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.
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:

<table>
<thead>
<tr>
<th>PO#</th>
<th>Graduate Attribute</th>
<th>Programme Outcome</th>
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<tbody>
<tr>
<td>1</td>
<td>Scientific knowledge</td>
<td>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.</td>
</tr>
<tr>
<td>2</td>
<td>Practical ability</td>
<td>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</td>
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<tr>
<td>3</td>
<td>Design/development of radiation treatment</td>
<td>Can pursue a broad range of translational clinical research projects in radiotherapy.</td>
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<tr>
<td>4</td>
<td>Knowledge transfer</td>
<td>Will be able to be instrumental in the evaluation and implementation of new technologies and in translation of research into professional practice.</td>
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</table>
5  Modern tool usage  Will be able to develop the skills to critically evaluate and optimize the performance of medical equipment and procedures.

6  The Medical Physicist and society  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  Environment and sustainability  Design the system with environment consciousness and 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 engineers.

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 be 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:

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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

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Total No. of Credits : 85

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Total Credits: 0

SUMMARY

M.Sc. MEDICAL PHYSICS (2 YEARS)

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5/8
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
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 – fusion.

UNIT II INTERACTION OF RADIATION WITH MATTER
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

UNIT IV PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS

UNIT V RADIATION MONITORING INSTRUMENTS

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.

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TEXT BOOKS

REFERENCES:

MP5102 RADIATION GENERATING EQUIPMENT IN MEDICINE

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-Proton 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

TOTAL: 60 PERIODS
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

REFERENCES
2. Samantha Morris, Radiotherapy physics and equipment, Churchill Livingstone, 2001

MP5103 ELECTRONIC CIRCUITS AND MICROPROCESSOR

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 emphasize the electronic circuits in processing and analyzing the signals from radiation detectors.

UNIT I BASIC ELECTRONICS:

UNIT II DIGITAL ELECTRONICS

UNIT III POWER SUPPLIES IN NUCLEAR INSTRUMENTATION
UNIT IV  NUCLEAR DEVICES

UNIT V  ELECTRONICS FOR NUCLEAR DEVICES

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:

REFERENCES:

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 RADIATION PHYSICS IN MEDICINE
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
UNIT III MEDIPHOTONICS 9

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 therapy

UNIT V RADIO FREQUENCY AND MICROWAVES 9
Production and properties - Interaction mechanism of RF and microwaves 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
- Tissue 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

REFERENCES
3. Harry Moseley, Hospital Physicists’ Association, Non-ionising radiation: microwaves, ultraviolet, and laser radiation, A. Hilger, in collaboration with the Hospital Physicists’ Association, 1988
UNIT II 
COMPLEX ANALYSIS 
12

UNIT III 
FOURIER TRANSFORMS 
12

UNIT IV 
PARTIAL DIFFERENTIAL EQUATIONS 
12

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 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

REFERENCES

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.
ANY TEN EXPERIMENTS

1. Dual regulated power supply
2. Astable & Monostable multivibrator design
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
9. Half Adder & Full Adder
10. Instrumentation amplifier Op-Amp
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

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

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

UNIT V  NERVOUS SYSTEM
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 hormones and their molecular mechanism in disease diagnosis

TEXTBOOKS
3. Ross and Wilson, Anatomy and Physiology.
REFERENCES
2. Edward Alcamo, Barbara Krumhardt, Barron’s Anatomy and Physiology the Easy Way, Barron’s Educational Series, 2004

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 nonlinearity.
- 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

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

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
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

REFERENCES

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

UNIT II CALIBRATION, MEASUREMENT AND QUALITY ASSURANCE OF TELERAPHERY UNITS

UNIT III RADIATION TREATMENT PLANNING PARAMETERS
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

UNIT V EXTERNAL BEAM TREATMENT PLANNING ASPECTS 12

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

REFERENCES

MP5211 BIOMEDICAL INSTRUMENTATION LABORATORY

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.
4. Pacemaker
5. ECG pattern generation
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 $\gamma$-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

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.
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.

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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.
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
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

UNIT III   DOSIMETRY

UNIT IV   CLINICAL PRACTICE
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


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


REFERENCE:

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

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 BIOELECTRICAL POTENTIAL ELECTRODES AND TRANSDUCERS

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

UNIT II BIOELECTRIC SIGNAL RECORDING

Introduction-characteristics of recording systems – Electrocardiography (ECG) - Electroencephalograph (EEG) - Electromyograph (EMG) - Electroneurograph (ENG) - recording units.

UNIT III PHYSIOLOGICAL ASSIST DEVICES

UNIT IV  CLINICAL AND OPERATION THEATER EQUIPMENTS  

UNIT V  BIOTELEMETRY AND SAFETY INSTRUMENTATION  

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
2. S. Ananthi, A Textbook of Medical Instruments (Paperback), New Age International Private Limited , January 2005

REFERENCES

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  

UNIT II  BIOLOGICAL PERFORMANCE OF MATERIALS AND CHARACTERIZATION TECHNIQUES  
UNIT III  OPHTHALMOLOGIC APPLICATIONS AND DRUG DELIVERY SYSTEMS


UNIT IV  ARTIFICIAL ORTHOPEADIC AND DENTAL MATERIAL


UNIT V  CARDIOVASCULAR MATERIALS


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


REFERENCES


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.

Any Ten experiment only
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
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- Obstetrics 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:
UNIT III X-RAY IMAGING SYSTEMS

UNIT IV CT
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

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

REFERENCES

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 :
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

UNIT III  THERAPEUTIC APPLICATIONS  9

UNIT IV  SPECTROSCOPY AND IMAGING  9

UNIT V  NANOPHOTONICS AND LASER SAFETY  9

TOTAL: 45 PERIODS

OUTCOME
- The student can able to design different laser spectrometers
- With the knowledge of Laser – Tissue 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

REFERENCES

MP5003  NUCLEAR MEDICINE  L T P C
 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
UNIT I  RADIO NUCLIDE AND RADIOPHARMACEUTICALS  

UNIT II  INSTRUMENTATION IN NUCLEAR MEDICINE  

UNIT III  QUALITY CONTROL OF EQUIPMENTS IN NUCLEAR MEDICINE  

UNIT IV  CLINICAL RADIONUCLIDE IMAGING AND DOSIMETRY  
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  

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

REFERENCES
3. Magdy M. Khalil, Basic Sciences of Nuclear Medicine, Springer, 2011
BIOLOGICAL EFFECTS OF IONIZING RADIATION

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
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
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

UNIT IV GENETIC EFFECTS OF RADIATIONS

UNIT V RADIOBIOLOGICAL BASIS OF RADIOTHERAPY
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

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
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
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 knowledge.
- 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 4DCT imaging -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.

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
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
5. IAEA technical report series 483:Dosimetry of small static fields used in External Beam
REFERENCES
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 be 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

UNIT II EVALUATION OF EXTERNAL AND INTERNAL HAZARDS 10

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 AND TRANSPORT 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
UNIT V MANAGEMENT OF RADIATION EMERGENCIES


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

REFERENCES
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

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
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
UNIT III  TYPES OF BIOSENSORS

- 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

- 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

UNIT V  BIOSENSORS FOR MEDICAL APPLICATIONS

- 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

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


REFERENCES

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  

UNIT II  IMAGE FORMATION  

UNIT III  EXPOSURE AND EXPOSURE TIME ESTIMATION  

UNIT IV  TESTING METHODS FOR DIFFERENT APPLICATIONS  
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  
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

REFERENCES
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 TECHNIQUE


UNIT II  MONTE CARLO TECHNIQUES FOR PHOTON AND NEUTRON TRANSPORT

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

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 LIGHT TRANSPORT IN TISSUES


UNIT V  DIFFUSION THEORY OF LIGHT TRANSPORT IN TISSUE


TOTAL: 45 PERIODS

OUTCOME

Apply various Monte Carlo techniques in solving various mathematical 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

REFERENCES


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 biomaterial interaction.

UNIT I FUNDAMENTALS OF MICRO FABRICATION 9

UNIT II MICRO FLUIDIC PATTERNING AND BIOPOLYMER PATTERNING 9

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

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.
TEXTBOOKS

REFERENCES

MP5011 ULTRASONICS IN MEDICINE

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 Ultrasonic within the safety limits for medical applications

UNIT I GENERATION AND DETECTION OF ULTRASOUND
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

UNIT III SIGNAL PROCESSING, DISPLAY AND SAFETY:
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 GYNAECOLOGY

UNIT V ULTRASOUND IN OPHTHALMOLOGY AND ECHOCARDIOGRAPHY

TOTAL: 45 PERIODS
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

REFERENCES

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

UNIT III TYPES OF DOSIMETERS: 9
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: CaSO₄: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.

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
5. Advanced Materials and Techniques for Radiation Dosimetry, Khalil Arshak and Olga
   Korostynska, Artech House Publishers, 2017
   Ramtrans Publishing (December 1995)

ADDITIONAL BOOKS:

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.

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:

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
UNIT II  INTELLIGENT MATERIALS FOR ENERGY GENERATION
Artificial Intelligence in Materials, Ferroelectricity: 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
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

UNIT V  INTELLIGENT OPTICAL MATERIALS FOR ENVIRONMENT

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
UNIT I  HUMAN INFLUENCES
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
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 CO₂ emissions.

UNIT III  JOURNALISTIC CHALLENGES
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
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
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
DIGITAL PHOTOGRAPHY

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

UNIT II LENS AND ELEMENTS OF PHOTOGRAPHY

UNIT III COLOUR AND LIGHTING
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
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
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

2. Balakrishna Aiyer, Digital Photojournalism, Authors press, 2005
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


UNIT II GREEN REAGENTS AND CATALYSTS

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

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 SYNTHESSES

Microwave induced green synthesis (Hoffmann Elimination and Oxidation of alcohols) – Ultrasonic 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


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

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

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

UNIT III  ASSESSMENT  9

UNIT IV  MANAGEMENT  9

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

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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

UNIT II OCEAN RESOURCES

UNIT III ENERGY RESOURCES
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
Marine sampling - Water Samplers - Bottom Samplers - Instrumentation

UNIT V OCEAN MINERAL MINING

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.

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MC5491 BASIC CRYSTALLOGRAPHY AND CRYSTAL GROWTH

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

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

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

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


UNIT V CRYSTAL GROWTH TECHNIQUES

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

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

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

UNIT IV  BIOLOGICAL SYSTEMS 9

UNIT V  GEOLOGICAL SYSTEMS 9

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


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

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
REFERENCES

HS5491 PROFESSIONAL EMAIL COMMUNICATION

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 and 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.
• 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

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

UNIT II

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

TOTAL: 45 PERIODS
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

REFERENCE BOOKS

HS5493 BASIC PRESENTATION SKILLS

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

UNIT IV

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

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C

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

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

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AX5092 DISASTER MANAGEMENT

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
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

UNIT III DISASTER PRONE AREAS IN INDIA
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
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

TOTAL: 30 PERIODS

OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an 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.
REFERENCES

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
Alphabets in Sanskrit  6

UNIT II  TENSES AND SENTENCES
Past/Present/Future Tense - Simple Sentences  6

UNIT III  ORDER AND ROOTS
Order - Introduction of roots  6

UNIT IV  SANSKRIT LITERATURE
Technical information about Sanskrit Literature  6

UNIT V  TECHNICAL CONCEPTS OF ENGINEERING
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics  6

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.
REFERENCES
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

AX5094 VALUE EDUCATION

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

UNIT II

UNIT III

UNIT IV

SUGGESTED READING

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.
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 nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and 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:

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:

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.

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.
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

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’ts 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. “Rajayogs or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098   PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS          L T P C
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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: Chapter 2 - Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16, 17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter 2 - Verses 17, Chapter 3 - Verses 36, 37, 42 - Chapter 4 - Verses 18, 38, 39 Chapter 18 - 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 mankind 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