Course Specification

RARD 525:Clinical Practice of Medical Physics

Institution Name: Mahidol University

Campus/Faculty/Department: Faculty of Medicine Ramathibodi Hospital, Department of Diagnostic and Therapeutic Radiology

Section 1: General information

1. ***Course number and name***
   Course number: RARD 525
   Course name: Clinical Practice of Medical Physics

2. ***Credits: 2(0-6-2)***

3. ***Curriculum and type of course***

   3.1 Curriculum: Clinical Practice of Medical Physics

   3.2 Type of course: Core course

4. ***Instructors***
   4.1 Course Coordinator: Lect.Dr.PuangpenTangboonduangjit
   4.2 Instructors

Lect.Dr.Puangpen	Tangboonduangjit
Asst.Prof.Dr.Sawwanee	Ausawapatiboon
Lect.Dr.Krisanat	Chuamsaamarkkee
Lect.Dr. Puthhiporn	Charoenphun
Lect.Dr.Nualjan	Stansook
Lect. Suphaluck	Kajornkum
Lect. Pimolpun	Changkaew
Lect. Daranee	Piriyasang
Lect. Supaporn	Srisuwan
Lect. Sukanya	Rutchantuek
Lect. Siwaporn	Sakulsingharoj
Lect. Chanida	Voothiprasertpong
Lect. Sithipong	Supapong

Lect.	Prapa	Sodkokgruad
Lect.	Pornpan	Yongvithitsatit
Lect.	Sasithorn	Amnuaywattakorn
Lect.	Sasivimol	Promma
Lect.	Suchavadee	Musikarat
Lect.	Siripong	Vittayachokkitikhun
Lect.	Kittipong	Thongklam

5. ***Semester/Year:*** 2nd Semester, Academic Year 2020, 2nd year students
6. ***Pre-requisite:*** Physics of Radiation Therapy
   Physics of Nuclear medicine
   Physics of Diagnostic Imaging
7. ***Co-requisite:*** None
8. ***Classroom:*** To be announced
9. ***Revision Date:*** Nov 2019 ***By:*** Committee

Note: Revised course learning outcome and course description

Section 2: Purpose and objective

1. Course Learning Outcomes

1.1 Have a comprehensive understanding and able to perform and manage the quality assurance for radiotherapy, nuclear medicine and diagnostic radiology

1.2 Calculate dose in phantom and patient using standard protocol of measurement.

1.3 Calculate shielding related to radiotherapy, nuclear medicine, or diagnostic imaging.

1.4 Communicate and share the knowledge by effective presentation skill

1.5 Value the professional conduct of medical physics field

1.6 Describe the workflow, clinical process and roles of medical physicist in radiotherapy, nuclear medicine, or diagnostic imaging

Section 3: Course details

1. ***Course description***

Major in Radiation Therapy

Performing in quality assurance of linear accelerator, CT-simulator, treatment planning system; absolute dose measurement following TRS398 protocol; monitor unit calculation; brachytherapy; shielding design. Carrying out treatment planning dose calculation for external beam and brachytherapy.

Major in Nuclear Medicine

Student will receive extensive clinical and theoretical knowledge, which will equip you with the specialist skills required for the clinical medical physicist. Student will develop skills in performing and management of quality assurance of nuclear medicine equipment, internal dosimetry, radioactivity measurement and radiation protection from real clinical setting. In addition, student will gain the understanding of the workflow, clinical process and roles of medical physicist in nuclear medicine.

Major in Diagnostic Imaging

Perform dosimetry in diagnostic radiology using standard protocol 457, quality assurance of diagnostic instrument, shielding calculation including optimization of diagnostic image quality and radiation dose.

2. ***Hours per semester:*** Practice 90 hours
3. ***Feedback:*** Every 2 weeks

Section 4: Course Learning Outcomes

Course level learning outcomes	Programme level learning outcomes	Methods	Assessment
1. Be able to have a comprehensive understanding and perform the management of quality assurance for radiotherapy, nuclear medicine, or diagnostic imaging	ELO 2, 6	Demonstration	- Paper/Oral/Practical exam - Rubric portfolio assessment
2. Be able to calculate dose in phantom and patient using standard protocol of measurement.	ELO 2, 6	Demonstration	- Paper/Oral/Practical exam - Rubric portfolio assessment

Course level learning outcomes	Programme level learning outcomes	Methods	Assessment
3. Be able to calculate shielding related to radiotherapy, nuclear medicine, or diagnostic imaging.	ELO 2, 6	Demonstration	- Paper/Oral examination - Rubric portfolio assessment
4. Be able to communicate and share the knowledge by effective presentation skill	ELO 5	Demonstration	- Rubric presentation skill assessment
5. Be able to value the professional conduct of medical physics field	ELO 1	Demonstration	- Rubric portfolio assessment
6. Be able to describe the workflow, clinical process and roles of medical physicist and also collaborate with the multidisciplinary profession in radiotherapy, nuclear medicine, or diagnostic imaging.	ELO 2, 4, 6	Internship in real clinical situation	- Paper/Oral examination - Rubric portfolio assessment

Section 5: Lesson plan and assessment

1. Lesson plan

Time	Topics	Instructors	Method	Assessment
Major in Radiation Therapy (Total of 60 practical-hours)				
6 hr	Observe the workflow in Linear accelerator room, CyberKnife, Tomotherapy, CT-simulator room, and Brachytherapy room	Senior radiotherapist and staff	Demonstration	-Paper/Oral exam -Rubric portfolio assessment
15 hr	Hands on Treatment planning system (TPS) for Head and Neck, Prostate, Brachytherapy, Breast, SBRT, and manual MU calculation	Senior medical physicist and staff	Demonstration/ Practice	-Paper/Oral exam -Rubric portfolio assessment
15 hr	Hands on QA of mechanical Linear accelerator, output calibration, IGRT, patient specific QA, shielding calculation	Senior medical physics and staff	Demonstration/ Practice	- Paper/Oral/Practical exam -Rubric portfolio assessment
6 hr	Observe the workflow in clinical examination room	Medical doctor staff	Demonstration	-Paper/Oral exam -Rubric portfolio assessment
3 hr	Case TPS presentation	Lect.Dr.Puangpen and staff	-	-Rubric presentation skill
15 hr	Observe workflow medical physics department for 4 external hospitals	Senior medical physicist and staff	Demonstration	-Rubric portfolio assessment

Time	Topics	Instructors	Method	Assessment
Minor in Radiation Therapy (Total of 30 practical-hours)				
5 hr	Observe the workflow in Linear accelerator room, CyberKnife, Tomotherapy, CT-simulator room, and Brachytherapy room	Senior radiotherapist and staff	Demonstration	-Paper/Oral exam -Rubric portfolio assessment
10 hr	Observe Treatment planning system (TPS) for Head and Neck, Prostate, Brachytherapy, Breast, SBRT, and manual MU calculation	Senior medical physicist and staff	Demonstration	
10 hr	Observe QA of mechanical Linear accelerator, output calibration, IGRT, patient specific QA, shielding calculation	Senior medical physics and staff	Demonstration	
5 hr	Observe the workflow in clinical examination room	Medical doctor staff	Demonstration	
Major in Diagnostic Imaging				
12 h	Observer the workflow, clinical process the roles of medical physicist in diagnostic radiology	Diagnostic medical physicist and staff	Demonstration	-Paper/Oral exam -Rubric portfolio assessment
18 h	Hand on QA and dosimetry of general x-ray, fluoroscopy, mammography and CT including QA in MRI	Lect.Dr. Sawwanee Lect. Prapa Diagnostic medical physicist and technician	Demonstration Practice	-Paper/Oral exam -Rubric portfolio assessment
12 h	Hand on optimization of image quality and radiation dose in	Lect.Dr. Sawwanee Lect. Prapa Diagnostic medical physicist and technician	Demonstration Practice	-Paper/Oral exam -Rubric portfolio assessment

Time	Topics	Instructors	Method	Assessment
18 h	Analysis of QA and dosimetry data, presentation, practical feedback and examination	Lect.Dr. Sawwanee Lect. Prapa	Assigned Reading Practice Presentation	Rubric Presentation Assessment Oral examination
Minor in Diagnostic Imaging				
6 h	Observer the workflow, clinical process the roles of medical physicist in diagnostic radiology	Lect.Dr. Sawwanee Lect. Prapa Diagnostic medical physicist and technician	Demonstration	-Paper/Oral exam -Rubric portfolio assessment
15 h	Hand on QA and dosimetry of general x-ray, fluoroscopy, and CT including QA in MRI	Lect.Dr. Sawwanee Lect. Prapa Diagnostic medical physicist and technician	Demonstration	-Paper/Oral exam -Rubric portfolio assessment
12 h	Analysis of QA and dosimetry data, presentation, practical feedback and examination	Lect.Dr. Sawwanee Lect. Prapa	Assigned Reading/Presentation	Rubric Presentation Assessment Oral examination
Major in Nuclear Medicine (Total of 60 practical-hours)				
9 h (15%)	Observer the workflow, clinical process the roles of medical physicist in nuclear medicine	All qualified nuclear medicine staff (nuclear medicine physician, medical physicist, radiopharmaceutical scientist, nurse, technologist)	Demonstration	Oral Examination and Rubric Portfolio Assessment
24 h (40%)	Hand on Advance QA of gamma camera, SPECT/CT. PET/CT, BMD	Lect.Dr. Krisanat/Lect.Dr. Putthiporn/Lect. Wirote/Lect. Sasithorn/ Lect. Sasivimol/ Lect. Suchavadee	Demonstration/ Practical	Oral Examination and/Laboratory Report

24 h (40 %)	Case Study of Qualitative Method in Nuclear Medicine, Internal Dosietry and Radiation Protection	Lect.Dr. Krisanat/Lect.Dr. Putthiporn/Lect. Wirote	Demonstration/ Practical	Laboratory Report
3 h (5 %)	Presentation and Practical Feedback	Lect.Dr. Krisanat/Lect.Dr. Putthiporn	Assigned Reading/Presen tation	Rubric Presentation Assessment
1 week (optional)	Internship to partner institute (optional)	Senior Staff in Partner Institute	Demonstration	Rubric Portfolio Assessment
Minor in Nuclear Medicine (Total of 30 practical-hours)				
10 h (33.3 %)	Observer the workflow, clinical process the roles of medical physicist in nuclear medicine	All qualified nuclear medicine staff (nuclear medicine physician, medical physicist, radiopharmaceuti cal scientist, nurse, technologist)	Demonstration	Oral Examination and Rubric Portfolio Assessment
10 h (33.3 %)	Hand on Basic QA of gamma camera, SPECT/CT. PET/CT, BMD	Lect.Dr. Krisanat/Lect.Dr. Putthiporn/Lect. Wirote/Lect. Sasithorn/ Lect. Sasivimol/ Lect. Suchavadee	Demonstration/ Practical	Oral Examination and/Laboratory Report
6 h (20 %)	Case Study Basic Dosimetry and Radiation protection in nuclear medicine	Lect.Dr. Krisanat/Lect.Dr. Putthiporn/Lect. Wirote	Demonstration	Report
4 h (13.4 %)	Practical Feedback/Examination	Lect.Dr. Krisanat/Lect.Dr. Putthiporn	Discuss	Oral/Paper Examination

2. Measurement and Evaluation of Student Achievement

2.1. Major field:

2.1.1. Paper exam (short answer questions) 15%
2.1.2. Oral exam 15%
2.1.3. Practical exam 20%
2.1.4. Presentation 15%
2.1.5. Portfolio report 20%
2.1.6. Professional awareness 15%

2.2. Minor field:

2.2.1. Portfolio report	50%
2.2.2. Paper exam	25%
2.2.3. Oral exam	25%

Section 6: Assessment and improvement of the course operation

1. Strategies to assess the effectiveness of the courses by the students
   - Assessment of instructor's teaching by student

2. Strategy to assess the instruction
   - Assessment of students' learning records
   - Assessment of instructor's teaching by student

3. Improvement of Instruction
   - Consider the students' learning records
   - Consider the students' assessment of instructor's teaching
   - Consider the program committee's comment

4. Verification of student achievement in the subject
   - By program committee and faculty-level academic committee

5. Review and action plan to improve the effectiveness of the course
   - Using the results from 1 - 4 as inputs to the instruction improvement

Learning Resources

1. Reports from the American Association of Physicists in Medicine (AAPM), the National Council onRadiation Protection and Measurements (NCRP), the International Commission on RadiationProtection (ICRP) and the International Commission on Radiation Units and Measurements (ICRU):
   - 1.1. NCRP Report No. 147
   - 1.2. NCRP Report No. 151
   - 1.3. NCRP Report No. 160
   - 1.4. AAPM Report 45 (Task Group 34)
   - 1.5. AAPM Report 51 and updates (Task Group 43)
   - 1.6. AAPM Report 54 (Task Group 42)
   - 1.7. AAPM Report 61 (Task Group 59)
   - 1.8. AAPM Report 62 (Task Group 53)
   - 1.9. AAPM Report 67 (Task Group 51)
   - 1.10. AAPM Report 72 (Task Group 50)
   - 1.11. AAPM Report 75 (Task Group 58)
   - 1.12. AAPM Report 76 (Task Group 61)

1.13. AAPM Report 81 (Task Group 63)
1.14. AAPM Report 82 (Radiation Therapy Committee IMRT Subcommittee)
1.15. AAPM Report 83 (Task Group 66)
1.16. AAPM Report 85 (Task Group 65)
1.17. AAPM Report 87 (Task Group 62)
1.18. AAPM Report 91 (Task Group 76)
1.19. AAPM Report 95 (Task Group 75)
1.20. AAPM Report 97 (Task Group 74)
1.21. AAPM Report 101 (Task Group 101)
1.22. AAPM Report 104 (Task Group 104)
1.23. AAPM Report 106 (Task Group 106)
1.24. AAPM Report 114 (Task Group 114)
1.25. AAPM Report 142 (Task Group 142)
1.26. AAPM Report 148 (Task Group 148)
1.27. AAPM Report 166 (Task Group 166)
1.28. AAPM Report 216 (Task Group 69)
1.29. ICRU Reports No. 50 and 62
1.30. ICRP Report 118

Journal articles, such as:

2. QUANTEC Reports, published in International Journal of Radiation Oncology BiologyPhysics. 76 S1 2010

3. D Georg et al. Current status and future perspective of flattening filter free photon beams.Medical Physics. 2011;38(3):1280-93.

4. J Palta et al. Intensity-Modulated Radiation Therapy – The State of the Art. Medical Physics.2003;30:3265.

5. A Siochi et al. Information technology resource management in radiation oncology. Journalof Applied Clinical Medical Physics. 2009;16-35

6. A Arjomandy et al. An overview of the comprehensive proton therapy machine qualityassurance procedures implemented at The University of Texas M.D. Anderson CancerCenter Proton Therapy Center-Houston. Medical Physics. 2009;36(6):2269

7. S Kry et al. Ion recombination correction factors (P(ion)) for Varian TrueBeam high-doseratetherapy beams. Journal of Applied Clinical Medical Physics. 2012;13(6):3803

8. Mackie TR. History of tomotherapy. Physics in medicine and biology. 2006;51(13):R427-53

9. D Schwartz et al. Adaptive Radiotherapy for Head-and-Neck Cancer: Initial ClinicalOutcomes From a Prospective Trial. International Journal of Radiation Oncology BiologyPhysics. 2011;83(3):986- 993

10. S Fox et al. Performance evaluation of an automated image registration algorithm using anintegrated kilovoltage imaging and guidance system. Journal of Applied Clinical MedicalPhysics. 2006;7(1):105-14

11. E Ford et al. A streamlined failure mode and effects analysis. Medical Physics. 2014;41(6)

12. M Law et al. Informatics in radiology: DICOM-RT and its utilization in radiation therapy.Radiographics. 2009; 29(3):655-667

Standard reference texts including:

13. Khan: The Physics of Radiation Therapy, 5th Ed, Lippincott Williams & Wilkins, 2014

14. Hendee, Ibbott, and Hendee: Radiation Therapy Physics, John Wiley & Sons, 2005

15. Paganetti: Proton Therapy Physics, CRC Press, 2011

16. Wazer et al; Accelerated Partial Breast Irradiation: Techniques and Clinical Implementation, Springer 2009

17. Curry et al.: Christensen's Physics of Diagnostic Radiology, 4th Ed, Lippincott Williams & Wilkins,1990

18. Heilburn: Cyberknife Radiosurgery Practical Guide-Author Heilbrun, CyberKnife Society, 2005

19. Bushberg et al.: The Essential Physics of Medical Imaging, Lippincott Williams & Wilkins, 2011

20. Germano: LINAC and Gamma Knife Radiosurgery (Neurosurgical Topics), Thieme/AANS, 2000

21. Halperin et al.: Perez and Brady's Principles and Practice of Radiation Oncology, LippincottWilliams & Wilkins, 2013

22. Knoll: Radiation Detection and Measurement, Wiley, 2010

23. Metcalfe et al.: The Physics of Radiotherapy X-rays from Linear Accelerators, Medical Physics PubCorp, 1997

24. Van Dyk: "Imaging for Radiation Therapy Treatment Planning" in The Modern Technology ofRadiation Oncology, Medical Physics Publishing, 2005

25. Hall and Giaccia: Radiobiology for the Radiologist, 7th Ed, Lippincott Williams & Wilkins, 2011

26. Mundt and Roeske: Image-Guided Radiation Therapy: A Clinical Perspective, BC Decker Inc, 2005

27. TPawlicki et al,: Quality and Safety in Radiotherapy, CRC Press, 2010

28. Cherry, S.R., Sorenson, J.A. and Phelps, M.E., 2012. Physics in Nuclear Medicine E-Book. Elsevier Health Sciences.

29. Bailey, D.L., Huum, J.L., Todd-Pokropek, A. and Aswegen, A.V., 2014. Nuclear medicine physics: a handbook for teachers and students. Vienna: International Atomic Energy Agency (IAEA).