Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B++' Grade (CGPA 2.96)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: Physics (GE)

Name of the Course: B.Sc. I Sem. I & II (Liberal Science)

(Syllabus to be implemented from June 2022)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B. Sc. First Year (Liberal Science)

Semester-I and II

Generic Elective (GE-I and II): PHYSICS

Teaching Scheme:

Lectures – 3 Hours/week, 2 Credits

Examination Scheme:

UA – 40 Marks

CIE – 10 Marks

About Course:
This course is introduced to physics students to understand basics concepts and principal and laws in medical physics and energy of physics. Students should understand 1) Fundamental of computer 2) X-Rays 3) Ultrasonic waves 4) Interaction of ultrasonic wave with human tissue 5) renewable sources of energy and their storage systems 6) characteristics of solar radiation, conversion methods of solar energy to heat and power with different types of solar cells.

Course Prerequisite:
Student shall have knowledge of types of energy, energy conversion and understanding semiconductor and some energy storage devices

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Preamble:

The systematic and planned curricula for first year students shall motivate and encourage them for pursuing higher studies in Renewable energy and its storage and solar energy conversion

Course Objectives:

1. To learn fundamental of computer such as number system, function of CPU, basic principle of networking and security.
2. To familiarize with the X-ray and its characteristics and their use in medical field.
3. To expose the students to the ideas of interaction of Ultrasound waves with tissues of human body.
4. To learn basic of piezoelectric materials and their applications.
5. To learn fundamental of computer such as number system, function of CPU, basic principle of networking and security.
6. To familiarize with the X-ray and its characteristics and their use in medical field.
7. To expose the students to the ideas of interaction of Ultrasound waves with tissues of human body.
8. To learn basic of piezoelectric materials and their applications.

9. To provide understanding of the application of the LASER concepts and methods of Physics in Medical science
10. To accentuate the principle, effects and clinical applications of magnetic resonance imaging.
11. To explore the effects of radiation in matter.
12. To study effects of sound and light in human body.
13. To enunciate the fundamentals of radiation detectors and dosimeter.
14. To introduce students with renewable energy resources availability and utilization.
15. To understand the difference between renewable and nonrenewable energy resources.
16. To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of renewable source of Energy.
17. To understand the different ways to energy storage
18. Understand semiconductor physics relevant to solar cell conversion.
    1. Basics/suitable of materials for solar energy capture and conversion.
    2. The solar radiations and its measurements techniques.
    3. The fundamentals of conversion of solar energy.
    4. Properties of various materials for photovoltaic applications.
    5. Solar cell systems.

Course Outcomes:

Paper I and II

At the end of this course, Students will be able to,

1. Operate the computer in effective way.
2. Handle X-ray machine and identify types of X-ray.
3. Understand the application of Ultrasound.
4. Apply knowledge of computer, X-Ray Generators and Ultrasound to increase their potentials in medical field.
5. Interpret the properties of LASER radiations and its effect on human tissues.
6. Apply the magnetic resonance concept in medical science.
7. Explain the interaction of radiation with matter.
8. Apply knowledge of radiation detectors to count radiation.

Paper: III and IV

At the end of this course, Students will be able to,

1. To understand the key physical characteristics of renewable energy resources
2. To have the knowledge to assess the advantages and disadvantages renewable energy technologies.
3. To evaluate and recommend alternative renewable energy storage technologies
4. To understand the requirements for PV materials as well as the types of solar energy conversion
5. Derive the basic laws of radiation.
6. Calculate efficiency of solar cells with help different parameters.
7. Apply knowledge of solar panels in various sectors

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B.Sc. (Liberal Science) Part – I Semester I

Generic Elective- GE-I , Physics Paper: I

Title of the paper: Medical Physics-I

Theory: 30 Hours Marks: 50; [UA: 40 and CIE: 10] (Credits: 2.0)

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Unit 1 a) Computers in Medical Imaging (10)

Storage and transfer of data in computers: number systems, decimal and binary number systems. Components and operation of computers: CPU - input/output bus and expansion slots, memory devices, storage devices, keyboard and printer, Performance of Computer systems. Computer Software: Storage, Processing and display of digital Images. Computer Networks: basic principles - local area network, large area network and network linking, network security, images, network for image and data transfer, storage of images, display of images.

b) X-Ray Generators for Medical Use (10)

Discovery, Production and Properties of X-rays, Characteristic and Continuous X-ray spectra, Design of hot cathode X-ray tube, Basic requirements of Medical diagnostics, Rotating anode tubes, safety devices in X-ray tubes, X-Ray proof and shock proof tubes, Insulation and cooling of X-ray tubes, Current and Voltage stabilizers, Automatic exposure control, Automatic Brightness control, Measuring instruments- measurement of kV and mA,

Unit 2 - Applications of Ultrasonics in Medicine (10)

Characteristics of sound: propagation of sound - wavelength, frequency and speed, Pressure, intensity and dB scale. Interactions of Ultrasound waves with body tissues, Production of ultrasonics, acoustic coupling, Image formation, reflection, refraction, scattering, attenuation, Transducers**,** Piezoelectric materials, resonance transducers, damping block, matching layer Acoustic coupling, Image data acquisition.

- **Continuous Internal Evaluation (CIE):**

CIE will consist of Home Assignment/Tutorials/Tests/Seminars, etc.

- **Text Books/Reference Books:**
  1) Curry, T. S. Dowdey, J. E. Murry, R. C, (1990), Christensen's Introduction to the Physics of diagnostic radiology, 4th edition
  2) Hendee, W. R. & Ritenour, R. (1993) Medical Imaging Physics, 3rd edition
  3) E. Seeram, X-ray imaging equipment, An introduction
  4) Ramesh Chandra, Nuclear Medicine Physics 5th edition , Lea & Febiger, Philadelphia
  5) J. T. Bushberg, J. A. Seibert, E. M. Leidholdt Jr. and J. M. Boone, The essential Physics of Medical Imaging, (Lippincott, Williams & Wilkins, Philadelphia, 2012).

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B.Sc. (Liberal Science) Part – I Semester I

Generic Elective- GE-I , Physics Paper: II

Title of the paper: Medical Physics-II

Theory: 30 Hours Marks: 50; [UA: 40 and CIE: 10] (Credits: 2.0)

Unit 1: Applications of Optics and Lasers in Medicine (10)

Various types of optical radiations: UV, Visible and IR, LASER: Theory and production of medical lasers, Laser Surgical Systems, Measurement of fluence from optical sources, Optical properties of tissues: theory and experimental techniques-interaction of laser radiation with tissues, photothermal, photochemical, photoablation and electromechanical effects; Basic laser safety: eye hazards, skin hazards, electrical hazards, fire and flood hazards, safety measurements.

Unit 2- Magnetic Resonance Imaging (MRI) (10)

Magnetization properties, Magnetic resonance image, Proton density, Generation and detection of MR signal-free induction decay T1 and T2 relaxation, Pulse sequences: Spin Eco T1 weighting, spin density weighting, T2 weighting, Inversion Recovery, Gradient recalled Eco, Signal from flow, Magnetization transfer contrast, Localization of the MR Signal, magnetic field gradients, slice select gradient, frequency encode gradient, phase encode gradient, safety and Bio effects.

Unit 3 -Radiation Detection and Dosimeters (10)

Principles of Radiation detection, properties of dosimeters, Theory of gas filled Detectors, Ion chamber dosimetery systems, free air ion chamber, parallel plate Chamber, ionization chamber, GM counter, condenser type chambers, working and different applications, film dosimetery, Luminescence dosimetry, semiconductor dosimeter, Gel dosimetry, radiographic and radiochromic films, scintillation detections.

- **Continuous Internal Evaluation (CIE):**

CIE will consist of Home Assignment/Tutorials/Tests/Seminars, etc.

- **Text Books/Reference Books:**
    1) K. Thayalan, The Physics of Radiology And Imaging (Jaypee Brothers Medical Publishers, 2014)
    2) B. H. Brown, R. H. Smallwood, D. C. Barber, P.V. Lawford and D. R. Hose, Medical Physics and Biomedical Engineering (CRC Press, 1998)
    3) Markolf H. Neimz, Laser-Tissue Interactions, Springer Verlag, Germany, 1996.
    4) MRI – Perry Sprawls – Medical Physics Publishing, Madison, Wisconsin-2000.
    5) Advances in Diagnositc Medical Physics – Himalaya Publishing House-2006.

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B.Sc. (Liberal Science) Part – I Semester II

Generic Elective- GE-II , Physics Paper: III

Title of the paper: Renewable energy and storage systems

Theory: 30 Hours Marks: 50; [UA: 40 and CIE: 10] (Credits: 2.0)

Unit I: ENERGY SOURCES (15)

Energy Scenario and Energy Forms, Energy Sectors: Domestic, Transportation, Agriculture, Industry, Sector Availability of Conventional and Non-Conventional Energy Recourses:
Fossil Fuel, Hydro Resources, Nuclear Resource, Coal, Oil, Gas Thermal Power Stations (Principle, Construction, Operation and Applications) Advantages and Disadvantages of Conventional Energy Source
Non-Conventional Energy Sources: Solar Energy, Wind Energy, Energy from Biomass and Biogas, Ocean Thermal Energy Conversion (Principle, Construction, Operation and Applications), Tidal Energy, Geothermal Energy, Hydrogen Energy, Fuel Cell, Magneto Hydro-Dynamics Generator, (Principle, Construction, Operation and Applications), Advantages and Disadvantages of Non-Conventional Energy Sources, The Energy Future

Unit II: ENERGY STORAGE SYSTEMS (15)

Need of energy storage, Types of energy storage: mechanical: Flywheel and Hydraulic accumulator Electrical: Capacitor Supercapacitor, Electromagnetic: Superconducting Magnet Energy Storage (SMES), Biological, Electrochemical: Primary & Secondary Batteries, Thermal: Brick storage heater, Ice storage air conditioning, Molten salt storage, Solar pond, Chemical: Hydrogen storage, Bio-fuels Fossil Fuel etc. (Principle, construction, and operation)

- **Continuous Internal Evaluation (CIE):**

CIE will consists of Home Assignment/Tutorials/Tests/Seminars, etc.

- **Reference Books:**

1. Kothari P, K C Singal and Rakesh Ranjan, “Renewable Energy Sources and Emerging Technologies”, PHI Pvt. Ltd., New Delhi, 2008.
2. Frank Kreith and Yogi Goswami D, “Handbook of Energy Efficiency and Renewable Energy”, CRC Press, 2007.
3. Abbasi S A and Naseema Abbasi, “Renewable Energy Sources and their Environmental Impact”, PHI Private Limited, 2001.

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B.Sc. (Liberal Science) Part – I Semester II

Generic Elective- GE-II , Physics Paper: IV

Title of the paper: Solar energy conversion materials and solar cell

Theory: 30 Hours Marks: 50; [UA: 40 and CIE: 10] (Credits: 2.0)

Unit 1: Solar radiation and solar electrical energy conversion (15)

Solar spectrum: Electromagnetic spectrum, Basic laws of radiation, Solar photovoltaic energy conversion: Principles : Physics and operation of solar cells, Solar cell energy conversion efficiency, I-V characteristics, Variation of efficiency with optical band-gap and electrical conductivity, Methods of fabrication of solar cells (one physical and one chemical method), Applications of PV system

Unit 2: Materials for solar energy conversion and their properties (15)

Organic, inorganic, 2-d, nanomaterials for solar cell, Advantages and disadvantages of solar energy conversion materials, Requirements and properties of solar cells, Emerging technologies (Thin film, Perovskite, Quantum dot, Dye sensitized, CZTS, Solid state solar cell), Advantages and disadvantages of solar PV cell,

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- **Reference Books:**

1. Garg .H.P, Prakash .J, "*Solar Energy Fundamentals and Applications"*, Tata McGraw-Hill, 2005.
2. Duffie .J.A, Beckman W.A. "*Solar Engineering of Thermal Processes"*, 3rd ed., Wiley, 2006.
3. Andrews .J, Jelley .N, "*Energy Science"*, Oxford University Press, 2010.
4. Tiwari .G.N, "*Solar energy: Fundamentals, Design, Modeling and Applications"*, CRC Press Inc., 2002.
5. Jha .A.R, "*Solar Cell Technology and Applications"*, CRC Press, 2010.
6. John R. Balfour, Michael L. Shaw, Sharlave Jarosek*., "Introduction to Photovoltaics",* Jones & Bartlett Publishers, Burlington, 2011.
7. Raghavan .V, "*Materials Science and Engineering",* Prentice-Hall India, 2007.
8. Tsakalakos .L, "*Nanotechnology for Photovoltaic"s*, CRC, 2010.

PRACTICAL (GENERIC ELECTIVE)
B. Sc. First Year (Liberal Science)
Semester-I & II

Practical – I: PHYSICS

Teaching Scheme:	**Examination Scheme:**
Practical – 4 Hours/week, 4 Credit	**UA – 80 Marks**
	CIE – 20 Marks

List of Practical: (Minimum 20 Maximum 25 Practical)

Students should perform minimum 20 practical during Semester I & II

Group I

1. Quality assurance of diagnostic x-ray machine
2. Verification of inverse square law
3. Determination resolving time of a GM counter and its application in measurement of beta source activity
4. Range of beta particles measurement.
5. Calibration of survey instruments and pocket dosimeters
6. Filtering and removal of artifacts in Biosignals
7. To stimulate Biopotential amplifier
8. To simulate Electrocardiogram(ECG) waveform
9. To simulate Electroencephalogram (EEG) waveform
10. Determination of wavelength of LASER.
11. Plot a graph using any data with excel.
12. Determine the efficiency of GM Counter.

Group II

1. Determine the Energy Band Gap of a Semiconductor by using PN Junction Diode
2. Type of conductivity by two probe method
3. Type of conductivity by four probe method
4. Solar cell characteristics
5. Determination of Planck's Constant
6. Verification of Stefan's law radiation by electrical method
7. Verification of Kirchoffes law
8. Thermocouple: Variation of thermoemf with temperature
9. Determination of Stefan's constant for Black body radiation.
10. Obtain a graph of optical absorbance and transmission with given values by origin or excel
11. Half wave, Full wave rectifies
12. Bridge rectifier π filter- γ and β
13. Photocell (Inverse square law)