**0**	**3**	---
PHYS 200	Lab. Safety	**0**	**3**	**1**	---
PHYS 202	General Physics II	**3**	**3**	**4**	**PHYS 110 MATH 110**
MATH 202	Calculus II	**4**	**0**	**4**	**MATH 110**
PHYS 203	General Physics III	**3**	**3**	**4**	**PHYS 110**
PHYS 281	General Physics Lab.	**0**	**3**	**1**	**PHYS 110**
TOTAL CREDITS		**17**			

Level 4

Course No.	Course Title	Unit			Prerequisites
		T	P	C	
ISLS 101	Islamic Culture (1)	**2**	**0**	**2**	---
CHEM 200	Lab. safety	**0**	**3**	**1**	**CHEM 110**
ANTM 207	Structural Anatomy	**2**	**3**	**3**	**BIO 110**
MPHY 231	Electricity and Magnetism	**3**	**0**	**3**	**PHYS 202**
PHYS 241	Modern Physics I	**3**	**0**	**3**	**PHYS 202 MATH 202**
PHYS 251	Mathematical Methods	**4**	**0**	**4**	**PHYS 202 MATH 202**
CHEM 281	General Chemistry Lab.	**0**	**3**	**1**	**CHEM 110**
TOTAL CREDITS		**17**			

Level 5

Course No.	Course Title	Unit			Prerequisites
		T	P	C	
ISLS 201	Islamic Culture (2)	**2**	**0**	**2**	**ISLS 101**
MPHY 321	Medical Imaging I	**3**	**0**	**3**	**MPHY 231 PHYS 241 PHYS 251**
PHYS 354	Quantum Mechanics I	**3**	**0**	**3**	**PHYS 241 PHYS 251**
MPHY 360	Radiation Physics and Dosimetry	**3**	**0**	**3**	**MPHY 231 PHYS 241 PHYS 251**
MPHY 381	Radiation Physics Lab.	**0**	**3**	**1**	**MPHY 231 PHYS 241 PHYS 251**
PHYS 461	Nuclear Physics	**3**	**0**	**3**	**PHYS 241**
XXXX XXX	Elective from outside the Dept.	**3**	**0**	**3**	---
TOTAL CREDITS		**18**			

Level 6

Course No.	Course Title	Unit			Prerequisites
		T	P	C	
ISLS 301	Islamic Culture (3)	**2**	**0**	**2**	**ISLS 201**
MPHY 322	Medical Imaging II	**3**	**0**	**3**	**ANTM 207 MPHY 321 MPHY 360 MPHY 381**
MPHY 341	Physics of Semiconductors	**3**	**0**	**3**	**MPHY 231 PHYS 354**
MPHY 362	Radiation Protection I	**3**	**0**	**3**	**MPHY 360 MPHY 381**
MPHY 371	Nuclear Medicine	**3**	**0**	**3**	**MPHY 360 MPHY 381**
MPHY 382	Medical Imaging Lab.	**0**	**3**	**1**	**MPHY 321**
XXXX XXX	Elective from outside the Dept.	**3**	**0**	**3**	---
TOTAL CREDITS		**18**			

Summer Semester

Course No.	Course Title	Unit				Prerequisites
		Th.	Pr.	Tr.	CH	
MPHY 390	Training I	**0**	**0**	**6**	**2**	**Approval of the Department**
TOTAL CREDITS		**2**				

Level 7

Course No.	Course Title	Unit			Prerequisites
		T	P	C	
ISLS 401	Islamic Culture (4)	**2**	**0**	**2**	**ISLS 301**
MPHY 410	Electronics and Instrumentation	**3**	**0**	**3**	**MPHY 341 PHYS 354**
MPHY 464	Radiobiology	**3**	**0**	**3**	**BIO 110 MPHY 360 MPHY 381**
MPHY 472	Radiotherapy Physics I	**3**	**0**	**3**	**ANTM 207 MPHY 360 MPHY 381**
MPHY 481	Electronics and Instrumentation Lab.	**0**	**3**	**1**	**MPHY 341 PHYS 354**
MPHY 482	Radiotherapy Physics I Lab.	**0**	**3**	**1**	**ANTM 207 MPHY 360 MPHY 381**
MPHY 4XX	Elective from Medical physics	**3**	**0**	**3**	*
TOTAL CREDITS		**16**			

Level 8

Course No.	Course Title	Unit			Prerequisites
		T	P	C	
ARAB 201	Arabic Language (2)	**3**	**0**	**3**	**ARAB 101**
MPHY 491	Graduation project	**0**	**6**	**2**	**MPHY 322 MPHY 362 MPHY 371 MPHY 472**
MPHY 492	Training II	**0**	**6**	**2**	**Approval of the department**
MPHY 4XX	Elective from Medical physics	**3**	**0**	**3**	*
MPHY 4XX	Elective from Medical physics	**3**	**0**	**3**	*
TOTAL CREDITS		**13**			

*** Refer to table 3.C.6**

3.C.6: Units for Elective Courses from Medical Physics Program:

No.	Course Title	Course Code / No.	Arabic Code	Units			CH	Prerequisites
				Th.	Pr.	Tr.		
1	Optics and Laser in Medicine الضوء والليزر في الطب	**MPHY 412**	**ف ط 412**	**3**	**0**	**0**	**3**	**PHYS 203, PHYS 241**
2	Magnetic Resonance Imaging التصوير بالرنين المغناطيسي	**MPHY 423**	**ف ط 423**	**3**	**0**	**0**	**3**	**MPHY 321, MPHY 382 MPHY 383**
3	Nanoscience in Medical Physics علم النانو في الفيزياء الطبية	**MPHY 442**	**ف ط 442**	**3**	**0**	**0**	**3**	**PHYS 241, MPHY 342**
4	Radiation Protection II الوقاية من الإشعاع 2	**MPHY 463**	**ف ط 463**	**3**	**0**	**0**	**3**	**MPHY 362**
5	Radiotherapy **Physics** II فيزياء العلاج الإشعاعي 2	**MPHY 474**	**ف ط 474**	**3**	**0**	**0**	**3**	**MPHY 472**
6	Computer Applications in Medical Physics تطبيقات حاسوبية في الفيزياء الطبية	**MPHY 483**	**ف ط 483**	**2**	**3**	**0**	**3**	**CPIT 100, MPHY 321**
7	Ethics for medical physics أخلاقيات الفيزياء الطبية	**MPHY 494**	**ف ط 494**	**3**	**0**	**0**	**3**	**CPIT 100, COMM 101**
TOTAL CREDITS				**21**				

3.C.7: Units for Compulsory Courses from other departments:

No.	Course Title	Course Code / No.	Arabic Code	Units			CH	Prerequisites
				Th.	Pr.	Tr.		
1	Lab. safety	**CHEM 200**	**ك 200**	**0**	**3**	**0**	**1**	**CHEM 110**
2	Anatomy	**ANTM 207**	**تش 207**	**2**	**3**	**0**	**3**	**BIO 110**
3	General Chemistry Lab.	**CHEM 281**	**ك 281**	**0**	**3**	**0**	**1**	**CHEM 110**
TOTAL CREDITS				**5**				

Anatomy

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Anatomy ***علم التشريح***	ANTM 207	***207 تش***	*2*	*3*	*0*	*3*
Prerequisites		*BIO 110*				

Objectives:
This course aims to thoroughly acquaint the student with detail studies and understanding of anatomical terms, anatomical structures of human body. After attending this course, students should be able to:

- Understand the anatomical terms, and use them correctly.
- Recognize the anatomical structures correctly.
- Apply his/her knowledge to understand anatomy of human body.
- Indicate the application of the anatomical knowledge in his/her future Health Practice.

Assessment methods for the above elements:

1st Midterm Exam	15%
2nd Midterm Exam	15%
Coursework and quizzes	10%
Lab. Reports	20%
Final Lab. Exam	10%
Final Exam	30%

Textbook:

- Fundamentals of Systemic Anatomy, Hamid Saleh& others, Jaddat UI Ebda, 2007, 1st edition.

Supplementary references:

- Memmler's Structure and Function of the Human Body, Barbara J Cohen, Elsevier, 2005, 8th edition.

Week	Theoretical course contents	Remarks
1	**Anatomical Terms:** Demonstrations of the different types of fasciae, muscles and bones.	
2	**Skeletal System:** General features of different parts of axial skeleton: Skull, sternum, ribs & vertebral column.	
3	**Skeletal System:** General features of different bones of the upper limb and shoulder girdle. General features of different bones of the lower limb and pelvic girdle.	
4	**Articular System:** Demonstration of different types of joints. Demonstration of the main joints of the upper limb. Demonstration of the main joints of the lower limb.	
5	**Muscular System:** Identification of Scalp, main muscles of face, eye, mastication, tongue & sternomastoid. Identification of major muscle groups of Upper Limb.	
6	**Muscular System:** Identification of muscles of Abdomen and back. Identification of Muscle Groups of Lower Limb.	
7	**Cardiovascular System:** Heart: Its major features and big vessels. Major arteries of upper limb. Major arteries of lower limb. Main arteries of the head and neck, chest, abdomen and pelvis.	
8	**Cardiovascular System:** Superior & Inferior venae cavae. Main veins in neck, upper limb & lower limb.	
9	**Respiratory System:** Sagittal section of nasal cavity, pharynx & larynx. Trachea & main bronchi. Lungs & its major features. Pleural cavity.	
10	**Digestive System:** Tongue. Sagittal section of pharynx. Oesophagus & stomach. Small intestine & Large Intestines. Pancreas. Liver lobes, impressions, gall bladder. Spleen. Suprarenal glands. Salivary glands.	
11	**Urinary System:** Kidney: surfaces, hilum, ureter & urinary bladder. Male Genital System.	
12	Testis, epididymis & spermatic cord. Seminal vesicles & prostate. Female Genital System Ovaries. Uterine tubes & uterus Vagina.	
13	**Lymphatic System:** The Lymphoid Tissue: Tonsils, Spleen, lymph nodes. Endocrine System The Endocrines glands: Thyroid, Suprarenal glands, Pancreas.	

14	**Nervous System:** Dura mater, main folds & main cranial venous sinuses. Cerebral hemisphere: Poles, surfaces, borders, lobes & main sulci and gyri. Main arteries. Brain Stem Cerebellum & ventricular system.	
15	**Nervous System:** Spinal cord, Filum terminal & caudaequina. Major cranial nerves. Brachial plexus & its main branches: "radial axillary, median, ulnar & musculocutaneous nerves'. Main branches of lumbar plexus "femoral & obturator nerves. Sciatic, common peroneal & tibial nerves. Sympathetic chain.	

Electricity and Magnetism

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Electricity and magnetism الكهرومغناطيسية	MPHY 231	ف ط 231	*3*	*0*	*0*	*3*
Prerequisites		*PHYS 202*				

Objectives:
The objective of this course is to give the student an introduction to the subject of classical electrodynamics gradually leading to the development of Maxwell's equation. By the end of this course students should be able to:

- Understand the basic relations of vector analysis, and to demonstrate its application to electrostatics, work and energy.
- Employ special techniques in calculating potential (Laplace's equation, the method of images).
- Calculate electromagnetic fields interactions in matter (Polarization, electric displacement, linear dielectrics).
- Examine the static magnetism in matter, electromagnetic induction, Faraday's law.
- Describe Maxwell's equations.
- Explain electromagnetic waves interactions and their propagation in conducting and non-conducting media,
- Differentiate the dispersion, emission of electromagnetic radiations from dipoles and point charges.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Introduction to Electrodynamics; by D.J. Griffiths, 4th edition (2017), Prentics-Hall, Inc.

Supplementary references:

- Fundamentals of electromagnetic theory; by Reitz, Milford and Christy (1979)
- Electromagnetic concepts and Applications, 2nd edition; by S.V. Marshall and A. A. Skitek (1987). Prentice-Hall, Inc.

Week	Theoretical course contents	Remarks
1	**Vector analysis:** Vector Algebra, Differential Calculus.	
2	**Integral Calculus:** The Fundamental Theorem for Gradients, The Fundamental Theorem for Divergences, The Fundamental Theorem for Curls, The Theory of Vector Fields, The Helmholtz Theorem, and Potentials.	
3	**Electrostatics:** The Electric Field**:** Divergence and Curl of Electrostatic Fields: The Divergence of E, Applications of Gauss's Law**,** The Curl of E.	
4	**Electric Potential:** Introduction to Potential, Comments on Potential, Poisson's Equation, and Laplace's Equation.	
5	**Work and Energy in Electrostatics:** The Work Done to Move a Charge, The Energy of a Point Charge Distribution, The Energy of a Continuous Charge Distribution**,** Comments on Electrostatic Energy.	
6	**Conductors:** Basic Properties, Induced Charges, Surface Charge and the Force on a Conductor, Capacitors.	
7	**Magnetostatics**: Magnetic Forces**,** Currents, The Biot-Savart Law, The Divergence and Curl of B, Applications of Ampere's Law.	
8	**Magnetostatics:** The Vector Potential, Summary; Magnetostatics, Boundary Conditions.	
9	**Electrodynamics**: Electromagnetic Induction, Maxwell's Equations.	
10	**Conservation Laws:** Charge and Energy, The Continuity Equation**,** Poynting's Theorem.	
11	**Momentum:** Newton's Third Law in Electrodynamics, Maxwell's Stress Tensor, Conservation of Momentum, Angular Momentum.	
12	**Electromagnetic Waves:** Waves in One Dimension**,** The Wave Equation**,** Sinusoidal Waves.	
13	**Boundary Conditions:** Reflection and Transmission. Polarization.	
14	**Electromagnetic Waves in Matter.** Propagation in Linear Media, Reflection and Transmission at Normal Incidence**,** Reflection and Transmission at Oblique Incidence.	
15	**Revision.**	

Medical Imaging I

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Medical Imaging I ***التصوير الطبي 1***	MPHY 321	***ف ط 321***	*3*	*0*	*0*	*3*
Prerequisites		*MPHY 231, PHYS 241, PHYS 251*				

Objectives:
This course aims to explain the meaning of medical imaging with more emphasis nonionizing radiation such as: ultrasound, MRI, EEG, MEG, ECG, EMG and some other techniques. After completing this course, students should be able to:

- Understand the introduction of the major medical imaging (non-ionizing radiation) techniques employed in modern hospitals, including Ultrasound Imaging, Magnetic Resonance Imaging, Electromagnetic Imaging, and some other non-ionizing imaging techniques.
- Learn and understand the basic physical principles and clinical applications of these imaging techniques.
- Learn and understand the instrumentation used in these imaging techniques.
- Learn and understand the biological hazards, safety levels and methods of measurement of ultrasound, radiofrequency and magnetic fields.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Medical Imaging Physics by WR Hendee and ER Ritenour. Wiley-Liss, 2002.

Supplementary references:

- *Webb's Physics of Medical Imaging. M. A. Flower (Editor) CRC Press, Taylor & Francis Group, 2012. ISBN: 978-0-7503-0573-0.*
- *The Essential Physics of Medical Imaging* by Bushberg, Seibert, Leidholdt and Boone, 2nd edition, Lippincott Williams & Wilkins, 2002.

Week	Theoretical course contents	Remarks
1	Introduction to Medical Imaging.	
2	Ultrasound: definition + acoustic impedance.	
3	Ultrasound: Interaction of Ultrasound with Matter + Echo Imaging System.	
4	Ultrasound: Transducers + instrumentation + Image Artefacts and Quality.	
5	Ultrasound: Doppler Imaging System + contrast agents + Safety + Therapeutic ultrasound.	
6	MRI: NMR Basics.	
7	MRI: Relaxation Mechanisms.	
8	MRI: Tissue Contrast.	
9	MRI: Pulse Sequence, Fourier Transform.	
10	MRI: Image Construction.	
11	MRI: k space and pulse sequence diagram.	
12	MRI: Hardware and Safety.	
13	EEG, MEG: Neuroelectrical Phenomena and Field Generation and Detection.	
14	ECG, EMG: Neuroelectrical Phenomena and Field Generation and Detection.	
15	Other Techniques: Infrared Thermal Imaging (DITI) + UV Photography + Electrical Impedance.	

Medical Imaging II

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Medical Imaging II ***التصوير الطبي 2***	MPHY **322**	***ف ط 322***	*3*	*0*	*0*	*3*
Prerequisites		*ANTM 207, MPHY 321, MPHY 360, MPHY 381*				

Objectives:
This course aims to deliver knowledge of the theoretical principles and technology and clinical applications of imaging modalities using ionizing radiation to screen human anatomy. Demonstrate the devices instrumentations and image reconstruction of each system. After completing the course, students should be able to:

- Understand the basics of x-rays productions and detection.
- Differentiate between conventional x-ray and CT imaging.
- Impart knowledge on Fluoroscopy and Mammogram
- Develop understanding on imaging reconstruction and artifacts.
- Be able to apply their knowledge in clinical practices.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- *Medical Imaging Physics* by WR Hendee and ER Ritenour. Wiley-Liss, 2002.

Supplementary references:

- *The Essential Physics of Medical Imaging* by Bushberg, Seibert, Leidholdt and Boone, 2nd Edition, Lippincott Williams & Wilkins, 2002.

Week	Theoretical course contents	Remarks
1	X-ray production.	
2	X-ray interactions.	
3	X-ray detection.	
4	Conventional x ray.	
5	Fluoroscopy.	
6	Mammography.	
7	Computed Tomography, basic principles, Generations.	
8	CT generations, Hounsfield numbers.	
9	CT Contrast Agents	
10	Subtraction radiography, digital subtraction.	
11	Images reconstruction.	
12	Image artefacts, QA and QC.	
13	Image artefacts, QA and QC (Hospital visit).	
14	Applications.	
15	Applications.	

Physics of Semiconductors

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Physics of Semiconductors ***فيزياء أشباه الموصلات***	MPHY 341	***ف ط 341***	*3*	*0*	*0*	*3*
Prerequisites		*MPHY 231, PHYS 354*				

Objectives:
After attending this course, students should be able to:

- Use crystal structure in describing materials and their properties.
- Appling the concepts of quantum mechanics in explaining the electric conduction in solids.
- Analysis of structure and functions of basics electronic devices such as pn junctions, Schottky diodes, and transistors.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Semiconductor physics and devices basic principles, Donald Neamen**,** 4th edition.

Supplementary references:

- Introduction to Solid State Physics, Charles Kittel, (2018)
- Elementary solid state physics M Ali omar.

Week	Theoretical course contents	Remarks
1	**The crystal structure of solids:** Semiconductor materials, types of solids, space lattice, atomic bonding.	
2	**Introduction of quantum theory of solids:** Allowed and forbidden energy bands, electric conductions in solids.	
3	**Introduction of quantum theory of solids:** Extension to three dimensions, density of state function, statistical mechanics.	
4	**The semiconductor in equilibrium:** Charge carriers in semiconductors, dopant atomic and energy levels, the extrinsic semiconductor.	
5	**The semiconductor in equilibrium:** Statistics of donors and acceptors, charge neutrality, position of Fermi level.	
6	**Carrier transport phenomena:** Carrier drift, carrier diffusion.	
7	**Non equilibrium excess carriers:** Carrier generation and recombination, characteristics of excess carriers.	
8	**The pn junction:** The basic structure of pn junction, zero applied bias.	
9	**The pn Junction:** Reverse applied bias.	
10	**The pn Junction diode:** The pn junction current.	
11	**The pn junction diode:** Generation recombination current, junction breakdown.	
12	**Metal-semiconductor junction:** The schottky barrier diode.	
13	**Metal-semiconductor junction:** Ohmic contact.	
14	**The bipolar transistor:** The bipolar transistor action.	
15	**The bipolar transistor action:** Minority carrier distribution.	

Radiation Physics and Dosimetry

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Radiation Physics and Dosimetry ***الفيزياء الإشعاعية وقياس الجرعات***	MPHY 360	***ف ط 360***	*3*	*0*	*0*	*3*
Prerequisites		*MPHY 231, PHYS 241, PHYS 251*				

Objectives:
The course concentrates on the basic concepts of atom and nucleus, types of radiation, interaction of radiation with matter, radiation detectors, radiation spectroscopy and cavity theory. After completing this course, students should be able to:

- Definitions of nuclear models, mass formula, radioactive decay, fission and fusion processes.
- Calculations of activity of isotopes, binding energy, fission and fusion energy, thinking how to make a simple accelerator.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Physics and Engineering of Radiation Detection by Sayd Ahmed 1st edition (2007), Academic Press Inc

Supplementary references:

- Radiation Detection and measurements; by G. F. Knoll, 4th edition (2010).
- Fundamentals of Ionizing Radiation Dosimetry; by Pedro Andreo *et.al.*1st edition (2017).

Week	Theoretical course contents	Remarks
1	Introduction.	
2	Radioactivity and radioactive decay.	
3	Decay Equilibrium (Secular & Transient Equilibrium).	
4	Interactions of photons with matter	
5	Interaction of electrons and heavy charged particles with matter.	
6	Production of Radiation (X-ray- generator- reactors)	
7	Production of Radiation (Accelerator)	
8	General properties of radiation detectors	
9	Gas filled detectors (Giger counter, Ionization chambers)	
10	Semiconductor diode detectors.	
11	Other solid state detectors	
12	Scintillator detectors.	
13	Position Sensitive detectors and Imaging	
14	Signal Processing	
15	Radiation Spectroscopy.	

Radiation Protection I

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Radiation Protection I ***الوقاية من الإشعاع 1***	MPHY 362	***ف ط 362***	*3*	*0*	*0*	*3*
Prerequisites		*MPHY 360, MPHY 381*				

Objectives:
The course aims to introduce the essential concepts of radiation protection and emphasize the practical aspects of radiation protection in hospitals and/or industries. After completing this course, students should be able to:

- Differentiate between different concepts and units used in radiation protection.
- Practice the right act while in a radiation hazard area.
- Be alert to the values of dose limits to different categories of people.
- Apply the ALARA concept in a radiation hazard area.
- Act the right way in case of radiation accident.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Radiation Protection in the Health Sciences, by M. Noz and G. Maguire, second edition 2007.

Supplementary references:

- Radiation Protection: A Guide for Scientists, Regulators, and Physicians, by J. Shapiro, (2002).
- Atoms, Radiation, and Radiation Protection by James E. Turner third edition 2007.

Week	Theoretical course contents	Remarks
1	Introduction.	
2	Sources of exposure to ionizing radiation	
3	Fundamental concepts of radiation protection; Protection definition, aim, regulations & Principles.	
4	Units associated with radiation protection (exposure, Absorbed dose, kerma, biological effectiveness).	
5	Units associated with radiation protection (equivalent dose and effective dose, other dosimetric quantity).	
6	Radiation doses from different imaging modalities	
7	Biological effects of radiation and effective/equivalent dose limits.	
8	Radiation dose limits and maximum permissible dose	
9	Radiation Accidents: Analysis and protection.	
10	Nuclear accidents: Analysis and protection.	
11	Common survey and calibration instruments (general characteristics, delayed readout personnel monitors, immediate readout personnel monitors).	
12	Common survey and calibration instruments (personal alarm dosimeters, personal air samplers, area survey meter).	
13	Practical means of radiation protection (Principles of time, distance, and shielding).	
14	Practical means of radiation protection (Survey meter & personal dosimeters).	
15	Shield design project (FasRad softwear).	

Nuclear Medicine

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Nuclear Medicine ***الطب النووي***	MPHY 371	***ف ط 371***	*3*	*0*	*0*	*3*
Prerequisites		*MPHY 360, MPHY 381*				

Objectives:
The course covers the use of radionuclides in medicine. It covers an introduction of isotopes and isotope production. The importance of a revision and classification of radiation detectors open the door for the explanation of Gamma camera. SPECT, PET and PET-CT are well explained here. After completing this course, students should be able to:

- Gain knowledge of the theoretical principles and technology and clinical applications of the imaging modalities that use radionuclides to screen human physiological function.
- Demonstrate the devices instrumentations and image reconstruction.
- Gain knowledge of targeted therapy

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Physics of Nuclear medicine, 4th edition, 2012, Simon R.cherry, James A Sorenson and Michael E phelps.

Supplementary references:

- *Essentials of Nuclear Medicine Physics and Instrumentation*, 3rd edition, 2013, R. Powsner, M. Palmer and E. Powsner, Wiley Blackwell.
- *The Essential Physics of Medical Imaging* by Bushberg, Seibert, Leidholdt and Boone, 2nd Edition, Lippincott Williams & Wilkins, 2002.
- *Medical Imaging Physics* by WR Hendee and ER Ritenour. Wiley-Liss, 2002.

Week	Theoretical course contents	Remarks
1	Introduction.	
2	Radionuclide and radiopharmaceutical productions.	
3	Gamma camera: Basic principle.	
4	Gamma camera: Basic principle.	
5	Gamma camera performance characteristics.	
6	Gamma camera performance characteristics.	
7	Single Photon Emission computed tomography (SPECT).	
8	Tomographic reconstruction in nuclear medicine.	
9	Digital Image processing in Nuclear Medicine.	
10	Positron Emission Tomography (PET).	
11	Positron Emission Tomography (PET).	
12	Hybrid imaging: motivation of Hybrid imaging, PET/CT, SPECT/CT, PET/MRI, SPECT/MRI, attenuation correction using CT.	
13	Examples of clinical application of diagnostic nuclear medicine (planar, SPECT and PET studies).	
14	Image quality, Image artefacts, quality control.	
15	Targeted therapy.	

Radiation Physics Lab.

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Radiation Physics Lab. ***معمل الفيزياء الإشعاعية***	MPHY 381	***ف ط 381***	***0***	*3*	***0***	***1***
Prerequisites		*MPHY 231, PHYS 241, PHYS 251*				

Objectives:
This lab. course is a practical integration to the Radiation Physics course. After completing this course, students should be able to:

- Apply the inverse-square law in dealing with radioactive sources.
- Differentiate between low and high energy radiation sources.
- Choose the right shielding material for different types of radiation.
- Deal with and operate radiation detectors.

Assessment methods for the above elements:

Lab. Work and reports	40%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Physics and Engineering of Radiation Detection by Sayd Ahmed 1st edition (2007), Academic Press Inc.

Supplementary references:

- Radiation Detection and measurements by G. F. Knoll, 4th edition (2010).

Week	Experiment name	Remarks
1	Introduction to radiation detection.	
2	Photoelectric effect.	
3	Inverse square law.	
4	Radiation Attenuation.	
5	Radiation energy spectroscopy.	
6	Energy calibration of radiation detector.	
7	Half-life determination.	
8	Detector Resolving Time (Dead Time).	
9	Detector efficiency.	

Medical Imaging Lab.

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Medical Imaging Lab. ***معمل التصوير الطبي***	MPHY 382	*382 ف ط*	***0***	*3*	***0***	***1***
Prerequisites		*MPHY 321*				

Objectives:
This lab. Course is a practical integration to the Introduction to Medical Imaging courses. After completing this course, students should be able to:

- Demonstrate the basic principles of optics in medicine.
- Understand the principles of ultrasound imaging.
- Explore the characteristics of x-ray imaging techniques.
- Apply the principles of NMR and MRI.

Assessment methods for the above elements:

Lab. Work and reports	40%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- *Suzanne Amador Kane*, 2003, Introduction to Physics in Modern Medicine, Taylor & Francis, Inc.

Supplementary references:

- *Medical Imaging Physics* by WR Hendee and ER Ritenour. Wiley-Liss, 2002.
- *The Essential Physics of Medical Imaging* by Bushberg, Seibert, Leidholdt and Boone, 2nd Edition, Lippincott Williams & Wilkins, 2002.
- *Magritek Limited*. (2006) Terranova-MRI Student Guide, Wellington, NEW ZEALAND.

Week	Experiment name	Remarks
Optics		
1	Image formation.	
2	Focusing at different distances: Accommodation.	
3	Refractive errors: near-sightedness and far-sightedness.	
Ultrasound		
4	Principles of Ultrasound Imaging and the intensity of ultrasound echoes.	
5	Ultrasound absorption and Time-Gain-Compensation (TGC).	
6	Making an ultrasound image: B-scans and Ultrasound Imaging of a model Breast Tumour.	
X-ray		
7	Investigation of the attenuation of x-rays as a function of the thickness and the atomic number of the absorber.	
8	The demonstration of the effect of contrast media with Blood vessel model.	
9	Fluorescence of a luminous screen due to x-ray with any object, i.e. pocket calculator.	
MRI		
10	Basic NMR Signal Acquisition.	
11	Relaxation times: T1, T2 Calculations.	

Training I

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Training I ***التدريب 1***	MPHY 390	***ف ط 390***	*0*	*0*	*6*	*2*
Prerequisites		*Approval of the department*				

Objectives:
After attending this course, students should be able to:

- Observe and investigate important procedures in medical physics.
- Demonstrate competence in practical aspects of medical physics, such as:
  - Develop the use of technology, equipment and materials, safely.
  - Gain skills required for future jobs such as data acquisition.
  - Learn how to record and analyze data.
- Develop problem-solving skills in medical physics context.
- Communicate about medical physics in: writing, public speaking, and with professionals.
- Practice principles of safety and risk reduction in hospitals.
- Exhibit management skills in medical physics projects.
- Exhibit medical physics' professional standards in ethical reasoning.

Assessment methods for the above elements:

Students activities at hospitals	80%
Report and oral presentation	20%

Week	Timetable for hospital visit orientation	Remarks
1	Introduction to Hospital regulations and theoretical background	
2	Radiation Protection	
3	Medical Diagnostic Imaging	

Electronics and Instrumentation

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Electronics and instrumentation ***الإلكترونيات والأجهزة***	MPHY 410	***ف ط 410***	*3*	*0*	*0*	*3*
Prerequisites		*MPHY 341, PHYS 354*				

Objectives:
This course will provide basic knowledge for circuit analysis, semiconductor diodes and transistors, small signal models, and operational amplifiers. After completing this course, students should be able to:

- Analyze resistive circuits and determine currents and voltages.
- Analyze the transient behavior of RC and RL circuits.
- Use phasors and complex impedances to analyze steady-state responds.
- Understand operations of diodes, transistors and amplifiers.
- Perform noise measurements.
- Impart knowledge on logic gate and analog to digital conversion and application.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- *The art of electronics*, 2nd edition, 1989 Paul Horowitz and Winfield Hill, Cambridge University Press, New York, USA.

Supplementary references:

- *Electronics for Radiation Detection (Devices, Circuits, and Systems)*, 1st edition 2011, Krzysztof Iniewsky, CRC Press.

Week	Theoretical course contents	Remarks
1	Voltage, current and resistance.	
2	Signals, capacitor and ac circuits.	
3	Inductors and transformers, impedance and resistance.	
4	Diodes and diodes circuits.	
5	Some basic transistor circuits.	
6	Field effect transistors.	
7	Feedback and operational amplifiers.	
8	Feedback and operational amplifiers.	
9	Active filters and oscillators.	
10	Amplifier noise.	
11	Noise measurements, shielding and grounding.	
12	Basic logic concepts.	
13	Analog-digital conversion.	
14	Some A/D conversion examples.	
15	Data communications concepts.	

Optics and Laser in Medicine

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Optics and laser in medicine ***الضوء والليزر في الطب***	MPHY 412	***412 ف ط***	*3*	*0*	*0*	*3*
Prerequisites		*PHYS 203, PHYS 241*				

Objectives:
After completing this course, students should be able to:

- Provide a basic knowledge and understanding of the optical properties of tissues, the effects of multiple scattering on light distribution and mathematical methods for calculating the transport of light in tissues.
- Impart knowledge on applications of microscopy techniques including optical coherence tomography and fluorescence microscopy.
- Impart knowledge in laser physics and the principles of the thermal, photochemical and photomechanical effects that light can have on biological tissue.
- Impart knowledge on the physical principles underlying the safe usage of lasers.
- Impart knowledge on the application of European Community standards on laser safety.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- J. A. S. Carruth and A. L. Mckenzie, *Medical Lasers - science & clinical applications*, Adam Hilger Ltd, 1986. (TM).

Supplementary references:

- J. Wilson and J. F. B. Hawkes, *Lasers, Principles and Applications*, Prentice Hall, 1987. (TM)
- M. H. Niemz, *Laser tissue interactions*, Springer Verlag.
- A. Katzir, *Lasers and Optical Fibres in Medicine*, Academic Press Inc. 1993. (TM)
- *Safety of laser products. Part I: equipment classification, requirements and user's guide*. British Standards Institute (1994). BS EN 60825-1

Week	Theoretical course contents	Remarks
1	Introduction to light transport in matter.	
2	Law of absorption.	
3	Theories of light scattering: Rayleigh, Rayleigh Ganz Debye, and Mie theory.	
4	Models of light transport including: Diffusion theory, Kubelka Munk, and Monte Carlo.	
5	Nonlinear effects including fluorescence and phosphorescence.	
6	Applications: Oximetry and Optical Coherence Tomography.	
7	Applications: Microscopy.	
8	Sources of light: Incoherent and coherent light sources.	
9	Sources of light: Properties of laser light.	
10	Sources of light: Mechanisms of laser light generation.	
11	Effects of laser light in Tissue: Thermal effects; laser ablation and coagulation, laser hyperthermia, thermal relaxation time.	
12	Effects of laser light in Tissue: Photochemical effects; photoablation, photodynamic therapy.	
13	Effects of laser light in Tissue: Photoacoustic effects; photoacoustic spectroscopy, laser generation of shock waves.	
14	Laser safety: European Safety Standard; Laser safety of the eye.	
15	Laser safety: Laser safety of the skin; Laser safety calculations.	

Magnetic Resonance Imaging

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Magnetic resonance imaging ***التصوير بالرنين المغناطيسي***	MPHY 423	***ف ط 423***	*3*	*0*	*0*	*3*
Prerequisites		*MPHY 321, MPHY 382, MPHY 383*				

Objectives:
After completing this course, students should be able to:

- Describe the principles used for spatial localization of MR signal and many of the common techniques that are implemented.
- Describe variations on the resulting basic techniques that increase tissue contrast or ensure the quality of the measurement.
- Illustrate some of the major applications of MRI in current use, including MR spectroscopy, functional MRI and diffusion-weighted imaging.
- Describe the major hardware components of all MRI systems and assess the biological effects and physical hazards associated with MRI scanners.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Magnetic Resonance Imaging: Physical Principles and Sequence Design, E. Mark Haacke , Robert W. Brown , Michael R. Thompson , Ramesh Venkatesan , 1999, 1st edition.

Supplementary references:

- *MRI: The Basics Ray, H. Hashemi, William G. Bradley, Christopher J. Lisanti, 2010, 3rd edition.*
- *MRI from Picture to Proton, Donald W. Mc Robbie, Elizabeth A. Moore ,Martin J. Graves, Martin R. Prince, 2007, 2nd Edition*
- *Functional Magnetic Resonance Imaging, Scott A. Huettel, Allen W. Song, Gregory McCarthy (Sinauer, Sunderland, 2004)*

Week	Theoretical course contents	Remarks
1	Principles of MRI: Review.	
2	Fast Pulse Sequence.	
3	Fast Pulse Sequences. Measurement Parameters and Image Contrast.	
4	Additional Sequence Modification.	
5	Artefacts: Motion and External.	
6	Artefacts: Sequence / Protocol Related.	
7	Motion Artefact Reduction Techniques.	
8	MRA.	
9	Perfusion.	
10	MR Diffusion.	
11	fMRI.	
12	Ultra-High Field MRI / DTI.	
13	MRS.	
14	MRI Safety.	
15	MRI Safety (case study).	

Nanoscience in Medical Physics

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Nanoscience in medical physics ***علم النانو في الفيزياء الطبية***	MPHY 442	***442 ف ط***	*3*	*0*	*0*	*3*
Prerequisites		*PHYS 241, MPHY 342*				

Objectives:
After completing this course, students should be able to:

- Develop a good understanding of the physical concepts in nanoscience and the uniqueness of nano-sized and nano-manipulated materials.
- Obtain knowledge in nanomaterials synthesis and characterization and the applications of these nanomaterials and devices in the medical field.
- Preview up-to-date information about the safety of use of nanomaterials in medicine.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Nanomaterials for Medical Applications, by: Zoraida Aguilar, 2012.

Supplementary references:

- Introduction to Nanoscience, by: Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, and Anil K. Rao, 2008.
- Nanophysics and Nanotechnology, by: Edward L. Wolf, Wiley, 2006, 3527406514.
- Nanotechnology A Crash Course, by: Raul J. Martin-Palma and Akhlesh Lakhtakia, 2010.
- Introduction to Nanoscience and Nanomaterials, by: Dinesh C. Agrawal, 2013.

Other References:

1. http://www.nanotechproject.org/
2. http://nanohub.org/

Week	Theoretical course contents	Remarks
1	Introduction to Nanoscience and Nanotechnology, Physics of the Nanoscale.	
2	Effects of the Nanometer Length Scale on the Properties of Materials.	
3	Types of Nanomaterials and Corresponding Methods of Synthesis and Characterization.	
4	Interactions of Nanomaterials with their Biological Environment, Biocompatibility and Functionalization.	
5	Nanobiosensors: DNA Nanobiosensors, Protien Nanobiosensors, Whole-Cell Nanobiosensors, Quantum Dot-Based Detection of Breast Cancer Cells.	
6	**A Trip to the Nano-Centre.**	
7	Targeted Drug Delivery: Nanomaterials as Vehicles for Drug Delivery, Factors of Consideration, Drug Loading.	
8	Nanomaterials Targeting for Drug Delivery, Binding and Uptake.	
9	Drug Release and Biodegradation, Nanomaterial Clearance, The Blood-Brain Barrier.	
10	Nanomedical Devices: Nanorobots, Nanochips and Nanoimplants, Prosthesis, Tissue Engineering, Cell Repair.	
11	Nanopharmacology: Nanomaterials for Gene Delivery, Nanoimmunotherapy, Thermal Ablation, Contrast Agents, Tumor Cell Isolation.	
12	Nanomaterials for Thermal Ablation, Contrast Agents, Tumor Cell Isolation.	
13	Nanotoxicology and Remediation.	
14	Oral Projects Presentations.	
15	Oral Projects Presentations.	

Radiation Protection II

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Radiation protection II ***الوقاية من الإشعاع 2***	MPHY 463	***463 ف ط***	*3*	*0*	*0*	*3*
Prerequisites		*MPHY 362*				

Objectives:
After attending this course, students should be able to:

- Practice the right act while in a radiation hazard area.
- Be alert to the values of dose limits to different categories of people.
- Apply the ALARA concept in a radiation hazard area.
- Act the right way in case of radiation accident.
- Deal with different types of radiation sources in the right way.
- Participate in the radiation awareness community service programs.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Radiation Protection in the Health Sciences, by M. Noz and G. Maguire, 2nd edition 2007.

Supplementary references:

- Radiation Protection: A Guide for Scientists, Regulators, and Physicians, by J. Shapiro, (2002).
- Atoms, Radiation, and Radiation Protection by James E. Turner 3rd edition 2007.

Week	Theoretical course contents	Remarks
1	Principles governing specific devices: Responsibility, facility design, quality assurance, specific recommendations for X-ray generating equipment.	
2	Principles governing specific devices: Specific Recommendations for: Sealed Sources of Radioactivity, Particle Accelerators, Neutron Generators, Unsealed Sources of Radioactivity.	
3	Protection procedures in diagnostic imaging department	
4	Radionuclides and the law, Protection procedures in nuclear medicine department	
5	Shielding from external radiation	
6	Protection procedures in radiotherapy unit	
7	Project 1: Shielding design for an accelerator.	
8	Project 1: Shielding design for an accelerator.	
9	Internal dosimetry.	
10	Absorbed dose from external photons.	
11	Neutron shielding and protection	
12	Monte Carlo simulation in radiation protection.	
13	Monte Carlo simulation in radiation protection.	
14	Project 2: Shielding design for X-ray or CT machine.	
15	Project 2: Shielding design for PET.	

Radiobiology

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Radiobiology ***الأحياء الإشعاعية***	MPHY 464	***464 ف ط***	*3*	*0*	*0*	*3*
Prerequisites		*BIO 110, MPHY 360, MPHY 381*				

Objectives:
After completing this course, students should be able to:

- Describe how radiation interact with living systems.
- Describe quantitatively vs and quantitatively the cell killing and surviving after irradiation.
- Utilize radiobiological modeling in optimizing radiotherapy and nuclear medicine.
- Utilize radiobiological modeling in radiation protection.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Basic Clinical Radiobiology, M. Joiner & A. Kogel, 5th edition, (2016).

Supplementary references:

- Radiotherapy treatment planning linear – quadratic radiobiology, D. Chapman & A. Nahum, 1st edition (2016).
- The physics of radiology, Johns & Cunningham, 4th edition, (1984).

Week	Theoretical course contents	Remarks
1	Introduction: The significance of radiobiology and radiotherapy for cancer treatment.	
2	Linear energy transfer and relative biological effectiveness.	
3	Cell cycle and cell death.	
4	Irradiation induced damage of the cells and types of radiation damage.	
5	Quantifying cell kill and cell survival curves and factors affecting.	
6	Dose response relationship in radiotherapy, types and factors affecting.	
7	Tumour growth and response to radiation.	
8	Normal and tumour cells therapeutic ratio.	
9	Biological effects of radiation on cells, critical organs and whole body.	
10	Factors determine biological effects of radiation.	
11	Factors determine biological effects of radiation (continue); fractionation, dose rate effect, volume effect and oxygen effect.	
12	Time factor in normal tissue response to irradiation.	
13	Radio protectors & radio sensitizers.	
14	Therapeutic Benefit and R.T.	
15	Companied radiotherapy and chemotherapy.	

Radiotherapy Physics I

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Radiotherapy Physics I ***فيزياء العلاج الإشعاعي 1***	MPHY 472	***ف ط 472***	*3*	*0*	*0*	*3*
Prerequisites		*ANTM 207, MPHY 360, MPHY 381*				

Objectives:
After attending this course, students should be able to:

- Explain the principle of equipment used in radiotherapy such as linear accelerator, ionization chambers, and water phantoms.
- Carry out the measurements, calculations and interpretation related to isodose curves.
- Carry out the classical radiotherapy treatment planning and delivery (under supervision) for several sites such as head and neck, breast, bladder and rectum.
- Carry out the treatment planning and delivery (under supervision) for superficial tumors using electron beams.
- Explain the basics physics and procedure of brachytherapy.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Khan, F.M., *The Physics of Radiation Therapy*. 2010: Lippincott Williams & Wilkins.

Supplementary references:

- Handbook of Radiotherapy Physics: Theory and Practice P Mayles, A. Nahum, J.C Rosenwald.
- Radiotherapy physics and equipment: Churchill Livingstone.

Week	Theoretical course contents	Remarks
1	Radiotherapy treatment machines, linear Accelerator, alternative mega voltage treatment machines	
2	Photon beam characteristics	
3	Dose distribution and radiation treatment parameters.	
4	2D treatment planning.	
5	Dosimetric calculations within the patients.	
6	General principles of planning techniques.	
7	Dose distributions.	
8	Patient data, corrections, and set-up.	
9	Patient positioning and treatment verification.	
10	Beam modifiers, field shaping, skin dose, field separation and missing tissue compensators.	
11	Electron beam therapy.	
12	Brachytherapy, basics, sources and principles.	
13	Brachytherapy, treatment planning and advantages.	
14	Quality control and Assurance.	
15	Quality control and Assurance.	

Radiotherapy Physics II

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Radiotherapy Physics II ***فيزياء العلاج الإشعاعي 2***	MPHY 474	***ف ط 474***	*3*	*0*	*0*	*3*
Prerequisites		*MPHY 472*				

Objectives:
After attending this course, students should be able to:

- Explain the advantage of modern radiotherapy techniques such as IMRT, IGRT, rapid arc over the classical radiotherapy
- Carry out treatment planning using modern radiotherapy techniques.
- Use radiobiology method to evaluate and improve treatment plans.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Khan, F.M., *The Physics of Radiation Therapy*. 2010: Lippincott Williams & Wilkins.

Supplementary references:

- The Physics of Three Dimensional Radiation Therapy: Conformal Radiotherapy, Radiosurgery and Treatment Planning S, Weep.
- Intensity-Modulated Radiation Therapy S, Weep.
- Radiobiological Modelling in Radiation Oncology Roger G Dale.

Week	Theoretical course contents	Remarks
1	Three dimensional conformal radiotherapy.	
2	Three-dimensional conformal radiotherapy.	
3	Three-dimensional conformal radiotherapy.	
4	Intensity modulated radiotherapy.	
5	Intensity modulated radiotherapy.	
6	Intensity modulated radiotherapy and VMAT.	
7	Stereotactic Radiosurgery.	
8	Stereotactic Radiosurgery.	
9	Image-Guided Radiation Therapy and adaptive radiotherapy.	
10	Image-Guided Radiation Therapy and adaptive radiotherapy.	
11	Proton beam therapy.	
12	Adaptive therapy	
13	Radiation biology.	
14	Radiobiological Modelling in Radiotherapy.	
15	Radiobiological Modelling in Radiotherapy.	

Electronics and Instrumentation Lab.

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Electronics and instrumentation lab. ***معمل الإلكترونيات والأجهزة***	MPHY 481	***ف ط 481***	***0***	*3*	***0***	***1***
Prerequisites		*MPHY 341, PHYS 354*				

Objectives:
This lab. Course is a practical integration to the Electronics Instrumentation course. After completing this course, students should be able to:

- Familiarize the student with electrical measurements and electronic circuits.
- Render the concepts taught in the Electronics and Instrumentation course.

Assessment methods for the above elements:

Lab. Work and reports	40%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- *The art of electronics* – 2nd edition, 1989 Paul Horowitz and Winfield Hill, Cambridge University Press, New York, USA.

Week	Experiment name	Remarks
1	Ohm’s law measurements	
2	RC measurements.	
3	Characterization of pn diodes	
4	Characterization of pnp and npn transistors	
5	Characterization of Schottky diodes	
6	Characterization of MOSFET transistors	
7	Electronic circuit of pre-amplifier	
8	Electronic circuit of shaping amplifier	
9	Signal conversion from analogue to digital.	
10	Signal conversion from digital to analogue to	

Radiotherapy Physics I Lab.

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Radiotherapy physics I lab. ***معمل العلاج الإشعاعي 1***	MPHY 482	***ف ط 482***	***0***	*3*	***0***	***1***
Prerequisites		*ANTM 207, MPHY 360, MPHY 381*				

Objectives:
This lab. course is a practical integration to the Radiotherapy Physics I course. After completing this course, students should be able to:

- Explain the principle of equipment used in radiotherapy such as linear accelerator, ionization chambers, and water phantoms.
- Carry out the measurements, calculations and interpretation related to isodose curves.
- Carry out the classical radiotherapy treatment planning and delivery (under supervision) for several sites such as head and neck, breast, bladder and rectum.
- Carry out the treatment planning and delivery (under supervision) for superficial tumors using electron beams.
- Explain the basics physics and procedure of brachytherapy.

Assessment methods for the above elements:

Lab. Work and reports	40%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- Khan, F.M., *The Physics of Radiation Therapy*. 2010: Lippincott Williams & Wilkins.

Supplementary references:

- Handbook of Radiotherapy Physics: Theory and Practice P Mayles, A. Nahum, J.C Rosenwald.
- Radiotherapy physics and equipment: Churchill Livingstone.

Timetable for distribution of experimental course contents		
Week	**Experiment name**	**Remarks**
1	The linear Accelerator “hospital visit”.	
2	Depth Dose Distribution in water phantom.	
3	Measurement of Isodose Curves and Manual planning.	
4	Treatment planning using Single Field and Parallel Opposed Fields.	
5	Treatment planning using Isocentric and SSD Techniques.	
6	Hands on: treatments planning for head and neck.	
7	Hands on: treatments planning for breast.	
8	Hands on: treatments planning for Lung.	
9	Hands on: treatments planning for prostate, bladder and cancer.	
10	Hands on: treatments planning using electron beam.	
11	Hands on: Brachytherapy.	
12	Hands on: QA for LINAC.	
13	Hands on: QA for TPS.	

Computer Applications in Medical Physics

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Computer applications in medical physics ***تطبيقات حاسوبية في الفيزياء الطبية***	MPHY 483	***ف ط 483***	*2*	*3*	*0*	*3*
Prerequisites		*CPIT 100, MPHY 321*				

Objectives:
After attending this course, students should be able to:

- Gain knowledge of the use of computers in hospitals.
- Understand the principles of computer-assisted diagnosis.
- Understand the basics of computer programming and write computer programs in Matlab.
- Understand the basics of image processing.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- *Isaac Bankman, Handbook of Medical Image Processing and Analysis, Academic Press 2008.*

Supplementary references:

- Matlab – Modelling, Programming and Simulations, E. P. Leite, 1st edition, (2010).

Week	Theoretical course contents	Remarks
1	Computer Components, Numerical Systems Conversions	
2	Signal Processing	
3	Analog to Digital Conversion	
4	Matlab I: Variables, scripts, and operations + Visualization and programming.	
5	Matlab II: Solving equations and curve fitting.	
6	Matlab III: Matrices and Arrays + image operations.	
7	Image Representation and storage.	
8	Image Characteristics and Quality.	
9	Image Processing; Registration.	
10	Image Processing; Filtration.	
11	Image Processing; Segmentation I.	
12	Image Processing; Segmentation II.	
13	Image Processing; Classification.	
14	Networking and PACS I.	
15	Networking and PACS II.	

Graduation Project

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Graduation project ***مشروع التخرج***	MPHY 491	***ف ط 491***	*0*	*0*	*6*	*2*
Prerequisites		*MPHY 322, MPHY 362, MPHY 371, MPHY 472*				

Objectives:
After completing this course, students should be able to:

- Acquire experience in applying problem-solving strategies.
- Develop an understanding of the problem, establish project objectives, and decompose of the problem into its sub-problems.
- Design methodology to solve the problem, analyze and test results.
- Justify the results, extract conclusions, and provide recommendations.

Assessment methods for the above elements:

Interim report (Proposal)	20%
Continuous evaluation	20%
Oral presentation	20%
Final report	40%

Training II

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Training II ***التدريب 2***	MPHY 492	***ف ط 492***	*0*	*0*	*6*	*2*
Prerequisites		*Approval of the department*				

Objectives:
After completing this course, students should be able to:

- Observe and investigate important procedures in medical physics.
- Demonstrate competence in practical aspects of medical physics, such as:
  - Develop the use of technology, equipment and materials, safely.
  - Gain skills required for future jobs such as data acquisition.
  - Learn how to record and analyze data.
- Develop problem-solving skills in medical physics context.
- Communicate about medical physics in: writing, public speaking, and with professionals.
- Practice principles of safety and risk reduction in hospitals.
- Exhibit management skills in medical physics projects.
- Exhibit medical physics' professional standards in ethical reasoning.

Assessment methods for the above elements:

Students activities at hospitals	80%
Report and oral presentation	20%

Week	Timetable for hospital visit orientation	Remarks
1	Introduction to Hospital regulations and theoretical background.	
2	Radiation Protection.	
3	Nuclear Medicine.	
4	Radiotherapy.	

Ethics for Medical Physics

COURSE TITLE	*ENGLISH CODE /No.*	*ARABIC CODE/NO.*	*CREDITS*			
			Th.	*Pr.*	*Tr.*	*CH*
Ethics for medical physics ***أخلاقيات الفيزياء الطبية***	MPHY 494	***ف ط 494***	*3*	*0*	*0*	*3*
Prerequisites		*CPIT 100, COMM 101*				

Objectives:
After completing this course, students should be able to:

- Understand ethics and ethical decision making in clinical practice and research.
- Develop problem-solving skills in applying ethical standards, and research methods.
- Understand the basics of statistical reasoning and inferential methods, as well as statistical modeling and its limitations.
- Explain the methods of collecting data in addition to interpreting and communicating the results of statistical analysis.
- Successfully write and present a short medical physics research paper.

Assessment methods for the above elements:

1st Midterm Exam	20%
2nd Midterm Exam	20%
Coursework and quizzes	20%
Final Exam	40%

Textbook:

- T. F. Budinger and M. D. Budinger, *Ethics of Emerging Technologies: Scientific Facts and Moral Challenges*, Wiley, New Jersey, 2006.

Supplementary references:

- Michael J. Campbell, David Machin, Stephen J. Walters, *Medical statistics: a textbook for the health sciences*, John Wiley & Sons, 2007
- *Ethical Principles for Medical Research Involving Human Subjects*," World Medical Association Declaration of Helsinki, WMA General Assembly, 1964.
- R. E. Bulger, E. Heitman, and S. J. Reiser, *The Ethical Dimensions of the Biological and Health Sciences*, 2nd edition. Cambridge University Press, Cambridge, 2002

Week	Theoretical course contents	Remarks
1	Ethical Principles.	
2	Ethical Encounters or Dilemmas.	
3	Professional Conduct, Clinical Practice Ethics.	
4	Research Ethics.	
5	Research methods.	
6	Statically methods: Sampling and observational studies.	
7	Statically methods: Summarizing and presenting data.	
8	Statically methods: Estimation and Significance tests.	
9	Statically methods: Comparing the means of samples.	
10	Starting the mini project.	
11	Data collection.	
12	Statically methods: Regression and correlation.	
13	Statically methods: Choosing the statistical method.	
14	Preparing the final draft.	
15	Presentation and Discussion of the mini project.	