MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College, Kuttapuzha P.O, Tiruvalla					
Faculty/ Discipline	Physics					
Programme	BSc (Hons) Physics					
Course Coordinator	Dr.I. John Berlin					
Contributors	Dr. Anju K Nair					
Course Name	Introduction to Medical Physics					
Type of Course	DSE					
Specialization title	Medical Physics and Instrumentation					
Course Code	MG3DSEPHYA00					
Course Level	200					
Course Summary	This course introduces the fundamental concepts of Medical Physics, focusing on the basic applications of light, sound, and electronics in the medical field. The course will cover the principles behind medical imaging techniques, therapeutic applications, and diagnostic tools. Students will engage with practical sessions to reinforce theoretical knowledge.					
Semester	3	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Basic ideas of Sound and light waves-their properties, reflection and refraction					

Course Outcomes (CO)

Number of COs		**7**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the basic principles of light and vision, as well as the fundamentals of lasers and their applications in the medical field.	U, A	PO2, PO3
2	Apply interdisciplinary concepts from physics to explain the principles and technologies used in optical coherence tomography, endoscopy, and laparoscopy.	U, A	PO2, PO3
3	Understanding the fundamentals of acoustics, ultrasound, and Doppler ultrasound systems adds value to the field of medical physics.	K, U	PO2, PO3
4	llustrate the basic principles and applications of ultrasound scanners, and understand various audiometry techniques.	U, A	PO2, PO3
5	Familiarize with solid-state devices such as diodes and transistors, and understand the concepts of operational amplifiers and transducers in the context of medical physics.	U, A	PO2, PO3

Number of COs		7	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
6	Understand the role of medical electronics in bioelectrical activities and describe the working principles of key medical imaging techniques.	U, A	PO2, PO3
7	Develop expertise in conducting experiments related to medica Physics.	A, S	PO2, PO3

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	-	3	3	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-
CO 3	-	3	3	-	-	-	-	-	-	-
CO 4	-	3	3	-	-	-	-	-	-	-
CO 5	-	3	3	-	-	-	-	-	-	-
CO 6	-	3	3	-	-	-	-	-	-	-
CO 7	-	3	3	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Physics of Light in Medical field			
	1.1	Light and vision- Light wave propagation, Light diffraction, Light dispersion, Light absorption, Light polarization The eye: vision, The retina, The mechanism of vision, Color triangle and color vision Electromagnetic waves: spectrum, emission and absorpt	4	["1"]
	1.2	Laser Physics and Applications in Medical field Semiconductor laser, Types of lasers used in medicine (e.g., CO2, Nd:YAG, excimer lasers) - Applications: Laser in Surgery-Opthalmology, Components of a laser system in ophthalmology, Laser tissue inte	5	["1"]
	1.3	Optical Coherence Tomography (OCT) - Principle of OCT - Applications	2	["2"]
	1.4	Endoscopes and Laproscopy - Standard flexible gastroscope - Modern endoscopes - Advantages and disadvantages	4	["2"]

Module	Units	Course Description	Hrs	CO No.
2	Physics of Sounds in Medical field			
	2.1	Basic Acoustics - Sound waves: Frequency, speed, wavelength and phase, frequencies and wavelength used in diagnosis Reflection of ultrasound waves- Acoustic impedance, scattering, diffuse reflection, refraction	4	["3"]
	2.2	Ultrasound applications in medical instrunments Ultrasound - Attenuation, ultrasound beams, focusing. Doppler Ultrasound systems-Doppler effect, Doppler displays, continuous wave and pulsed wave. Doppler flowmetry	4	["3"]
	2.3	Ultrasound Scanner Principles of Doppler Scanner- 3D/4D imaging techniques- freehand systems, endoprobe 3D ultrasound, Visualization-2D display, shaded surface display. Applications-fetel, cardiac,trans-rectal, intravascular	4	["4"]
	2.4	Hearing and Audiometry Ear and sensation, stethoscope and body sounds. - Audiometry-Basic audiometer, Pure tone audiometer, speech audiometer	3	["4"]
3	Medical Electronics			
	3.1	Basic Electronic Components and Circuits Introduction to semiconductor diodes, and transistors Operational amplifiers-inverting and non-inverting(Qualitative ideas) Op-amps in medical instrumentation, Transducers and its classification	6	["5"]
	3.2	Medical Instrumentation Electric phenomena in biological systems Bioelectric activities (ECG, EEG, EMG) Electrocardiography- The dipolar model and the total dipole moment of the heart, Electrocardiographic leads, Precordial leads and dipolar layer mo	5	["6"]
	3.3	Basics of Imaging Systems X-ray-properties of X-rays, photoelectric effect, compton effect, Bremsstrahlung CT scan imaging, MRI-Magnetic resonance fundamentals	4	["6"]
4	Practicals (30hrs)			
	4.1	1) Optical Coherence Tomography (OCT) simulation exercises 2) Fiber optics in endoscopy: Hands-on with models 3) Optical fiber-numerical aperture. 4) Ultrasound imaging simulation 5) OP-Amp - Adder and Substractor 6) Audiometric test practices 7) Zener diode characteristics 8) Transistor characteristics-CB 9) OP amp. IC741- Inverting amplifier-To construct an inverting amplifier using IC741 and determine its voltage gain 10) OP amp. IC741- Non-inverting amplifier - To construct a non-inverting amplifier using IC741 and determine its voltage gain 11) ECG and EEG signal analysis 12) Basics of patient monitoring systems: Hands-on with simulators 13) Introduction to MRI technology: Virtual lab experience 14) To compare the viscosities of two liquids using Ostwald's Viscometer 15) To find the frequency of a AC mains by means of sonometer. 16) To verify Malus law using Laser 17) Determine the pulse rate using stethoscope	30	["7"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture, Demonstration, PPT presentations, Simulations, Practical

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Both **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 25 Marks** 1. Formative assessment ● Quiz ● Assignment ● Seminar 2. Summative assessment ● Written test **• Practical – 15 Marks** ● Lab involvement ●Viva **B. End Semester Evaluation (ESE)** **• Theory – 50 Marks** Assessment Methods – Written Exam Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B Answer Type: ∘ PART - A ∘ Short answer - (10 out of 14) – 10 × 2 = 20 ∘ PART - B ∘ Short Essays - (6 out of 8) – 6 × 5 = 30 **• Practical – 35 Marks** Assessment Methods – Lab Exam-30, Record-5 Duration of Examination – 3.00 Hrs

References

- Ananthi, S. (n.d.). A textbook of medical instruments (Chapters 7, 9, 12). New Age International Limited.
- Diagnostic ultrasound: Physics and equipment (Chapters 2, 7, 13). Peter Hoskins, Kevin Martin, Abigail Thrush, Cambridge University Press.
- Bacchetta, A., & Scannicchio, D. (2023). Introduction to medical physics (Chapters 7, 8, 9, 10, 12). Zanichelli Alessandro & CEA.
- Theraja, B. L. (n.d.). Basic electronics: Solid state, S. Chand Publications.

Suggested Readings

- An Overview of Laser Principle, Laser-Tissue Interaction Mechanisms and Laser Safety Precautions for Medical Laser Users, https://www.imrpress.com/journal/IJP/7/2/10.3923/ijp.2011.149.160
- Principles of physics: Halliday and Resnick, tenth edition
- Optics, Ajoy Ghatak, McGraw Hill, New Delhi (2020).
- “The Physics of radiation Therapy” by Faiz M Khan, Edn 3, Lippincott Williams and Wilkins
- Modern Physics: R.Murugesan, S.Chand & Co.
- A Text Book of Optics, Brijlal & N Subramanyam, S Chand & CO

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necessary for the successful implementation of the specialization, for as long as the college offers this programme.

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2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College, Kuttapuzha P.O, Tiruvalla					
Faculty/ Discipline	Physics					
Programme	BSc (Hons) Physics					
Course Coordinator	Dr.I. John Berlin					
Contributors	Dr.Angel Susan Cherian					
Course Name	Physics of Medical diagnostics					
Type of Course	DSE					
Specialization title	Medical Physics and Instrumentation					
Course Code	MG4DSEPHYA00					
Course Level	200					
Course Summary	The course is designed to give students basic understandings about the imaging techniques in the medical field. It makes them capable of testing, calibration & repairing of various medical imaging equipment.					
Semester	4	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Basic knowledge about electromagnetic spectrum and spectroscopic techniques					

Course Outcomes (CO)

Number of COs		**7**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	To Understand the principles and physics of different imaging techniques	K, U	PO2
2	To understand the instrumentation part used in the imaging equipment	K, U	PO2
3	To analyse the operation and maintenance of imaging equipment safely and effectively.	AN	PO2, PO3
4	To acquire Knowledge of the clinical applications of MRI in various medical applications	K	PO2, PO3
5	To Acquire knowledge about the clinical applications of nuclear imaging and ultrasonic imaging	U	PO2, PO3
6	To get the practical knowledge about sensors used in medical applications	K, U	PO2, PO3
7	To get the practical knowledge about sensors used in medical applications	A	PO3

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	-	2	-	-	-	-	-	-	-	-
CO 2	-	2	-	-	-	-	-	-	-	-
CO 3	-	2	3	-	-	-	-	-	-	-
CO 4	-	2	3	-	-	-	-	-	-	-
CO 5	-	2	3	-	-	-	-	-	-	-
CO 6	-	2	3	-	-	-	-	-	-	-
CO 7	-	-	3	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to Medical Imaging:			
	1.1	General image characteristics - Receiver operating characteristic analysis - accuracy, sensitivity, specificity-spatial resolution	3	["1"]
	1.2	Qualitative Signal processing in medical instrumentation- signal and noise, noise sources in instruments, Artifacts	3	["1"]
	1.3	Data acquisition and image reconstruction-A-D convertors - Image quality-mottle, sharpness and resolution, Factors affecting attenuation	3	["1"]
	1.4	Imaging sensor technology and applications - CCD, CMOS	3	["6"]
2	X ray Imaging			
	2.1	X-ray tube, Block diagram of X-ray machine-Collimator, Bucky grid, X-ray detector, Power supply	3	["2"]
	2.2	X-ray machines for diagnosis, X-ray examination of organs, factors affecting image quality-Maintenance of X-ray equipment in hospitals	3	["3"]
	2.3	Fluoroscopy: Direct fluoroscopic system - Image intensifier design, Mammography: Technical aspects of Mammography	4	["2"]

Module	Units	Course Description	Hrs	CO No.
3	CT scan, MRI, Ultrasound and Nuclear imaging			
	3.1	Computed Tomography:Historical background, various generations of scanners, CT scan machines, Algorithm for tomography, Scanner instrumentation, Detectors, Image processing. Clinical applications	6	["2", "4"]
	3.2	Magnetic Resonance Imaging (MRI): NMR-Principle, Magnetic Resonance Phenomena. Factors affecting image appearance, MRI scanner- Instrumentation, Fourier transform in NMR, Chemical shift, Magnetic field strengths and gradients, Pulse sequences, Imaging pro	6	["2", "4"]
	3.3	ULTRASONOGRAPHY- Advantages - B-scan ultrasonic systems--Probes-Time-motion mode-ultrasonic display-imaging principles-Doppler techniques-real time ultrasound- Clinical applications	6	["2", "5"]
	3.4	Radioisotope Imaging -positron emission computed tomography (PET) and single photon emission computed tomography (SPECT) imaging. Clinical Applications of Nuclear Medicine, Radiation Protection in Nuclear Medicine	5	["2", "5"]
4	Practical			
	4.1	1. Magnetic resonance of the compass needle in the magnetic field of the fridge magnet. 2.To find out the the velocity of sound by means of a resonance tube closed at one end 3.Digital to Analog Conversion 4. Analog to Digital conversion 5. Determination Particle (biomolecules) size using X-ray powder diffraction method 6. Demonstration of basic procedures with all radiographic equipment X Ray & Portable X Ray, Fluoroscopy, CT, MRI, 7. Imaging softwares adapted for various imaging equipment 8. Pulse shaping circuits 9. Colorimetric technique to measure absorbance, or the amount of light a solution absorbs at a specific wavelength, to determine the concentration of a colored substance 10.CMOS – Measurement of voltage	30	["7"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Demonstration, Observation, Interactive, PPT demonstrations, Softwares of imaging techniques

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Both **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 25 Marks** Formative assessment:Assignment, Seminar, Tutorial work: Summative assessment: MCQ exams, Written exam **• Practical – 15 Marks** Viva, Lab involvement **B. End Semester Evaluation (ESE)** **• Theory – 50 Marks** Assessment Methods – Written Exam Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B Answer Type: ◦ PART - A ◦ Short answer - (10 out of 12) – 10 × 2 = 20 ◦ PART - B ◦ Short Essays/Problems - (5 out of 6) – 5 × 6 = 30 **• Practical – 35 Marks** Assessment Methods – Lab Exam, Record Duration of Examination – 3.00 Hrs

References

- A textbook of Medical instruments- S-Artathi
- Textbook of biomedical instrumentation- K.N.Scott amd A.K.Mathur
- Physical Principles of Medical imaging – Perry Sprawls

Suggested Readings

- Concepts in Medical Radiographic imaging By: Marianne Tortoise
- Radiographic imaging-Derrick P. Roberts and Nigel L. Smith. Churchill. Livingstone, Edinburgh (1994)

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2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College, Kuttapuzha P.O, Tiruvalla					
Faculty/ Discipline	Physics					
Programme	BSc (Hons) Physics					
Course Coordinator	Dr.I. John Berlin					
Contributors	Dr Arun Vinod					
Course Name	Introduction to Radiological Physics					
Type of Course	DSE					
Specialization title	Medical Physics and Instrumentation					
Course Code	MG5DSEPHYA00					
Course Level	300					
Course Summary	This course is divided into three parts. First part introduces the concept of radiation production and its interaction. Second part is devoted to giving a basic introduction to various detectors to detect the produced radiation. Third part introduces the significance of radiational safety. This part will not only enhance the skills towards the basic understanding of the radiation but will also provide the knowledge about the protective measures against the radiation exposure. Thus, after successful completion of this course, a student will be able to understand and apply how to generate radiation, various methods of detection, and the safety measures to be taken.					
Semester	5	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Basic knowledge and idea about radiation					

Course Outcomes (CO)

Number of COs		**6**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	To analyse the concept behind different types of particle accelerators and their applications.	U, A	PO1, PO2, PO3
2	To develop the concept about sources of radiation, its application and its interaction	U, A	PO1, PO2, PO3, PO4
3	To understand/classify the technical know-how of radiation detectors and its application	U, A	PO1, PO2, PO3, PO9, PO10
4	To understand the applications and uses of radiation safety devices.	U	PO1, PO2, PO3, PO8, PO10
5	To apply the laws of nuclear radiation for practical applications	U, A	PO1, PO2, PO3, PO4

Number of COs		6	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
6	To gain expertise in experiment/simulation in experiments related to Radiological Physics	A, AN, S	PO1, PO2

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	3	2	-	-	-	-	-	-	-
CO 2	2	3	2	2	-	-	-	-	-	-
CO 3	2	3	3	-	-	-	-	-	2	2
CO 4	2	2	2	-	-	-	-	2	-	2
CO 5	3	3	3	2	-	-	-	-	-	-
CO 6	3	3	-	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Radiation Generation and Interaction (17 hours)			
	1.1	Introduction- Production - Properties of X-rays – Characteristics and continuous spectra - Moseley's Law	3	["1"]
	1.2	Electrostatic accelerators- Van de Graff Generator, Linear Accelerator	2	["1"]
	1.3	Oscillating field accelerators – Cyclotron, Synchrotron	2	["1"]
	1.4	Radioactive sources - naturally occurring sources, production of artificial isotopes, and its application in medical fields	3	["2"]
	1.5	Interaction of radiation with matter: Introduction, interaction of charged particle with matter, Photon interactions with matter-Photoelectric effect, coherent and incoherent scattering, pair production (Dirac Theory)	7	["2"]
2	Radiation Detection and Instrumentation (15 hours)			
	2.1	Principles of Radiation Detection- Gas Filled Detectors – operating regions of gas detectors	2	["3"]
	2.2	Solid state detectors- construction and working	2	["3"]
	2.3	GM Counter- Construction, working Quenching, Dead time, recovery time, resolving time	2	["3"]
	2.4	Scintillation detectors- Principle, Construction, Working, Different types	2	["3"]
	2.5	Rutherford Backscattering Spectrometer	4	["3"]
	2.6	Radiation Hazards, Radiation Dosimeters – Thermoluminescence, Thermoluminescent Dosimeter, energy level diagram, Pocket Dosimeter	3	["4"]

Module	Units	Course Description	Hrs	CO No.
3	Radioactivity and Radiation effects (13 hours)			
	3.1	Effects of Radiation- biological effects of radiation (Interaction of radiation with tissue) - Linear energy transfer- Biologic effects - Radiation risk (basic idea)- Ten day rule and its present status	3	["4"]
	3.2	Basics of Radiation safety: Time, Distance and shielding; Concept of HVL	3	["4"]
	3.3	Radioactivity, types of radiations, law of radioactive decay, half life, relation between decay constant and half life, life time	2	["5"]
	3.4	Successive disintegration, radioactive equilibrium-ideal, transient, and permanent, artificial radioactivity, preparation of radioelements, application of radioisotopes- medical, agricultural, and industrial applications	5	["5"]
4	Practicals (30 hours)			
	4.1	1. Simulation of the interaction of radiation particle with single layer target of RBS 2. GM Counter- Inverse Square Law: Gamma Rays 3. Comparison of low Z and high Z elements and verification of Rutherford Scattering formula 4. Bandgap determination of semiconductor 5. Construction of multilayer using simulation and study the interaction of radiation particle with multilayer and obtain the spectrum. 6. Fitting data of RBS using simulation. 7. Thickness determination using RBS. 8. Detection of known source using Gama ray spectrometer/spectrograph 9. Calculate the diffraction cross-section using Rutherford Scattering formula 10. Verification of the Stefan-Boltzmann law 11. Verification of Inverse square law of intensity of light 12. GM counter: half value thickness/layer 13. Plank's constant determination 14. GM counter: inverse square law	30	["6"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Demonstration, Tutorial, Simulations, Practical

Assessment Types

MODE OF ASSESSMENT
Mode of Assessment: Both

A. Continuous Comprehensive Assessment (CCA)
• Theory – 25 Marks
1. Formative assessment ● Quiz ● Assignment ● Seminar ●Activity/Field Visit/Industrial Visit ●Case Study/Project/ Site Visit/Workshop/Internship 2. Summative assessment ● Written test
• Practical – 15 Marks
● Lab involvement ● Viva

B. End Semester Evaluation (ESE)
• Theory – 50 Marks
Assessment Methods – Written Exam
Duration of Examination – 2.00 Hrs
Pattern of examination for Theory – Non-MCQ
Different parts of written examination – Part - A , B
Answer Type:
◦ PART - A
◦ Short answer/ Problem - (10 out of 15) – 10 × 2 = 20
◦ PART - B
◦ Short Essays/Problems - (6 out of 10) – 6 × 5 = 30
• Practical – 35 Marks
Assessment Methods – Lab Exam, Record
Duration of Examination – 2.00 Hrs

References

- 1. Introductory nuclear and particle physics, Kulwant S Thind, Manmohan Singh, Vijayakumar, Leif Gerward, Vishal Publishing Co., Jalandhar-Delhi, 2017
- 2. Solid State Physics, M A Wahab, 2nd Ed., Narosa Publishing House, 2005
- 3. Textbook of Radiological Safety, K Thayalan, 1st Edi., Jaypee Brothers Medical Publishers (P) Ltd, 2010
- 4. Modern Physics, R. Murugeshan, K Sivaprasath, 18th Edi., S. Chand & Company Ltd, 2016.
- 5. Instrumentation for PIXE and RBS, International Atomic Energy Agency, VIENNA, 2000, IAEA-TECDOC-1190, ISSN 1011-4289
- 6. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed, Academic Press Inc.1st Edi.2007

Suggested Readings

- 1. Swift Heavy Ions for Materials Engineering and Nanostructuring, Devesh Kumar Avasthi, Girijesh Kumar Mehta, Springer, 2011
- 2. Production and applications of radioisotopes, Sahoo and Sahoo, Phys. Educ., (2006), pp. 5-11.
- 3. Backscattering Spectrometry, Wei-Kan Chu, James W. Mayer, Marc A. Nicolet, Academic Press,1978

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SIGNATURE COURSE						
Name of the College	Marthoma College, Kuttapuzha P.O, Tiruvalla					
Faculty/ Discipline	Physics					
Programme	BSc (Hons) Physics					
Course Coordinator	Dr.I. John Berlin					
Contributors	Dr.I. John Berlin					
Course Name	Physics in Operation Theatre Safety and Instrumentation					
Type of Course	DSE					
Specialization title	Medical Physics and Instrumentation					
Course Code	MG6DSEPHYA00					
Course Level	300					
Course Summary	The course aims to provide an understanding of the principles and applications of Biophysics and Bioelectronics in operation theatre equipment, basic biomedical monitoring instrumentation, anaesthesia equipment, bio-waste management, and hospital equipment safety.					
Semester	6	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic idea in Bio Physics & Basic Electronics					

Course Outcomes (CO)

Number of COs		**7**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	To Understand the Principle and Physics Operation theatre Equipment	U	PO2, PO3
2	To Understand the Basics of Technology in Medical Instrumentation	K, U	PO2, PO3
3	To appreciate the working mechanism of Biomedical Monitoring Instruments	U, AN	PO2, PO3
4	To analyse the fundamental components and function of Anaesthesia Equipment	U, A, AN	PO2, PO3
5	To Acquire knowledge about the Safety measures of Anaesthesia Equipment	U, A, S	PO2, PO3
6	To develop the knowledge in Hospital Equipment Safety	U, A, AN, S	PO3, PO6, PO8
7	To get the practical knowledge about Bio Medical Waste Management	U, A, AN, S	PO6, PO8

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	-	2	3	-	-	-	-	-	-	-
CO 2	-	3	3	-	-	-	-	-	-	-
CO 3	-	3	3	-	-	-	-	-	-	-
CO 4	-	3	3	-	-	-	-	-	-	-
CO 5	-	3	3	-	-	-	-	-	-	-
CO 6	-	-	3	-	-	3	-	3	-	-
CO 7	-	-	-	-	-	3	-	3	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Operation theatre Equipment & Technology			
	1.1	Basic Physics and Technology in Medicine, Artificial Intelligent (AI) Medicine, Robotic Surgery, Relevant to Operation Theatre Equipment: Vapour and Gases, Defibrillators, Pulse oximetry	4	["1", "2"]
	1.2	Specialised equipment- endoscopy/ laproscopy, operating microscope, ultrasonic aspirators, C arm- sterilization and maintenance	4	["2"]
	1.3	Electric vacuum, nitrogen cylinders, compressed air and vacuum pipelines and outlets – physical principles, safety measures and maintenance of Operation Theatre.	4	["2"]
	1.4	Anaesthetic Machine : Gas supply system, Anaesthetic Vaporizers, Anaesthetic Breathing System Ventilators, Pre- Anaesthetic Checklist, Duties of Operation Theatre Technologist	4	["2"]
2	Basic Biomedical Monitoring Instrumentations			
	2.1	Advanced monitoring equipment- Clinical, Instrumental - invasive blood pressure, ultrasound probe, cardiac output, neuromuscular, depth of anaesthesia monitoring.	3	["3"]
	2.2	Sterilization Technique & CSSD: Methods of Sterilization-Ethylene oxide sterilization, Central sterile and Department (CSSD)	3	["3"]
	2.3	Diathermy –Electrosurgical diathermy– shortwave, microwave, ultrasonic diathermy – Diathermy for Physiotherapy -Ventilators	4	["3"]
	2.4	Non-invasive Blood gas analysis and interpretation, Point of care testing of haemoglobin, blood glucose and anticoagulation- ACT (activated clotting time), Thromboelastography (TEG)	5	["3"]

Module	Units	Course Description	Hrs	CO No.
3	Anaesthesia Equipment and Safety			
	3.1	Modern anaesthesia machine and vaporisers– design, function, physical principles, safety measures	4	["4", "5"]
	3.2	Gas cylinders, safety measures, Manifold and central oxygen pipeline supply	3	["4", "5"]
	3.3	Endotracheal intubation- laryngoscopes, endotracheal tubes, facemasks, airways (LMA, ILMA, video-laryngoscopes), Paediatric anaesthesia equipment and preparation	4	["4"]
	3.4	Neuraxial blocks- spinal and epidural anaesthesia- techniques, positioning and preparation, monitoring, complications Central venous lines, indications, techniques, preparation and complications	5	["4"]
4	Hospital Equipment Safety & Bio waste management			
	4.1	Electrical Hazards - microshock and macroshock - electrical accidents in hospitals	3	["6"]
	4.2	Operation Theatre Planning and Management, Physical Set-up, Modular Operation Theatre, Sterilization of operation Theatre	3	["6"]
	4.3	Devices to protect against electrical hazards, Equipment Safety Program- Hospital regulation	3	["6"]
	4.4	Biomedical waste management-Elements of Biomedical waste management, Treatment of Biomedical waste, Safety issues of Health care workers.	4	["7"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, use of demonstrations and animations/videos, Field visit in Multispecialty Hospitals

Assessment Types

MODE OF ASSESSMENT
Mode of Assessment: Theory

A. Continuous Comprehensive Assessment (CCA)
• Theory – 30 Marks
● Quiz ● Assignment ● Seminar Summative assessment ● Written test • MCQ exams

B. End Semester Evaluation (ESE)
• Theory – 70 Marks
Assessment Methods – Written Exam
Duration of Examination – 2.00 Hrs
Pattern of examination for Theory – Non-MCQ
Different parts of written examination – Part - A , B
Answer Type:
◦ PART - A
◦ Short answer - (10 out of 12) – 10 × 3 = 30
◦ PART - B
◦ Short Essays/Problems - (8 out of 12) – 8 × 5 = 40

References

- Textbook of Operation Theatre Technology by Manjushree Ray and MM Ray CBS Publishers
- Text Book of Biomedical Instrumentation by K.N Scott and A.K. Mathur CBS Publishers
- A Text Book of Medical Instruments by S. Ananthi New Age International (P) Ltd, Publishers.
- Introduction to medical physics (Chapters 12). By Bacchetta, A., & Scannicchio, D. (2023). Zanichelli Alessandro & CEA.

Suggested Readings

- Textbook of Operation Theatre Technology AITBS PUBLISHERS
- Medical Instruments and Devices: Principles and Practices Schreiner, Steven; Bronzino, Joseph D. and Peterson, Donald R.
- Biomedical electronics and Instrumentation made easy 2011 by G. S. Sawhney (Author)
- Textbook of Equipments in Anaesthesia March 2022 by Dr. Anuja Agrawal (Author), Dr. Malini Mehta (Author), Dr. Dinesh Chauhan (Author)
- Principles of Anaesthesia Equipment , Jaypee Brothers Medical Publishers

Affidavit

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