



D.Y. PATIL EDUCATION SOCIETY
[Deemed to be University], Kolhapur
Re-accredited by NAAC with 'A' Grade

LEARNING OUTCOMES AND GRADUATE ATTRIBUTES



Outcome Based Education (OBE) Platform

Institutional outcome:

- Knowledge and Skills
- Planning and Problem-solving abilities
- Communication
- Research Aptitude
- Professionalism and Ethics
- Leadership



Centre for Interdisciplinary Research

Programme: M.Sc. Stem Cell and Regenerative Medicine

Graduate Attributes:

- ❖ Get knowledge and skill of Stem Cell and Regenerative Medicine in Industry, Medical or hospital related organizations, Regulatory Agencies and Academia.
- ❖ to develop Planning and Problem-solving abilities in Stem cell handling and preservation, molecular biology, disease diagnosis, handling and maintenance biological instrumentation, analytical methods, interpretation of experimental data.
- ❖ Develop communication skills to communicate effectively in teaching, research project, interview, healthcare sectors, industries, academia for collaborative research by explaining his ideas with good interpersonal and workplace-based skills.
- ❖ Able to do research in Stem cryopreservation, transplantation, diagnosis and drug development for carrier as well as placement.
- ❖ Develop understanding and implementation ethics in profession, research, society, animal experiment, biosafety, workplace, hospital, clinical research and human trial.
- ❖ Develop leadership skills, logical reasoning, time management and values required for self-directed, lifelong learning, soft skills for professional development and execute their professional roles in society as stem cell professionals, employers and employees in various industries, academic institutions and research laboratories.
- ❖ Develop character with good moral values, human values, good social behavior, gratitude, honesty, ethics, safety, hygiene, responsibility, confidence, tolerance and critical thinking.
- ❖ Able to Contribute in sustainable development to achieve the national sustainable development goal 3.
- ❖ This course is helpful for lifelong learning in Medical Science Stream.

Learning Outcome

Paper 1. Biochemistry

At the end of the course, the student will be able to:

1. Describe the Structure and properties of biomolecules like Nucleic acids, Proteins amino acids, estimation of biomolecules, Carbohydrates and Proteins and their role in metabolic and cellular pathways.
2. Describe the classification and functional properties of enzymes, enzyme kinetics and enzyme inhibition.
3. Explain about the role of vitamins and cofactors in enzyme activity.
4. Describe the metabolism of carbohydrates.
5. Describe the metabolism of lipids.
6. Describe the metabolic disorders in human.



Paper 2. Cell Biology and Developmental Biology

At the end of the course, the student will be able to:

1. know the basics concepts of cell biology including structure and function of different organelles.
2. Understand the transport mechanisms and Mechanism of cellular recognition and communication.
3. Develop the basics understanding of receptor, ligand and different types cell signaling and their mechanisms.
4. Explain the importance of development and development process.
5. Explain the Growth, Morphogenesis and Genetic assimilation.
6. Understand of role of stem cells in development of organisms and developmental anomalies.

Paper 3 Genetics and Molecular Biology

At the end of the course, the student will be able to:

1. Explain the mechanisms of DNA replication and repair, RNA synthesis and processing, and protein synthesis.
2. Contribute to the education of peers by actively engaging in small group sessions, and by clearly communicating information in an oral presentation based on a personal literature search on a specific genetic disease.
3. Critically evaluate one's performance in the course to identify strengths and personal limitations in either knowledge of molecular cell biology and genetics or study methods; develop learning goals to address any deficiencies and actively seek out assistance from appropriate sources to successfully remediate these deficiencies.
4. Explain the mechanisms of gene transcription and its regulation.
5. Explain the Gene mutations and human genetic disorders Consequences of mutation, Causes and occurrences.

(Paper 4) SCRM.1.1.4 Immunology and Virology

At the end of the course, the student will be able to:

1. The role and importance of innate and adaptive immunity to host defense against micro-organisms and the processes involved in immune cell development.
2. Concepts of regulation of Immune responses.
3. Understanding of Immunologic basis of graft rejection and immunotherapies.
4. Knowledge of viral diseases.
5. Understanding of development of vaccines.



Paper 5 Clinical Biochemistry and Disease Metabolism

At the end of the course, the student will have:

1. The understand the concepts of protein metabolism and understand the importance of clinically important enzymes and related pathophysiology.
2. To know about cause of metabolic diseases.
3. biochemical methods for diagnosis of metabolic diseases.
4. The knowledge of Metabolic disorders and organ system function test.
5. To get the knowledge Metabolic disorders involved in metabolism.
6. To understand about clinically important Enzymes.

Paper 6 Biostatistics and Bioinformatics

At the end of the course, the student will be able to:

1. Understand the basic concepts of bioinformatics and databases available for Bioinformatics study.
2. Apply the knowledge of bioinformatics for getting DNA sequence and protein sequence for desired gene.
3. To study the comparison of Nucleotides, Amino acids sequences between various organisms.
4. Recognize the definition of statistics and its relation with biological sciences.
5. Apply the knowledge of sampling techniques, probability distributions.
6. Apply the knowledge of sampling correlation and regression in problem solving.

Paper 7 Biomedical Instrumentation and Nano biotechnology

At the end of the course, the student will be able to:

1. Understand the fundamental principles of Chromatography, electrophoresis, Spectrophotometry etc.
2. Development of technical Skills involved in Chromatography, electrophoresis, Spectrophotometry etc.
3. To understand principle and Instrumentation involved in PCR and Flow cytometry techniques.
4. To understand basic principles in Nano biotechnology.
5. Acquire knowledge about techniques used in nanobiotechnology.
6. Understand the applications of nanobiotechnology in Tissue engineering.

Paper 8 Stem Cell Biology

At the end of the course, the student will be able to:

1. Explain basic concepts of stem cells, and different types of stem cells.



2. Understand the Pluripotent stem cell and molecular mechanism of Self renewal and differentiation.
3. Demonstrate methods of isolation of stem cell types.
4. Understand the Hematopoietic stem cell, their Characterization, and Differentiation of hematopoietic stem cell lineages.
5. Explain basic concepts of endothelial progenitor cells, Multipotent adult progenitor cells.
6. Understand the Cancer stem cells and their regulation.

Paper 9. Stem Cell, Disease and applications.

At the end of the course, the student will be able to:

1. Understand the concepts of stem cell therapy in degenerative neuronal disease and spinal cord regeneration.
2. Explain the Role of stem cells in acute myocardial infarction and dilated cardiomyopathy.
3. Understand the Role of stem cells in diabetes and muscular dystrophies.
4. Understand the Role of stem cells in treatment of hereditary hemolytic anemias.
5. Understand the CART cell therapy, NK & dendritic cell therapy for solid tumors.
6. Explain Role of Hematopoietic stem cell transplantation for malignancies, lymphoma, leukemia and myeloma.

Paper 10. Biomaterials, Tissue engineering and 3 D bio printing.

At the end of the course, the student will be able to:

1. Understand the Properties of Materials, Classes of materials used in Tissue engineering.
2. Concepts of biomaterials used in medicine and their reactions with biological systems.
3. Demonstrate the Tissue engineering of organs like bone, cartilage, liver, cornea.
4. Explain Tissue engineering of organs and their clinical application.
5. Understand the advances of 3D Printing Technology and its clinical applications.
6. Explain the concepts of Bio ink for 3D printing of Bone, cartilage, skin, arteries and heart.

Paper 11 Clinical Research, Bioethics and Regulatory Affairs

At the end of the course, the student will be able to:

1. Understand and Explain Clinical Research, Terminologies and definition in Clinical Research.
2. To know origin and History of Clinical Research, Difference between Clinical Research and Clinical Practice.
3. To understand and explain the Biosafety in laboratory institution: laboratory associated infection and other hazards, assessment of biological hazards and level of biosafety.
4. To understand and explain the rules and regulations involved in Clinical research.
5. To understand and explain concepts of Bioethics.
6. To understand and explain Intellectual property rights.



Paper 12 Cell and Tissue Banking and Cryopreservation

At the end of the course, the student will be able to:

1. Understand the concepts of Cell and Tissue banking.
2. To know instrumentation for setting up of cell and organ tissue bank.
3. To understand the applications of cord blood banking.
4. To know advantages and disadvantages of transplantation.
5. Understand apply the knowledge of cryopreservation and cryoprotectants for cryopreservation.

Paper 13 Research Methodology

At the end of the course, the student will be able to:

1. Understand basic concept of Research, Types of Research methodology.
2. To know about selection of research problem and Hypothesis.
3. To write research project and thesis.
4. Use application of computer for research.
5. Use Power point presentation, Excel, Word to compilation and analysis of data.
6. Use of search engine for searching of literature.

Paper 14 Entrepreneurship and Management

At the end of the course, the student will be able to:

1. **CO1:** Understand the nature of management, Roles of Management and Levels of Management.
2. Understand the Nature and purpose of planning and Organization.
3. Know the Nature and importance of staffing–Process of Recruitment and Selection.
4. Understand the Meaning and nature of directing.
5. Understand the Structure of a Biotechnology Company.
6. Know the function of entrepreneur in successful, commercial application of innovations.

Programmed: M.Sc. Medical Biotechnology

Graduate Attributes:

- ❖ Demonstrate subject knowledge and skill of Medical Biotechnology for appropriate applications in Industry, Medical or hospital related organizations, Regulatory Agencies and Academia.
- ❖ Planning and problem-solving abilities in molecular biology, rDNA technology, disease diagnosis, handling and maintenance biological instrumentation, analytical methods, problem solving and interpretation of experimental data.



- ❖ Develop communication skills to communicate effectively in teaching, research, interviews, healthcare sector, industries, academia for collaborative research by explaining his ideas with good interpersonal and workplace-based skills.
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4. Understand the Hematopoietic stem cell, their Characterization, and Differentiation of hematopoietic stem cell lineages.
5. Explain basic concepts of endothelial progenitor cells, Multipotent adult progenitor cells.
6. Understand the Cancer stem cells and their regulation.



Paper 9 Industrial Biotechnology

At the end of the course, the student will be able to:

1. Explain the concepts of Fermentation process, media Formulation and sterilization.
2. To know about bioreactors design and strain improvement.
3. To understand preparation of bio fertilizers and bio pesticides.
4. Genetic modification of organism for improvement.
5. Explain the downstream processing, pollution control, bioremediations.
6. To understand the Intellectual property rights.

Paper 10 Cell culture and Animal Biotechnology

At the end of the course, the student will be able to:

1. Explain the basic concepts of cell culture laboratory, media formulation, procedure for cell culture.
2. Demonstrate the techniques involved in animal cell culture for animal biotechnology
3. Know applications of animals in *in vivo* studies.
4. Understand the application of cell culture technology in production of human and animal viral vaccines.
5. understand the application of cell culture technology in pharmaceutical proteins.
6. To understand the concept of cryopreservation.

Paper 11 Medical Microbiology

At the end of the course, the student will be able to:

1. Explain types of fungal diseases and its diagnosis.
2. To understand bacterial diseases and its diagnosis.
3. To understand the causes of diseases and its diagnosis.
4. Demonstrate methods of detection of protozoan and sexually transmitted diseases.
5. To know the epidemiology of viral diseases.
6. To understand transmissibility of pathogenic diseases.

Paper 12 Molecular Diagnostics and Therapeutics

At the end of the course, the student will be able to:

1. Explain basic concepts molecular diagnostics.
2. To demonstrate the techniques involved in PCR for disease diagnosis.
3. To know the concepts of gene therapy.
4. To understand the various methods of disease diagnosis.
5. To detect recognized genetic aberrations in clinical samples from cancer patients.
6. Explain basic concepts oncology.



Paper 13 Research Methodology

At the end of the course, the student will be able to:

1. Understand basic concept of Research, Types of Research methodology.
2. To know about selection of research problem and Hypothesis.
3. To write research project and thesis.
4. Use application of computer for research.
5. Use Power point presentation, Excel, Word to compilation and analysis of data.
6. Use of search engine for searching of literature.

Paper 14 Entrepreneurship and Management

At the end of the course, the student will be able to:

1. Understand the nature of management, Roles of Management and Levels of Management
2. Understand the Nature and purpose of planning and Organization
3. Know the Nature and importance of staffing–Process of Recruitment and Selection
4. Understand the Meaning and nature of directing
5. Understand the Structure of a Biotechnology Company
6. Know the function of entrepreneur in successful, commercial application of innovations.

Programme: M. Sc. Medical Physics

Graduate Attributes

- ❖ Possess knowledge of basics human anatomy, nuclear & radiation physics, diagnostic radiology, radiotherapy, brachytherapy, nuclear medicine, radiation detection, dosimetry, radiation biology, and radiation safety as recommended by the atomic energy regulatory board (AERB), Mumbai / international regulatory agencies.
- ❖ To demonstrate an ability to apply the knowledge acquired through the state-of-the art radio therapeutic techniques and medical imaging for providing and ensuring safety treatment for the needy human.
- ❖ To develop communication skills to communicate effectively in interviews, patient, colleagues, healthcare sector, industries, academia for collaborative research by explaining his ideas with good interpersonal and workplace-based skills.
- ❖ To do research in radiation application in cancer treatment, radiation measurement, radiation biology, artificial intelligence application on radiation therapy, cancer diagnosis, handling and maintenance radiation therapy installation and instrumentation.
- ❖ Develop understanding and implementation of ethics in profession, research, society, workplace, clinical research and human trials.
- ❖ Develop leadership skills, to work effectively and efficiently, logical reasoning, time management, values required for self- directed and lifelong learning, soft skills for



professional development and execute their professional roles in society as medical physicist/radiation safety officers.

- ❖ Develop character with good moral values, human values, good social behavior, gratitude, honesty, ethics, safety, hygiene, responsibility, confidence, tolerance and critical thinking.
- ❖ Able to contribute in environment and sustainable development to achieve the national sustainable development goals.
- ❖ Well prepared for lifelong learning in Medical Physics Stream.

Paper I: Mathematical Physics

1. Comprehend the knowledge of matrices, differential equations, integral transforms and its special functions to enable problem analysis and solving.
2. To understand the various special functions of differential equations and Fourier integral transform.
3. To understand the probability and statistical distributions, Central tendency, computational programming to collect, analyze, interpret data, and apply relevant statistical tests to make a scientific report.
4. To understand the deviation and distribution for various physical data.
5. To provide the correlation and regression analysis to find the relation between two sets of data.
6. To teach various types of statistical distribution and uses for small to very large sampling sizes.

Paper II: Solid State Physics

1. To understand the basics of crystal structure and its various types of bonding.
2. To know about the band structure in conductor, direct and indirect semiconductor and insulator.
3. To understand the basic physics of solids such as thermal behavior and magnetic characteristics in view of its usage in medical instrumentation.
4. To learn the Einstein's, Debye's theories and lattice vibrations.
5. To learn phenomenon of superconductivity, fluorescence and phosphorescence, thermo luminescence, Electroluminescence and to identify, analyze and solve the problem associated with it.
6. To understand the superconductivity and various types of luminescence, Fluorescence and Phosphorescence and LASER etc.

Paper III: Electronics and Instrumentation

1. To know the concepts various junction like p-n, BJT, JFET, MOSFET, UJT and SCR.
2. To understand the various diode construction and its circuits.
3. To understand the principles of various oscillators for constructing electronic circuits.
4. To know functioning of transducers and thermocouple-based thermometers.



5. Capable of how the logic and integrated circuits digital data is generated.
6. To explain the concepts of amplifier AC-DC converter, various dose rate meters and radiation detectors circuits.

Paper IV: Classical and Quantum Mechanics

1. To learn the basic mathematical tools like variation calculus to mechanical systems and able to compute Lagrangian and Hamiltonian equation of motion.
2. To understand about the central force problem, phase space, canonical transformation and Hamilton Jacobi technique.
3. To solve the hydrogen atom problem to calculate energy levels by quantum mechanics.
4. To learn the Schrodinger equations to solvable simple problems.
5. To understand the quantum mechanical angular momentum algebra and spin.
6. To compute corrections in energy and wave functions by approximation technique.

Paper V: Electrodynamics

1. Interpret the deeper meaning of the Maxwellian field equations and account for their symmetry and transformation properties. Define and derive expressions for the energy both for the electrostatic and magneto statics fields.
2. To learn the basics of analog electronics such as ICs, CCDs, RC and LC.
3. To calculate the electromagnetic radiation from localized charges which move arbitrarily in time and space, taking into account retardation effects. Formulate and solve electrodynamic problems in relativistically covariant form in four-dimensional space time.
4. To learn the transmission of electromagnetic waves through wave guide.
5. To understand the basics of electromagnetic radiations, particle accelerators and radiation reactions.
6. Know the electric, magnetic fields, electric potential and vector potentials for point charge and radiation emitted by moving charges.

Paper VI: Nuclear Physics

1. Familiarize with the properties of an atom and nucleus to know various interesting branches such as radioactivity, fission and fusion reactions, nuclear reactors, nuclear power plants, particle physics etc. that has huge applications for the benefits of society.
2. To gain knowledge how ionizing radiation interacts with matter, how it affects living organisms and how it is used as a therapeutic technique and radiation safety practices.
3. To understand the nuclear models and various decay process like Alpha, Beta, and Gamma
4. Familiarize with the electromagnetic spectrum, radiation sources, types and its properties
5. To learn the various nuclear reactions by examples and experiments.
6. Familiarize with the four basics of in nature, its relative strength and various classification of elementary particles.



Paper VII: Radiation Physics and Radiation Generators

1. To understand the basic of radioactivity, natural radioactive series, artificial production of radioactivity and various decay modes.
2. To gain functional knowledge regarding need for radiological protection and the sources and approximate level of radiation exposure for treatment purposes.
3. To learn the construction and working of different types of particle accelerators.
4. To learn the construction of X-ray generator used in diagnostic radiology.
5. To learn the various ionizing radiation interaction with matter (Electron, Photon, Neutron).
6. To learn the penetration and linear energy stopping powers of various radiations.

Paper VIII: Anatomy and Physiology

1. To learn about the human anatomy, physiology and biophysics, exploring its performance as a physical machine.
2. To understand the digestive system and its functions
3. To study Cell, Tissue and boney structures and functions.
4. To learn about mouth, teeth, esophagus, stomach, small and large intestine, blood
5. circulatory system and function of heart.
6. To understand the respiratory, reproduction and excretory system.
7. To know the importance of pituitary gland, Brain and Spinal cord functions.

Paper X: Radiation Dosimetry and Standardization

1. To learn the basics units of radiation, natural and artificial radioactive source productions.
2. To understand the technical report serious-277 & technical report serious-399 protocols and its formalism.
3. To understand the primary & secondary standards Neutron dosimeters, working principles of GM counter and chemical dosimetry for its clinical applications.
4. To understand the standardization of HDR- ^{192}Ir , ^{60}Co and ^{125}I .
5. To know the chemical dosimetry and its applications in radiation measurements.
6. To learn the various radiation counting instruments like beta, gamma, and GM counters.

Paper XI: Clinical and Radiation Biology

1. To understand the structure and behavior of normal and abnormal cells, gain the knowledge about the biological effects of radiation.
2. To understand the various therapies such as radiation therapy, chemotherapy, hormone therapy and immunotherapy for cancer treatment and understand the 4rs of radiation biology and time dose relationship of tumor.
3. To understand the ionizing radiation effects on living organisms.
4. To know the radio-biological impact on living cells, tissue at the DNA, cellular, organ, and whole body.



5. To understand the radiobiological model of fractionated radiation therapy.
6. To understand the optimization of the Radiotherapy plans through biological aspects to enhance clinical outcome.

Paper XII: Medical Imaging

1. To learn the physical principle and components of conventional and digital radiography techniques including computed Tomography (CT), MRI and Ultrasound Imaging
2. To understand the fundamentals of physics with emphasis on medical imaging.
3. To focus the physical principles of diagnostic radiology and explains about Radiography techniques, Image quality and quality assurance.
4. To learn the basics of thermography and its applications.
5. To understand the various radio pharmaceuticals, thyroid uptake system, and Gamma camera.
6. To know the radioactive dilution methods to identify the unknown subject radioactivity.

Paper XIII: Nuclear Medicine and Internal Dosimetry

1. Gain knowledge about different imaging techniques such as PET; evaluate image quality parameters (resolution, contrast, and noise) using quality assurance techniques.
2. To learn about Internal dosimetry and the production of radionuclide for its uses in Nuclear Medicine.
3. To give the knowledge about the radionuclides production and their application in Nuclear Medicine and In-vivo and in-vitro techniques.
4. To understand about the radionuclide imaging techniques.
5. To learn the principles of PET/SPECT and their working Principle.
6. To learn the basics of Internal dosimetry and its dose evaluation techniques.

Paper XIV: Radiation Therapy-Tele therapy

1. To know about development of kV beam therapy and Co-60 treatments, working principles of the beam modifying devices, clinical electron beams and its applications, various quality assurance used in radiation therapy departments.
2. To know the basics of radiation, beam central axis dosimetry parameters, beam modifiers and shaping devices.
3. To learn the role of radiation therapy for the treatment of various cancers.
4. To understand the specialized procedures of radiation therapy for cancer treatment.
5. To learn the modern radiation dose delivery techniques, such as IMRT, IGRT, rotational therapy, SRS/SRT, TBI, TSET, and SBRT.
6. To know about the machine commissioning, quality, dosimetry and treatment planning.

Paper XV: Radiation Therapy-Brachytherapy

1. To understand various Brachytherapy techniques used in cancer treatment, AAPM Task Group 60 Protocols, Computers and its applications in brachytherapy treatment planning such as algorithm's, DICOM, PACS etc.,



2. To understand the various classification of brachytherapy by treatment time, placement of source, manual or remote after loading, low dose rate or high dose rate etc.,
3. To learn the brachytherapy special techniques and treatment planning.
4. To understand the special advance techniques in radiotherapy which includes Total Skin Electron Therapy (TSET), Stereotactic radiosurgery/ radiotherapy (SRS/SRT), Intensity Modulated Radiation Therapy (IMRT), and Image Guided Radiation Therapy (IGRT) etc.,
5. To understand the different types of protocols used in brachytherapy techniques.
6. To understand the computers and their application in treatment planning systems.

Paper XVI: Radiation Safety

1. To learn the principles of radiation protection standards and its recommendations, understand the radiation safety in medical, agricultural and its radiation application in research.
2. To learn about the principals of safe transport of radioisotopes and waste disposal mechanisms, legislation, handling of radiation emergencies of radioisotopes.
3. To understand the principles of radiation protection and its recommendations.
4. To learn about the radiation dose and units, categories of exposures in occupational, and public.
5. To know the radiation safety in medical uses and the various radioactive waste disposal mechanisms.
6. To know the radioisotope transport, legislation, radiation emergencies and system of medical management.