DEPARTMENT OF MEDICAL PHYSICS

ANNA UNIVERSITY, CHENNAI

VISION

The Medical Physics course is planned in such a way that it is committed to being at the forefront of finding better diagnosis and treatments for cancer patients by way of superior clinical care and clinical trials coupled with cutting edge research in medical physics field, cancer biology and health services.

MISSION

The Mission of the medical physics program is to introduce advancement in the practice of principles of Physics for diagnosis and treatment of disease by educating students, on the concepts of radiological physics, medical imaging, radiation therapy and radiation safety aspects. The program aims to provide students with necessary foundation and confidence through rigorous teaching, hands on practice and mentored research.

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

M.Sc. MEDICAL PHYSICS (2 YEARS)

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

I. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. Train students in the understanding and recognizing the anatomical structures and explain the physiological functions of body system and able to explain the interrelationships within and between anatomical and physiological systems of the human body with emphasis on content applicable to clinical diagnostic imaging and/or radiation oncology.
2. To teach the students radiological physics, radiation dosimetry, medical imaging with nuclear medicine and brachytherapy aspects in order to trainin development of new methods & techniques in radiation oncology in particular diagnosis and treatment of various cancer diseases and to have high cure rate of cancer patients.
3. To provide knowledge on biological effects of ionizing radiation, development and maintenance of a quality assurance program for all treatment equipments, modalities, localization procedures, and computational equipment and programs to assure accurate radiation dose delivery.
4. Train students in engineering methods as applied to medicine, to provide trained manpower in healthcare and medical research and to enable them to design and understand the use of medical equipment.
5. To create awareness of health hazards due to ionizing radiation and to impart knowledge on the radiation safety and Protection aspects in using radiation in health care.
6. To develop radiation oncology decision-making skills and in training radiation physicists in radiation therapy, radio-diagnosis and in nuclear medicine.

II. PROGRAMME OUTCOMES (POs):

After two years of completing the M.Sc. Medical Physics course the students are expected to have the following attributes with the corresponding outcomes:

PO#	GraduateAttribute	ProgrammeOutcome
1	Scientific knowledge	Will develop specialist knowledge and skills in the field of medical physics, including quantitative measurements and evaluation of radiation exposure for the benefit of patients.
2	Practical ability	Will have the ability to practice all aspects of clinical medical physics for an accurate, safe and effective delivery of radiotherapy treatment for the cancer patients
3	Design/development of radiation treatment	Can pursue a broad range of translational clinical research projects in radiotherapy.
4	Knowledge transfer	Will be able to be instrumental in the evaluation and implementation of new technologies and in translation of research into professional practice.

5	Modern tool usage	Will be able to develop the skills to critically evaluate and optimize the performance of medical equipment and procedures.
6	TheMedical Physicistandsociety	Will be able to comply with all applicable regulations and requirements regarding radiation safety of personnel, public and environment , and of clinical and research ethics and procedures.
7	Environmentandsustainability	Designthe systemwithenvironment consciousnessand sustainable development.
8	Ethics	Practice ethical, responsible, reliable, and dependable behavior in all aspects of professional lives, and a commitment to the Medical Physicists profession and society.
9	Individual and team work	Ability to become an advisor to a team of professionals including oncologists, radiologists, radiotherapists, technologists and biomedical
10	Communication	Proficiency in oral and written Communication.
11	Project Management	Will be able to use problem solving abilities to analyze outputs, diagnose problems and provide quality assurance in new radiation oncology projects.
12	Life-long learning	Will be able to gain and induce lifelong learning skills, attitudes for social and personal development .

III. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of the program the student will have following Program specific outcomes.

1. Will have the ability to perform the radiation dosimetry, treatment planning for cancer patients and also able to carry out quality assurance tests for teletherapy and brachytherapy units.
2. Will have the ability to practice all aspects of clinical medical physics for an accurate, safe and effective delivery of radiation treatment for the cancer patients and able to practice radiation safety and protection in medical institutions.
3. Can pursue a broad range of translational clinical research projects in radiotherapy.
4. Can teach medical physics courses to graduate students/Post graduate Medical students and Medical Physics students / dosimetrists.

1. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	✓									
II	✓	✓	✓	✓	✓							
III	✓	✓	✓	✓	✓	✓			✓			
IV	✓	✓			✓		✓			✓	✓	
V	✓		✓	✓	✓	✓	✓	✓	✓			
VI	✓		✓	✓	✓	✓	✓	✓	✓		Attested	✓

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Mapping of Course Outcome and Programme Outcome

		CourseName	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
YEAR 1	Semester1	Radiological Physics	✓	✓	✓	✓	✓					✓		
		Radiation Generating Equipment in Medicine	✓	✓	✓	✓						✓		
		Electronic Circuits and Microprocessor	✓	✓	✓	✓								
		Non-Ionizing Radiation Physics in Medicine	✓	✓	✓	✓						✓		
		Mathematical Physics and Bio-Statistics	✓	✓	✓	✓								
		English for Research Paper Writing(Audit -I)	✓			✓	✓	✓		✓	✓	✓		✓
		Diagnostic & Therapeutic Laboratory	✓	✓	✓	✓						✓		
		Engineering Graphics Laboratory	✓	✓	✓	✓						✓		
	Semester2	Anatomy and Physiology	✓	✓	✓	✓								
		Numerical Methods and MATLAB	✓	✓	✓	✓		✓				✓		✓
		Radiation Dosimetry and Treatment Planning.	✓	✓	✓	✓						✓		
		Medical Imaging Techniques	✓	✓	✓	✓						✓		
		Medical Applications of Laser	✓	✓	✓	✓						✓		
		Disaster Management (Audit – II)	✓	✓	✓	✓			✓					
		Electronics Laboratory	✓	✓	✓	✓						✓		
		Biomedical Spectroscopy Laboratory	✓	✓	✓	✓						✓		
YEAR 2	Semester3	Brachytherapy Physics	✓	✓	✓	✓						✓		
		Biomedical Instrumentation	✓	✓	✓	✓						✓		
		Materials for Implant Applications	✓	✓	✓	✓				✓		✓		
		Nuclear Medicine	✓	✓	✓	✓								
		Biological Effects of Ionizing Radiation	✓	✓	✓	✓						✓		
		Open Elective												
		Radiation Treatment Planning Laboratory	✓	✓		✓	✓	✓		✓				
		Seminar	✓				✓			✓		✓		✓
	Semester4	Advanced Radiation Therapy Techniques	✓	✓	✓	✓								✓
		Radiation Hazards, Evaluation and control	✓	✓					✓	✓				✓
		Project	✓			✓	✓	✓		✓			✓	✓

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ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS

M.Sc. MEDICAL PHYSICS (2 YEARS)

REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MP5101	Radiological Physics	PCC	3	0	0	3	3
2.	MP5102	Radiation Generating Equipments in Medicine	PCC	4	0	0	4	4
3.	MP5103	Electronic Circuits and Microprocessor	PCC	3	0	0	3	3
4.	MP5104	Non-Ionizing Radiation Physics in Medicine	PCC	3	0	0	3	3
5.	MP5105	Mathematical Physics and Bio-statistics	FC	3	1	0	4	4
6.		Audit Course I*	AC	2	0	0	2	0
PRACTICAL								
7.	MP5111	Electronics Laboratory	PCC	0	0	6	6	3
8.	MP5112	Engineering Graphics Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**1**	**10**	**29**	**22**

***Audit course is optional**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MP5201	Anatomy and Physiology	PCC	3	0	0	3	3
2.	MP5202	Numerical Methods and MATLAB	PCC	3	1	0	4	4
3.	MP5203	Radiation Dosimetry and Treatment Planning	PCC	4	0	0	4	4
4.		Program Elective I	PEC	3	0	0	3	3
5.		Program Elective II	PEC	3	0	0	3	3
6.		Audit Course II*	AC	2	0	0	2	0
PRACTICAL								
7.	MP5211	Biomedical Instrumentation Laboratory	PCC	0	0	6	6	3
8.	MP5212	Biomedical Diagnostic Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**1**	**10**	**29**	**22**

***Audit course is optional**

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SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MP5301	Brachytherapy Physics	PCC	3	0	0	3	3
2.	MP5302	Biomedical Instrumentation	PCC	3	0	0	3	3
3.	MP5303	Materials for Implant Applications	PCC	3	0	0	3	3
4.		Program Elective III	PEC	3	0	0	3	3
5.		Program Elective IV	PEC	3	0	0	3	3
PRACTICAL								
6.	MP5311	Radiation Dosimetry and Treatment Planning Laboratory	PCC	0	0	6	6	3
7.	MP5312	Seminar	EEC	0	0	2	2	1
			TOTAL	**15**	**0**	**8**	**23**	**19**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Program Elective V	PEC	3	0	0	3	3
2.		Program Elective VI	PEC	4	0	0	4	4
3.		Open Elective	OEC	3	0	0	3	3
PRACTICAL								
4.	MP5411	Project Work	EEC	0	0	24	24	12
			TOTAL	**10**	**0**	**24**	**34**	**22**

Total No. of Credits : 85

PROGRAM CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MP5101	Radiological Physics	PCC	3	0	0	3	3
2.	MP5102	Radiation Generating Equipments in Medicine	PCC	4	0	0	4	4
3.	MP5103	Electronic Circuits and Microprocessor	PCC	3	0	0	3	3
4.	MP5104	Non-ionizing Radiation Physics in Medicine	PCC	3	0	0	3	3
5.	MP5111	Electronics Laboratory	PCC	0	0	6	6	3
6.	MP5112	Engineering Graphics Laboratory	PCC	0	0	4	4	2
7.	MP5201	Anatomy and Physiology	PCC	3	0	0	3	3
8.	MP5202	Numerical Methods and	PCC	3	1	0	4	4

		MATLAB						
9.	MP5203	Radiation Dosimetry and Treatment Planning	PCC	4	0	0	4	4
10.	MP5211	Biomedical Instrumentation Laboratory	PCC	0	0	6	6	3
11.	MP5212	Biomedical Diagnostic Laboratory	PCC	0	0	4	4	2
12.	MP5301	Brachytherapy Physics	PCC	3	0	0	3	3
13.	MP5302	Biomedical Instrumentation	PCC	3	0	0	3	3
14.	MP5303	Materials for Implant Applications	PCC	3	0	0	3	3
15.	MP5311	Radiation Dosimetry and Treatment Planning Laboratory	PCC	0	0	6	6	3
			TOTAL					36

FOUNDATION COURSE

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MP5105	Mathematical Physics and Bio-statistics	FC	3	1	0	4	4
			TOTAL	3	1	0	4	4

PROGRAM ELECTIVE COURSES (PEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MP5001	Medical Imaging Techniques	PEC	3	0	0	3	3
2.	MP5002	Biophotonics	PEC	3	0	0	3	3
3.	MP5003	Nuclear Medicine	PEC	3	0	0	3	3
4.	MP5004	Biological Effects of Ionizing Radiation	PEC	3	0	0	3	3
5.	MP5005	Advanced Radiation Therapy Techniques	PEC	3	0	0	3	3
6.	MP5006	Radiation Hazards, Evaluation and Control	PEC	4	0	0	4	4
7.	MP5007	Biosensors	PEC	3	0	0	3	3
8.	MP5008	Industrial Radiography	PEC	3	0	0	3	3
9.	MP5009	Monte Carlo Techniques in Dosimetry	PEC	3	0	0	3	3
10.	MP5010	Nano Technology for Biomedical Applications	PEC	3	0	0	3	3
11.	MP5011	Ultrasonics in Medicine	PEC	3	0	0	3	3
12.	MP5012	Materials for Radiation Dosimeters	PEC	3	0	0	3	3

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EMPLOYABILITY ENHANCEMENT COURSE (EEC)

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MP5312	Seminar	EEC	0	0	2	2	**1**
2.	MP5411	Project Work	EEC	0	0	24	24	**12**
			TOTAL	**0**	**0**	**26**	**26**	**13**

OPEN ELECTIVE COURSES (OEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MP5491	Nuclear Energy in Health Care and Industry	OEC	3	0	0	3	3
2.	MP5492	Smart Materials for Energy and Environment Applications	OEC	3	0	0	3	3
3.	EA5491	Climate Journalism	OEC	3	0	0	3	3
4.	EA5492	Digital Photography	OEC	3	0	0	3	3
5.	AC5491	Green Chemistry	OEC	3	0	0	3	3
6.	AC5492	Food Chemistry	OEC	3	0	0	3	3
7.	AG5491	Natural Hazards and Management	OEC	3	0	0	3	3
8.	AG5492	Ocean Resources and Exploration Techniques	OEC	3	0	0	3	3
9.	MC5491	Basic Crystallography and Crystal Growth	OEC	3	0	0	3	3
10.	MC5492	Nonlinear Science	OEC	3	0	0	3	3
11.	MT5491	Statistical Methods	OEC	3	0	0	3	3
12.	HS5491	Professional Email Communication	OEC	3	0	0	3	3
13.	HS5492	Project Report Writing	OEC	3	0	0	3	3
14.	HS5493	Basic Presentation Skills	OEC	3	0	0	3	3

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AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL.NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	AX5091	English for Research Paper Writing	2	0	0	0	1/2
2.	AX5092	Disaster Management	2	0	0	0	
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0	
4.	AX5094	Value Education	2	0	0	0	
5.	AX5095	Constitution of India	2	0	0	0	
6.	AX5096	Pedagogy Studies	2	0	0	0	
7.	AX5097	Stress Management by Yoga	2	0	0	0	
8.	AX5098	Personality Development through Life Enlightenment Skills	2	0	0	0	
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0	
					Total Credits:	0	

SUMMARY

	M.Sc. MEDICAL PHYSICS (2 YEARS)					
	Subject Area	**Credits per Semester**				**Credits Total**
		I	**II**	**III**	**IV**	
1.	FC	04	00	00	00	**04**
2.	PCC	18	16	12	00	**46**
3.	PEC	00	06	06	07	**19**
4.	OEC	00	00	00	03	**03**
5.	EEC	00	00	01	12	**13**
6.	Non Credit/Audit course	✓	✓	00	00	
	Total Credit	**22**	**22**	**19**	**22**	**85**

MP5101 **RADIOLOGICAL PHYSICS** **L T P C**
3 0 0 3

OBJECTIVE

Topics in this paper is designed to

- Make the students to learn about nuclear transformation and atomic physics aspects.
- Familiarize the Students with different interaction mechanism of radiation with matter.
- Ensure the students understand the various dosimetric quantities and concepts.
- Make the medical physics students to learn principles of radiation detection.
- Gain knowledge about various radiation measuring and monitoring instruments.

UNIT I ATOMIC PHYSICS A N D NUCLEAR TRANSFORMATION 9

Structure of matter - atom - nucleus -atomic mass and energy units -distribution of orbital electrons - atomic energy levels -nuclear forces -nuclear energy levels- particle radiation -Electro magnetic radiation- Binding energy - General properties of alpha, beta and gamma rays. Laws of equilibrium – modes of radioactive decay - nuclear isomerism -nuclear reactions - natural and artificial radioactivity - reactor and cyclotron produced isotopes - fission products – fusion.

UNIT II INTERACTION OF RADIATION WITH MATTER 9

Interaction of electromagnetic radiation with matter, Thomson scattering, Rayleigh scattering, Compton scattering, Photoelectric absorption, Pair production – Interaction of light (electrons and positrons) and heavy charged particles with matter–specific ionization – Cerenkov radiation-mass-energy- attenuation and absorption coefficient - Bethe-Block formalism for energy loss by heavy charged particles, mass-collision – Bragg peak, mass-radioactive stopping power, range and path length of charged particles - Interaction of neutron with matter.

UNIT III DOSIMETRIC QUANTITIES AND UNITS 9

Introduction -exposure-Roentgen - photon fluence and energy fluence -KERMA-Kerma and absorbed dose -CEMA -Absorbed dose - Radiation Dose Equivalent - stopping power - relationship between the dosimetric quantities - stopping power ratio.

UNIT IV PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS 9

Principles of Radiation detection – properties of dosimeters - Theory of gas filled detectors – Ion chamber dosimetry systems - free air ion chamber – parallel plate chamber - ionization chamber – proportional chamber - GM counter– thimble chambers working and different applications – film dosimetery- Luminescence dosimetry - TLD - OSLD - semiconductor dosimetry – Gel dosimetry – radiographic and radiochromic films – scintillation detections.

UNIT V RADIATION MONITORING INSTRUMENTS 9

Introduction – operational quantities for Radiation monitoring – Area survey meters – Ionization chambers – proportional counters – neutron area survey meters – GM survey meters – scintillation detectors – Personal monitoring -Pocket Dosimeters– film badge – TLD – Properties of personal monitors.

TOTAL: 45 PERIODS

OUTCOME

Upon completion of the course

- Medical physics students will demonstrate understanding of radiological physics applied to medicine.
- students will able to apply the interaction of radiation knowledge effectively in shielding calculation.
- Will able to apply confidently the concepts of radiation dosimetry in radiation therapy .
- Will be able to measure accurately the radiation dose radiation treatment.
- Will be able to select appropriate monitoring radiation instruments for survey and protection purpose.

Attested

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TEXT BOOKS

1. E.B.Podgorsak, Radiation Physics for Medical Physicists, 3rd Edition, Springer, 2016.
2. F.M.Khan, The Physics of Radiation Therapy, Fifth Edition, Lippincott W il l ia m s and Wilkins, U.S.A.,2015.
3. W. J. Meredith and J. B. Massey, Fundamental Physics of Radiology, John Wright and Sons, U. K., 2000.

REFERENCES:

1. H. E. Johns, J. R. Cunningham, The Physics of Radiology, Charles C. Thomas, New York, 2002
2. Frank Herbert Attix, Introduction to Radiological Physics and Radiation Dosimetry, Wiley-VCH Verlag, 2007.
3. Donald T. Graham, Paul J. Cloke, Principles of Radiological Physics, Churchill Livingstone, 2003.

MP5102 RADIATION GENERATING EQUIPMENT IN MEDICINE L T P C
4 0 0 4

OBJECTIVE

The course is designed

- to enable students to become knowledgeable and technically proficient medical physicists.
- to familiarize the students with design of telecoblat unit and its safety features.
- to gain knowledge about the high energy linear accelerators design and functional aspects.
- to ensure enough information about radiotherapy simulators role in treatment of cancer.
- to make the students develop the knowledge for clinical competence in radiation therapy.

UNIT I TELEGAMMA MACHINES 12

Co60 and Cs137 as teletherapy sources - source containers - international source capsule -effect of penumbra- Types of collimators - beam directing devices – Different Source Shutter Systems-Quality Assurance of telegamma units.

UNIT II PARTICLE ACCELERATORS 12

Particle accelerators for medical applications – Resonant transformer – cascade generator-Van De Graff Generator – Pelletron – Cyclotron – Betatron – Synchro- cyclotron - electron synchrotron-Protron synchrotron

UNIT III LINEAR ACCELERATORS 12

Components of modern linear accelerator-Standing and travelling wave guides, Magnetrons and Klystrons. Bending Magnet, Target, Flattening filter, Collimators Need for high quality portal imaging - Fluoroscopic, diode, crystal, - Diagnostic imaging on a linear accelerator - portal dose images, Portal Dosimetry. TelecobaltVsLinacs.

UNIT IV RADIOTHERAPY SIMULATORS 12

Conventional simulators - CT simulators - cone beam CT simulators (CBCT) - comparison and quality assurance of simulators - different simulation techniques - Virtual Simulation Techniques.

UNIT V ADVANCED RADIOTHERAPY EQUIPMENTS 12

Radio Surgery equipment - Gamma knife - cyber knife - Intra operative radiation therapy units-Tomotherapy -Neutron therapy - Boron Neutron Capture Therapy - proton therapy.

TOTAL: 60 PERIODS

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OUTCOME

Upon completion of the course

- Students will be able perform the operation and quality assurance tests of telecobalt unit effectively.
- Will be able to demonstrate effective utilization of accelerators .
- Students will properly employ the accessories and immobilization devices for radiation therapy.
- will be able to demonstrate competence in simulation procedures for delineating tumor and normal tissues and organs.
- students will demonstrate competence in radiation treatment delivery.

TEXTBOOKS

1. F. M. Khan, The Physics of Radiation Therapy, Fifth Edition, Lippincott Williams and Wilkins,U.S.A.,2015.
2. Radiation oncology physics: A Handbook for teachers and students. IAEA publications 2005.
3. David Greene, P.C Williams, Linear Accelerators for Radiation Therapy, Second Edition, CRC Press, 1997

REFERENCES

1. David Greene, P.C. Williams, Linear Accelerators for Radiation Therapy, 2nd Edition, CRC Press , 1997.
2. Samantha Morris, Radiotherapy physics and equipment, Churchill Livingstone, 2001
3. David M. Hailey, Australian Institute of Health, High Energy Radiotherapy Equipment: A Discussion Paper, Australian Institute of Health, 1989

MP5103 ELECTRONIC CIRCUITS AND MICROPROCESSOR L T P C
3 0 0 3

OBJECTIVE:

- To foster friendly and stimulating learning environment in which students are motivated to reach high standards in the field of medical and Nuclear Electronics.
- To understand the fundamentals of analog and digital electronics and its advancement in modern world.
- To gain knowledge about various radiation detector and its functioning.
- To know the importance of power supplies in nuclear instrumentation.
- To emphasis the electronic circuits in processing and analyzing the signals from radiation detectors.

UNIT I BASIC ELECTRONICS: 9

Semiconductor diodes-JFET- MOSFET- Integrated Circuits- Operational Amplifiers (OPAMP) and their Characteristics- Differential Amplifier-Operational Amplifier Systems-OPAMP Applications – Addition- subtraction- Integration and Differentiation – Active Amplifiers – Pulse Amplifiers – Active filters –oscillator circuits –Relaxation Oscillator -555 timer as an Oscillator.

UNIT II DIGITAL ELECTRONICS 9

Introductory digital concepts-overview of logic functions – fixed function integrated circuits-programmable logic devices – functions of combinational logic –Encoder and Decoder. Flip flops and related devices – counters – shift registers – memory and storage – Introduction to microprocessors – Architecture of 8085 / 8086 – Assemble Language Programming – Peripherals.

UNIT III POWER SUPPLIES IN NUCLEAR INSTRUMENTATION 9

Rectifier – Half wave - Full wave rectifier- Centre Tapped Full wave Rectifier –Transformer-Regulation – AC Regulators- Power Supplies –Regulated Power Supplies using IC's – DC-DC Converter and RF Power Supplies – Switching mode Power Supplies- Voltage Multiplier – Regulating Systems in Nuclear Instrumentation.

UNIT IV NUCLEAR DEVICES 9

Introduction to Nuclear detector - Gas filled Detector – Semiconductor detector -scintillation dose rate meter – scintillator photodiode x-ray detector – high range gamma survey meter circuit – personal monitoring devices- - pocket dosimeter – general purpose contamination monitor.

UNIT V ELECTRONICS FOR NUCLEAR DEVICES 9

Preamplifier – Types of Preamplifier -pulse shaper – isolator – circuit design – Noise and Resolution – Connection between detector and preamplifier – Analog Signal Processing – Base line restoration – Linear gating-Amplitude Analysis - Discriminator – Single Channel Analyzer-Analog to Digital Conversion – Multi Channel Analyzer – Circuits for Time measurement –Time to amplitude Conversion.

TOTAL: 45 PERIODS

OUTCOME:

Students will be able to gain knowledge on

- Electronics in medical instrumentation.
- Understand the fundamentals of analog and digital electronics concepts.
- Aware different radiation detector and its working.
- Know the significance of power supplies in nuclear instrumentation.
- Importance of electronic circuits in processing and analyzing the signals from radiation detectors.

TEXT BOOKS:

1. T.L.Floyd, Electronic devices', (10th edition), Pearson Education Inc., New Delhi,2017.
2. R.F.Coughlin and F.F.Driscoll,'Operational amplifiers and linear integrated circuits', (6th edition), Pearson Education Inc., New Delhi, 2001.
3. T. L. Floyd, Digital Fundamentals, (11th deition), Pearson education Inc., New Delhi,2015.

RERERENCES:

1. S.Brown and Z.Vranesic,'Fundamentals of digital logic with Verilog design' (Third Edition), Tata McGraw Hill PublCo.Ltd., New Delhi, 2013.
2. H.Skalsi, "Electronic instrumentation (Third edition), Tata McGraw Hill Publ. Co. Ltd., New Delhi, 2012. A.P.Malvino, "Electronic principles', (7th edition), Tata McGraw Hill Publication .Co. Ltd., New Delhi, 2007.

MP5104 NON-IONIZING RADIATION PHYSICS IN MEDICINE L T P C
3 0 0 3

OBJECTIVE

This paper provides a broad knowledge on the

- Interaction Of Non-Ionizing Radiation
- Applications of Laser in Medicine
- Ultrasound in tissues and their use in medicine.

UNIT I REVIEW OF NON-IONISING RADIATIONPHYSICS IN MEDICINE 9

Different sources of Non Ionising radiation-their physical; properties-first law of photochemistry-Law of reciprocity- - Electrical Impedance and Biological Impedance - Principle and theory of thermography - applications –

UNIT II TISSUE OPTICS 9

Various types of optical radiations - UV, visible and IR sources - Lasers: Theory and mechanism-Laser Surgical Systems-Measurement of fluence from optical sources - Optical properties of tissues – theory and experimental techniques-interaction of laser radiation with tissues – photothermal -photochemical – photoablation – electromechanical effect

UNIT III MEDIPHOTONICS 9

Lasers in dermatology, oncology and cell biology - Application of ultrafast pulsed lasers in medicine and biology-Lasers in blood flow measurement - Fiber optics in medicine - microscopy in medicine - birefringence - Fluorescence microscope - confocal microscope - Hazards of lasers and their safety measures.

UNIT IV MEDICAL ULTRASOUND 9

Production, properties and propagation of ultrasonic waves- Bioacoustics - Acoustical characteristics of human body- Ultrasonic Dosimetry - Destructive and nondestructive tests - Cavitation - Piezo electric receivers, thermoelectric probe – Lithotropy - High power ultrasound in theraphy

UNIT V RADIO FREQUENCY AND MICROWAVES 9

Production and properties - interaction mechanism of RF and mirocwaves with biological systems: Thermal and non-thermal effects on whole body, lens and cardiovascular systems -tissue characterization and Hyperthermia and other applications-Biomagnetism - Effects - applications.

TOTAL: 45 PERIODS

OUTCOME

Students will be able to understand

- Various sources of Non Ionizing Radiations
- Tiisue Optical Properties
- Use of Laser in dermatology oncology and cell biology
- Ultrasound production and its application in Medicine
- Ultra sound and microwaves for different diagnosis and Therapeutic applications

TEXTBOOKS

1. S. S Martellucci and A. N. Chester, Laser Photobiology and Photomedicine, Plenum Press, New York, 1985.
2. Markolf H. Neimz, Laser-Tissue Interactions, Springer Verlag, Germany, 1996.

REFERENCES

1. J. R. Greening, Medical Physics, North Holland Publishing Co., New York, 1999.
2. R. Pratesi and C. A. Sacchi, Lasers in Photomedicine and Photobiology, Springer Verlag, West Germany, 1980.
3. Harry Moseley, Hospital Physicists' Association, Non-ionising radiation: microwaves, ultraviolet, and laser radiation, A. Hilger, in collaboration with the Hospital Physicists' Association, 1988

MP5105 MATHEMATICAL PHYSICS AND BIO-STATISTICS L T P C
3 1 0 4

OBJECTIVE

- To educate the student with advanced mathematical concepts so that it can be used in future career as medical physicist or researcher.
- To know various vector theorem and their uses.
- To apply matrices and complex analysis for advanced problems.
- To be familiar with Fourier transforms and apply to medical imaging.

UNIT I VECTOR CALCULUS AND MATRICES 12

Scalar and vector fields – Gradient, Divergence, Curl and Laplacian – line, surface, volumeintegrals – Theorems of Gauss, Green and Stokes – Applications, Vector operators incurvilinear co-ordinates Eigen Value, problem, diagonalisation and similarity transformation.

UNIT II COMPLEX ANALYSIS 12

Analytic functions – Conformal mapping- Simple and Bilinear transformation- Applications- Cauchy's Integral Theorem and Integral formula – Taylor's and Laurent's series –Singularities – Zeros, Poles and Residues – Residue theorem- Contour integration with circular and semicircular contours.

UNIT III FOURIER TRANSFORMS 12

Fourier series – Harmonic analysis, Fourier transform- Properties – transforms of simple functions and derivatives- Convolution theorems – Laplace's transform – Properties –Transforms of simple functions and derivatives – periodic functions – Convolution theorem –Applications of Fourier Transform in Medical imaging.

UNIT IV PARTICAL DIFFERENTIAL EQUATIONS 12

Transverse vibration of string – Wave equation – One dimensional heat conduction – diffusion equation – two dimensional heat flow – Laplace's equation – method of separation of variables- Fourier series solution in Cartesian coordinate.

UNIT V PROBABILITY, STATISTICS AND ERROR 12

Laws of probability, conditional probability, collection, tabulation and graphical representation of data.measures of central tendency, mean, median, mode, dispersion, standard deviation, root mean square deviation, moments, skewness and kurtosis. Application to radiation detection – error propagation, Binomial distribution, poisson distribution, gaussian distribution, exponential distribution, Bivariate distribution, Correlation and Regression-Chi-Square distributiont-distribution- F – distribution – Principle of Monte Carlo Simulation.

TOTAL: 60 PERIODS

OUTCOME

- The student will be able to apply advanced mathematics for practical solution.
- Will learn fundamental and advanced concepts for applying in the research field
- Will understand the uses of mathematics in medical imaging.
- apply partial differential equation to physical problems.
- apply statistics and Monte Carlo simulation in diagnostics.

TEXTBOOKS

1. Pipes L.A. &Harvill L.R, Applied Mathematics for Engineers and Physicists (3rd edition), Dover Publications, 2014.
2. Butkov E. Mathematical Physics, Addison Wesley, New York, (2nd edition 2010) .
3. Sathyapraksh, Mathematical Physics, Sultan chand& Co., New Delhi, 1994.

REFERENCES

1. Walpole,E, Myers,R.M, Myers,S.L and Ye,K, "Probability & Statistics for Engineers and Scientists (9th edition), Pearson Education, 2013.
2. Arfken, Weber, and Harris, Mathematical Methods for Physicists, 7th edition, Elsevier, 2012.
3. S.C.Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2014.

MP5111 ELECTRONICS LABORATORY L T P C
0 0 6 3

OBJECTIVE

- To design different analog electronic circuits and that can perform various arithmetic operations, amplification, filters and power supplies etc.
- To design the digital electronic circuit and understand the functioning of logic gates, flip flop and register.
- To train the students to understand and write assembly language programs and executes it in the microprocessor kit 8085.
- Train students to design electronic circuits and verify the laws of physics.
- To design and characterization of different sensors for biomedical applications.

Attested

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ANY TEN EXPERIMENTS

1. Dual regulated power supply
2. Astable & Monostable multivibrator design
3. Implementation of Boolean Expressions using Universal Gates.
4. Operational Amplifier - Characteristics of summer, difference amplifier and integrator, Comparator Circuit, Schmitt Trigger
5. Filters - high pass, low pass and band pass
6. Programming using Microprocessor 8085 / 8086
7. IC regulated power supply
8. Flip Flop, JK & RS using Logic Gates.
9. Half Adder & Full Adder
10. Instrumentation amplifier Op-Amp
11. Digital Circuits for Measurements.
12. Data Transfer using Shift Register.
13. Hall Effect Measurement
14. Verification of Ohm's law and Kirchoff's law
15. Characterization of light sensors: LDR, Photodetector and Photo-multiplier
16. Characterization of temperature sensors: Thermistors. Band-gap determination by Bridge amplifier

TOTAL: 90 PERIODS

OUTCOME:

The student will gain practical knowledge on

- Analog electronic circuit and devices.
- Digital electronics and understand functioning of digital components and devices.
- Programming using microprocessor 8085.
- Implement physical laws through electronic circuits.
- Design and characterization of different sensors.

MP5112 ENGINEERING GRAPHICS LABORATORY L T P C
0 0 4 2

OBJECTIVE

Creating awareness to the students on

- fundamentals of graphics
- Engineering Drawing
- Handling Of Machine Tools Including CNC Machines

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1. **ENGINEERING GRAPHICS**

Drawing Instruments and their uses, lines, lettering and dimensioning – orthographic projections – section of solids, Isometric projections – Isometric views of simple objects such as square, cube and rectangular blocks – Free hand sketching of nuts, bolts, rivets and washers with dimensions, from samples – BIS standards and codes (Elementary treatment)

TOTAL: 60 PERIODS

OUTCOMES

To make the students to understand the

- Concept on basic drawing / graphics
- Design the radiotherapy room
- Visualization of the 3D images from 2D pictures

REFERENCE

1. N.D.Bhatt. Elementary Engineering Drawing.Charater Publishing Co. 1990.

MP5201 **ANATOMY AND PHYSIOLOGY** **L T P C**
3 0 0 3

OBJECTIVE

This paper is designed in such a way that the student will

- Identify gross anatomical structure.
- Define the major organ and understand their function.
- Understand the physiological mechanism for repair maintenance and growth.
- Knowledge on physics and chemistry of different organs.
- Able to correlate with the imaging modalities used to view them.

UNIT I HUMAN ANATOMY OVERVIEW 9

Applications, History- Cells, structure and functions, sex cells, early development - The tissues - the systems - skin, cartilage and bone - Bacteria - Inflammation - injection - ulceration - neoplasm, bones - the skeleton - joints - The skeletal system - the skull - vertebral column, thorax etc. - the muscular system - the thoracic cage - the mediastinum, the diaphragm the abdominal cavity and abdominal regions - anatomy of the heart.

UNIT II DIGESTIVE AND CIRCULATORY SYSTEM 9

Functions of mouth, tongue, teeth, esophagus, stomach, small intestine, large intestine - digestion and assimilation of carbohydrates - Fats and proteins - Gastric juice - Pancreatic juice - Function of liver and spleen, blood and circulatory system, Blood and its composition, RBC and WBC - blood grouping - coagulation of blood, artery, vein, capillaries and heart structure and functions - Physiological properties of heart muscle, cardiac dynamics - ECG - blood pressure and its regulation.

UNIT III RESPIRATORY, REPRODUCTION AND EXCRETORY SYSTEMS 9

Physical laws of respiration - Trachea - lungs and its functions - oxygen transport - nervous regulation of respiration. Hormonal control over reproduction.Kidney and its functions - water and electrolyte metabolism.

UNIT IV ENDOCRINE SYSTEM 9

Pituitary glands and its functions - functions of adrenal, thyroid etc. secretion - chemistry - physiological actions, effect on removal effect on administration, hormonal assay detailed molecular mechanism of hormone action.

UNIT V NERVOUS SYSTEM 9

Brain and spinal cord - its functions - central nervous system and Autonomic Nervous system functions - Physiology of special senses of hearing, taste vision etc.

TOTAL: 45 PERIODS

OUTCOME

After completion of the course the student will be able to

- Identify and describe the structure and function of different human systems
- Obtain an overview on human anatomy.
- Will understand the constituents and functions of digestive, circulatory and respiratory systems.
- Will be able to correlate the physical and chemical action of various organs.
- Apply the knowledge of harmones and their molecular mechanism in disease diagnosis

TEXTBOOKS

1. C. H. Best and N. B. Taylor, A Test in Applied Physiology, Williams and Wilkins Company, Baltimore, 1999.
2. C. K. Warrick, Anatomy and Physiology for Radiographers, Oxford University Press, 2001.
3. Ross and Wilson, Anatomy and Physiology.

REFERENCES

1. J. R. Brobek, Physiological Basis of Medical Practice, Williams and Wilkins, London, 1995.
2. Edward Alcamo, BarbaraKrumhardt, Barron's Anatomy and Physiology the Easy Way, Barron's Educational Series, 2004
3. Lippincott, Lippincott Williams & Wilkins, Anatomy and Physiology, 2002.
4. W. E. Arnould-Taylor, A textbook of anatomy and physiology, Nelson Thornes, 1998.

MP5202 NUMERICAL METHODS AND MATLAB L T P C
4 0 0 4

OBJECTIVE

- Emphasizing the role of numerical methods for solving problems arising in different areas of applied physics and equip the students with the skill required for Biomedical application.
- Acquire knowledge on efficient numerical approaches to deal with discrete experimental data.
- To know the behavior of the approximation error as a function of integral evaluation. Utilize the numerical methods for handling large system of equation with different degrees of nonlinearities.
- To acquire knowledge about different curve fitting methods and help them to develop empirical equation.
- Train the students to implement the numerical methods in MATLAB computing platform.

UNIT I SOLUTIONS OF EQUATIONS 12

Roots of equations - Methods of bisection & false position - Newton-Raphson method - Simultaneous equations - Gauss elimination - Gauss Jordan methods - matrix inversion andLU decomposition method - Gauss-Seidel iterative method - Eigenvalues of matrices –Powermethod, Jacobi's method.

UNIT II INTERPOLATIONS 12

Finite differences- Forward –Backward- Central differences-Newton-Gregory forward, backward interpolation Formulae for equal intervals-Missing terms-Lagrange's interpolation formula for unequal intervals-Inverse interpolations.

UNIT III DIFFERENTIATION, INTEGRATION AND DIFFERENTIAL EQUATIONS 12

Numerical integration - Trapezoidal rule and Simpson's rule - Numerical solution of ordinary differential equations - Taylor series - Euler's method, improved and modified methods - RungeKutta methods - Milne's predictor -corrector method

UNIT IV CURVE FITTING 12

Curve fitting – linear law – graphical method – method of group averages – with two and three constants - principle of least squares – straight line, parabola and exponential curve fitting – Estimation of residuals – method of moments.

UNIT V MATLAB PROGRAMMING 12

Arrays- – arithmetic operations and shorthand notations – loops and conditional operators – Toolbox – Curve fitting – elementary examples of programs (three programs at least from each of the above units)

TOTAL: 60 PERIODS

Attested

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OUTCOME

The students will be able to

- Gain knowledge on numerical methods for solving different problems in biomedical applications.
- Utilize the numerical methods in experiment data
- Understand the behavior of approximations and have capability to solve system of equations.
- Aware about different curve fitting methods which leads to develop empirical equations.
- Students can be trained to do numerical computation using MATLAB.

TEXTBOOKS

1. M. K. Venkatraman, "Numerical Methods in Science and Engineering", National Publishing Company, Madras, 1996
2. MATLAB: An Introduction with Applications, Amos Gilat, Wiley, 2012.

REFERENCES

1. Bracewell, R. N, The Fourier Transform and its applications, McGraw Hill International Edition, 2000
2. S. S. Sastry, Introductory Methods of Numerical Analysis (5th edition), Prentice Hall of India, New Delhi, 2012.
3. Applied Numerical Analysis Using MATLAB, Laurene v. Fausett, Pearson, 2009.

MP5203 RADIATION DOSIMETRY AND TREATMENT PLANNING L T P C
4 0 0 4

OBJECTIVE

To provide the knowledge on the

- Dosimetric Concepts
- Importance of Treatment Efficacy and Quality
- Accuracy of Radiation Therapy Treatments through Improved Clinical Dosimetry.

UNIT I DOSIMETRIC CONCEPTS AND QUANTITIES 12

Introduction -exposure-Roentgen - photon fluence and energy fluence –fluence rate – Vector radiometric quantities – absorbed dose – KERMA - CEMA - stopping power - relationship between the dosimetric quantities - cavity theory- Bragg gray theory – spencer – attrix cavity theory – Burlin cavity theory - Interaction coefficients – mass attenuation coefficients, mass energy transfer coefficients, mass energy absorption coefficient, stopping power (collision and radiative), Linear Energy Transfer (LET).

UNIT II CALIBRATION, MEASUREMENT AND QUALITY ASSURANCE OF TELETHERAPY UNITS 12

Dosimeter based on current measurement – different type of electrometers – MOSFET – secondary standard therapy level dosimeters – farmer dosimeters – radiation field analyzer (RFA)— water phantom dosimetry systems – calibration and maintenance of dosimeters.IAEA TRS 398 protocol for the calibration of teletherapy units - -Definition of calibration coefficients -Nx,Nk,ND,air,ND,w -calibration of the cobalt telegamma units – cross calibration of the chambers –calibration of High Energy photon beams - calibration for electron beams. IAEA TLD postal inter comparison. AAPM Task Group142 report: Quality Assurance of medical accelerators.

UNIT III RADIATION TREATMENT PLANNING PARAMETERS 12

Build-up, - Skin Dose - central axis depth doses for different energies and their determination - Tissue Air Ratio, Tissue Maximum Ratio and Tissue Phantom Ratio - their relationship - back scatter factor–phantom scatter factor –collimator scatter factor - source to surface distance – dependence of SSD

UNIT IV BEAM DATA ACQUISITION AND MODELLING & COMMISSIONING 12

Measurements of percentage depth dose and profiles – photon beams and electron beams-use of various detectors in relative dosimetry – Diamond Detectors - Semiconductor detectors - measurements of conventional and dynamic wedge profiles-Quality Assurance of treatment planning systems IAEA TRS 430 protocol.AAPM TG 53 and 106 protocols.

UNIT V EXTERNAL BEAM TREATMENT PLANNING ASPECTS 12

Treatment positioning - immobilization -Patient data acquisition from CT and MRI - Image registration and fusion - contouring – Introduction to ICRU 50/62. correction for contour irregularities - correction for body inhomogenities- O'cono's density scaling theorem,Batho and modified batho methods.TAR , effective TAR, Effective Path length differential TAR and delta volume method. Photon beam algorithm-Pencil Beam Algorithm, Collapsed Cone Convolution, Analytical Anisotropic Algebraic Algorithm – Monte carlo –Comparison of algorithms – generalized pencil beam algorithms and electron montecarlo algorithms.

TOTAL: 60 PERIODS

OUTCOME

The Students will be able to understand about

- Calibration of Radiation dosimeters
- Calibration and Quality Assurance of Telecobalt
- Calibration and Quality Assurance of Linear Accelerator
- Radiation treatment Planning System and their protocols
- Treatment planning Algorithms and principles

.TEXTBOOKS

1. F M Khan-Physics of Radiation Therapy, 5 t h Edition, Liippincott Williams &Wilkins,USA, 2015.
2. W. R. Hendee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.
3. Kristina Bliznakova, Ivan Buliev and ZhivkoBliznakov ,Anthrophomorphic Phantoms in Image quality and patient dose Optimization - part of IPEM-IOP Series in Physics and Engineering in Medicine and BIology, 2018.

REFERENCES

1. R. F. Mould, Radiotherapy Treatment Planning, Medical Physics Hand Book Series No. 7, Adam Hilger Ltd., Bristol, 1981.
2. Khan, Faiz M. Treatment Planning in Radiation Oncology, 2nd Edition Lippincott Williams & Wilkins, 2007
3. Edward C. Halperin, Carlos A. Pérez, Luther W.. Brady, Perez and Brady's principles and practice of radiation oncology, Lippincott Williams & Wilkins, 2008
4. Gunilla C. Bentel, Charles E. Nelson, K. Thomas Noell, Treatment planning and dose calculation in radiation oncology, McGraw-Hill, 1989.
5. AntoniRodolphe, Bourgois Laurent, Applied Physics of External Radiation Exposure, 1st Edition, Springer publisher, 2017.

MP5211 BIOMEDICAL INSTRUMENTATION LABORATORY L T P C
0 0 6 3

OBJECTIVE

- To familiarize on electronic circuits used in biomedical instrumentation
- To give hands-on training to students on fundamental radiation detecting equipments
- To train the students to correlate the physical principles and the collected data

(Any TEN experiments)

1. ECG Preamplifier
2. EMG Amplifier.

3. Bridge Amplifier.
4. Pacemaker
5. ECG pattern generation
6. Digital - Analogy & Analog-Digital Converter.
7. Ultrasonic Interferometer
8. Flaw detection using Ultrasonic flaw detector
9. Acoustic Grating
10. Dielectric Properties of bio-molecules
11. Polarimeter : Determination of Optical Rotatory power
12. Gamma Ray Spectrometer (GRS)- Strength of the source
13. G. M Counter: Determination of Attenuation Co-efficient
14. GRS energy resolution characteristics.
15. G. M Counter: verification of inverse square law for γ-ray.
16. Study of characteristics of GM tube and determination of operating voltage and plateau length.

TOTAL: 90 PERIODS

OUTCOME

- Students can construct their own circuits for pacemaker
- Can understand the functioning of the heart from the ECG patterns, thus diagnose the defects in the pattern
- Perceive the interaction of sound with matter and they can mimic and detect the flaws present in the system
- Can identify the strength of the radioisotope
- Measure the attenuation coefficient of the given or created material

MP5212 BIOMEDICAL DIAGNOSTIC LABORATORY L T P C
0 0 4 2

OBJECTIVE

- To provide knowledge on various state of the art spectroscopic equipments.
- To characterize various biomolecules using spectrometer experiments.
- To estimate physio-chemical properties of biological molecules.
- To determine the components in the blood sample.
- To estimate the elasticity of biomolecules.

(Any TEN experiments only)

1. Estimate the concentration of the given sample from UV-Vis Spectra using Beer- Lambert Law
2. Characterization of various biomolecules using UV-Vis Spectrometer.
   a) Characterization of urine using Raman Spectrometer/ Fluorescence Spectrometer.
   b) Characterization of blood using Raman Spectrometer/ IR Spectra.
3. Determination of the pH of the given solution and shift the pH to acidic and basic by molar addition of H^+ and OH^- salt solution.
4. Determine the Haemo-compatability of the blood samples using prepared normal saline.
5. Identify cell viability using Fluorescence microscope.
6. Preparation of protein solution and evaluating the functional groups using ATR-FTIR spectroscopy.
7. Study of FTIR vibration characteristics of biomolecules.
8. Determine protein fluorescence characteristics.
9. Estimation of urea concentration in the blood sample.

Attested

10. Estimation of degree of polarization and anisotropy of molecules at different temperature.
11. Estimate the blood group in the given sample.
12. Estimate the cholesterol level in the blood.
13. Estimate the sugar level in the blood.
14. Characterization of biomolecules using Raman Spectra.
15. Evaluate drug-DNA interaction using spectrofluorometer.
16. Young's modulus of bone.

TOTAL: 60 PERIODS

OUTCOME

The students will gain the practical knowledge and hands-on experience on

- measure basic calibration methods.
- Various state-of-the-art spectroscopic equipments.
- Characterize the biomolecules and estimate its physio-chemical properties.

MP5301 BRACHYTHERAPY PHYSICS L T P C
3 0 0 3

OBJECTIVE

To develop the knowledge on

- The Physics of Low Dose Rate Brachytherapy
- The high dose rate Brachytherapy
- Brachytherapy dosimetry.

UNIT I DEFINITIONS AND CLASSIFICATION 9

Definitions and classification of brachytherapy based on the dose rate, (LDR, MDR, HDR, PDR) based on techniques (Intracavity, interstitial, intraluminal and surface mould) – Applicators used in Brachytherapy - temporary and permanent implants. AAPM and IEC requirements for remote afterloading HDR Brachytherapy equipment.Acceptance, commissioning and QA of HDR brachytherapy equipments.

UNIT II RADIONUCLIDES AND THEIR PROPERTIES 9

Introduction – properties of ideal radionuclide – production and construction of sealed source – Radium (needles), Cobalt -60(HDR and LDR), Cesium -137(LDR), Gold-198(LDR seeds), Iridium-192(HDR and LDR), Iodine-125 (LDR seeds), Cesium- 131(LDR seeds)- Californium-252. ISO requirements and QA of Brachytherapy sources.

UNIT III DOSIMETRY 9

Source specification – concept of exposure rate constant, reference air kermarate, apparentactivity, airkermastrength, Primarystandard, watercalorimetry,Nk factor for Iridium 192 HDR calibration, room scatter correction–Stockholm System-. Manchester system- Paris System –Point and line source dosimetry formalisms, Sievert integrals TG43/TG43 U1 dosimetry formalism. IAEA TECDOC 1274.

UNIT IV CLINICAL PRACTICE 9

Applicator reconstruction and treatment planning- Model based dose calculation algorithms-optimization methods- intracavitary& Interstitial HDR Brachytherapy - ICRU38 and ICRU89-ICRU58 Recommendations.

UNIT V ADVANCED BRACHYTHERAPY SYSTEMS 9

Accelerated Partial breast irradiation using balloon catheter –Intra-operative Brachytherapy - Integrated Brachytherapy unit-electronic brachytherapy – IMBT-micro Brachytherapy .AAPM TG60 Protocol for intravascular brachytherapy-Image guided adaptive brachytherapy.

TOTAL: 45 PERIODS

OUTCOME

Students will be able to decide and use

- Basics of Brachytherapy
- Different Types Of Radioisotopes
- Different dose delivery techniques in Brachytherapy.
- Various Reconstruction techniques
- Advanced techniques in Brachytherapy

TEXTBOOKS

1. D Baltas, Taylor and Francis , The physics of modern brachytherapy for oncology,. 2007.
2. F.M.Khan,The Physics of Radiation Therapy, 5th Edition,Lippincott Williams and Wilkins,U.S.A., 2015.
3. Phillip.DevlinBrachytherapy: Applications and Techniques1 edition Lippincott Williams and WilkinsU.S.A. 2010.
4. D. Baltas, Taylor and Francis, The physics of modern brachytherapy for oncology, 2007.

REFERENCE:

1. Principles and Practice of Brachytherapy, CAJoslin, Flynn, EJhall, Arnold Publications,2001
2. ESTRO handbook of brachytherapy, 2002 .
3. AAPM summer school, Brachytherapy physics, 2005.
4. Peter Hoskin, Catherine Coyle, Radiotherapy in Practice, Oxford University Press,2011
5. Guidelines by the AAPM and GEC-ESTRO on the use of innovative
6. Brachytherapy devices and applications: Report of AAPM TG167. 2016.

MP5302 BIOMEDICAL INSTRUMENTATION L T P C

3 0 0 3

OBJECTIVE

To enable the student to understand

- The physics and theory behind the bio electric signal recording,
- Physiological assist devices,
- operation theater equipments and biotelemetry and their safety measures.

UNIT I BIOPOTENTIAL ELECTRODES AND TRANSDUCERS 9

Cell structure-nature of cancer cells - Transport of ions through cell membrane - Resting and action potential - half cell potential - bioelectric potential - design and co;mponents of medical insturments - electrodes - surface, needle, depth electrodes - electrical circuits.

UNIT II BIOELECTRIC SIGNAL RECORDING 9

Introduction-characterstics of recording systems – Electrodcardiography (ECG) - Electroencephalograph (EEG) - Electromyograph (EMG)- Electroneurograph (ENG) - recoring units.

UNIT III PHYSIOLOGICAL ASSIST DEVICES 9

Cardiac pacemakers - natural and artificial pacemakers - pacemaker batteries - defibrillator -A. C./D. C. synchronized defibrillator - stimulators - bladder stimulators - Heart lung machine - Various types of oxygenators - kidney machine - hemodialysing units - peritoneal dialysis.

UNIT IV CLINICAL AND OPERATION THEATER EQUIPMENTS 9

Flame Photometer - Spectroflurometer - pH meters - Audiometer - endoscopes - Electromagnetic and laser blood flow meters - ventilators - diathermy units - ultrasonic, microwave and short wave diathermy – Types and their applications – Surgical diathermy.

UNIT V BIOTELEMETRY AND SAFETY INSTRUMENTATION 9

Principles of a biotelemetry system: radiotelemetry with subcarrier - multiple channel telemetry systems - problems in implant telemetry - uses of biotelemetry – physiological effects of 50Hz current - microshock and macroshock - electrical accidents in hospitals – devices to protect against electrical hazards.

TOTAL: 45 PERIODS

OUTCOME

To make the students to familiarize on

- Nature of human cells
- Signal Recording in Human body
- physical design of the devices
- Spectroscopy
- Maintenance of different biomedical instrument used in medical field.

TEXTBOOKS

1. M. Arumugam, Biomedical Instrumentation, Anuradha Publishing Co., Kumbakkonam, Tamilnadu, 2004.
2. S. Ananthi, A Textbook of Medical Instruments (Paperback), New Age International Private Limited , January 2005

REFERENCES

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi, 1990.
2. Richad Aston, Principles of Biomedical Instrumentation and measurement, Merrill Publishing Co., London, 1990.

MP5303 MATERIALS FOR IMPLANT APPLICATIONS L T P C
3 0 0 3

OBJECTIVE

To provide knowledge on

- The physics of materials such as metals, polymers, ceramic, composites and their differences
- Preparation of bio compatible and heamocompatible materials ,their Characterization and their use as bioimplants
- Materials used in ophthalmology, Orthopedics and Cardiovascular applications

UNIT I CLASSES OF MATERIALS USED IN MEDICINE 9

Polymers – principles – Polyurethene - Silicone & acrylics - Hydrogels - degradable and resorbable biomaterials-Metals and alloys; stainless steel, cobalt based alloys, titanium based materials – ceramics – bioinert ceramics – carbon, alumina, zircona and titania – bioactive ceramics – bioactive glass and glass ceramics, calcium phosphate ceramics –composites, matrix and filter components.

UNIT II BIOLOGICAL PERFORMANCE OF MATERIALS AND CHARACTERIZATION TECHNIQUES 9

Surface properties & surface Characterization-Contact angle-ESCA- SIMS- IR spectroscopy - microscopic methods - SEM-IR, visible, UV and X-ray methods, differential thermal analysis, differential thermogravimetric analysis, NDT methods-Biofunctionality and biocompatibility – material response – deformation and failure – friction and wear-corrosion – Host response – Inflammatory process – capsule formation – coagulation and hemolysis – approach to thromboresistant material development – chemical and foreign body carcinogenesis.

UNIT III OPHTHALMOLOGIC APPLICATIONS AND DRUG DELIVERY SYSTEMS 9

Materials for ophthalmology – contact lens and intraocular lens materials – Corneal Implants-Implants for Glaucoma-Implants for Retinal Detachment surgery- drug delivery systems - Diffusion Controlled-Water penetration controlled –Chemically Controlled-Regulated Systems-Sutures materials-categories and Characteristics.

UNIT IV ARTIFICIAL ORTHOPEADIC AND DENTAL MATERIAL 9

Materials for bone and joint replacement –dental metals and alloys – ceramic – bioinert – bioactive ceramics – polymers - dental restorative materials – dental amalgams-Burn dressing–Principles of wound coverage and healing-Nano Biomaterials.

UNIT V CARDIOVASCULAR MATERIALS 9

Artificial organs – cardio vascular materials– cardiac prosthesis; vasculargraft materials cardiac pacemakers – cardiac assist devices – Extra corporeal Artificial organs –Dialysis-Heamofiltration-Apheresis-Lung Substitutes and Assists.

TOTAL: 45 PERIODS

OUTCOME

- To design , develop and Understand about new abutments
- Understand about Various material Characterization
- Design of new hydrogel bio compatiable materials .
- Design of New nano material based Drug Delivery systems
- Development of new polymers for extracorporeal devices

TEXTBOOKS

1. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science “An Introduction to Material in Medicine” Third Edition, 2013.
2. Jonathan Black, Biological Performance of materials, Fundamentals of Biocompatibility, Marcel Dekker Inc., New York, 1992.

REFERENCES

1. D. F. Williams (editor), Material Science and Technology - A comprehensive treatment, Vol. 14, Medical and Dental Materials, VCH Publishers Inc., New York, 1992.
2. Sujatha.V..Bhat II Edition Alpha Science 2005
3. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBS Publishers, New Delhi, 1986.
4. AmitBandhyopadhya, Susmita Bose, Characterization of Biomaterials, Newnes, 2013

MP5311 RADIATION DOSIMETRY AND TREATMENT PLANNING LABORATORY L T P C
0 0 6 3

OBJECTIVE

The experiments are designed to gain practical knowledge

- About the use of manual treatment planning system.
- Accelerator, telecobalt, brachytherapy, computer based TPS.
- G.M counter and Gamma spectroscopy techniques for clinical application purpose.

(**Any Ten experiment only)**

1. To draw a dose distribution for a parallel and opposing field- SSD technique.
2. To draw a dose distribution for a parallel and opposing field- SAD technique.
3. To draw a dose distribution for a parallel and opposing field- Grid technique.
4. To draw a dose distribution for a parallel and opposing field- Wedge technique.
5. To draw a dose distribution for a Ca. Esophagus using three field technique.
6. To draw a dose distribution for a Ca. Buccal Mucosa using two wedge field technique.
7. To draw a dose distribution for a Ca. Cervix using four field technique.
8. To draw a dose distribution for a Ca. pituitary gland using three field technique.

9. To study quality assurance of a diagnostic x-ray machine.
10. To measure output calibration of a telecobalt unit.
11. To study the calibration of photon beam and electron beam energies using IAEA protocol.
12. To study the radiation survey of linear accelerator, telecobalt and brachytherapy installation.
13. To study the measurements of beam characteristics of photon and electron beam.
14. Air kerma strength measurement of an HDR brachytherapy source using well type and cylindrical ionization chamber.
15. Determination of virtual source position for electron beam.
16. To study the back scattering of beta particle using GM Counter.
17. To study the production and attenuation of Bremsstrahlung using GM Counter.
18. To study the short half-life of radioisotopes using GM Counter.
19. To study the spectrum analysis of Cs-137 and Co-60 using GRS.
20. To study Cs-137 spectrum, calculation of FWHM and resolution for a given scintillation detector using GRS.
21. To study the unknown energy of a radioactive isotopes using GRS.
22. To study the energy resolution with gamma energy using GRS.

TOTAL: 90 PERIODS

OUTCOME

Students will be able to

- carryout the planning for various field techniques independently,
- carryout the quality assurance tests
- Able to calibrate of radiation generating equipment
- Will be able to do all clinical beam characteristics measurements
- Familiarized about computerized treatment planning techniques

MP5001 MEDICAL IMAGING TECHNIQUES L T P C
3 0 0 3

OBJECTIVE

- Explain the Physical principles behind the diagnostic ultrasound and their limitations
- To illustrate how electromagenetic spectrum is used in Medical imaging
- How to exploit the parameters in getting better resolution and contrast in Medical image.

UNIT I DIAGNOSTIC ULTRASOUND 9

Ultrasonic waves - Beam characteristics –- attenuation of ultrasound - Specific acoustic impedance - reflection at body interfaces-Coupling medium- Interaction ultrasound with tissues -A scan B scan and M mode-real time scanners Image clarity - Resolution –axial and lateral resolution - Artifacts-Pulse echo imaging- Obsterics abdominal investigations Echo cardiograph (UCG) – The Doppler Effect-Doppler Shift- continuous wave Doppler system-pulsed wave Doppler systems - duplex scanning - display devices for ultrasonic imaging.

UNIT II MAGNETIC RESONANCE IMAGING: 9

Basic principles – Spin – Precession – Relaxation time – Free induction decay – T1, T2 proton density weighted image – Pulse sequences - Basic and advance Pulse sequences – MR instrumentation –– Image formation–Localisation of the signal - Factors influencing signal intensity- contrast and resolution - MR Spectroscopy- fMRI – MR Artifacts – safety aspects in MRI.

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UNIT III X-RAY IMAGING SYSTEMS 9

Production of X-ray - Bremsstralung-characteristic line spectrum- factors affecting the x-ray spectrum- Focal spot - Heel Effect - X ray generators - Attenuation of heterogeneous and homogenous x-rays – Attenuation coefficients- Attenuation mechanisms - X-ray film - Intensifying Screens - Computed Radiography - Digital Radiography - Radiographic image quality-factors affecting image quality- Filters – Grids - Diagnostic applications of X-rays- - Fluoroscopy - mobile and dental x- ray machine-mammography.

UNIT IV CT 9

Basic Principle - Generation of CT- Helical CT - Slip ring Technology - Single slice and Multi slice CT scan system - Image reconstruction - post processing technique - CT artifacts.

UNIT V THERMOGRAPHY AND OPTICAL IMAGING TECHNIQUES 9

Physics of thermography - infrared detectors –thermographic equipments - quantitative medical thermography - pyroelectric video camera - applications of thermography - Fluorescence Imaging –Fluorescence Life-time Imaging –OCT- Electrical impedance tomography (EIT) – Electrical Source Imaging (ESI) – Magnetic Source Imaging (MSI).

TOTAL: 45 PERIODS

OUTCOMES

On completion, students will be able to:

- The student can be able to discuss the principle and working of State of the Art imaging techniques Viz., MRI,CT PET ,SPECT
- Identify the suitable medical imaging method for clinical and biomedical research
- Describe Methods For Generating 2D And 3D Medical Images.
- Learn About the importance of image fusion such as PET-CT
- Understand about applications of Fluorescence and Thermographic imaging

TEXTBOOKS

1. Christensen',s Physics of Diagnostic Radiology by Thomas S Curry, IV Edition, Lippincott Williams & Wilkins, 1990.
2. The Essential Physics for Medical Imaging–2nd Edition–Jerrold T Bushberg, Lippincott Williams & Wilkins 2002.
3. Medical Physics: Imaging, Jean A. Pope, Heinemann Publishers, 2012
4. MRI – Perry Sprawls – Medical Physics Publishing, Madison, Wisconsin-2000.

REFERENCES

1. Advances in Diagnositc Medical Physics – Himalaya Publishing House-2006.
2. Diagnositc Ultrasound applied to OBG – Sabbahaga – Maryland -1980.
3. Essentials of Nuclear Medicine Imaging. F A Mettler,MJ Guibertau,Saunders, 2005.
4. Molecular Imaging FRET Microscopy and Spectroscopy Edited by AmmasiPeriasamy and Richard N Day, Oxford Press 2005.

MP5002 BIOPHOTONICS L T P C
3 0 0 3

OBJECTIVE

- To impart knowledge about various Lasers and their interaction Mechanism with tissues
- To gain knowledge about optical properties of turbid media
- To explain light transportation in biological system

Designed to provide the knowledge for use of different laser spectroscopic methods in bioanalysis

UNIT I TISSUE OPTICS : 9

Light and matter interaction-Absorption-Scattering—absorption length- Mean Free optical path length-Turbid Media- Optical albedo- Optical depth- Photon Transport theory- First orderscattering-Kubelka-Munk theory- Diffusion Approximation- Monte Carlo Simulations-Inverse Adding Doubling Method- Tissue optical properties- Integrating sphere Method

UNIT II LASER – TISSUE INTERACTION AND MEDICAL LASER 9

Laser tissue interaction - photophysical process - photobiological process - absorption by biological systems - different types of interactions - thermal - photochemical (one photon and multiphoton) - electro mechanical photo ablative process. Laser systems for biophotonics- CO_2Laser. Nd-YAG Laser - Ar Ion Laser - Excimer laser- Diode lasers- Ti :Sapphire Laser- Beam Characteristics and Radiometry – 12

UNIT III THERAPEUTIC APPLICATIONS 9

Evaporation and excision techniques - sterilization - hemostasis - - cancer surgery - liver surgery - stomach surgery - gynecological surgery - urological surgery - cardiac surgery- lasers in Ophthalmology – Dermatology and Dentistry – cosmeticsurgery – Laser – Tissue Welding and Regeneration- Femto laser surgery- Photodyanmic therapy- LLLT

UNIT IV SPECTROSCOPY AND IMAGING 9

Electronic Abosortion – Emission spectropscopy _ Diffuse Reflection – Vibrational Spectroscopy - Fluorophores: Endogeneous – Exogeneous Near IR – IR Fluorophores- Nanoflorophores- Fluorescence Microscopy – Multiphoton Confocal Microscope – Cellular & Tissue Imaging – FRET- FLIM- Fundamentals of OCT

UNIT V NANOPHOTONICS AND LASER SAFETY 9

Nano Materials- Quantum Dots – Nano Rods - Up converting nanomaterials - Nano Imaging and PDT- Laser hazards – Eye Hazards – Skin Hazards – Other Associated Hazards – Safety Measures & Standards.

TOTAL: 45 PERIODS

OUTCOME

- The student can able to design different laser spectrometers
- With the knowledge of Laser –Tisssue interactions they can choose laser of right wavelength with optimum power for various therapeutic applications
- Learn about the use of various devices for spectroscopic analysis and imaging of cells and tissues
- Apply suitable lasers for various clinical Applications
- Can handle lasers with care and precautions

TEXTBOOKS

1. Markolf H Niemz, Laser-Tissue Interactions Fundamentals and Applications, Springer-Verlag Berlin Heidelberg New York,1996.
2. Paras N Prasad, Introduction to Biophotonics , Wiley Interscience, 2003
3. A.J.Welch, M. Van Germet, Optical Thermal Responseof Laser-Irradiated Tissue, Plenum press, NY,1995.

REFERENCES

1. Joseph RLakowitz, Principles of Fluorescence spectroscopy, Plenum press, NY,2002.
2. William W .Parson, Modern Optical Spectroscopy:With Exercises and Examples from Biophysics and Biochemistry, Springer,2009.
3. Nikolai V. Tkachenko, Optical Spectroscopy: Methods and Instrumentations, Elsevier,2006

MP5003 NUCLEAR MEDICINE L T P C
3 0 0 3

OBJECTIVE

- Designed to impart knowledge about the production of Radioisotope
- To provide knowledge on the use of unsealed radioactive isotopes in diagnosis and radiation medicine.
- To impart knowledge on radionuclide imaging and dosimetry

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UNIT I RADIO NUCLIDE AND RADIOPHARMACEUTICALS 9

Basic Physics of Nuclear Medicine - Atom- Nuclear structure- Nuclear nomenclature- Nuclear stability curve – Radioactivity- Natural and artificial radioactivity- Specific activity-Specific concentration-Effective half-life -Radioactive decay- Law of successive disintegration –Types of equilibrium. Historical developments of radionuclide -Production of radionuclides- Radionuclide generators- Method of preparation - Toxicity of radionuclides- Radiopharmaceuticals- Ideal characteristics- Mechanism of localization of radiopharmaceuticals- List of radionuclides and radiopharmaceuticals - Quality control of radiopharmaceuticals.

UNIT II INSTRUMENTATION IN NUCLEAR MEDICINE 9

Historical developments of equipment's-Single head- Dual head scanner/Camera- PET – Detectors- Gas filled, scintillation& semiconductor - Properties, Design ,Principle –Construction, working-Annihilation coincidence detection-Attenuation correction- Acquisition, SPECT, Processing, Reconstruction technique ,Attenuation correction, Filters, Algorithm, SUV calculation, Display – Grey scale – comparison between black and white & color - Applications- Limitations .

UNIT III QUALTIY CONTROL OF EQUIPMENTS IN NUCLEAR MEDICINE 9

Quality Control of Dose Calibrator/Activity meter- Calibration sources, Survey meter- contamination monitor- importance of survey and limits – hand foot cloth monitor – zone monitor – fume hood – Protective apron – Thyroid uptake probe – Gamma probe –Well counter - Gamma camera/SPECT – PET/CT.

UNIT IV CLINICAL RADIONUCLIDE IMAGING AND DOSIMETRY 9

Clinical radio isotopes/Radiopharmaceuticals, In vivo non-imaging and imaging procedures- In vitro technique –RIA- Thyroid uptakes ,procedures, calculation, measurement- Few imaging procedures – Bone scan, Thyroid scan, Liver scan.., Pre and Post instructions, Absorbed dose, equivalent dose, effective dose, limitations, Pregnancy and breast feeding, children, Newer radiopharmaceuticals and developments.

UNIT V NUCLEAR MEDICINE THERAPY AND APPLICATIONS 9

Therapeutic application of radionuclides and radiopharmaceuticals –Targeted therapies- α and β therapy- Treatment of thyroid cancer I-131- Treatment of palliative cancer P-32, Sm-153, Lu-177- SIRT- Monoclonal antibodies- Pre and post therapy instructions –AERB discharge limits.

TOTAL: 45 PERIODS

OUTCOME

Students will be able to,

- Prepare Dilute the radioisotope with suitable tracer
- Learn about the QA of equipments in nuclear Medicine
- Safely administer the radioisotope to the patients
- Aware of the Radiation emergency preparedness
- Therapeutic application of radionuclides and radiopharmaceuticals

TEXTBOOKS

1. W. H. Blahd, Nuclear Medicine, McGraw Hill Co., New Delhi, 2002.
2. W. N. Wagner, Principles of Nuclear Medicine, W. B. Saunders Co., London, 1990.
3. Nuclear Medicine Physics, A Hand Book for Teachers and Students, D.L.Bailey, J.L.Humm., A.Todd-Pokropek, A.VanAswegen, IAEA, 2014
4. Essential Nuclear Medicine Physics, Rachel A Powsner and Edward R Powsner, 2nd Edition, Blackwell publishing, 2006.
5. Physics and Radibiology of Nuclear Medicine, Gobal B Saha, 3rd Edition, Springer, 2006.

REFERENCES

1. J. Herbert and D. A. Rocha, Text Book of Nuclear Medicine, Vol. 2 and 6, Lea and Febiger Co., Philadelphia, 2002.
2. S. Webb, The Physics of MedicalImaging Medical Science Series Adam Hilger Publications, Bristol, 1990.
3. Magdy M. Khalil, Basic Sciences of Nuclear Medicine, Springer, 2011
4. Marie Claire. Cantone, Christoph. Hoeschen, Radiation Physics for Nuclear Medicine, Springer, 2010.

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MP5004 BIOLOGICAL EFFECTS OF IONIZING RADIATION L T P C
3 0 0 3

OBJECTIVE

- To provide knowledge on the interaction of radiation at cellular and tissue level
- To impart knowledge on somatic effects of radiation
- To learn about the TNM rational of fractionation

UNIT I ACTION OF RADIATION ON LIVING CELLS 9

Target theory - single hit and multi hit target theory - other theories of cell inactivation - concepts of micro dosimetry - direct and indirect action - radicals and molecular products - cellular effects of radiations - in activations - division delay - DNA damage - depression of macromolecular synthesis - giant cells - chromosomal damage - point mutations.

UNIT II CELL RESPONSE TO IRRADIATION AND ITS RADIOSENSITIVITY 9

Cell survival parameters – in vitro and in vivo experiments on mammalian cell systems - RBE - response - modifiers - LET, oxygen, cell stage - recovery mechanism radio protective and radio sensitizing chemicals - radiometric substances - chemical mutagenesis - effects of UV, microwave and other non - ionizing radiations.

UNIT III SOMATIC EFFECTS OF RADIATION 9

Bergonis - Tribondeau law - radio sensitivity protocol of different tissues in human LD50/30 - effect of radiation on skin - blood forming organs, lenses of eyes, blood constituents, embryo, digestive tract, endocrine glands, gonads, dependence of effect on dose, dose rate, type and energy of radiation syndrome - effects of chronic exposure to radiation - radiation carcinogenesis- shortening of life span - risk estimates.

UNIT IV GENETIC EFFECTS OF RADIATIONS 9

Threshold and linear dose - effect relationship - factors affecting frequency of radiation induced mutations recessive and dominant mutations - gene controlled hereditary diseases - human data on animals and lower species - doubling dose and its influence of genetic equilibrium.

UNIT V RADIOBIOLOGICAL BASIS OF RADIOTHERAPY 9

Tumor growth kinetics –TNM rational of fractionation - problem of hypoxic compartment and quiescent cells - radiobiology of malignant neoplasm - solution of hypoxic cell sanitizers, hyperthermia, recourse to high LET radiation - combination of chemotherapy and radiotherapy - chronoradiobiology and its applications to get better cure - problem of tumor regression.

TOTAL: 45 PERIODS

OUTCOME

- Students will be able to decide the type of radiation for cancer treatment
- Know to identify the TNM Staging of cancer
- Design the dose and, fractionation with respect to different type of cancer and stage.
- Certain about genetic effects of radiation
- Know to analyze the cell survival curve

TEXTBOOKS

1. E. J. Hall, Radiobiology for Radiologists, J. B. Lippincott Co., Philadelphia, 2000.
2. S. P. Yarmonenko, Radiobiology of Humans and animals, MIR, Publishers, Moscow, 1990.
3. Bushong, Stewart C, Radiological sciences for technologists- physics, biology and protection, 1997, Mosby, St. Louis.

REFERENCES

1. Late biological effects of ionizing radiation: proceedings of the Symposium on the Late Biological Effects of Ionizing Radiation held by the International Atomic Energy Agency in Vienna, 13-17 March 1978
2. H. Smith, J. W. Stather, Biological effects of ionising radiation, Landolt-Börnstein - Group VIII Advanced Materials and Technologies Volume 4, 2005, pp 5-40
3. Dr. Claus Grupen Biological Effects of Ionizing Radiation Graduate Texts in Physics 2010, pp 212-228
4. B. Kanyár, G. J. Köteles, Dosimetry and Biological Effects of Ionizing Radiation, Handbook of Nuclear Chemistry 2011, pp 2211-2257

MP5005 ADVANCED RADIATION THERAPY TECHNIQUES L T P C
3 0 0 3

OBJECTIVE

The topics in this advanced radiation therapy techniques paper is designed

- To enable the students to understand the basics of conformal radiotherapy using MLC
- To understand the IMRT concepts
- To study special techniques in Radiotherapy
- To ensure students have an update 4D Radiotherapy knolwedge.
- to make students understand knowledge on the VMAT technique

UNIT I CONFORMAL RADIOTHERAPY WITH MULTI LEAF COLLIMATOR 9

Basics of conformal therapy-ICRU Definitions-ICRU 83-Modern developments in MLC – Different categories of MLC – Leaf position detection – commercially available MLC systems — MLC acceptance testing, commissioning and safety assessment – Tongue and groove effect– Dosimetric leaf gap measurement-MLC Quality assurance.

UNIT II INTENSITY MODULATION RADIATION THERAPY 9

Introduction to IMRT – physical optimization – Biological models for evaluation and optimization of IMRT – Target and critical structure definitions for IMRT – Static MLC IMRT- Dynamic MLC IMRT–potential problems with IMRT – Commissioning and QA for IMRT treatment planning – patient specific quality assurance– IMRT measurement based verification QA –AAPM TG 218.

UNIT III SPECIAL TECHNIQUES IN RADIATION THERAPY 9

Total Body Irradiation, Total Skin Electron Therapy-Stereotactic radiosurgery- X knife-gamma knife - dosimetry and planning procedures. QA protocols-Physical, clinical and planning aspects of stereotactic body radiotherapy-AAPM-TG101- tomotherapy and cyberknife based therapy- 5. IAEA technical report series 483: Dosimetry of small static fields used in External Beam Radiotherapy

UNIT IV IMAGE GUIDED RADIATION THERAPY 9

Concept of 4DCTimaging -4D planning- 4DRT Delivery. Mechanics of breathing – problems of breathing motion-Methods to manage respiratory motion in radiation treatment –Gating methods– Effect of motion on the total dose distribution – x-ray imaging techniques for guidance in the Radiation therapy setting kV CBCT and MV CBCT

UNIT V VOLUMETRIC MODULATED ARC THERAPY 9

Recent trends in Linear accelerator-VMAT Commissioning and Quality Assurance- -Treatment Planning- Comparison of VMAT treatment plans with conventional IMRT planning-Patient Specific Quality Assurance.-Electronic Portal Imaging device -its clinical applications including QA.Patient specific quality assurance in VMAT and gamma index analysis.

TOTAL: 45 PERIODS

OUTCOME

- Knowledge of clinical applications of MLC, Commissioning and Quality Assurance will improve.
- will develop competence in Optimizing Treatment Planning as well as QA in IMRT
- will gain Knowledge of TBI, TSET, SRS, SBRT and Tomotherapy techniques.
- Clinical and research update on 4DCT, Planning and delivery techniques.
- will develop clinical competence in VMAT planning, patient specific QA based on latest AAPM protocols

TEXTBOOKS

1. Steve Webb, The Physics of Three–Dimensional Radiotherapy, Institute of Physics Publishing, Bristol and Philadelphia, 2002.
2. Faiz M Khan , The Physics of Radiation Therapy, 5th Edition, Lippincott Williams & Wilkins, USA, 2003.
3. Jatinder R Palta and T. Rockwell Mackie, Intensity Modulation Radiation Therapy, Medical Physics publishing, Madison, Wisconsin, 2003.
4. AAPM Report No:91,Management of Respiratory motion in radiation oncology,2006.
5. IAEA technical report series 483:Dosimetry of small static fields used in External Beam Radiotherapy,IAEA,2017.

REFERENCES

1. AAPM Report No:218, IMRT measurement based verification QA,2018.
2. AAPM Report No. 72 , Basic Applications of Multileaf collimators, AAPM, USA, 2001.

MP5006 RADIATION HAZARDS, EVALUATION AND CONTROL L T P C
4 0 0 4

OBJECTIVE

The topics in this paper is designed

- to minimize the health effects due to radiations exposure during radiation therapy.
- Will able to understand radiation protection standards and regulatory aspects
- will develop competence in evaluation of both external and internal radiation hazards.
- Students can effectively do layout planning and shielding calculations for radiation treatments rooms.
- to motivate the medical physicists to dispose the radioactive waste as per safety guidelines.

UNIT I RADIATION PROTECTION STANDARDS & REGULATIONS 15

National legislation – Regulatory framework – Atomic Energy Act – Atomic Energy (Radiation Protection) Rules – Applicable Safety Codes, Standards, Guides and Manuals – Regulatory Control - philosophy behind radiation protection and Basic concepts of radiation protection standards - ICRP and its recommendations – the system of radiological protection – Justification of practices, Optimization of protection and individual dose limits – Radiation and tissue weighting factors, equivalent dose, effective doe, committed equivalent dose, committed effective dose – concepts of collective dose – potential exposures, dose and dose constrains-system of protection for intervention – categories of exposures – occupational, public and medical exposures – factors governing internal exposure – radionuclide concentrations in air and water – ALI, DAC and contamination levels.

UNIT II EVALUATION OF EXTERNAL AND INTERNAL HAZARDS 10

Effects of time, distance, shielding - shielding materials- shielding calculations- different barrier thickness calculations - definition of working conditions - personnel and area monitoring rules and instruments – Brachytherapy facilities- radio toxicity of different radionuclides and classifications of laboratories – control of contamination – bioassay and air monitoring – chemical protection – radiation accidents – disaster monitoring.

UNIT III SITE LAYOUT PLANNING AND SHIELDING CALCULATIONS 10

Planning of medical radiation installations – design of diagnostic, deep therapy, telegamma and accelerator installations, brachytherapy facilities and medical radioisotope laboratories - Classification of radio nuclide labs - bioassay and air monitoring - Particle accelerators Protective equipment - protective equipment - waste disposal rules and facilities - Radiation safety during source transfer operations Special safety features in accelerators – General considerations and evaluation of work load.

UNIT IV RADIOACTIVE WASTE DISPOSAL ANDTRANSPORT OF RADIONUCLIDES 15

Radioactive wastes – sources of radioactive wastes - Classification of waste - Permissible limits for disposal of waste -Disposal of radioactive wastes - General methods of disposal - General packing requirements - Transport documents - Labeling and marking of packages - Regulations applicable for different modes of transport - Exemptions from regulations – Shipment approval – Shipment under exclusive use – Transport under special arrangement – Consignor's and carrier's responsibilities

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UNIT V MANAGEMENT OF RADIATION EMERGENCIES 10

Radiation accidents and emergencies in the use of radiation sources in medicine - Loss of radiation sources and their tracing - Typical accident cases. Radiation injuries, their treatment and medical management - Responsibilities of Employers, Licensees, Radiological Safety Officers and Radiation Workers – National inventories of radiation sources – Import, Export procedures - Emergency preparedness - Emergency response plan - Lessons learned from accidents in Radiotherapy.

TOTAL: 60 PERIODS

OUTCOME

The following are the students learning outcome after completing the course

- students will demonstrate safe radiation protection practices.
- will able to justify all radiotherapy practices results in benefit to human beings.
- will develop competence in optimizing safe use of radiation sources.
- students will be able to ensure that occupational radiation dose limits will be kept within permissible limit.
- students will be educationally prepared and practically competent in handling radiation emergency situations in hospitals.

TEXTBOOKS

1. R. F. Mold, Radiation Protection in Hospitals, Adam Hilger Ltd., Bristol, 1985.
2. A. Martin and S. A. Harbisor, An introduction to Radiation Protection, John Wiley & sons Inc., New York, 1981.
3. ICRP Publications, 1990.
4. Radiation Safety codes Atomic Energy Act 1962.

REFERENCES

1. Khan, Faiz M. Treatment Planning in Radiation Oncology, 5 t h Edition Lippincott Williams &Wilkins, 2014
2. AERB, Safety code for medical diagnostic X-ray equipment and installations AERB Code No. SC/MED-2 , 1986, Publisher AERB.
3. AERB/NRF-TS/SC-1 (Rev.1), Safe Transport of Radioactive Materials, 2016, Publisher, AERB.

MP5007 BIOSENSORS L T P C
3 0 0 3

OBJECTIVE

The objective of this course is to

- Link engineering principles to understand biosystems in biosensor and bioelectronics.
- To provide fundamental knowledge on type and function of biosensors.
- To educate the students on various types of fabrication techniques.
- To provide knowledge on various biomolecules and their response to external stimuli.

UNIT I BIOSENSOR TRANSDUCERS 9

Electrochemical transducers (amperometric- potentiometric, conductimetric) - Semiconductor transducers(ISFET, ENFET)-Optical transducers (absorption, fluorescence-bio/chemiluminescence, SPR)-Thermal transducers; Piezoelectric and acoustic-wave transducers-Limitations & problems to be addressed-An Overview of Performance and Applications.

UNIT II BIOSENSOR FABRICATION 9

Methods for biosensors fabrication – self-assembled monolayers – screen printing-photolithography – soft lithography– micro contact printing – Deposition and selective etching – thin film growth and deposition - MEMS – Engineering concept

UNIT III TYPES OF BIOSENSORS 9

Catalytic biosensors- mono-enzyme electrodes-bi-enzyme electrodes-enzyme sequence electrodes and enzyme competition electrodes-Affinity-based biosensors- Inhibition- based biosensors-Cell-based biosensors-Biochips and biosensor arrays- Problems and limitations.

UNIT IV DETECTION IN BIOSENSORS/ BIORECOGNITION SYSTEM 9

Enzymes- Oligonucleotides and Nucleic Acids - Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes) - Membrane receptors and transporters; Microbial metabolism-Tissue and organelles (animal and plant tissue)-Cell culture; Immunoreceptors-Chemoreceptors-Limitations.

UNIT V BIOSENSORS FOR MEDICAL APPLICATIONS 9

Bio recognition elements and transduction technology - Biosensors for diabetes applications - Glucose as diabetes biomarker - Biosensors for glucose measuring - Biomarker & Biosensors for cardiovascular diseases applications - Biomarker & Biosensors for cancer applications.

TOTAL: 45 PERIODS

OUTCOME

Upon successful completion of this course, students will be able to

- Explain biosensing and transducing techniques.
- Understand the different types of biosensors and methods of fabrication.
- Appreciate the uses of biosensors in medical imaging and diagnostics.
- Able to design and construct novel biosensor instrumentation.

TEXTBOOKS

1. Tatsuo Togawa,Toshiyo Tamura, P. Ake Oberg, Biomedical Transducers and Instruments, CRC Press, New York, 1997.
2. Jacob Kline, Handbook of Bio Medical Engineering, Academic press Inc., Sandiego, Oxford University Press, 2004.
3. Smart Biosensor Technology, G. K. Knoff, A. S. Bassi, CRC Press, 2006

REFERENCES

1. Jiri Janata, Principles of Chemical Sensors, Plenum Press, 1989
2. Frontiers in Biosensors, Edited by: F. Schellr, F. Schubert, J. Fedrowitz, Birkhauser Verlag,1995.
3. Optical Biosensors. Present & Future. Editors: F. Ligler, C. Rowe Taitt, Elsevier,2002.
4. Biosensors for Health, Environment and Biosecurity, Edited by Prof. Pier Andrea Serra, Intech 2011.

MP5008 INDUSTRIAL RADIOGRAPHY L T P C
3 0 0 3

OBJECTIVE

The topics in this paper are framed

- to enable the students to gain knowledge on various radioactive sources used in NDT methods
- to understand the how image formation is taking place during industrial radiography procedure.
- to develop practical experience in radiographic exposure techniques.
- to make students learn various methods of NDT and its applications in various fields.
- to understand basic knowledge on neutron radiography.

UNIT I RADIATION SOURCES 9

X-Ray source - Coolidge tube- equipment controls - kV and mA and their influence - attenuation of radiation - photoelectric effect - Rayleigh scattering - Compton effect - pair production - focal spot, optical focus - radiography equivalence - gamma ray sources - characteristics - curie, roentgen, Gray, rhm, Sievert - natural and artificial sources - advantages and disadvantages of artificial sources.

UNIT II IMAGE FORMATION 9

Recording mediums - structure of a film - theory of image formation - characteristics of films - characteristic curves - film processing - effect of temperature, concentration of developer, developing time etc., on film development , contrast and density - types of film - selection of a film for a specific application.

UNIT III EXPOSURE AND EXPOSURE TIME ESTIMATION 9

Density of a radiograph - X-ray exposure charts - preparation of charts - its applications - gamma ray exposure charts and their preparation - contrast and definition - factors affecting contrast and definition - screens for radiographs, types, applications of screens - care of screens - percentage sensitivity and its meaning - image quality indicators - different types - sensitivity and equivalent sensitivity calculations.

UNIT IV TESTING METHODS FOR DIFFERENT APPLICATIONS 9

Inspection of flat plates, curved plates, complex shapes - inspection of welds - arc welds -fillet (single, double) - corner, lap joints - resistance welds - tubular sections - DWDI, DWSI, SWSI techniques - motion radiography - types of flaws and their appearance in castings and welds.

UNIT V NEUTRON RADIOGRAPHY 9

Sources of neutron - nuclear reactors, radioactive sources and accelerators - characteristics of sources and their capabilities - flux density, energy range and applications - classification of neutrons - thermal, slow and fast neutrons - neutron radiography methods - direct exposure, transfer methods and real time methods - applications - difference between neutron radiography and X-ray radiography and gamma radiography.

TOTAL: 45 PERIODS

OUTCOME

Upon completing the course on industrial radiography course, students

- will be able to effectively use different radiations from various sources with appropriate quantities and units.
- will have competence in making proper adjustments as needed to obtain radiography, with correct parameters.
- will be well versed in obtaining high quality image with optimal radiation exposures.
- Students will demonstrate radiographic positioning knowledge to obtain diagnostic images.
- will demonstrate knowledge of the principles of radiation safety and protection of self and others.

TEXTBOOKS

1. McGonnagle," Non destructive testing", McGraw Hill, New York, 1984
2. B. Hull and V.John, "Non destructive testing" McMillan Education LTD., London, 1988.

REFERENCES

1. R. Halmshaw, Industrial Radiology: Theory and Practice, Springer, 1995.
2. S V Rainey, H. W. Hogben, The Elements of Industrial Radiography, Association of Engineering and Shipbuilding Draughtsmen, 1956.
3. Ancel St. John, Herbert Rudolf Isenburger, Industrial Radiography, Wiley, 1934.

MP5009 MONTE CARLO TECHNIQUES IN DOSIMETRY L T P C
3 0 0 3

OBJECTIVE

- To understand the fundamentals of modeling ionizing and non-ionizing radiation transport.
- To appreciate the role of Monte Carlo in terms of making measurement dosimetry more accurate.
- To provide knowledge for the evaluation of dosimetry using statistical approach.
- To expose the students to different computer codes used for dosimetry.

UNIT I ELEMENTS OF MONTE CARLO TECNHIQUE 9

Generation of random numbers - uniformity - auto correlation coefficient - time of generation - period. Solving simple integrals using Monte Carlo techniques - different Monte Carlo techniques - sampling from distribution - cosine - exponential - Gaussian distribution. Monte Carlo means, variances and standard deviation - precision and accuracy - the central limit theorem - variance of the variance - variance reduction techniques - particle weight - exponential biasing- forced collision - weight window - Russian roulette. Geometry description - Boolean operators- intersections - unions – complement.

UNIT II MONTE CARLO TECHNIQUES FOR PHOTONAND NEUTRON TRANSPORT 9

Simulating the physical processes - difference between charged and uncharged particle transport - Neutron transport in tissue 1-D problem - Photon transport - Cross section for Photon/Neutron transport - Structure of a general purpose computer code - Tallies - flux to dose conversion factors.

UNIT III MONTE CARLO TECHNIQUES FOR ELECTRON TRANSPORT 9

Interaction of electron with matter - continuous slowing down model - condensed random walk method –class I and class II model - electron transport - flow chart - discrete & continuous energy loss - energy loss in a thin slab of water - step size - energy straggling - tally/scoring.

UNIT IV MONTE CARLO MODELING OF LIGHTTRANSPORT IN TISSUES 9

Introduction - sampling random variables - rules of photon propagation : conventions, launching the photon, photon step size moving a photon - photon absorption - terminating a photon - scattering a photon - multilayered and complex tissues. Data analysis: Basic idea - conversion techniques. Varieties of sources : distributing photons at launch and convolution of impulse response.

UNIT V DIFFUSION THEORY OF LIGHT TRANSPORT IN TISSUE 9

Introduction - Ficks' law - energy conversion and the diffusion equation - boundary conditions. Diffusion approximation in transport theory - transport equation - diffusion theory derived from the transport equation - phase functions. Diffusion theory in simple geometries: planar, spherical and cylindrical geometry. Diffusion approximation in three dimensions - finite beam profiles - green's function - diffuse radiant fluence rates for finite beams.

TOTAL: 45 PERIODS

OUTCOME

Apply various Monte Carlo techniques in solving various mathemetical and physical problems.

- The student will be able to use Monte Carlo code to design the source and evaluate the dosimetric parameters and doses.
- To interpret and evaluate the results of statistical nature.
- To master the theory behind the Monte Carlo simulation of ionizing and non-ionizing radiation.
- The student should be able to create a mathematical model of tumor in tissue.

TEXTBOOKS

1. K. P. N. Murthy, Monte Carlo Basics, Indian Society for Radiation Physics, India, 2000.
2. Judith F. Briesmeister, A General Monte Carlo N-Particle Transport Code, Report No. LA-12625-M version 4B (1997) Web Address. http://www.Xdiv.alnl.gov/XTM/Xtm1/world1/docs/mcnp-anual/pdf/mcnp4b_man.pdf/

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1. D. W . O. Rogers and A. F. Bielajew, Monte Carlo Techniques of Electron and Photon transport for Radiation Dosimetry, The Dosimetry Radiation by Attix, Vol III, Academic Press, London, 1992.
2. M. J. Berger, Monte Carlo Calculation of the penetration and diffusion of fast charged particles, Computational Physics, Vol. 2, 1965.
3. W. R. Nelson, H. Hirayam and D. W. O. Rogers, The EGS4 code system, Stanford Linear Accelerator Centre report, SLAC-265, Web Address
4. http://www.slac.stanford.edu/oubs/slarcreports/slac-r-265.html

MP5010 NANO TECHNOLOGY FOR BIOMEDICAL APPLICATIONS L T P C
3 0 0 3

OBJECTIVE

- Provides knowledge on the various synthesis techniques for preparing nanomaterials.
- To give insights on the application of nanomaterials to targeted biological applications.
- To give a knowledge on the basics of device fabrication for nanomaterials based biosensors.
- To make the students understand the concept of nanomaterial and biomateiral interaction.

UNIT I FUNDAMENTALS OF MICRO FABRICATION 9

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)

UNIT II MICRO FLUIDIC PATTERNING AND BIOPOLYMER PATTERNING 9

Micro fluidic Processes: Fundamentals of Laminar Fluids Micro fluidic Processes: The Role of Micro-Scale Fluid Dynamics in BioMEMSNeuro MEMS - Microelectrodes and Neuronal Interfaces, Microstereolithography.

UNIT III NANOFABRICATION 9

Molecular Engineering and Quantum Dots, Nanoscale Structures as Biological Tags and as Functional Interfaces with Biological Systems

UNIT IV NANO-BIOTECHNOLOGY 9

Nanoparticles and Microorganisms, Nano-materials in Bone Substitutes and Dentistry, Nanoparticles in Food and Cosmetic applications, Drug delivery and its applications.

UNIT V NANOBIOSENSORS 9

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

TOTAL: 45 PERIODS

OUTCOME

- From this syllabus, the students can understand the fabrication techniques used for developing nanostructured materials.
- Students can obtain the knowledge on some of the important biomolecule tagging with nanomaterials.
- Nanomaterials applications in the field of research, industrial and fulfilling human therapeutic needs.
- Students can avail the knowledge of fabrication of sensors for biomedical applications.

Interested

TEXTBOOKS

1. Michael Koch, Alan Evans, Arthur Brunnschweiler, Micro fluidic Technology and Applications (Micro technologies and Microsystems Series) , CRC Press; London, 2001.
2. Niemeyor, christober M. Mirkin, Nanobiotechnology: concepts, applications and perspectives, Kluwer publications , USA, 2004.
3. Robert A. FreitasJr ,Nanomedicine , FreitasJr.Kluwerpublications, USA, 1998.

REFERENCES

1. Richard Coombs, Dennis W. Robinson, Nanotechnology in medicine and the biosciences, Gordon and Breach Publishers, 1996.
2. Eugene J. Koprowski,Gene Koprowski, Nanotechnology in medicine: Emerging applications, Mcgraw-Hill Education, 2011.
3. Tuan Vo-Dinh, Nanotechnology in Biology and Medicine: Methods, Devices, and Applications, CRC Press, 2007
4. Gabriel A. Silva, Nanotechnology for biology and medicine, Springer, 2012.

MP5011 ULTRASONICS IN MEDICINE L T P C
3 0 0 3

OBJECTIVE

- To impart knowledge about sound and their method of production and detection
- Educate about the mechanism and signal processing to visualize sound interactions
- Educate them the applications of Ultrasound within the safety limits for medical applications

UNIT I GENERATION AND DETECTION OF ULTRASOUND 9

Propagation of ultrasound in biological materials - Piezoelectric effect - intensity changes by reflection, scattering, refraction, absorption and attenuation – impedance – transducer probes.

UNIT II PULSE ECHO AND NIC DIAGNOSTIC TECHNIQUES 9

Principles of Echo ranging - A scan - detection, smoothing and filtering - time gain compensation - application of A, B, and M mode scan – Doppler ultrasound - Ultrasound in Tomography: Ultrasonic microscope - ultrasonic holography.

UNIT III SIGNAL PROCESSING, DISPLAY AND SAFETY: 9

Signal processing in ultrasonic imaging apparatus (qualitative ideas only) - processing of Doppler signals - Gray scale test object - Resolution test object - safety of diagnostic ultrasound.

UNIT IV ULTRASOUND IN OBSTETRICS AND GYNAECOLOGYVASCULAR SYSTEM ‘ 9

Identification of early pregnancy - foetal malformation - foetal anatomy - foetal growth - multiple pregnancy - foetal activity - ultrasound assessment of gynecological pathology
– Vas lab – arterial occlusion measurements.

UNIT V ULTRASOUND IN OPHTHALMOLOGY ANDECHOCARDIOGRAPHY 9

The normal eye in B-scan section - Diagnosis of posterior vitreous detachment - intra ocular tumors - assessment of rheumatic mitral valve, aortic murmur and calcified aortic valve - malfunction of prosthetic valve - estimation of acute myocardial infarction- assessment of left ventricular heart disease.

TOTAL: 45 PERIODS

Attested

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OUTCOME

Students can able to understand

- Propagation of ultrasonic waves through tissues,
- Know the limitations of ultrasound energy for various organs
- Can operate the flaw detector for Scanning the defects
- Can carryout the signal processing and noise reduction for better imaging
- Know the conditions of defects in gynecology ophthalmology and echocardiography

TEXTBOOKS

1. M. Hussey, Basic Physics and Technology of Medical Diagnostic Ultrasound, 2nd Edition, McMikkan, London 1990.
2. W. M. McDicken, Diagnostic Ultrasonic principles and use of Instrument, 2nd edition, JohnWiley and Sons, New York, 1992.
3. D. H. Evans and J. P. Wood Cock, Doppler ultrasound Physics Instrumentation and Clinical applications, John Wiley, Chichester, 1998.

REFERENCES

1. C. R. Hill, J. C. Bamber, G. R. terHaar, Physical Principles of Medical Ultrasonics, John Wiley & Sons, 2005.
2. George L. Gooberman, Ultrasonics: Theory and Application, Hart Publishing Company, 1969.
3. MichielPostema, Fundamentals of Medical Ultrasonics, Taylor & Francis, 2011
4. Francis A. Duck, A.C Baker, H.C Starritt, Ultrasound in Medicine, CRC Press, 2002.

MP5012 MATERIALS FOR RADIATION DOSIMETERS L T P C
3 0 0 3

OBJECTIVES:

- To provide fundamental concepts of radiation dosimeters from the perspective of Solid State Physics.
- To familiarize the students on the principles of dosimeters based on the electronic band structure concepts.
- To make students understand different types of dosimeters and their respective applications.
- To provide an overview on various synthesis techniques.
- To give detailed understanding in working principles of current dosimeter materials.

UNIT I ENERGY BAND IN SOLIDS: 9

Electrons in periodic potential, Origin of energy bands in solids, classification of solids as metals , insulators and semiconductors on the basis of the band picture, Origin of the energy gap (qualitative discussions). Bloch's theorem in one dimension, nearly free electron approximation - formation of energy bands and gaps - Brillouin zone, concept of effective mass and holes, Density of states for electrons in band.

UNIT II FUNDAMENTALS OF DOSIMETRY DEFECTS IN SOLIDS 9

Defects in Crystals: Point defects, line defects and planner (stacking) faults. The observation of imperfections in crystals.Colourcentres, F-centre and aggregate centres in Semiconductors. Types of Impurities – Substitutional impurities, Donors and acceptors, Isoelectronic impurities, vacancies, Defect complexes – Interstitial defect and anti-site defects. Mobility and conductivity – Characterizing defects: Hall-effect measurement.

UNIT III TYPES OF DOSIMETERS: 9

Thermoluminescence Dosimeters – Optically Stimulated Luminescence (OSL) Dosimeters – Principles and materials used – Absorption and Emission Wavelengths – OSL measuring technology - Compound semiconductor dosimeters – GaAs detectors – HgI_2 detectors - CdTe dosimeters - Role of impurities: Zn-doped CdTe detectors – Other novel dosimeter materials - Neutron detectors.

UNIT IV MATERIAL SYNTHESIS TECHNIQUES: 9

Powder synthesis method; hydrothermal synthesis of ceramic oxide powders, chemical methods. – Classification of crystal growth methods Nucleation –Melt Growth techniques **-** Bridgman method – Czochralski pulling method –**-** Growth by restricted evaporation of solvent, slow cooling of solution and temperature gradient methods **–** Vapour phase crystallization in a closed system – Gas flow crystallization.

UNIT V MEDICAL APPLICATIONS OF DOSIMETERS 9

Radiation dosimeters **–** pMOS and direct ion storage (DIS) dosimeters **-** In-vivo dosimetery – Materials and methods – Thermoluminescent (TL) materials: $CaSO_4$:Dy, and LiF:Mg, Cu, P, - Characteristics of TL - Spintronic Neutron detectors for enhanced signal-to-noise ratio – Effect of different synthetic techniques on radiation detection. Measurement techniques of doses – Radiopharmaceuticals and semiconductors used in nuclear medicine.

TOTAL : 45 PERIODS

OUTCOMES:

- The student will obtain fundamental knowledge on the working principle of dosimeters
- Will be able to distinguish different types of dosimeters and their applications
- Will get an overview on different synthesis techniques and their influence on the properties of dosimeters.
- Will be able appreciate the structure-property relationships of dosimeter materials
- Will know properties required for various materials used in medical applications.

REFERENCES:

1. Frank Herbert Attix, *Introduction to Radiological Physics and Radiation Dosimetry,* Wiley 2007.
2. Elementary Solid State Physics,M.Ali Omar – Pearson Education
3. Charles Kittel.," Introduction to Solid State Physics", John Wiley, 8th edition, 2013.
4. Ashcroft/ Mermin, Solid State Physics, India edition IE, Thomsom books, Reprint, 2014
5. Advanced Materials and Techniques for Radiation Dosimetry, Khalil Arshak and Olga Korostynska, Artech House Publishers, 2017
6. S.W.S. McKeever**, "**Thermoluminescence Dosimetry Materials: Properties and Uses", Ramtrans Publishing (December 1995)

ADDITIONAL BOOKS:

1. H.P.Myers, Introductory Solid State Physics, 2nd edition, Viva Books Pvt. Ltd (1998)
2. S. O. Pillai," Solid State Physics", New age International Pvt Ltd, 6th edition, 2005.

OPEN ELECTIVE COURSES (OEC)

MP5491 NUCLEAR ENERGY IN HEALTH CARE AND INDUSTRY L T P C
3 0 0 3

OBJECTIVES

- To provide the student about the action of radiation on living cells and the response.
- To make the student to understand the basic nuclear medicine physics and newer technology systems.
- To enable the students to understand the diagnostic and therapeutic nuclear medicine techniques.
- To provide a broad knowledge in radiation hazard evaluation and control

UNIT I BASICS OF NUCLEAR SCIENCE AND RADIATION EFFECTS 9

Radioactivity, nuclear reactions and interaction of ionizing radiation with matter, with emphasis on radiation detection, radiation shielding - photoelectric - Compton effect and pair production - biological effects on human health - Action of radiation on living cells -direct and indirect physical damage- cell response to radiation - somatic and genetic radiation effects -Radiation side effects - Acute and chronic effects of low dose effects.

UNIT II DIAGNOSTIC APPLICATIONS OF NUCLEAR ENERGY 9

Production of X rays and its applications X-ray radiography - CT scan -contrast studies in x ray imaging - fluoroscopic applications -Mammography - physics of nuclear medicine and nuclear imaging - radio isotopes in diagnosis of nuclear imaging - Tc-99m extraction - radiopharmaceuticals - scanning instruments and techniques.

UNIT III THERAPEUTIC APPLICATION OF NUCLEAR ENERGY 9

Production of nuclear radiations- alpha, beta and gamma rays and X-rays - External radiation therapy -telecobalt unit and linear accelerators - and internal radiation therapy - Iridium -192 HDR brachtherapy unit- therapeutic nuclear medicine.

UNIT IV INDUSTRIAL APPLICATIONS OF NUCLEAR ENERGY 9

Industrial applications — Non destructive testing - industrial radiography - tracing, gauging, Radiation sterilization of medical equipments - food preservation and other applications.

UNIT V NUCLEAR RADIATION SAFETY MEASURES 9

Basic concepts of radiation protection standards - ICRP recommendations - systems of radiological protection - Optimization of protection and individual dos limits - Radiation dose to individuals from natural radioactivity in the environment and man- made sources - Evaluation of external and internal radiation hazards - effect of time, distance and shielding - radioactive waste disposal and transport of radioactive nuclides.

TOTAL: 45 PERIODS

OUTCOMES

After successful completion of the course

- students will be able to handle radioactive source carefully for treatment purpose.
- will develop competence in radioactive waste disposal management
- Will be develop competency to face radiation emergency
- students will develop critical thinking skills in radiation safety and protection.
- will be able to safe guard the radioactive sources used in hospitals.

REFERENCE BOOKS:

1. W. R. Handee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.
2. E. J. Hall, Radiobiology for Radiologists, J. B. Lippincott Co., Philadelphia, 2000.
3. W. N. Wagner, Principles of Nuclear Medicine, W. B. Saunders Co., London, 1990.
4. R. F. Mold, Radiation Protection in Hospitals, Adam Hilger Ltd., Bristol, 1985.
5. Fred A Mettler and Milton J Guiberteau, The essentials of nuclear Medicine imaging, 2011.

MP5492 SMART MATERIALS FOR ENERGY AND ENVIRONMENT APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide fundamental understanding on smart and intelligent materials.
- To enhance students' understanding on the structure-property relationship.
- To enable students appreciate novel materials and their usage in current cutting edge technologies.

UNIT I BASICS OF SMART MATERIALS AND STRUCTURES 9

Introduction - components and classification of smart structures, Requirements of Intelligent Materials – Functions: Sensor, Memory, Processor, Actuator - Common smart materials - Applications of smart systems – Energy Harvesting systems: Regenerative braking - Smart polymers: Applications in drug delivery, tissue engineering. Biomimetics and bio-inspiration.

UNIT II INTELLIGENT MATERIALS FOR ENERGY GENERATION 9

Artificial Intelligence in Materials, Ferrolectricity: Introduction - Piezoelectric effect, Piezoelectric materials as sensors, Actuators and bimorphs - Transparent Conducting Materials – Band-gap and electrical conductivity, Conditions for transparency – role of defects on conductivity - Applications: Solar cells, Touch screen, etc.

UNIT III SHAPE MEMORY MATERIALS FOR ENERGY STORAGE 9

Introduction to structure types, Structure-property relationships, Shape memory effect (SME), One way and two-way SME, Shape memory alloys (SMAs), Intelligence in the form of SMA, Functional properties of SMAs. Thermal-storage, and aerospace materials. Shape-memory polymers, and their applications.

UNIT IV MULTIFERROIC MATERIALS FOR NOVEL REFRIGERATION 9

Ferromagnetism and ferroelasticity, Magneto-electric materials: Types of magnetic ordering phenomena, Conditions for multiferroicity– Applications of multiferroic materials. Magnetostrictive smart materials – Magneto-caloric materials for emission-less refrigeration - Magneto-Optic (MO) Materials: Examples (Heusler alloys, double perovskites) and Applications.

UNIT V INTELLIGENT OPTICAL MATERIALS FOR ENVIRONMENT 9

Smart optical materials for modifying spectral shift and refractive index shift. Electro-optic and Acousto-optic materials: Definitions, examples and applications –Chromogenic Materials – Types: Photochromic, Thermochromic, Electrochromic - Devices and Applications:Radiation absorption.

TOTAL: 45 PERIODS

OUTCOMES

- The student will understand the working principle of smart materials
- The student will get an overview on various types of smart materials and their application areas.
- The student will get ideas to use smart materials in green energy and environment applications
- The student will get motivated to find novel applications of these multifunctional materials in new technologies.
- The student will get an idea on different synthesis and characterization techniques

REFERENCES

1. D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007.
2. M. Addington, D.L. Schodek, Smart Materials and New Technologies, Elsevier 2005.
3. K. Otsuka, C.M. Wayman (Eds.), Shape Memory Materials, Cambridge University Press, 1998.
4. M.V. Gandhi, B. S. Thompson, Smart Materials and Structures, Springer, 1992.
5. P. Ball,Made to Measure: Materials for the 21st Century, Princeton University Press, 1997.
6. Ed. M. R. Aguilar and J.S. Roman, Smart Polymers and their Applications, Elsevier 2014.
7. Ed.: Peter L. Reece, Smart Materials and Structures: New Research, Nova Science 2007.
8. Ian Baker, Fifty Materials that Make the World, Springer, 2018.
9. Ed.: Mel Schwartz, Smart Materials, CRC Press, 2008.

EA5491 CLIMATE JOURNALISM L T P C
3 0 0 3

OBJECTIVES

- To offer a comprehensive approach to reporting of climate change.
- To impart knowledge about political, economic, and ethical questions raised by the need for transformative change of societies in the wake of climate change.
- To reflect over the development of climate change as a nature and a society issue.
- To synthesize knowledge from different areas related to climate change.
- To reflect on the norms and values of journalism in the context of climate change.

Attested

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UNIT I HUMAN INFLUENCES 9

Anthropocene Era (anthropo: man, and cene: new) - Freshwater scarcity - The decline of our oceans, fish, and wildlife - Environmental health - Sustainable energy, agriculture, and food systems – Role and responsibility of journalists – Making climate change relevant as a society issue – Politics and economics of climate change – Environmental ethics – Human health – Species migration.

UNIT II PUBLIC NARRATIVES 9

Complex science and uncertainty - Public apathy and politics - Well-funded counter-narratives - Zealous stakeholders - What can (incorrectly) appear due to a lack of news hook for stories - Two centuries of CO_2emissions.

UNIT III JOURNALISTIC CHALLENGES 9

Environmental Journalism as a craft - Roles and differences between journalism and communications – Finding the most accurate, credible and timeliest information on science and issues – Essentials of environmental reporting – Discerning uncompromised expert sources – Using human narratives and descriptive storytelling to relate real-world impact – Tapping the databases, records and other tools commonly used by environmental reporters.

UNIT IV CLIMATE ISSUES 9

The lack of diversity in environmental journalism – "Junk science" – Battling climate denial - Covering GMOs – The problem of doomsday climate reporting – Digital security for journalists and researchers etc.

UNIT V JOURNALISTIC SKILLS 9

Hands-on journalistic series – Reporting, developing, funding, crafting and publishing environmental stories – Writing diverse stories on environmental history, a wildlife or ocean story, a clam-aquaculture story, a work of nature writing, etc. – A polished, fact-checked, final story with questions answered and edits made from the first draft and at least two added elements such as photos, audio or video clips, graphics, timelines or others to draw people in.

TOTAL: 45 PERIODS

OUTCOMES

- Students will understand the importance of climate issues.
- Students will understand the various aspects of climate change and its effect in society.
- Students will learn to cover the climate change issues.
- Students will understand the need of journalistic skills for covering climate issues.
- Students will learn the various strategies, approaches on covering climate issues in various media.

REFERENCES

1. Lakoff, G., Why it matters how we frame the environment. In Environmental Communication, 2010.
2. Vetlesen, A. J., Nature, technology and environmental crisis. In Bhaskar, R., Næss, P., Høyer, K.G. (eds.), Eco philosophy in a World of Crisis. Critical Realism and the Nordic Contributions. London: Routledge, 2012.
3. Ytterstad, A., The climate crisis challenges the objectivity ideal in Norwegian journalism. In Ytterstad. A., Norwegian Climate Change Policy – Between Hegemony and Good Sense, Oslo: Unipub, 2012.
4. Anker, Peder, A pioneer country? A history of Norwegian climate politics. In Climatic Change. ISSN 0165-0009. 2016.
5. Klein, N., This Changes Everything - Capitalism vs the Climate. Part 1 and 3. London: Allan Lane, 2014.
6. Stoknes, P.E., What We Think About When We Try Not to Think About Global Warming: Toward a New Psychology of Climate Action. Vermont: Chelsea Green, 2015.

EA5492 **DIGITAL PHOTOGRAPHY** **L T P C**
3 0 0 3

OBJECTIVES

- To create opportunities for professional and creative expression through the practice and art of photography.
- To inculcate aesthetic sense involved in creativity.
- To get to know the genres of photography

UNIT I CAMERA **9**

Different camera formats, working of an SLR and DSLR and Mirrorless Cameras. Features and functions of SLR and DSLR Cameras. Various camera controls. Anseladams Zone system. Exposure. Image sensors. Different storage formats.

UNIT II LENS AND ELEMENTS OF PHOTOGRAPHY **9**

Different type of Lenses - Basic Shots and Camera Angles, Photographic Composition - View point and Camera angle-Eye Level, Low and High, Balance- Aspects of Balancing, Shapes and Lines, Pattern, Volume, Lighting, Texture, Tone, Contrast- and Colour, Framing, various Perspectives.

UNIT III COLOUR AND LIGHTING **9**

Colour Theory, Colour Temperature, Electromagnetic spectrum, Lighting Philosophies – Basic styles of Lighting – Properties of Light – Additive and Subtractive Light – Contrast and Lighting Ratios – Direct and Indirect Light – Three point and Five Point Lighting – Light Sources. Light meters and filters

UNIT IV PEOPLE AND PORTRAIT PHOTOGRAPHY **9**

Indoor and outdoor lighting techniques for portraits, the Casual Portrait, Environmental Portraits, Group Portraits, Familiar Subjects, Hands and Other Details.

UNIT V GENRES OF PHOTOGRAPHY **9**

Basic shooting and Lighting Techniques and Equipments required for different genres of Photography like Black and White, Landscape, Cityscape, Architecture, Advertising, Table top photography Fashion, Food, Automobile, Sports, Travel, Children, Portrait, wild life, Still Life, Event, Silhouette, Festival and Themes.

TOTAL: 45 PERIODS

OUTCOMES

- Students will be able to utilize the principles of good composition in photography.
- Students will be able to develop an individual style in representing the society through photographs.
- Students will have a thorough understanding of how to create visual variety
- Students will understand the foundation principles of design
- Students will gain understanding in Depth of field
- Students will understand the different genres of photography

REFERENCES

1. Ansel Adams, The Negative, Bulfinch press, Fourteenth Edition, 2008.
2. BalakrishnaAiyer, Digital Photojournalism, Authors press, 2005
3. Ben long, Complete Digital Photography, Charles River Media, Third Edition, 2005
4. Fil Hunter, Steven Biver, Paul Fuqua, Light - Science & Magic: an Introduction to Photographic Lighting, Focal Press,2007
5. Langford Bilissi,Langford's Advanced Photography, focal press, Seventh Edition, 2008.
6. Scott Kelby, The Digital Photography Book, Peachpit Press, 2009

AC5491 **GREEN CHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the basic concept and principles of green chemistry for environmental management.
- To make the students know about green reagents and its importance to the environment
- To acquaint the student with green solvents and its impacts in green chemistry
- To familiarize the synthesis of materials using green methods
- To impart the knowledge on applications of green synthesis technology

UNIT I PRINCIPLES OF GREEN CHEMISTRY 9

History of green chemistry and sustainability- Prevention of waste/by-products – maximum incorporation of reactants in final product-Atom economy – Prevention/minimization of hazardous products – Designing safer chemicals – optimizing reaction conditions.

UNIT II GREEN REAGENTS AND CATALYSTS 9

Choice of starting materials – reagents (Dimethyl carbonate, polymer supported reagents) – catalysts (microencapsulated Lewis acids, zeolites, basic catalysts polymer supported catalysts, introduction to biocatalysts).

UNIT III GREEN SOLVENTS 9

Aqueous phase reactions (Claisen rearrangement, Aldol condensation, wurtz reaction, reduction of carbon carbon double bond, oxidation of amines into nitro compounds – Electrochemical synthesis (synthesis of adiponitrile) - Ionic liquids – reactions in acidic ionic liquids- reactions in neutral ionic liquids (hydrogenations, diels-Alder reactions, Heck reactions, O-alkylation and N-alkylation, methylene insertion reactions.

UNIT IV GREEN SYNTHESES 9

Microwave induced green synthesis (Hoffmann Elimination and Oxidation of alcohols) – Ultra sound assisted green synthesis (Esterification, Saponification and Cannizaro reaction) – Solid state green synthesis (Dehydration of alcohols to alkenes, Grignard reaction)- Solid supported organic synthesis (Synthesis of furans and pyrrole)

UNIT V APPLICATIONS OF GREEN SYNTHESIS 9

Introduction – synthesis of styrene, adipica acid, catechol, 3-Dehydroshikimic acid, methyl methacrylate, urethane. Environmentally benign synthesis of aromatic amines – free radical bromination – synthesis of ibuprofen and paracetamol.

TOTAL: 45 PERIODS

OUTCOMES

- To be familiar with basic concepts of green chemistry and apply to them in various field
- To recognize the catalytic reaction with green reagents and its importance. To identify available green solvents and apply them to various synthesis process
- To recognize the preparations of materials with green process and its application to the environment.
- To gain the knowledge of preparation of various drugs using green synthesis methods
- To be have the skills and technology towards green chemistry and apply in industry.

REFERENCES

1. V.K. Ahluwalia and M. Kidwai, New trends in Green Chemistry, Anamaya Publishers, 2004.
2. V. K. Ahluwalia, Green Chemistry, Narsoa publishers, 2012
3. Bela Torok and Timothy Dransfield ,Green Chemistry, An Inclusive Approach, 1st Edition, Elsevier, 2017.

AC5492 **FOOD CHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES

- To enable the students to acquire knowledge on the macro and micro constituents of the food
- To know the structure and chemical characteristics of constituents of food.
- To demonstrate the knowledge of food chemistry and applying, the principles and concepts of chemistry as they apply to food systems.
- To familiarize the student with the relationship between water and food.
- To explain the rationale for certain food processes and preservation

UNIT I INTRODUCTION TO FOOD AND ITS PROPERTIES 12

Proteins-Enzymes- Chemistry and structure, kinetics, Maillard reaction. Food carbohydrates: Structural, nutritional and functional aspects. Emulsifiers-role of emulsifiers selection of emulsifier based on hydrophilic and Lipophilic balance (HLB) and its application. Thickeners-definition, chemical structure, gel formation, list of permitted thickeners and food application. Chemical and biochemical changes: changes occur in foods during different processing.

UNIT II PROCESSING AND PRESERVATION 12

Scope and benefits of industrial food preservation. Preservation of foods by chemicals, antibodies, antioxidants, salt and sugar. Principles of food freezing: freezing point of foods Psychrometric chart, Freeze concentration, freeze drying, IQF. Nanotechnology: Principles and application in foods, Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

UNIT III FLAVOURS AND COLOURING AGENTS 9

Chemistry of food flavor, definitions, Flavourmatics /flavouring compounds, flavor retention-off flavours and food taints. Colour -Natural and synthetic food colours, their chemical structure, stability, permitted list of colours, usage levels and food application.

UNIT IV WATER RELATIONS IN FOOD 6

Moisture in food: Structure, properties, Types of water in food and their specific function water activity and stability.

UNIT V FOOD ADDITIVES 6

Definitions, uses and functions of: Acids, Bases, Buffer system, chelating/sequestering agents, Antioxidants, Anti-caking agents, Firming agents. Flour bleating agents and Bread improvers. Anti-microbial agents/ class I & II.

TOTAL: 45 PERIODS

OUTCOMES

- Will know about the factors governing the food quality and chemical constituents.
- Will be able to name and describe the general chemical structures of the major components of foods and selected minor components
- Will come to know about the techniques involved in food processing and preservation
- Will be acquitted with food additives and their function in preservation
- Will be familiarize with the nature of packed food from industrial processes

REFERENCES

1. Damodaran, S., Parkin, K. L., and Fennema, O.R. (2008) Fennema's Food Chemistry 4th Edition, CRC Press
2. Belitz, H-D., Grosch, W. & Schieberle, P. (2004) Food Chemistry 3rd Ed. (translation of fifth German edition), Springer
3. DeMan, J.M. Principles of Food Chemistry 4rd Ed. Aspen Publishers (2018)
4. Peter C. K. Cheng, Handbook of Food Chemistry, Vol 1, Springer Reference, 2015
5. Jaswinder Kaur and Barry H. Grump Fundamentals of Food Chemistry, Abhizeet Publications, 2010.
6. Harish Kumar Chopra and Parmjit Singh Panesar, Food Chemistry, Narosa Publication, 2010.

AG5491 NATURAL HAZARDS AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

- To teach characteristics of natural hazards.
- To teach mitigation methods for natural hazards.
- To provide knowledge on assessment and management of natural hazards.

UNIT I DISASTER PHENOMENON 9

Disaster threat - characteristics-parameters – mapping aspects for earthquake, landslides, tsunami, cyclones, flood, drought and epidemics.

UNIT II MITIGATION 9

Geological and hydrological hazards - Reduction of hazard proneness – reducing structural vulnerability – changing the functional characteristics of settlement – building code provisions.

UNIT III ASSESSMENT 9

Elements of risk – vulnerability analysis on dam and other infrastructures – risk assessment – plan area – organizational aspects, planning and mapping levels – socio-economic aspects – cost of risk reducing measures.

UNIT IV MANAGEMENT 9

Prevention – preparedness – response – recovery – resource utilization – international assistance – policy and legislation – training – public awareness.

UNIT V CASE STUDIES AND ADVANCED TOOLS 9

Post disaster review – role of remote sensing and GIS –National and state level case studies on various disasters.

TOTAL: 45 PERIODS

OUTCOMES

On completion of this course, the students expected to be able to:

- Gain knowledge on natural hazards and their characteristics
- Have better understanding on geological and hydrological hazards
- Appreciate various mitigation techniques.
- Carryout risk assessment and vulnerability mapping
- Understand the role of remote sensing and GIS in natural hazard risk reduction.

REFERENCES

1. Nick Carter, W. Disaster management, A Disaster manager's Handbook, Publisher: Asian development bank, Manila, 1992.
2. Mitigating natural disasters: Phenomena, effects and options, a Manual for policy makers and planners. Publisher: United Nations, Hew York, 1991.
3. Edward A. Keller, DeVecchio. Natural Disasters: Earth's Processes as Hazards, Disasters and Catastophes, Routledge, 3rd Edition, 2011.
4. Harsh K. Gupta, Disaster Management, Indian National Science Academy, ISBN 8173714568,788173714566, 2006 second Edition, 152 Pages.
5. Ghanshyam Singh and Sandip Bhandari, Disaster Management, Gullybaba Publishing House (P) Ltd; 1st edition (2012), ISBN-13: 978-9381066492.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√	√	√	√	√	√	√	√
CO2	√		√	√	√	√	√	√	√	√	√	√
CO3	√	√	√	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√		√	√	√		√	√	√
CO5	√		√	√	√	√	√			√		√

AG5492 OCEAN RESOURCES AND EXPLORATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES

- To understand the Sources of Marine Minerals.
- To understand the various energy resources pertain to marine system
- To understand the importance and economic aspects of marine minerals

UNIT I INTRODUCTION 9

Marine Mineral Resources - sources of Marine Minerals -sources in ocean basins. Formation Processes of Polymetallic Sulfides (PMS) on the Ocean Floor- Plate boundaries and associated mineral and energy occurrences.

UNIT II OCEAN RESOURCES 9

Mineral deposits derived from land sources - Placer Deposits - Lime, Phosphorite and Salt Deposits - Beach Deposits of Continental Margins - rock salt (sodium chloride) - magnesium metal - magnesium compounds and bromine. metalliferous sediments-Seafloor Polymetallic Massive Sulphides - polymetallic manganese nodules. Methane hydrate.

UNIT III ENERGY RESOURCES 9

Wind Energy - Wave Energy - Tidal Energy - Ocean Current Energy - Ocean thermal energy conversion (OTEC) - osmotic power plant-Petroleum resources and radioactive nuclear mineral deposits

UNIT IV OCEAN RESOUCE EXPLORATION AND EXPLOITATION 9

Marine sampling - Water Samplers - Bottom Samplers - Instrumentation

UNIT V OCEAN MINERAL MINING 9

Mining aspects of deep-sea polymetallic sulphides - Manganese Nodules - Methane Hydrates. Sand, Sand Mining & Beach replenishment-Marine maps of Exclusive Economic Zone (EEZ).

TOTAL: 45 PERIODS

OUTCOMES

- Students will understand the various sources of marine minerals.
- Students will able to understand the Mineral deposits derived from land sources.
- Students will learn about the energy resources of marine system.
- Students will learn about various sampling methods and instrumentation.
- Students will able to understand the economic aspects of marine minerals.

REFERENCES

1. H. Kunzendorf, Marine Mineral Exploration, Volume 41, 1st Edition, Elsevier Science, 1986
2. David Spencer Cronan, Handbook of Marine Mineral Deposits, CRC Press, 24-Nov-1999
3. Yves Fouquet , Denis Lacroix , Deep Marine Mineral Resources, 2014th Edition, Springer Dordrecht Heidelberg London New York
4. H. Kunzendorf , Marine Mineral Exploration, ISBN-10: 0444426272, Elsevier Oceanography Series

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√	√	√	√	√	√	√	√
CO2	√		√	√	√	√	√	√	√	√	√	√
CO3	√	√	√	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√		√	√	√	√	√		√
CO5	√		√	√	√	√	√		√	√	√	

Attested

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MC5491 BASIC CRYSTALLOGRAPHY AND CRYSTAL GROWTH L T P C
3 0 0 3

OBJECTIVES

- To introduce the basics of crystal symmetry and crystal structures.
- To provide students with a background to X-ray generation and detection
- To provide instruction on the steps involved in single crystal structure determination
- To teach the concept of powder X-ray diffraction and its applications
- To teach various crystal growth techniques

UNIT I CRYSTAL SYMMETRY AND STRUCTURES 9

Crystalline and non-crystalline materials –– symmetry: symmetry operations, symmetry elements - translational symmetries - point groups - space groups – equivalent positions - space lattice - crystal systems – Bravais lattices – crystal directions - crystal planes – Miller indices- interplanar spacing – coordination number– atomic radius – atomic packing factor of SC, BCC, FCC and HCP structures – linear density – planar density – close packed structures.

UNIT II X-RAYS 9

X-rays - generation of X-rays - sealed tube and rotating anode generators – synchrotron radiation – continuous and characteristic X-rays - X-ray absorption – X-ray monochromators – collimation – Soller slits - X-ray detectors (principles only)

UNIT III SINGLE CRYSTAL STRUCTURE DETERMINATION 9

Diffraction by X-rays - Bragg's law – reciprocal lattice and Ewald sphere – atomic scattering factor - intensities of diffracted X-rays -– Single crystal X-ray diffractometers – measurement of intensities – systematic absences – space group determination - factors affecting X-ray intensities – data reduction – solving the structure - phase problem in crystallography – direct methods – refining the structure – results - geometrical parameters.

UNIT IV POWDER X-RAY DIFFRACTION 9

X-ray diffraction by polycrystalline materials - formation of powder diffraction patterns - Debye-Scherrer camera – powder X-ray diffractometer – diffractograms – sample holders – sample preparation – orientation of crystallites – sample rotation – diffraction geometries – indexing of powder pattern – applications of powder diffraction.

UNIT V CRYSTAL GROWTH TECHNIQUES 9

Bridgman technique - Czochralski method - Verneuil technique - zone melting – gel growth – solution growth methods – low and high temperature solution growth methods – vapour growth - epitaxial growth techniques- LPE – MOCVD – MPE.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course the students will

- understand crystal symmetry, crystal planes and simple crystal structures
- gain a knowledge of X-ray generation, absorption, monochromatization and detection
- get a working knowledge of single crystal structure determination
- get some insight into the powder diffraction and its applications
- be able to understand the basics of various crystal growth techniques

REFERENCES

1. Tareen, J.A.K. and Kutty, T.R.N. A Basic course in Crystallography. University Press, 2001.
2. Cullity, B.D. and Stock,S.R. Elements of X-ray Diffraction. Pearson, 2014
3. Stout, G.H. and Jensen, L. X-ray Structure Determination, A Practical Guide. Macmillan : New York, 1989.
4. Woolfson, M.M. An Introduction to X-ray Crystallography. Cambridge University Press, New York, 1997.
5. Bhat, H.L Introduction to Crystal Growth: Principles and Practice. CRC Press, 2014.

MC5492 **NONLINEAR SCIENCE** **L T P C**
3 0 0 3

OBJECTIVES

- The students will be introduced to the basics of nonlinear dynamics and its applications.
- The students will learn about the mathematical models needed to study the concepts of fixed points, oscillations, bifurcations and integrability.
- The students will know about the nonlinear dynamical phenomena in chemical systems.
- The students will understand the importance of nonlinear dynamics in biological systems.
- The students will be introduced to the concepts of nonlinear dynamical analysis in geological systems.

UNIT I NONLINEAR DYNAMICS 9

Dynamical systems - linear systems - importance of nonlinearity - nonlinear dynamical systems - Autonomous and non-autonomous systems - phase-space, flows and limit sets . Classification of equilibrium points in planar systems – periodic and chaotic motions - fractals - pattern formation - cellular automata - self-self-organised criticality - networks - stochastic resonance.

UNIT II MATHEMATICAL MODELS 9

First-order differential equations - separation of variables - slope fields - Euler's method - equilibria and phase plane - bifurcations - higher-order equations - trace-determinant plane - harmonic oscillators - equilibrium point analysis - non-autonomous systems and chaos - finite dimensional integrable systems - dispersive systems - solitary waves - solitons - analysis of soliton solutions.

UNIT III CHEMICAL SYSTEMS 9

Chemical oscillations - waves and patterns - transport and external field effects - polymer systems - coupled oscillators - Turing patterns - stirring and mixing effects - Briggs-Rauscher reaction - Belousov-Zhabotinsky reaction - BZ waves - propagating pH front - chemical clocks.

UNIT IV BIOLOGICAL SYSTEMS 9

Biological oscillators - excitable systems - neuronal systems: HH equations - FN equations - physiological control systems - dynamics of bone remodelling - dynamics of nucleic acids:Protein complexes - patterns in biological membranes - cell replication and control - pupil light reflex - dynamical analysis of human tremor - fractals in living organisms.

UNIT V GEOLOGICAL SYSTEMS 9

Computational models of earthquakes - earthquake processes - multi fractals in geosciences - entropy analysis of seismicity - tectonics - spatial distribution of earthquakes - volcanic eruptions - short and long range interactions - RJB model - precursory dynamics - landscape dynamics - dynamics of earth's magnetosphere. Snow avalanches and system model - geomorphology: drainage networks, fractal trees, growth models, diffusion-limited aggregation.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students should able to

- Understand the basics of nonlinear dynamics and its applications.
- Gain knowledge on the concepts of fixed points, oscillations, bifurcations and integrability.
- Appreciate the importance of nonlinear dynamical phenomena in chemical systems.
- Understand the role of nonlinear dynamics in biological systems.
- Apply nonlinear dynamical analysis for geological systems.

REFERENCES

1. M. Lakshmanan and S. Rajasekar. Nonlinear Dynamics: Integrability Chaos and Patterns. Springer-Verlag, 2003
2. M. Lakshmanan and K. Murali. Chaos in Nonlinear Oscillators. World Scientific,Singapore, 1996.
3. S.H.Strogatz. Nonlinear Dynamics and Chaos. CRC Press, 2014.
4. Paul Blanchard, R.L.Devaney and G.R.Hall. Differential Equations. Brooks/Cole, 2012.

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5. Irving R.Epstein and J.A. Pojman. An Introduction to Nonlinear Chemical Dynamics. Oxford University Press, 1998.
6. Anne Beuter, Leon Glass, M.C.Mackey and M.S.Titcombe. Nonlinear Dynamics in Physiology and Medicine. Springer, 2003.
7. Donald L. Turcotte. Fractals and Chaos in Geology and Geophysics. Cambridge University Press, 1997.

MT5491 STATISTICAL METHODS L T P C
3 0 0 3

OBJECTIVES

- To organize and describe the data and hence compute the various descriptive measures
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using standard sampling distributions
- To expose to the basic principles of experimental design and hence carry out the analysis of variance
- To use non parametric methods on data sets which are not from normally distributed population
- To prepare the students to implement the various concepts in statistics using R statistical tool

UNIT I DESCRIPTIVE STATISTICS 9

Frequency distribution - Graphs of frequency distribution - Descriptive Measures - Quartiles and Percentiles - Calculation of sample mean and population mean

UNIT II HYPOTHESIS TESTING 9

Sampling Distributions- Central Limit Theorem - Testing a Statistical Hypothesis - Tests Concerning Means and variances - Independence of Attributes - Goodness of Fit

UNIT IV ANALYSIS OF VARIANCES 9

One way and two way classification - Completely Randomized Design - Randomized Block Design - Latin Square Design

UNIT V NONPARAMETRIC METHODS 9

Sign Test - Wilcoxon's Signed Rank Test - Rank Sum Tests - Tests of Randomness - Kolmogrov Smirnov and Anderson Darling Tests

UNIT V CALCULATIONS USING R 9

Classification and tabulation of data - Graphical representation - Calculation of central tendency and dispersion of data - Implementation of skewness, moments and kurtosis - Hypothesis Testing - Implementation of ANOVA, sign test and rank sum test.

TOTAL: 45 PERIODS

OUTCOMES

- It equips the student to compute mean, variances, quartiles and percentiles for a large set of data points obtained from a series of measurements
- It imparts the knowledge of various test statistics used in hypothesis testing for mean and variances of large and small samples
- It enables the students to compare several means
- It makes the students use sign test and rank test which can be applied to any raw data without the underlying assumptions that the observations are from normal population.
- It equips the students to implement the various concepts learnt using R tool for statistics

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REFERENCES

1. Gupta S. C. and Kapoor V. K, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 11th Edition, New Delhi, 2002.
2. John E. Freund ," Mathematical Statistics with Applications", 8th Edition, Pearson Education, New Delhi, 2017.
3. Richard A. Johnson, Irwin Miller and John Freund, "Miller and Freund's Probability and Statistics for Engineers", 8th edition, Pearson Education, New Delhi, 2015.

HS5491 PROFESSIONAL EMAIL COMMUNICATION L T P C
3 0 0 3

UNIT I Email as a medium of professional communication (1 hour)

a. Clear, grammatically correct sentences
b. Clear and coherent paragraphs
c. Polite and professional expression
d. Accurate punctuation

The nature of the e-mail in its present technological state

a. The pros and cons of using email for professional communication

UNIT II Standard email conventions and etiquette

a. Conventions for effective emailing intra and inter workplaces(inclusive of formatting)
b. Interpersonal etiquette to be used in professional emailing
c. Cross- cultural dos and don'ts when using email across borders

UNIT III Understanding email messages accurately (2 hours)

a. Understanding the core message
b. Understanding the writer's intention and expectation accurately
c. Interpreting the style ad tone of the message
d. Reading and understanding messages quickly

UNIT IV Writing clear and contextually appropriate responses (12 hours)

a. Writing appropriate opening and closing sentences
b. Structuring the email logically and coherently
c. Positioning the core message for reader attention and action
d. Writing messages for a range of professional functions such as giving an update, reporting, requesting , clarifying and confirming, giving instructions etc.

UNIT V Using a range of professional styles (10 hours)

a. Maintaining courtesy and professional poise in all messages
b. Being direct or indirect as necessary
c. Being elaborate or brief as necessary
d. Being assertive and decisive when needed

TOTAL: 45 PERIODS

LEARNING OUTCOME: At the end of the course, the students should

- Understand email as a professional communication medium and as it is used in workplaces today.

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- Use standard e-mailing conventions and etiquette used in workplaces internationally.
- Use appropriate style and tone for communicating a variety of professional messages that are generally communicated via e-mail in work and business communication.
- Read and interpret e-mail messages accurately and write contextually appropriate responses.
- Use English accurately while writing emails in generic professional contexts.
- Use punctuation accurately while writing e-mail messages.

Assessment (with individualised feedback for mid-course tests) :

Mid-course Assessment - 1 hour + 1 hour for feedback after evaluation)

Mid-course Assessment - 2 (1 hour + 1 hour for feedback after evaluation)

Final Assessment – 2 hours (inclusive of Email English test)

Classroom teaching methodology: Concept familiarisation will be accompanied with practice in generic professional emailing contexts. Practice tests and individualised feedback will be used feedback.

Material for the course will be teacher generated

HS5492 **PROJECT REPORT WRITING** **L T P C**
3 0 0 3

OBJECTIVES

The Course aims to,

- Develop the project writing skills of engineering graduates
- Give engineering and technology students practice in writing a project report
- Enhance their awareness on the importance of report writing in the professional context

UNIT I

Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing

UNIT II

Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis

UNIT III

Structure of the Project Report: (Part 1)Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework

UNIT IV

Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations - Recommendations – Conclusion – Bibliography

UNIT V

Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report orally – Techniques Attested

TOTAL: 45 PERIODS

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OUTCOMES

At the end of the course students will be able to,

- Write reports successfully
- Analyze issues threadbare and arrive at findings based on the analysis
- Write reports for different purposes

REFERENCE BOOKS

1. Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall(2012)
2. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012)
3. Daniel Riordan - Technical Report Writing Today (1998)
4. Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.

HS5493 BASIC PRESENTATION SKILLS

L	T	P	C
3	0	0	3

OBJECTIVES

The course aims to,

- Develop public speaking skills among students of engineering and technology
- Enhance the presentation skills of students
- Heighten the awareness related to the fundamentals of presentations.

UNIT I

Presentation skills – Characteristics of an effective Oral Presentation – Audience - Context, Content, Speaker Status - Purpose – Modus Operandi – Extempore

UNIT II

Emphasis on syllable stress, pronunciation, intonation, pauses, pace - Preparation for a presentation – Avoiding plagiarism –Ample use of Referencing skills – Efficient ways of Collecting and Collating data (due emphasis on important information)

UNIT III

Impressive introduction – Body language – Use of icebreakers – “Start Proper” for the presentation – Relevant Anecdotes & Jokes - Responding constructively to questions – Time Management – Information sharing

UNIT IV

Impressive introduction – Body language – Use of icebreakers – “Start Proper” for the presentation – Relevant Anecdotes & Jokes - Responding constructively to questions – Time Management – Information sharing

UNIT V

Presentation skills – Guidelines – Group Presentation - Creative approaches to presenting – Technical presentation - Speaking under time constraint – variations in pitch, tone & intonation - Credibility in presentation (Use of authentic data/information) Podium panache – Effective Delivery

Learning Outcomes: At the end of the course, students will be able to,

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Michael Osborn, Susan Osborn, Randall Osborn & Kathleen J Turner, “Public Speaking: Finding Your Voice”, 10th Edition, Pearson, 2012.
2. John Hughes & Andrew Mallett, “Successful Presentations DVD & Student’s Pack”, OUP, Oxford, 2012.

3. Nancy Duarte, “Resonate: Present Visual Stories That Transform Audiences”, John Wiley & Sons, New Jersey, 2010.
4. Scott Berkun, “Confessions of a Public Speaker”, O’Reilly Media, Inc, Canada, 2010.
5. Barbara Pease & Allan Pease, “The Definitive Book of Body Language”, Bantum Books, New York, 2006.
6. Naomi Karten, “Presentation Skills for Technical Professionals: Achieving Excellence (Soft Skills for IT Professionals), IT Governance Publishing, UK, 2010.

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING **L T P C**
2 0 0 0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING **6**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS **6**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS **6**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS **6**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS **6**

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

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REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

AX5092 DISASTER MANAGEMENT L T P C
2 0 0 0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explaina critical understanding of key concepts in disaster riskreduction and humanitarian response.
CO3: Ability to illustratedisaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describean understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS 6

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES 6

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS 6

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE 6

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING 6

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

AX5094	VALUE EDUCATION	L T P C
		2 0 0 0

OBJECTIVES

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.

Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

SUGGESTED READING

1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

OUTCOMES

Students will be able to

- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

AX5095	CONSTITUTION OF INDIA	L T P C
		2 0 0 0

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Attested

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AX5096	PEDAGOGY STUDIES	L T P C 2 0 0 0

OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.

5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

AX5097 **STRESS MANAGEMENT BY YOGA** **L T P C**
2 0 0 0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do's and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098 **PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS** **L T P C**
2 0 0 0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and man kind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

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