Kingdom of Saudi Arabia
Ministry of Education
Umm Al-Qura University
Deanship of Graduate Studies

المملكة العربية السعودية
وزارة التعليم
جامعة أم القرى
عمادة الدراسات العليا

# Master of Medical Physics with Courses and Research Project

Table of Contents

## Course Title: Medical Physics Instrumentations

## Course Code: 403660–3

| Topics to be Covered | | |
|---|---|---|
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| **Classification of Ionizing Radiation**<br><br>**1- Directly and Indirectly Ionizing Radiation**<br>**2- Low LET and High LET Radiation**<br>**Use of Ionizing Radiation**<br><br>**Classification of Directly Ionizing Radiation**<br><br>**1- Electrons**<br>**2- Positrons**<br>**3- Heavy Charged Particles**<br>**4- Pions**<br>**Classification of Indirectly Ionizing Photon Radiation**<br><br>**1- Radiation Quantities and Units**<br>**2- Dose Distribution in Water for Various Radiation Beams**<br>**3- Dose Distribution in Water for Photon Beams**<br>**4- Dose Distribution in Water for Neutron Beams**<br>**5- Dose Distribution in Water for Electron Beams**<br>**6- Dose Distribution in Water for Heavy Charged Particle Beams**<br>**7- Choice of Radiation Beam and Prescribed Target Dose** | 3 | 9 |

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|---|---|---|
| **Production of X Rays**<br><br>**X-Ray Line Spectra**<br><br>**1- Characteristic Radiation**<br>**2- Fluorescence Yield and Auger Effect**<br>**3- Emission of Radiation by Accelerated Charged Particle (Bremsstrahlung Production).**<br>**4- Interactions of Charged Particles with Matter**<br>**5- Interactions of Photons with Matter**<br>**6- Energy Transfer and Energy Absorption in Photon Interactions with Matter**<br><br>**1- Interactions of Neutrons with Matter**<br>**2- Machines for Production of Clinical Fast Neutron Beams**<br>**3- Kinetics of Radioactive Decay**<br>**4- Modes of Radioactive Decay**<br>**5- Production of Radionuclides**<br>**6- Waveguide Theory**<br>**Particle Accelerators in Medicine**<br><br>**Basic Characteristics of Particle Accelerators.** | 4 | 12 |
| **Mid-term Exam** | | |
| **Practical Use of X Rays**<br><br>**Medical Physics**<br><br>**Industrial Use of X Rays**<br><br>**X-Ray Crystallography**<br><br>**X-Ray Spectroscopy**<br><br>**X-Ray Astronomy**<br><br>**Practical Considerations in Production of X Rays**<br><br>**Traditional Sources of X Rays: X-Ray Tubes**<br><br>**Crookes Tube and Crookes X-Ray Tube**<br><br>**Coolidge X-Ray Tube**<br><br>**Carbon Nanotube Based X-Ray Tube** | 4 | 12 |

| | | |
|---|---|---|
| **X-ray production from medical equipment:-**<br><br>**Conventional X-ray machine and Computed Tomography**<br><br>**Circular Accelerators:**<br><br>**1- Betatron**<br><br>**1- Cyclotron**<br>**2- Microtron**<br>**3- Synchrotron**<br>**4- Synchrotron Light Source**<br>**Clinical Linear Accelerator**<br><br>**1- Linac Generations**<br>**2- Components of Modern Linacs**<br>**3- Linac Treatment Head**<br>**4- Configuration of Modern Linacs**<br>**Pulsed Operation of Linacs**<br>**Practical Aspects of Megavoltage X-Ray Targets and Flattening Filters** | 4 | 12 |
| **Total** | 15 weeks | 45 hrs |

**2. Course components (total contact and credit hours per semester):**

| | | Lecture | Tutorial | Laboratory/ Studio | Practical | Other | Total |
|---|---|---|---|---|---|---|---|
| Contact Hours | Planned | *45* | | ------- | ----- | | 45 |
| | Actual | 45 | | | | | 45 |
| Credit | Planned | 3 | | | | | 3 |
| | Actual | 3 | | | | | 3 |

**3. Individual study/learning hours expected for students per week.** 6

**5. Assessment Task Schedule for Students During the Semester**

| | Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| 1 | Midterm exam | 5th week | 20 % |
| 2 | Essay , quizzes, homework and presentation | 10th week | 30% |
| 5 | Final exam | End of semester | 50 % |

## E Learning Resources

1. List Required Textbooks

Fundamental Physics of Radiology (3rd edition) by W.J.Merdith, and J.B.Massey 2013

Rachel A: Powsner, Mattew R. Palmer, Edward R. Powsner " Essential of Nuclear Medicine Physics and Instrumentation, 3rd Edition, Feb 2013, Wiley Blackwell

The Physics of Radiology (4TH edn), Thomas, 1983

2. List Essential References Materials (Journals, Reports, etc.)

1) Radiation Physics for Medical Physicists, Second, Enlarged Edition, Biological and Medical Physics, Biomedical Engineering ISSN 1618-7210 ISBN 978-3-642-00874-0 e-ISBN 978-3-642-008745-7, DOI 10.1007/978-3-642-008745-7.

2) PRINCIPLES and PRACTICE of RADIATION ONCOLOGY Matthew B. Podgorsak, PhD Department of Radiation Oncology.

3. List Electronic Materials, Web Sites, Facebook, Twitter, etc.

https://www.uni-oldenburg.de/en/medical-radiation-physics/

4. Other learning material such as computer-based programs/CD, professional standards or regulations and software.

# Course Title: Advanced Radiotherapy Physics

## Course Code : 403661-3

| 1. Topics to be Covered | | |
|---|---|---|
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| **Dose distribution and scatter analysis:**<br>1. **Phantoms**<br>2. **Depth dose Distribution (PDD- TAR- SAR)** | 3 | 9 |
| **A system of dosimetric calculations:**<br>1- **Dose Calculation Parameters**<br>2- **Practical Applications**<br>**Other Practical Methods of Calculating Depth Dose Distribution** | 3 | 9 |
| **Mid-term 1** | | |
| **Treatment Planning I: Isodose distributions:**<br>1- **Isodose Chart**<br>2- **Measurement of Isodose Curves**<br>3- **Parameters of Isodose Curves**<br>4- **Wedge Filters**<br>5- **Combination of Radiation Fields**<br>6- **Isocentric Techniques**<br>7- **Wedge Field Techniques**<br>8- **Tumor Dose Specification for External Photon Beams** | 3 | 9 |
| **Treatment Planning II: Patient data, Corrections, and set-up:**<br>**Acquisition of Patient Data**<br>1- **Treatment Simulation**<br>2- **Treatment Verification**<br>3- **Corrections for contour Irregularities**<br>4- **Corrections for Tissue Inhomogeneities**<br>5- **Tissue Compensation**<br>**Patient Positioning** | 2 | 6 |
| **Treatment Planning III:**<br>1- **Field shaping**<br>2- **skin dose and field separation**<br>3- **Field Blocks**<br>4- **Field Shaping**<br>**Skin Dose and Separation of Adjacent Fields** | 2 | 6 |

| | | |
|---|---|---|
| **Electron beam therapy:**<br><br>**1- Electron Interactions**<br>**2- Energy Specification and Measurements**<br>**3- Determination of Absorbed Dose**<br>**4- Characteristics of Clinical Electron Beams**<br>**5- Treatment Planning**<br>**6- Field Shaping**<br>**7- Electron Arc Therapy**<br>**Total Skin Irradiation** | 2 | 6 |

**2. Course components (total contact and credit hours per semester):**

| | | Lecture | Tutorial | Laboratory/ Studio | Practical | Other | Total |
|---|---|---|---|---|---|---|---|
| Contact Hours | Planned | 3 | | | | | 45 |
| | Actual | 3 | | | | | 45 |
| Credit | Planned | 3 | | | | | 3 |
| | Actual | 3 | | | | | 3 |

**3. Individual study/learning hours expected for students per week.** 6

**5. Assessment Task Schedule for Students During the Semester**

| | Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| 1 | Midterm 1 | 5th week | 20 % |
| 2 | Research assignment, Quizzes, presentation, homework and reports | 10th week | 30% |
| 3 | | | |
| 4 | Final exam | End of semester | 50 % |

## E Learning Resources

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|---|
| **1. Required Text(s)**<br><br>Hendee's Radiation Therapy Physics, Fourth Edition, Todd Pawlicki , Daniel J. Scanderbeg, George Starkschall, , February 2016. (Reviewer 1)<br><br>The Physics of Radiation Therapy (3rd edition ), LWW, 2003<br><br>Radiation Therapy Physics, (3rd edition.),William R, Hendee, Geoffrey S. Ibbott and Eric G. Hendee, Willey-Liss, 2004 |
| 2.List Essential References Materials (Journals, Reports, etc.)<br><br>https://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/radiation.html |
| 3.List Electronic Materials, Web Sites, Facebook, Twitter, etc.<br><br>https://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/radiation.htm. |
| 4. Other learning material such as computer-based programs/CD, professional standards or regulations and software. |

## F. Facilities Required

| |
|---|
| Indicate requirements for the course including size of classrooms and laboratories (i.e. number of seats in classrooms and laboratories, extent of computer access, etc.) |
| 1. Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)<br><br>There is enough classrooms with a good accommodation. |
| 2. Technology resources (AV, data show, Smart Board, software, etc.)<br><br>Computers with simulation software and a good access to internet are required for web-based projects |
| 3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list) |

## Course Title: Advanced Medical Imaging (1)

## Course Code.. (403663–3)

| 1. Topics to be Covered | | |
|---|---|---|
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| Digital Image Processing | 2 | 6 |
| Image construction | 1 | 3 |
| Radiography | 1 | 3 |
| X- ray | 1 | 3 |
| Interaction of radiation with matter | 1 | 3 |
| Radiation Detectors | 1 | 3 |
| Screen Detectors | 1 | 3 |
| Image Capacitor | 1 | 3 |
| Image quality | 1 | 3 |
| Computed tomogaphay (CT) | 2 | 6 |
| Electron tomography | 1 | 3 |
| Magnetic resonance imaging (MRI) | 1 | 3 |
| Gamma Camera | 1 | 3 |

| 2. Course components (total contact and credit hours per semester): | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Lecture** | **Tutorial** | **Laboratory/ Studio** | **Practical** | **Other** | **Total** |
| Contact Hours | Planned | 45 | -- | ------ | ----- | ----- | 45 |
| | Actual | 45 | ---- | ----- | ----- | ----- | 45 |
| Credit | Planned | 3 | | | | | 3 |
| | Actual | 3 | | | | | 3 |

| 5. Assessment Task Schedule for Students During the Semester | | | |
|---|---|---|---|
| | **Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.)** | **Week Due** | **Proportion of Total Assessment** |
| 1 | Midterm exam | 5th week | 20 % |
| 2 | Essay , quizzes, homework and presentation | 10th week | 30% |
| 5 | Final exam | End of semester | 50 % |

# Course Title: Medical Radiation Protection

# Course Code: 403667–3

| **Course Description:** | | |
|---|---|---|
| **1. Topics to be Covered** | | |
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| **Introduction to radiation protection**<br>**Goals of radiation protection**<br>**Concepts of radiation protection**<br>**Justification and responsibility for image procedures. Aa low as reasonably achievable (ALARA principles) -**<br>**Patient protection and patient education** | 3 | 9 |
| **Radiation quantities and units**<br>**Historical evolution of radiation quantities,and units.**<br>**Radiation Quantities and their SI units and units of measureurements.** | 1 | 3 |
| **Radiation Monitoring**<br>**Personnel Monitoing, Personnel, dosimeters,Rradiation Survey Instruments for area monitoring. Instruments used to measure X-ray Exposure in Radiology.** | 3 | 9 |

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|---|---|---|
| **Dose Limits for exposure to ionizing radiation ,**<br><br>**Basis of effective dose limiting system. Radiation Protection Standards organizations. Radiation Safety Program. ALARA concepts.dose lomits. Basis for the effective dose limiting system . occupational and non occupational dose limits.** | 2 | 6 |
| **Equipment design for radiation protection .**<br><br>**Radiation safety features of radiographic equipment , Fluroscopic , digital Fluroscopy and mobil C-Arm , devices and accessories.** | 2 | 6 |
| **Management of patient radiation dose during some x-ray procedures. Protection shielding , technical exposure factors protecting the pregnant .Pediatric considerations during radiographic imaging.** | 1 | 3 |
| **Methods for reduction of patient dose in Computed Tomograpjy. Computed Tomography dose parameters .**<br>**Goal of computed tomography imaging from a radiation protection point of view. Patient dose in mammography.** | 1 | 3 |
| **Management of Imaging Personnel Radiation dose during diagnostic X-ray procedures.**<br>**Annual limit for occupational exposed personnel. ALARA Concept. Dose reduction methods and techniques. Protection for pregnant personnel . Basic Principles of Radiation Protection for personnel exposure . Protecting during fluoroscopic procedures. Protection during Mobile Radiographic examinations. Protection during C-Arm Fluroscopy .** | 2 | 6 |
| **Total** | 15 weeks | 45 hrs |

| 2. Course components (total contact and credit hours per semester): | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Lecture** | **Tutorial** | **Laboratory/ Studio** | **Practical** | **Other** | **Total** |
| Contact Hours | Planned | 45 | | | | | 45 |
| | Actual | 45 | | | | | 45 |
| Credit | Planned | 3 | | | | | 3 |
| | Actual | 3 | | | | | 3 |

## E Learning Resources

| |
|---|
| 1. List Required Textbooks<br>Radiation Protection in Medical Radiography , 8th edition , Mary Alice, Paula J Viscont, E-Russel Ritenour, Keli Welch Haynes., 2018.<br>Leonie Munro. Basics of radiation protection for every day use. How to achive ALARA: working tips and Guidelines, WHO, 2004.<br>Radiation Protection in Medical Physics Edited by Yves Lemoigne Alessandra Caner, 2009 |
| 3.List Essential References Materials (Journals, Reports, etc.)<br><br>1)James E. Martin " Physics for Radiation Protection" 3rd edition, 2013<br><br>2)Journal of Radiological Protection.Publisher: Society for Radiological Protection, IOP Publishing<br><br>IAEA, Diagnostic Radiology Physics, 2014 |
| 3. List Electronic Materials, Web Sites, Facebook, Twitter, etc.<br>https://www.amazon.com/Radiation-Protection-Medical-Radiography-<br><br>https://www.epa.gov/radiation/protecting-yourself-radiation |
| 3.Other learning material such as computer-based programs/CD, professional standards or regulations and software.<br><br>Radiation Shielding software |

Course Title: **Brachytherapy Physics**

Course Code: **403668-3**

| **Course Description:** | | |
|---|---|---|
| **1. Topics to be Covered** | | |
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| **BRACHYTHERAPY RADIONUCLIDES AND THEIR PROPERTIES:-**<br>1. **Introduction**<br>2. **Notation**<br>3. **Cobalt-60**<br>4. **Caesium-137**<br>5. **Gold-198**<br>6. **Iridium-192**<br>7. **Iodine-125**<br>8. **Palladium-103**<br>9. **Ytterbium-169**<br>**Thullium-170** | 3 | 9 |
| **PRODUCTION AND CONSTRUCTION OF SEALED SOURCES:-**<br>1. **Introduction**<br>2. **Iridium Sources-192**<br>3. **Iodine LDR Seeds-125**<br>4. **Palladium LDR Seeds-103**<br>5. **Ytterbium LDR Seeds-169**<br>6. **Cobalt-60 HDR Sources**<br>7. **Cesium-137 LDR Sources**<br>8. **Gold-198 HDR Seeds**<br>9. **Thulium-170 High Activity Seeds**<br>10. **Caesium-137 LDR Seeds**<br>11. **Enrichment Methods**<br>**ß-ray Emitting Microparticles and Nanoparticles** | 3 | 9 |
| **SOURCE SPECIFICATION AND SOURCE CALIBRATION:- Source Specification, Source Calibration** | 2 | 6 |
| **Mid-term 1** | | |
| **SOURCE DOSIMETRY:-**<br>1. **Introduction**<br>2. **Coordinate Systems and Geometry Definition**<br>**Models of Dose Rate and Dose Calculation** | 2 | 6 |

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|---|---|---|
| **MONTE CARLO-BASED SOURCE DOSIMETRY:-**<br><br>**Introduction**<br><br>1. **Monte Carlo Photon Transport Simulations**<br>2. **Monte Carlo-Based Dosimetry of Monoenergetic Photon Point Sources**<br>3. **Monte Carlo-Based Dosimetry of 103Pd, 125I, 169Yb, and 192Ir Point Sources**<br>4. **Monte Carlo-Based Dosimetry of Commercially Available 192Ir Source Designs**<br>**Monte Carlo-Based Dosimetry of 125I and 103Pd LDR Seeds** | 2 | 6 |
| **EXPERIMENTAL DOSIMETRY:-**<br><br>1. **Introduction**<br>2. **Phantom Material**<br>3. **Ionization Dosimetr**<br>4. **TLD Dosimetry**<br>**Polymer Gel Dosimetry in Brachytherapy** | 2 | 6 |
| **MODEN BRACHYTHERAPY:-**<br><br>1. **HDR Brachytherapy**<br>2. **High Dose Rate Unit**<br>3. **Licensing Requirements**<br>4. **High Dose Rate Source Calibration**<br>5. **Treatment Planning**<br>6. **Quality Assurance**<br>7. **Prostate implants** | 1 | 3 |
| **Total** | 15 weeks | 45 hrs |

| **5. Assessment Task Schedule for Students During the Semester** | | | |
|---|---|---|---|
| | **Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.)** | **Week Due** | **Proportion of Total Assessment** |
| 1 | Midterm exam | 5th week | 20 % |
| 2 | Essay , quizzes, homework and presentation | 10th week | 30% |
| 5 | Final exam | End of semester | 50 % |

## E Learning Resources

1. List Required Textbooks

The physics of Radion Therapy " Forth Edition" Faiz M.Khan, 2010.

The Physics of Radiation Therapy (3rd edn), LWW, 2003

The Physics of Modern Brachytherapy for Oncology

Dimos Baltas, Loukas Sakelliou, Nikolaos Zamboglou

2. List Essential References Materials (Journals, Reports, etc.)
https://www.radiologyinfo.org/en/info.cfm?pg=brachy

2. List Electronic Materials, Web Sites, Facebook, Twitter, etc.

4. Other learning material such as computer-based programs/CD, professional standards or regulations and software.

# Course Title: Advanced Nuclear Medicine

# Course Code: 403669–3

| **Course Description:** | | |
|---|---|---|
| **1. Topics to be Covered** | | |
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| RADIOACTIVE DECAY:-<br><br>1. Exponential Decay, Specific Activity, Decay Of A Mixed Radionuclide Sample<br>2. Parent-Daughter Decay | 1 | 3 |
| RADIATION COUNTING SYSTEMS:-<br><br>1. NaI(Tl) well counter<br>2. 2. Counting with conventional NaI(Tl) detectors<br>Liquid scintillation counters 4. Gas-filled detectors 5. In vivo counting systems | 2 | 6 |
| THE GAMMA CAMERA: PERFORMANCE CHARACTERISTICS:-<br><br>1. basic performance characteristics<br>2. detector limitations: nonuniformity and nonlinearity<br>measurements of gamma camera performance | 2 | 6 |
| IMAGE QUALITY IN NUCLEAR MEDICINE:-<br><br>1. basic methods for characterizing and evaluating image quality<br>2. spatial resolution<br>3. contrast<br>4. noise | 2 | 6 |
| SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY:-<br><br>1. SPECT systems<br>2. practical implementation of SPECT<br>3. performance characteristics of SPECT systems<br>applications of SPECT | 3 | 9 |
| POSITRON EMISSION TOMOGRAPHY:-<br><br>1. basic principles of PET imaging<br>2. PET detector and scanner designs<br>3. data acquisition for PET<br>4. data corrections and quantitative aspects of PET<br>5. performance characteristics of PET systems<br>clinical and research applications of PET | 3 | 9 |

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|---|---|---|
| RADIATION SAFETY IN NUCLEAR MEDICINE:-<br><br>1. quantities and units<br>2. regulations pertaining to the use of radionuclides<br>3. safe handling of radioactive materials<br>disposal of radioactive waste | 2 | 6 |

| **2. Course components (total contact and credit hours per semester):** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Lecture** | **Tutorial** | **Laboratory/ Studio** | **Practical** | **Other** | **Total** |
| Contact Hours | Planned | 41 | 7 | | | | 48 |
| | Actual | 41 | 7 | | | | 47 |
| Credit | Planned | 3 | | | | | 3 |
| | Actual | 3 | | | | | 3 |

## E Learning Resources

1. List Required Textbooks

Physics in nuclear medicine, 4th Add 2012, Simon R. Cherry, James Sorenson and Michael E. Phelps, Philadelphia, PA 19103-2899, ISBN: 978-1-4160-5198-5

2. List Essential References Materials (Journals, Reports, etc.)

-Rachel A. Powsner, Edward R. Powsner "Essential Nuclear Medicine Physics" Blackwell Publishing Ltd 2006

-Peter F. Sharp, Howard G. Gemmell and Alison D. Murray "Practical Nuclear Medicine 3rd add." Springer–Verlag London Limited 2005

-Basics of PET Imaging, Second Edition, Gopal B. Saha Springer Science& Business Media, LLC 2010, ISBN; 978-1-4419-0804-9

-Radiation Safety in Nuclear Medicine, Second Edition, Max H. Lombardi, 2007 by Taylor & Francis Group, ISBN: 0-8493-8168-1

3. List Electronic Materials, Web Sites, Facebook, Twitter, etc.

https://www.justdial.com/Chennai/Advanced-Nuclear-Medicine-Research-Centre-Opposite-Hotel-Saravana-Bhavan-Purasawalkam/044P9019449_BZDET

4. Other learning material such as computer-based programs/CD, professional standards or regulations and software.

## Course Title: Radiation Measurements in Diagnostic Radiology

## Course Code: 403673–3

| Course Description: | | |
|---|---|---|
| **1. Topics to be Covered** | | |
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| **Dosimetric Quantities -**<br><br>**1. Basic dosimetric quantities**<br>**2- Application specific quantities**<br>**3- Quantities related to stochastic and deterministic effect**<br>**4- Conversion coefficient for the assessment of organ tissue dose** | 3 | 9 |
| **Fundamental of x-ray production: x-ray tubes, energizing and controlling the x-ray tube, x-ray tube abd generating ratings, collimation and filtration, factors influencing x-ray output and filtration.** | 2 | 6 |
| **Mid-term exam** | 7th week | |
| **Code of practice for clinical measurements**<br><br>**General radiography : Indirect dose measurement , Free in air and direct dose measurements , Design of phantoms, , X-ray phantoms, Choice of dosimetric quantities, measurements using phantom,patient dosimetry,**<br><br>**Fluroscopy : Choice of dosimetric quantities, measurements using phantoms, patient dosimetry, fluoroscopy, Interventional procedures,** | 4 | 12 |
| **Mammography: choice of dosimetric quantities, chpice the breast phantom, measurement practicalities, patient dosimetry,.Dose calculation for measurements with phantoms. Reference dose level** | 2 | 6 |

| | | |
|---|---|---|
| **Computed Tomography: special dosimetric quantities for CT, measurement using phantom and free in air and measurements o1n patients.**<br><br>**dental radiography: Choice of disimetric quantities , measurements using phantoms, patient dosimetry,.** | 3 | 9 |
| **Reference dose levels and Risks in Diagnostic Imaging**<br>**Reference dose levels for different x-ray modalities.**<br>Effective dose calculations and X-ray risk assessment. | 1 | 3 |

**2. Course components (total contact and credit hours per semester):**

| | | Lecture | Tutorial | Laboratory/ Studio | Practical | Other | Total |
|---|---|---|---|---|---|---|---|
| Contact Hours | Planned | 45 | - | - | - | | 45 |
| | Actual | 45 | | | | | 45 |
| Credit | Planned | 3 | | | | | 3 |
| | Actual | 3 | | | | | 3 |

**5. Assessment Task Schedule for Students During the Semester**

| | Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| 1 | Midterm exam | 5th week | 20% |
| 2 | Research assignment report, Presentation, discussion | 10th week | 20% |
| 3 | | | |
| 5 | Final exam | 16 th | 50 % |

## E Learning Resources

1. List Required Textbooks

Patient Dosimetry and Quality Control in Diagnostic Radiology: Radiation dose measurements, quality criteria and quality control in digital and interventional radiology Paperback – June 5, 2011 , by **Ibrahim Idris Suliman** (Author)

Dosimetry in Diagnostic Radiology: An International Code of Practice (TECHNICAL REPORTS SERIES) 1st Edition, by **Frantisek Pernicka** (Author), **Iain D McLean** (Author), **International Atomic Energy Agency** (Author), 2005.

2.List Essential References Materials (Journals, Reports, etc.)

JRRAS, ANSI N13.11 , EC, IAEA, NRPB

Patient dose measurements in diagnostic radiology procedures in Korea. February 2007, Radiation Protection Dosimetry 123(4):540-5, DOI: 10.1093/rpd/ncl501

Patient dosimetry techniques in diagnostic radiology. Wall, B.F. (National Radiological Protection Board, Chilton (UK)); Harrison, R.M. (Newcastle General Hospital (UK)); Spiers, F.W. Institute of Physical Sciences in Medicine, London (UK), 1988.

# Course Title. Radiobiology

# .Course Code: ..... 403662–3

| 1. Topics to be Covered | | |
|---|---|---|
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| **Basic Physics of Radiobiology:** Dose–Response Characteristics - Particle Track Structure (LET definition, RBE definition, Alternative Radiation Beams, Radiation Quantities and Units) | 1 | 3 |
| **Radiation Chemistry:** Water Radiolysis - Radical Interactions - Oxygen Effect (OER) and Radiosensitizers – Radio Protectors (DMF) | 2 | 6 |
| **DNA Damage and Repair:** Types of Radiation Damage - Chromosome Aberrations - Lethal and Non-Lethal Lesions - DSB and Lesion Yields - Basics of Carcinogenesis | 2 | 6 |
| **Cell Survival Curves :** Experimental Technique - Dual Action theory (Linear Quadratic) - Statistics of cellular "hits" - Mathematical Models | 1 | 3 |
| **"4 R's" of Radiobiology :** Dose Rate Effects - Repair of radiation damage - Redistribution (cell cycle) - Repopulation of cells - Re-Oxygenation (OER) | 1 | 3 |
| **Radiation Effects on Humans:** Acute Whole Body Exposures - Stochastic *versus* non-stochastic effects - Carcinogenesis | 1 | 3 |
| **Radiobiology Aspects in Radiotherapy:** Early-Reacting Tissue (TCP Calculations) - Late-Reacting Tissue Normal Tissue Response (NTCP) - Dose Fractionation/Rate (BED calculations) | 2 | 6 |
| **Radiologic Terrorism:** Scenarios for radiologic terrorism – External contamination – Internal Contamination – Medical Management Issues in the event of radiologic terrorism | 1 | 3 |
| **The Dose Rate Effect:** Mechanisms underlying the dose-rate effect - Isoeffect relationships between fractionated and continuous low dose-rate irradiation - Radiobiological aspects of brachytherapy – Radiological aspects of diagnostic radiology and nuclear medicine | 2 | 6 |
| **Heritable Effects of Radiation** Germ cell production and radiation effects on fertility - Radiation-Induced heritable effects in humans - International Commission on Radiological Protection estimates of heritable risks - Mutations in the children of the A-bomb survivors changing concerns for risks | 1 | 3 |

| | | |
|---|---|---|
| **Chemotherapeutic Agents from the Prespective of the Radiobiology**<br>Classes of agents and their mode of action – Dose-response relationship - Sublethal and potentially lethal damage repair – resistance to chemotherapy and hypoxic cytotoxins – drug resistance and cancer stem cells – comparison of chemotherapeutic agents with radiation – adjunct use of chemotherapeutic agents with radiation – assays for sensitivity of individual tumors | 1 | 3 |
| | 15weeks | 45 hrs |

**2. Course components (total contact and credit hours per semester):**

| | | Lecture | Tutorial | Laboratory/ Studio | Practical | Other | Total |
|---|---|---|---|---|---|---|---|
| Contact Hours | Planned | 3 | | | | | 45 |
| | Actual | 3 | | | | | 45 |
| Credit | Planned | 3 | | | | | 3 |
| | Actual | 3 | | | | | 3 |

**3. Individual study/learning hours expected for students per week.** 6

## E Learning Resources

1. List Required Textbooks
   - Eric J. Hall, and Amato J. Giaccia. **Radiobiology for the Radiobiologist**, 7th Eds., Lippincott Williams& Wilkins, 2012.

2. List Essential References Materials (Journals, Reports, etc.)
   - International Atomic Energy Agency (IAEA). Radiation Biology for teacher and student,academic press, 2010
   - Michael J.r and Albert v. K. Basic Clinical Radiobiology, 4th Eds., Edward Arnold, 2009.

3. List Electronic Materials, Web Sites, Facebook, Twitter, etc.
https://www.astro.org/Affiliate/ARRO/Resident-Resources/Educational-Resources/Radiobiology-Lectures
https://www.unscear.org

4. Other learning material such as computer-based programs/CD, professional standards or regulations and software.

# Course Title: Cell Biophysics

# Course Code:403664-3

| **Course Description:** | | |
|---|---|---|
| **1. Topics to be Covered** | | |
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| • Background Physics and Mathematics | 1 | **3** |
| • Membrane structure and basic Evoked Potential (EP)<br>• Ion Transport, Resting Potential, and Cellular Homeostasis<br>• Composition of cell membranes.<br>• Membrane transport.<br>• Diffusion with an external force in a frictional system.<br>• Steady-state equilibrium for a single ion.<br>• Nernst equation.<br>• Modeling of resting potential: the Bernstein and Gibbs-Donnan models.<br>• Steady-state, non-equilibrium.<br>• Modifications of the steady-state membrane model.<br>• Cellular homeostasis. | **2** | **6** |
| • /John Bridge on resting potential and Donan Equillibrium.<br>  ○ Ionic concentration of cell at resting.<br>  ○ Measuring Membrane Potential.<br>  ○ Membrane Equivalent Circuit.<br>  ○ The Donnan equilibrium system.<br>  ○ The Osmotic Argument.<br>  ○ Driving Forces of ions across the cell membrane.<br>  ○ Ohms Law and Electrophysiolgy.<br>• John Bridge on Action potentials and Excitation Contraction Coupling.<br>  ○ At the steady state (resting membrane) when there is not net current:<br>  ▪ The “sodium theory” of the action potential.<br>  ▪ Voltage Clamp.<br>  ▪ Channel (Gating) Simulations<br>  ▪ Cardiac Ion Currents<br>  ▪ Cardiac Action Potential<br>  ▪ Cardiac Cell Currents<br>  ▪ Calcium Cycle in Cardiac Muscle! | **2** | **6** |

| | | |
|---|---|---|
| • Introduction to ion channels<br>  ○ Ion channels: general properties.<br>  ○ Four major breakthroughs in ion channel biology.<br>  ○ Classification of ion channels.<br>  ○ Physiological functions of ion channels.<br>  ○ Ion channels can be highly localized.<br>  ○ Channel Gating: closed-open-inactivated.<br>  ○ Channel structure.<br>• Activation gate<br>  ○ Gates.<br>  ▪ Activation<br>  ▪ Inactivation<br>• Ion Selectivity<br>  ○ Selectivity filter.<br>  ○ Selective"ion"permeability.<br>• Voltage sensing<br>  ○ VSD: the voltage sensor domain.<br>  ○ Voltage sensor.<br>  ○ Voltage!gated"ion"channel"="pore"domain"+"VSD. | **2** | **6** |
| • John White on Neurons<br>  ○ N eurons.<br>  ○ What makes neurons different from cardiomyocytes?<br>  ○ The father of modern neuroscience.<br>  ○ Morphological polarity.<br>  ○ Cajal's art.<br>  ○ Microtubule-based transport.<br>  ○ Neuronal action potentials are $Na^+$ and $K^+$ dominated.<br>  ○ Refractory periods are short.<br>  ○ Crucial features of the neuronal action potential.<br>  ○ Neurons can fire at high rates.<br>  ○ Spike-rate adaptation is very common in neurons.<br>• Types of glia in the CNS<br>  ○ Astrocytes in neurovascular coupling.<br>  ○ Short-term enhancement is linked to presynaptic $Ca^{2+}$. | **2** | **6** |

| | | |
|---|---|---|
| **Midterm Class test Exam** | 1 | **3** |
| Methods in Cellular Biophysics<br>Principle, instruments and application of spectroscopic instruments:<br>• UV Visible: absorption of light, radiation sources, sample holders, monochroamtors, radiation detectors, single and double beam instruments, colorimeter.<br>IR spectroscopy:<br>• Rotational and vibration spectra, Instrumental features, applications.<br>Raman effect, strokes and anti-strokes, lines, advantages, applications. CD ORD principles and applications.<br>Fluorescence:<br>• Fluorescence and phosphorescence, bioluminescence and chemiluminiscence phenomenon, quenching, energy transfer, and applications.<br>Atomic absorption spectroscopy:<br>• Principle and instrumentations. | **2** | **6** |
| Separation techniques<br>Electrokinetics methods:<br>• Electrophoresis,<br>• Electrophoretic mobility (epm),<br>• Factors affecting epm, paper, Page,<br>• SDS-Page, disc gel, gradient gel,<br>• Electrophoresis of nucleic acid and its application,<br>• Pulse field electrophoresis,<br>• Single cell gel electrophoresis,<br>• Isolectrophoresis, preparative electrophoresis,<br>• 2-D gel electrophoresis, Capillary, Iso-Electric focusing,<br>• Applications in biology and medicine.<br>• Chromatography, tlc,<br>• Adsorption, partition,<br>• Ion exchange,<br>• Gel filtration, affinity and FPLC, GLC | **3** | **9** |
| | **15 weeks** | **45 hrs** |

| 2. Course components (total contact and credit hours per semester): | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Lecture** | **Tutorial** | **Laboratory/ Studio** | **Practical** | **Other** | **Total** |
| Contact Hours | Planned | 45 | - | - | - | - | 45 |
| | Actual | 45 | - | - | - | - | 45 |
| Credit | Planned | 3 | - | - | - | - | 3 |
| | Actual | 3 | - | - | - | - | 3 |

| **3. Individual study/learning hours expected for students per week.** | 6 |
|---|---|

| 5. Assessment Task Schedule for Students During the Semester | | | |
|---|---|---|---|
| | **Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.)** | **Week Due** | **Proportion of Total Assessment** |
| 1 | Exercises, Homework, Participation, In-Class Discussion<br><br>Essay, Reports and Oral Presentations. | All weeks | 30% |
| 2 | Mid-Term Class Test Exam | Week 8 | 20% |
| 3 | Final Exam | Week 15 | 50% |

## Course Title: Dosimetry in radiotherapy

## Course Code: 403676–3

| 1. Topics to be Covered | | |
|---|---|---|
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| **1. Prime quantities in medical radiation dosimetry**<br>**2. Energy Transfer (kerma and absorbed dose)**<br>**3. Electronic equilibrium**<br>**4. Basic concepts in metrology (traceability and uncertainty).** | 2 | 6 |
| **5. Theoretical basis for medical dosimetry (cavity theory).**<br>**6. Determination of absorbed dose using an absolute ion chamber**<br>**7. Effect of Temperature and Pressure on Ionization Measurements**<br>**8. Exposure – The Roentgen**<br>**9. Standard Air Chamber** | 3 | 9 |
| **10. Practical Ion Chamber- The Thimble Chamber**<br>**11. Effective Atomic Number**<br>**12. Types of Ion Chambers**<br>**13. Solid State Detectors-The Diode, TLD, Chemical Dosimetry, Film as a dosimeter, the Calorimeter**<br>**14. Basics of the TRS-398 measurement protocol for high-energy photons and electrons** | 3 | 9 |
| **Mid-term 1** | | |
| **15. Dosimetry problems related to measurements in standard conditions using the TRS-398 formalism**<br>**16. Dosimetry problems related to measurement in non-standard conditions. (measurements in the build-up zone, in small fields or in heterogeneous media).**<br>**17. Fluence spectra and dose deposition for simple situations using the EGSnrc Monte Carlo user codes flurznrc and dosnrcrz**<br>**18. Signal-generating mechanisms and the basis characteristics for a range of dosimetry systems such as ion chambers and solid-state detectors**<br>**19. Dose deposition kernel of a radionuclide decaying in water.**<br>**20. Concept of biokinetic distribution models** | 2 | 6 |

| | | |
|---|---|---|
| **21. Organ doses from S-factors and MIRD values**<br>**22. Sources of ionizing radiation in medical radiation dosimetry**<br>**23. Quantities and metrology**<br>**24. Monte Carlo introduction** | 2 | 6 |
| **25. Charge-particle and radiation equilibria**<br>**26. Monte Carlo calculations**<br>**27. Cavity theory and ionometry**<br>**28. Dosimetry protocols**<br>**29. Micro dosimetry**<br>**30. Internal dosimetry**<br>**31. Chemical dosimetry**<br>**32. EPR and Film dosimetry in practice**<br>**33. Solid-state dosimetry** | 3 | 9 |
| **Total** | 15 weeks | 45 |

**2. Course components (total contact and credit hours per semester):**

| | | Lecture | Tutorial | Laboratory/ Studio | Practical | Other | Total |
|---|---|---|---|---|---|---|---|
| Contact Hours | Planned | 45 | | | | | 45 |
| | Actual | 45 | | | | | 45 |
| Credit | Planned | 3 | | | | | 3 |
| | Actual | 3 | | | | | 3 |

# Course Title: Computational Methods in Medical Physics

# Course Code: 403670–3

| 1. Topics to be Covered | | |
|---|---|---|
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| **Digital Image Coomunication (DICOM) and Picture Archeiving Communication Sysrtem (PACS)**<br>Iintroduction to DICOctionM<br>**DICOM and Clinical data**<br>**Medical Image in DICOM**<br>**DICOM Communicationa**<br>**DICOM and Teleradiology**<br>**DICOM Applications** | 3 | 9 |
| **Medical Simulators**<br>Simulation Modalities and Technology<br>Simulation for health care displines | 3 | 9 |
| **Monte Carlo Calculations** | 3 | 9 |
| **Mid-term 1** | | |
| **Computational Methods for Radiological Sciences** | 2 | 6 |
| **Mathematical Methods for Radiological Sciences** | 1 | 3 |
| **Mathematical Methods for Imaging in Medicine** | 2 | 6 |
| **Digital X-Ray Imaging and Computed Tomography**<br>**Biomedical image processing**<br>**Noise reduction**<br>**Biomedical image segmentation** | 1 | 3 |
| **Final Exam** | | |

**5. Assessment Task Schedule for Students During the Semester**

| | **Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.)** | **Week Due** | **Proportion of Total Assessment** |
|---|---|---|---|
| 1 | Midterm 1 | 5th week | 20 % |
| 2 | Research | 10th week | 10% |
| 4 | Homework + reports | 15th week | 20% |
| 5 | Final exam | End of semester | 50 % |

## Course Title: Research Project

## Course Code: 403675–3 (Part (1)

:403675–3 (Part (2)

**C. Course Description** (Note: General description in the form used in the program's bulletin or handbook)

| **Course Descripton: A supervisor of the research** |
|---|

| **1. Topics to be Covered** | | |
|---|---|---|
| **List of Topics researches** | **Period** | **Contact hours** |
| Physics application in Medicine and Biology | 1st term and 2nd term of the second year | 90 |
| quality control and quality assurance for diagnostic x-ray machiners , Linear accelerators and and hot laboratorty and gamma camera of nuclear medicine imaging. | 1st term and 2nd term of the second year | 90 |
| dosimetry in diagnostic radiology , radiotherapy and nuclear medicine | 1st term and 2nd term of the second year | 90 |
| Radiation protection for workers<br>Radiation protection and dosimetry for patients undergoing diagnostic and computed tomography examination. | 1st term and 2nd term of the second year | 90 |
| Generation of nanoparticle of radiopharmaceticalls and its application in imaging and treatment | 1st term and 2nd term of the second year | 90 |
| Treatment planning system for linear accelerators . | 1st term and 2nd term of the second year | 90 |
| Comparison study for the modern radiotherapy technology | 1st term and 2nd term of the second year | 90 |

| | | |
|---|---|---|
| Special Topics: | 1st term and 2nd term of the second year | 90 |
| Total | 32 weeks | 90 hrs |

| **2. Course components (total contact and credit hours per two semester):** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Lecture** | **Tutorial** | **Laboratory/ Studio** | **Practical** | **Other** | **Total** |
| Contact Hours | Planned | 90 | | | | | 90 |
| | Actual | 90 | | | | | 90 |
| Credit | Planned | 6 | | | | | 6 |
| | Actual | 6 | | | | | 6 |

# Elective courses

## Course title: Advanced programming
## Course Code: 403615-3

| 1. Topics to be Covered | | |
|---|---|---|
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| Basics- Program construction, Output using "cout", Header files, when to use comments, Integer variables, variable names, integer constants the "endl" manipulator, exercises. | 1 | 3 |
| Basics- Character variables, character constants, escape sequence, input with "cin", floating point type, type bool, "setw" manipulator, the "iomanip" header file, arithmetic operation, library functions, exercises. | 1 | 3 |
| Loops and decisions – Relational operators, Loops, the "for" loop, the "while" loop, the "do" loop, Decisions, the "if" statement, the "if else" statement, the "switch" statement, the conditional operator | 1 | 3 |
| Loops and decisions- Logical operators, logical "AND" operator, logical "OR" operator, logical "Not" operator, the "break" statement, the "continue" statement, exercises | 1 | 3 |
| Structures- A simple structure, Defining the structure, accessing structure members, Structure within Structures, Structures and Classes, Enumeration, examples, exercises | 1 | 3 |
| Functions- Simple functions, the function declaration, calling the function, the function definition, passing arguments to functions, passing constants, passing variables, passing by value, Returning values from functions, the return statement, Returning structure variables | 1 | 3 |
| Functions- Reference arguments, Passing Data types by reference, Passing more complex pass by Reference, Passing Structures by Reference, Overloaded functions, inline functions, Returning by References. | 1 | 3 |

| | | |
|---|---|---|
| Objects and Classes- A simple class, classes and objects, defining the class, using the class, calling member functions | 1 | 3 |
| Objects and Classes- Constructors, Destructors, objects as function arguments, overloaded constructors, Member functions defined outside the class, Static class data, const and classes. | 1 | 3 |
| Arrays- Array fundamentals, arrays as class member data, arrays of objects and exercises | 1 | 3 |
| Pointers– Addresses and pointers, Pointers and arrays, examples | 1 | 3 |
| Pointers- Pointers and functions, the “new” and “delete” operators examples. | 1 | 3 |
| Inheritance- Derived class and base class, Derived class constructors, class inheritance, Public and private inheritance. | 1 | 3 |
| Virtual functions- Normal member functions accessed with pointers, virtual member functions accesses with pointers, friend functions, static functions, examples | 2 | 6 |
| **Total number** | 15 | 45 |

**2. Course components (total contact and credit hours per semester):**

| | | **Lecture** | **Tutorial** | **Laboratory/ Studio** | **Practical** | **Other** | **Total** |
|---|---|---|---|---|---|---|---|
| Contact Hours | Planned | 45 hrs | | | 45 hrs | | 90 hrs |
| | Actual | 45 hrs | | | 45 hrs | | 90 hrs |
| Credit | Planned | 3 hrs | | | 45 hrs | | 3 hrs |
| | Actual | 3 hrs | | | 45 hrs | | 3 hrs |

## Course Title. Nanotechnology for Biomedical Applications

## .Course Code: …403666–3

| 1. Topics to be Covered | | |
|---|---|---|
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| **Fundamentals of Micro Fabrication:** Photolithography - Deposition, and Selective Etching - Thin Film Growth and Deposition - Diffusion and Dopants - Atomic Layer Epitaxy - Soft Lithography. Self-assembled organized systems: Dendrimers, Liposomes, Vesicles, Supramolecular Complexes, Langmuir Blodgett films. Atomic Force Microscopy (AFM) | 4 | 12 |
| **Micro Fluidic Pattering and Biopolymer Pattering:** Fundamentals of Laminar Fluids Micro Fluidic Processes - The Role of Micro-Scale Fluid Dynamics in BioMEMS Neuro MEMS - Microelectrodes and Neuronal Interfaces, Microstereolithography | 3 | 9 |
| **Nanofabrication:** Molecular Engineering and Quantum Dots, Nanoscale Structures as Biological Tags and as Functional Interfaces with Biological Systems | 2 | 6 |
| **Nano-Biotechnology:** Nanoparticles and Microorganisms, Nano-materials in Bone Substitutes and Dentistry, Nanoparticles in medical imaging modalities, Drug delivery and its applications. | 3 | 9 |
| **Nanobiosensors:** Biochips and analytical devices, Biosensors Nanomedicine, Nanobiosensor, Nanofluidics, Nanocrystals in Biological Detection, Electro-chemical DNA Sensors, Integrated Nanoliter Systems. Clean rooms practice and environmental issues; Applications. | 3 | 9 |
| | 15 weeks | 45 hrs |

| 2. Course components (total contact and credit hours per semester): | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Lecture** | **Tutorial** | **Laboratory/ Studio** | **Practical** | **Other** | **Total** |
| Contact Hours | Planned | 3 | | | | | 45 |
| | Actual | 3 | | | | | 45 |
| Credit | Planned | 3 | | | | | 3 |
| | Actual | 3 | | | | | 3 |

| 3. Individual study/learning hours expected for students per week. | 10 |
|---|---|

| 5. Assessment Task Schedule for Students During the Semester | | | |
|---|---|---|---|
| | **Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.)** | **Week Due** | **Proportion of Total Assessment** |
| 1 | Short exams | 5 th week | 20% |
| 2 | Oral presentations/ seminars | All weeks | 30% |
| 3 | Essay/research report | | |
| 4 | Final written exam | 16th week | 50% |

## E Learning Resources

1. List Required Textbooks
   - Gabriel A. Silva, **Nanotechnology for biology and medicine**, 1st Ed., Springer, 2012.

2. List Essential References Materials (Journals, Reports, etc.)
   - Michael Koch, Alan Evans, Arthur Brunnschweiler, **Micro fluidic Technology and Applications (Micro technologies and Microsystems Series)**, 1st Ed., CRC Press; London, 2001.
   - Eugene J. Koprowski, Gene Koprowski, **Nanotechnology in medicine: Emerging applications**, Mcgraw-Hill Education, 2011
   - Sarah Hurst Petrosko and Emily S. Day. **Biomedical Nanotechnology**,.2nd Eds., Springer, 2017

3. List Electronic Materials, Web Sites, Facebook, Twitter, etc.
   - https://www.nano.gov/nanotech-101/what/definition
   - http://iopscience.iop.org/journal/0957-4484

4. Other learning material such as computer-based programs/CD, professional standards or regulations and software.

## Course Title: Advanced Medical Imaging (2)

## Course Code: 403671–3

| |
|---|
| **1.List Required Textbooks**<br><br>**1-Medical Inaging Proceesing : Concepts and applications , C.R. Pattel, 2014 ,Kindel edition.**<br><br>**2 -Digital Image Processing for Medical Applications, Geoff Dougherty, Cambridge University Press 2009, ISBN-13 978-0-511-53343-3.**<br><br>**3-Quantitative Analysis in Nuclear Medicine Imaging Habib Zaidi 2006 Springer ScienceBusiness Media, Inc. ISBN-13: 978-0387-23854** |
| **1-** List Essential References Materials (Journals, Reports, etc.) |
| **2-** List Electronic Materials, Web Sites, Facebook, Twitter, etc.<br>http://www.amibozeman.com/ |
| 4. Other learning material such as computer-based programs/CD, professional standards or regulations and software.<br>Pawer points and Data Show |

## F. Facilities Required

| |
|---|
| Indicate requirements for the course including size of classrooms and laboratories (i.e. number of seats in classrooms and laboratories, extent of computer access, etc.) |
| 1. Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.) |
| 2. Technology resources (AV, data show, Smart Board, software, etc.)<br><br>Smart panels in the department as well as the Internet inside the central library |
| 3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list) |

## Course Title: Computational Physics

## Course Cod: 403606

| 1. Topics to be Covered | | |
|---|---|---|
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| **-Programming:** Variables and arrays. Displaying output data, Data files, scalar and array operations, Built in functions. , the while Loop, the FOR Loop**.** Preserving data between calls to a function, subroutines. | 2 | 6 |
| **-Linear Algebra:** Solving a linear system, Gaussian elimination . Finding eigenvalues and eigenvectors, Matrix factorizations and examples. | 1 | 3 |
| **-Curve fitting and interpolation:** Polynomial fitting, Least square fitting, non-linear fits and examples, interpolation of data. | 1 | 3 |
| **-Numerical integration and differentiations:** Integration, differentiations, solving first order and second order Linear equation. | 1 | 3 |
| **-Modelling:** Harmonic motion example using a variety of numerical approaches. | 2 | 3 |
| **-Modelling:** The Solar system: Kepler's laws, planetary motion using different time steps, Orbits using different force laws. The three body problem and the effect of Jupiter on Earth. | 1 | **3** |
| **Modelling:** Potentials and Fields: Solution of Laplace's equation using the Jacobi relaxation method. Solutions of Laplace's Equation for a finite sized capacitor. Potentials and Fields near Electric Charges, Poisson Equation. | 2 | **3** |
| **-Modelling**: Waves: Waves on a string. Waves on a string with free ends. Frequency spectrum of waves on a string. | 2 | **3** |

| | | |
|---|---|---|
| **Modelling:** Monte-Carlo. Random Walk simulation. Markov-Chain techniques for simulating the Ising spin model in statistical mechanics. | 2 | **3** |
| **-Modelling:** -Quantum Mechanics: Time independent Schrodinger Equation. Wave packet construction. Time dependent Schrodinger Equation. | 1 | **3** |
| | 15 weeks | **45 hrs.** |

**2. Course components (total contact and credit hours per semester):**

| | | **Lecture** | **Tutorial** | **Laboratory/ Studio** | **Practical** | **Other** | **Total** |
|---|---|---|---|---|---|---|---|
| Contact Hours | Planned | 45 hrs | | 45 hrs | | | 90 hrs |
| | Actual | 45 hrs | | 45 hrs | | | 90 hrs |
| Credit | Planned | 3 hrs | | 45 hrs | | | 3 hrs |
| | Actual | 3 hrs | | 45 hrs | | | 3 hrs3 |

**3. Individual study/learning hours expected for students per week.** 8 hrs.

**5. Assessment Task Schedule for Students During the Semester**

| | **Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.)** | **Week Due** | **Proportion of Total Assessment** |
|---|---|---|---|
| 1 | Exercises & Home works | All weeks | 5% |
| 2 | Online quizzes | All weeks | 5% |
| 3 | Oral exam | 5th Week | 5% |
| 4 | Participation in activities lectures and labs | All weeks | 5% |
| 5 | Test (1) | 6th week | 10% |

| | | | |
|---|---|---|---|
| 6 | Test (2) | 13th week | 10% |
| 7 | Scientific project | 14th Week | 10 % |
| 8 | Final Exam | 16th week | 50% |

**E Learning Resources**

1. List Required Textbooks

-"Mastering Matlab 7" by Duane C. Hanselman and Bruce L. Littlefield, Prentice Hall, ISBN-13: 978-0136013303 (2011).
-"Computational Physics using Matlab" Second Edition, by Nick Giordano and Hisao Nakanishi, ISBN: 0-13-146990-8 (2005).

-"Introduction To Computational Physics Using Matlab", Khusniddin K. Olimov, Erkin Kh. Bozorov , (2017).

-"Computational Physics (2nd Edition)" Nicholas J. Giordano, Hisao Nakanishi, ISBN-13: 978-0131469907 (2005).

2. List Essential References Materials (Journals, Reports, etc.)

-"Mathematics for Physics: An Illustrated Handbook (Computational Mathematical and) 1st Edition, Kindle Edition" ISBN-13: 978-9813233911 (2017).

-"Computational Physics 2nd Edition", Jos Thijssen, ISBN-13: 978-1107677135 (2013)

## Course Title: Image Anatomy….

## Course Code: 403692–3..

| 1. Topics to be Covered | | |
|---|---|---|
| **List of Topics** | **No. of Weeks** | **Contact hours** |
| Head and neck CT scan. | 3 | 5/week |
| Chest CT scan, cardiac and musculoskeletal structure.<br><br>Periodical exam | 3 | 5/week |
| Midterm exam | 7th week | |
| Abdominal CT scan, biliary, pancreatic, gastric and renal structures.<br>Periodical exam | 2<br><br>9th week | 5/week |
| CT scan of male and female pelvis. | 2 | |
| X-ray figures for body regions Participation | 2<br><br>13th week | 5/week |
| Participation and Revision | 14th week | |
| Practical and Final exam | 15-16th week | |

| 2. Course components (total contact and credit hours per semester): | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Lecture** | **Tutorial** | **Laboratory/ Studio** | **Practical** | **Other** | **Total** |
| Contact Hours | Planned | 75 | 12 | | 12 | | 99 |
| | Actual | 75 | | | | | 99 |
| Credit | Planned | 3 | | | | | 3 |
| | Actual | 3 | | | | | 3 |