HANDBOOK OF MASTER OF MEDICAL PHYSICS (M MED PHYSICS)

An Institute of Physics and Engineering in Medicine (IPEM), United Kingdom, accredited programme

1. INTRODUCTION

Technological advances and development in medicine, particularly in radiology, radiotherapy and nuclear medicine have created a demand for qualified personnel to support the current progress in the country. In 1998 the University of Malaya launched the Master of Medical Physics programme to meet the growing need of qualified medical physicists. 25 graduates have come out from this program thus far.

Another proud achievement is the programme accreditation by the Institute of Physics and Engineering in Medicine (IPEM), United Kingdom. The course was accredited for a 5 year period (October 2002 - October 2007). This accreditation has made the University of Malaya programme to be the only one outside the British Isles (United Kingdom and Ireland) to receive such recognition.

Objective

- To provide postgraduate training in clinical applications of physics in medicine and biology.

- To train knowledgeable human resources in support of the rapid advances in high technology medicine.

This program trains and equips students to take up professional positions in education, research and service orientated positions in hospitals, government agencies, laboratories, medical industry and nuclear technology industry.

Duration

One calendar year, beginning July.

Medium of instruction

English is used during lectures, tutorials and practical sessions.

Entry requirement

Good Bachelor of Science honours degree in physics or related fields from recognized universities or equivalent qualifications.

Program structure

Coursework and dissertation or dissertation.

2. COURSES

Summary (total 40 credits)

Semester I		Credit hours
MQGQ6101	Anatomy and Physiology	4
MQGQ6102	Biostatistics	3
MQGQ6103	Computing and Medical Informatics	3
MQGQ6104	Applied Radiation Physics and Dosimetry	3
MQGQ6105	Radiobiology and Radiation Protection	3
MQGQ6106	Non-Ionising Radiation in Medicine	3
Semester II		
MQGQ6107	Medical Imaging	3
MQGQ6108	Radiotherapy Physics	3
MQGQ6109	Nuclear Medicine	3
MQGQ6189	Dissertation	12

ANATOMY AND PHYSIOLOGY

Objective

- To provide foundational understanding of general principles of anatomy.
- To understand basic physiological processes which takes place in the human body.

Content

Basic anatomy of the human body. Fetal and cellular anatomy. Respiratory system. Central nervous system. Cardiovascular system. Musculosketal system. Gastrointestinal tract. Genitourinary tract. Endocrine anatomy. Reproductive system. Cell physiology. Electrolytes and body fluids. Blood circulatory system. A brief overview of diseases the medical physicist may encounter in practising medical physics.

Suggested text

1. Grant A, Waugh A, *Ross and Wilson: Anatomy and Physiology in Health and Illness*. 9th ed. WB Saunders: 2001.
2. Seeley R, Stephens T, Tate P, *Essentials of Anatomy and Physiology*. 4th ed. McGraw-Hill: 2001.
3. Cameron JR, Skofronick JG, Grant RM, *Physics of the Body*. 2nd ed. Medical Physics Publishing: 1999.

BIOSTATISTICS

Objective

- To provide adequate understanding of biostatistical methodology and its application in medical physics and medicine.

Content

Basics of statistical data analysis: Characterizing data and measurements, data screening and transformation. Descriptive statistics, shapes of distributions, application of graphical methods. Elementary statistical inference. Regression analysis, logistic regression. Analysis of variance.

Suggested text

1. Dawson B, Trapp RG, *Basic & Clinical Biostatistics*. 3rd ed. McGraw-Hill: 2000.
2. Daniel WW, *Biostatistics: A Foundation for Analysis in the Health Sciences*. 7th ed. John Wiley & Sons: 1999.
3. Glantz SA. *Primer of Biostatistics*. 3rd ed. McGraw-Hill: 1991.

COMPUTING AND MEDICAL INFORMATICS

Objective

- To lay the foundation for the applications of computers in medicine.

Content

Structure of algorithms. Elements of number systems. Computer organisation and programming. Operating systems. Information theory and communications systems. Microprocessors, peripheral and interfaces. Medical informatics. Biomedical applications of computing. Principle of project and system design. Good programming practices. Introductory signal and image processing. Telemedicine.

Suggested text

1. Long L, Long N, *Computers: Information Technology in Perspective*. 11th ed. Prentice-Hall: 2003.
2. Norris AC, *Essentials of Telemedicine and Telecare.* John Wiley & Sons: 2002.
3. Gonzalez RC, Woods RE, *Digital Image Processing*. 2nd ed. Prentice-Hall: 2002.

APPLIED RADIATION PHYSICS AND DOSIMETRY

Objective

- To provide basic concepts and understanding on the principles in radiation physics and dosimetry.

Content

Ionising radiation. Radioactivity. Decay schemes. Interaction of radiation (alpha, beta, gamma and neutron) with matter. Radiation detectors. Neutron activation. Radiation quantities and units. Energy absorption in air and other media. Concept of absorbed dose. Dose measurement and radiation detection. Conditions of ionisation current measurement. Radiation detection. Monte Carlo methods. Nuclear methods for analysis of substance structure and compositions.

Suggested text

1. Attix FH, *Introduction to Radiological Physics and Radiation Dosimetry*. 2nd ed. John Wiley & Sons: 1999.
2. Knoll GF, *Radiation Detection and Measurement*. 3rd ed. John Wiley & Sons: 1999.
3. Rajan G, *Advanced Medical Radiation Dosimetry*. Medical Physics Publishing: 1992.

RADIOBIOLOGY AND RADIATION PROTECTION

Objective

- To introduce the concepts and processes involved in the interaction of radiation with living matter.
- To provide an understanding of the principles behind various radiation protection recommendations.

Content

Cell organelles, DNA structure, synthesis and replication; protein synthesis; energy metabolism. Free radical formation. Cell survival curves, OER, LET, RBE, dose fractionation, reoxygenation, repopulation and tissue sensitivity: cell population kinetics. Genetic effects of population exposure. Concept of therapeutic ratio. Linear Quadratic model. Stochastic and non-stochastic models. Biological effects of radiation. ICRP recommendations and Malaysian legislation. Control of exposure to radiation workers, patients and public. Storage, decontamination, waste disposal and transport of radioactive material. Shielding design for laboratories and medical installations.

Suggested text

1. Steel GG, *Basic Clinical Radiobiology.* 3rd ed. Arnold: 2002.
2. Martin CJ, Sutton DG, *Practical Radiation Protection in Healthcare*. Oxford University Press: 2002.
3. Hall EJ, *Radiobiology for the Radiologist*. 5th ed. Lippincott Williams & Wilkins: 2000.

NON-IONISING RADIATION IN MEDICINE

Objective

- To provide basic concepts and understanding of non-ionising radiation in medicine.
- To introduce the applications of non-ionising radiation in diagnosis and therapy.

Content

Laser, UV, IR-diagnosis, surgery and therapy. Thermography, cryosurgery, hyperthermia. RF and microwave diathermy. Ultrasound. Biological effects, dosimetry and safety of NIR. Physiological monitoring. Biomechanics. Rehabilitation Medicine. Hospital electrical safety. Recent advances.

Suggested text

1. Martin CJ, Sutton DG, *Practical Radiation Protection in Healthcare*. Oxford University Press: 2002.
2. Low J, Reed A, Electrotherapy *Explained: Principles and Practice*. 3rd ed. Butterworth-Heinemann: 2000.
3. Cember H, *Introduction to Health Physics*. 3rd ed. McGraw Hill: 1996.

MEDICAL IMAGING

Objective

- To provide basic concepts and understanding in medical imaging.
- To provide the theoretical basis needed for the clinical practice of medical imaging.

Content

General overview of image process and perception. Conventional radiology including diagnostic X-ray machines, image formation and enhancement. Photographic properties of X-ray film. Special techniques (cinefluorography, mammography, tomography, subtraction techniques). Computerised tomography and image reconstruction methods. Digital radiography. Digital image processing. PACS. Magnetic Resonance Imaging and spectroscopy. Quality assurance.

Suggested text

1. Bushberg JT, Seibert JA, Leidholdt EM, Boone JM, *The Essential Physics of Medical Imaging*. 2nd ed. Lippincott Williams & Wilkins: 2001.
2. Sprawls P, *Physical Principles of Medical Imaging.* 2nd ed. Medical Physics Publishing: 1995.
3. Hasegawa BH, *Physics of Medical X-Ray Imaging.* 2nd ed. Medical Physics Publishing: 1991.

RADIOTHERAPY PHYSICS

Objective

- To provide basic concepts and understanding in radiotherapy physics.
- To provide the theoretical basis needed for the practice of medical physics in radiotherapy.

Content

Linear accelerators and other clinical radiation generators. Dose distribution and scatter analysis. Dose calculations. Treatment planning with photons and electron. Brachytherapy; high dose rate and low dose rate treatment. Quality assurance of radiotherapy equipment. Calibration of sources used in brachytherapy. Calibration of high energy X-ray beams. Stereotactic radiotherapy / radiosurgery. Types of cancer and modes of treatment.

Suggested text

1. Hendee WR, Ibbott GS, *Radiation Therapy Physics*. 3rd ed. John Wiley & Sons: 2004.
2. Khan FM, *The Physics of Radiation Therapy*. 3rd ed. Lippincott Williams & Wilkins: 2003.
3. Metcalfe P, Kron T, Hoban P, *The Physics of Radiotherapy X-Rays from Linear Accelerators*. Medical Physics Publishing: 1997.

NUCLEAR MEDICINE

Objective

- To provide basic concepts and understanding in imaging and non-imaging nuclear medicine procedures.

Content

Physiological basis of nuclear medicine. Imaging techniques and instrumentation, including scintillation detectors, rectilinear scanner and Gamma camera. Production and properties of radionuclides and generators. Clinical radiochemistry. Static and dynamic imaging. Dual photon absorptiometry. SPECT and PET. Quality assurance and data processing.

Suggested text

1. Cherry SR, Sorenson JA, Phelps ME, *Physics in Nuclear Medicine*. 3rd ed. WB Saunders: 2003.
2. Chandra R, *Nuclear Medicine Physics: The Basics*. 5th ed. Lippincott Williams & Wilkins: 1998.
3. Early PJ, Sodee DB, *Principles and Practice of Nuclear Medicine*. 2nd ed. Mosby: 1995.

DISSERTATION

Objective

- To introduce the techniques and philosophy of research in medical physics.
- To provide a deeper understanding of the practice of medical physics.
- To provide an opportunity for students to interact with other medical specialists.

Clinically-oriented dissertation in one sub-speciality.

CLINICAL POSTING

Objective

- To give an overview of the role of a medical physicist in Radiology, Nuclear Medicine and Clinical Oncology (radiotherapy).

Clinical postings in Radiology, Nuclear Medicine and Clinical Oncology (Radiotherapy) for the whole duration of the program.

3. FACILITIES

Library

There are 4 libraries available to the students.

a. The main University library
b. Medical library at the Medical Faculty
c. Library at the Department of Radiology
d. Library at the Clinical Oncology Unit (houses the IOMP library)

The 4 libraries are equipped with the recommended textbooks and journals. The relevant journals in the medical library include, amongst others:

Acta Radiologica
American Journal of Roentgenology
Australasian Radiology
British Journal of Radiology
European Journal of Radiology
European Radiology
Journal of Australasian Physical & Engineering Sciences in Medicine
Medical Physics
Physics in Medicine and Biology
Radiology
Radiotherapy and Oncology
Seminars in Roentgenology

Most online journals are also available.

Laboratory

There are 4 laboratories available to the students, which are at the Department of Radiology, Clinical Oncology Unit, Nuclear Medicine Unit and Physics Department.

Computing facilities

Students have access to computers in various departments and libraries.
An imaging laboratory of networked PCs and workstations for imaging-related research and practical at the Department of Radiology.

Clinical equipment

The following equipments are available for students to carry out their research and training.

- 1.5 Tesla Magnetic Resonance Imaging (MRI)
- 3D treatment planning system
- Computed radiography (CR)
- Conventional simulator
- CT simulator
- Digital Cardiac Imaging (DCI)
- Digital mammography
- Digital Subtraction Angiography (DSA)
- Direct digital radiography (DR)
- Dual Energy X-ray Absorptiometry (DEXA) system
- High-dose rate brachytherapy
- Linear accelerators
- Low-dose rate brachytherapy

- Medical ultrasound scanners
- Multi-slice Computed Tomography (CT) scanners
- Single Photon Emission Computed Tomography (SPECT) systems
- Stereotactic radiotherapy / radiosurgery system
- Thermoluminescent dosimetry
- Ultrasound bone densitometer

4. FACULTY MEMBERS

Honorary (Adjunct) Professor

Dr. Perry Sprawls, PhD, PE, FACR, FAAPM, DABR, DABMP, CCE
Professor of Radiology and Radiation Oncology
Director of Medical Physics Education
Department of Radiology, Emory University School of Medicine, Atlanta, USA

Department of Radiology

Prof. Dr. Basri JJ Abdullah, MBBS, FRCR, AM - Head

Prof. Dr. Martin Lovat Wastie, MA, MBBChir, FRCP, FRCR

Prof. Dr. Ng Kwan Hoong, PhD, FIPM, MIPEM, DABMP, CSci, AM

Associate Prof. Dr. Fatimah Moosa, MBBS, FRCR, AM

Associate Prof. Dr. Gnana Kumar, MBBS, MMed (Rad), FRCR, AM

Associate Prof. Dr. John George, MBBS, DMRD, FRCR, AM

Associate Prof. Dr. Norlisah Mohd Ramli, MBBS, FRCR

Associate Prof. Dr. Roziah Muridan, MBBS, MRad

Associate Prof. Datin Dr. Sazilah Ahmad Sarji, MBBS, FRCR, AM

Associate Prof. Dr. Shaik Ismail Bux, MD, MRad, AM

Associate Prof. Dr. Yang Faridah Abdul Aziz, MBBS, MRad

Dr. Amir Fuad Hussain, MBBS, MRad

Dr. Anushya Vijayanathan, MBBS, MRad

Mr. Azlan Che Ahmad, BBEng, MMedPhysics

Dr. Khairul Azmi Abd Kadir, MBBS, MRad

Mr. Muhammad Shahrun Nizam A Daman Huri, BSc (Hons), MMedPhysics

Dr. Ouzreiah Nawawi, MBBS, MRad, FRCR

Mr. Tan Li Kuo, BEng, MEng

Dr. Tok Chung Hong, MBBS, MRad

Nuclear Medicine Division

Dr. Dharmendra Harichandra, MBBS, MMed (Int Med)

Ms. Azleen Mohd Zain, BSc (Hons)

Clinical Oncology Unit

Dr. Anita Zarina Bustam, MBBCh, FRCR - Head

Mr. Ung Ngie Min, BBEng, MMedPhysics

Department of Physiology

Prof. Dr. Ruby Husain - Head

Prof. Dr. Mohd. Afandi Muhamad

Prof. Dr. Lam Sau Kuen

Associate Prof. Dr. Rosnah Ismail

Dr. Badariah Ahmad

Dr. Raji Subramanian

Dr. Saadiah Mohd. Hidir

Dr. Naguib Salleh

Department of Molecular Medicine

Associate Prof. Dr. Maude Phipps

Clinical Investigation Centre

Dr. Esmond Yeoh - Manager

Department of Social and Preventive Medicine

Associate Prof. Dr. Atiya Abdul Sallam - Head

Department of Physics

Prof. Dr. Yusoff Mohd. Amin - Head

Associate Prof. Dr. Kwek Kuan Hiang

University of Nottingham Malaysia Campus

Associate Prof. Dr. Michel Bister

Ministry of Health, Engineering Division

Mr. Ahmad Shariff Hambali

Atomic Energy Licensing Board

Ms. Monalija Kostor

Malaysian Institute for Nuclear Technology Research

Dr. Noriah Mod Ali

Mr. Taiman Kadni

Visiting Lecturer

Dr. Adrian Perry, DPhil, FInstP, FIPEM
Head of Radiotherapy Physics Section, Royal Perth Hospital, AUSTRALIA

Online Teaching

Dr. Perry Sprawls, PhD, PE, FACR, FAAPM, DABR, DABMP, CCE
Professor, Department of Radiology, Emory University School of Medicine, USA

Dr. Milton Woo, PhD, FCCPM, PEng
Assistant Professor, Department of Medical Biophysics, University of Toronto
Senior Medical Physicist, Cancer Care Ontario, CANADA

External Examiners

Dr. Larry A. DeWerd, PhD, FAAPM (1998-2000)
Professor and Director, Radiation Calibration Laboratory
University of Wisconsin, USA

Dr. Gary D. Fullerton, PhD, FAAPM, FACR, FISMRM, DABR (2000-2002)
Professor and Chief, Radiological Sciences Division
University of Texas Health Science Center, USA

Dr. William R. Hendee, PhD, FAAPM, DABR, DABHP (2002, 2003)
Professor and Dean, Graduate School of Biomedical Sciences
Medical College of Wisconsin, USA

Dr. Timothy Van Doorn, PhD (2003)
Associate Professor, University of Adelaide
Chief Physicist, Department of Medical Physics, Royal Adelaide Hospital,
AUSTRALIA

Dr. David J. Dowsett, PhD (2004)
Lecturer, University College Dublin
Director, Medical Physics Consultants, Dublin, IRELAND

Dr. Roger M. Harrison, PhD, CPhys, CSci, FIPEM, FInstP (2004-2006)
Lecturer, University of Newcastle-upon-Tyne
Head, Radiation Physics Section, Newcastle General Hospital, UNITED KINGDOM

Programme Coordinator

Mr. Muhammad Shahrun Nizam
shahrun@um.edu.my

Head of Department

Prof. Dr. Basri JJ Abdullah
basrij@um.edu.my

Department Secretary

Ms. Norlela Yob
norlela@um.edu.my

Correspondence

Department of Biomedical Imaging
Faculty of Medicine
University of Malaya
50603 Kuala Lumpur
MALAYSIA
Tel: 6-03-7949 2069
Fax: 6-03-7958 1973

UNIVERSITY OF MALAYA (MASTER'S DEGREE) REGULATIONS 2001

Schedule 10

Faculty of Medicine

Part 18

Master of Medical Physics

1. **Course Registration**

(1) Programme by coursework and dissertation

(a) Registration for the courses shall commence the week prior to the start of the relevant semester.

(b) A candidate is required to register for at least nine credit hours in any semester except -

(i) in the final semester of his programme of study where he may register for less than the number of credits hours stated above

or

(ii) where the candidate has been permitted to withdraw from the semester concerned.

(c) A candidate may only register for Part II of the programme of study after he has obtained at least nine credit hours.

(2) Programme of dissertation

Except where he has been permitted to withdraw from the semester concerned, a candidate for the programme by dissertation who is required to follow or follow and pass such course or courses shall be required to register for the course or courses in the semester the course or courses is or are offered.

2. **Supervision**

(1) Programme by coursework and dissertation

(a) The supervisor for a candidate shall be appointed when the area of research is approved.

(b) The co-supervisor and/or consultant may be appointed at any time when required.

(2) Programme by dissertation

(a) The supervisor for a candidate shall be appointed when the area of research is approved.

(b) The co-supervisor and/or consultant may be appointed at any time when required.

3. **Determination of Area of Research**

(1) Programme by coursework and dissertation

The area of research for the dissertation shall be determined before the candidate commences the research part of his programme of study.

(2) Programme by dissertation

The area of research for the dissertation shall be determined when the candidate is accepted for admission to the programme of study.

4. **Submission**

(1) Programme by coursework and dissertation

(a) A candidate is permitted to submit his dissertation after he has obtained at least twenty eight (28) credit hours.

(b) A candidate is required to submit his dissertation before the end of his maximum period of candidature.

(2) Programme by dissertation

(a) A candidate is permitted to submit his dissertation after twelve (12) months of research from the date of initial registration of his programme of study.

(b) A candidate who is required to follow such course or courses as determined by the Faculty shall not be permitted to submit his dissertation until the Dean of the Faculty confirms that he has followed the course or courses to his satisfaction.

(c) A candidate who is required to follow and pass such course or courses as determined by the Faculty shall not be permitted to submit his dissertation unless he has passed such course or courses.

(d) A candidate is required to submit his dissertation before the end of his maximum period of candidature.