B.Sc. Honors Physics syllabus

Under

CHOICE BASED CREDID SYSTEM

School of Studies in Physics
Jiwaji University, Gwalior

PHYSICS- Discipline Specific Elective (DSE)

Any four courses are to be ELECTTED

S.No.	Course Name	Credit		
		Theory	Lab.	Tutorials
1	Experimental Techniques	4	2	
2	Embedded systems- Introduction to Microcontroller	4	2	
3	Physics of Devices and Instrumentation	4	2	
4	Nuclear and Particle Physics	5		1
5	Astronomy and Astrophysics	5		1
6	Nano Materials and Applications	4	2	
7	Medical Physics	4	2	
8	Biophysics	5		1

PHYSICS-DSE: EXPERIMENTAL TECHNIQUES

Credits: Theory-04, Practicals-02 Theory: 60 Lectures

Measurements: Accuracy and precision. Significant figures. Error and uncertainty analysis. Types of errors: Gross error, systematic error, random error. Statistical analysis of data Arithmetic mean, deviation from mean, average deviation, standard deviation, chi-square and curve fitting.Guassiandistribution. **7 L**

Signals and Systems: Periodic and aperiodic signals. Impulse response, transfer function and frequency response of first and second order systems. Fluctuations and Noise in measurement system. S/N ratio and Noise figure. Noise in frequency domain. Sources of Noise: Inherent fluctuations, Thermal noise, Shot noise,1/fnoise **7 L**

Shielding and Grounding: Methods of safety grounding. Energy coupling. Grounding. Shielding: Electrostatic shielding.ElectromagneticInterference. **4 L**

Transducers & industrial instrumentation working principle, efficiency, applications: Static and dynamic characteristics of measurement Systems. Generalized performance of systems, Zero order first order, second order and higher order systems. Electrical, Thermal and Mechanical systems. Calibration. Transducers and sensors. Characteristics of Transducers. Transducers as electrical element and their signal conditioning. Temperature transducers: RTD, Thermistor, Thermocouples, Semiconductor type temperature sensors AD590, LM35, LM75 and signal conditioning. Linear Position transducer: Strain gauge, Piezoelectric. Inductance change transducer: Linear variable differential transformer LVDT, Capacitance change transducers. Radiation Sensors: Principle of Gas filled detector, ionization chamber,scintillationdetector. **21 L**

Digital Multimeter: Comparison of analog and digital instruments. Block diagram of digital multimeter, principle of measurement of I, V, C. Accuracy and resolution of measurement. **5 L**

Impedance Bridges and Q-meter: Block diagram and working principles of RLC bridge. Q-meter and its working operation. DigitalLCRbridge. **4 L**

Vacuum Systems: Characteristics of vacuum: Gas law, Mean free path. Application of vacuum. Vacuum system- Chamber, Mechanical pumps, Diffusion pump & Turbo Modular pump, Pumping speed, Pressure gauges Pirani,Penning,ionization. **12 L**

Reference Books:

- Measurement, Instrumentation and Experiment Design in Physics andEngineering, M. Sayer and A. Mansingh, PHI Learning Pvt. Ltd.
- Experimental Methods for Engineers, J.P. Holman, McGrawHill
- Introduction to Measurements and Instrumentation, A.K. Ghosh, 3rd Edition, PHI Learning Pvt.Ltd.
- Transducers and Instrumentation, D.V.S. Murty, 2nd Edition, PHI Learning Pvt.Ltd.
- Instrumentation Devices and Systems, C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGrawHill
- Principles of Electronic Instrumentation, D. Patranabis, PHI Learning Pvt.Ltd.

- Electronic circuits: Handbook of design & applications, U.Tietze, Ch.Schenk,Springer

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PRACTICAL- DSE LAB: EXPERIMENTAL TECHNIQUES

60Lectures

1. Determine output characteristics of a LVDT & measure displacement usingLVDT
2. Measurement of Strain using StrainGauge.
3. Measurement of level using capacitivetransducer.
4. To study the characteristics of a Thermostat and determine itsparameters.
5. Study of distance measurement using ultrasonictransducer.
6. Calibrate Semiconductor type temperature sensor AD590, LM35, orLM75
7. To measure the change in temperature of ambient using Resistance Temperature DeviceRTD.
8. Create vacuum in a small chamber using a mechanical rotary pump and measure the chamber pressure using a pressuregauge.
9. Comparison of pickup of noise in cables of different types co-axial,single shielded, double shielded, without shielding of 2m length, understanding of importance of grounding using function generator of mV level & anoscilloscope.
10. To design and study the Sample and HoldCircuit.
11. Design and analyze the Clippers and Clampers circuits using junctiondiode
12. To plot the frequency response of amicrophone.
13. To measure Q of a coil and influence of frequency, using aQ-meter.

Reference Books:

- Electronic circuits: Handbook of design and applications, U. Tietze and C. Schenk, 2008,Springer
- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1990, Mc-Graw Hill
- Measurement, Instrumentation and Experiment Design in Physics & Engineering, M. Sayer and A. Mansingh, 2005, PHILearning.

PHYSICS-DSE: EMBEDDED SYSTEM: INTRODUCTION TO MICROCONTROLLERS

Credits: Theory-04, Practicals-02 **Theory: 60 Lectures**

Embedded system introduction: Introduction to embedded systems and general purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems, challenges & design issues in embedded systems, operational and non-operational quality attributes of embedded systems, elemental description of embedded processorsandmicrocontrollers. **6 L**

Review of microprocessors: Organization of Microprocessor based system, 8085μp pin diagram and architecture, concept of data bus and address bus, 8085programming model, instruction classification, subroutines, stacks and its implementation, delay subroutines, hardware andsoftwareinterrupts. **4 L**

8051 microcontroller: Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word PSW register, Jump, loop and call instructions. **12 L**

8051 I/O port programming: Introduction of I/O port programming, pin out diagram of 8051 microcontroller, I/O port pins description & their functions, I/O port programming in 8051 using assembly language, I/O programming: Bit manipulation. **4 L**

Programming: 8051 addressing modes and accessing memory using various addressing modes, assembly language instructions using each addressing mode, arithmetic and logic instructions, 8051 programming in C: for time delay & I/O operations and manipulation, for arithmetic and logic operations, for ASCII and BCD conversions. **12 L**

Timerandcounterprogramming: Programming8051timers,counterprogramming. 3 L

Serial port programming with and without interrupt: Introduction to 8051 interrupts, programming timer interrupts, programming external hardware interrupts and serial communication interrupt, interrupt priority inthe8051. **6 L**

Interfacing 8051 microcontroller to peripherals: Parallel and serial ADC, DAC interfacing,LCDinterfacing. **2 L**

Programming Embedded Systems: Structure of embedded program, infinite loop, compiling, linking and locating, downloadinganddebugging. **3 L**

Embedded system design and development: Embedded system development environment, file types generated after cross compilation, disassembler/ decompiler, simulator, emulator and debugging, embedded product development life-cycle, trends in embeddedindustry. **8 L**

Reference Books:

- Embedded Systems: Architecture, Programming & Design, R.Kamal, 2008,Tata McGrawHill
- The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A.

Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson EducationIndia.
- Embedded microcomputor system: Real time interfacing, J.W.Valvano, 2000,Brooks/Cole
- Microcontrollers in practice, I. Susnea and M. Mitescu, 2005,Springer.
- Embedded Systems: Design & applications, S.F. Barrett, 2008, Pearson EducationIndia
- Embedded Microcomputer systems: Real time interfacing, J.W. Valvano 2011, CengageLearning

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PRACTICALS- DSE LAB: EMBEDDED SYSTEM: INTRODUCTION TO MICROCONTROLLERS

60 Lectures

Following experiments using 8051:

1. To find that the given numbers is prime ornot.
2. To find the factorial of anumber.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largestnumber.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter 8 bit on LED's.
5. Program to glow the first four LEDs then next four using TIMERapplication.
6. Program to rotate the contents of the accumulator first right and thenleft.
7. Program to run a countdown from 9-0 in the seven segment LEDdisplay.
8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LEDdisplay.
9. To toggle '1234' as '1324' in the seven segment LEDdisplay.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwisedirection.
11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing akeyboard.

Reference Books:

- Embedded Systems: Architecture, Programming& Design, R.Kamal,]2008,Tata McGrawHill
- The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A.Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson EducationIndia.
- Embedded Microcomputor System: Real Time Interfacing, J.W.Valvano, 2000,Brooks/Cole
- Embedded System, B.K. Rao, 2011, PHI Learning Pvt.Ltd.
- Embedded Microcomputer systems: Real time interfacing, J.W. Valvano 2011, CengageLearning

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PHYSICS-DSE: PHYSICS OF DEVICES AND INSTRUMENTS

Credits: Theory-04, Practicals-02 **Theory: 60 Lectures**

Devices: Characteristic and small signal equivalent circuits of UJT and JFET. Metal-semiconductor Junction. Metal oxide semiconductor MOS device. Ideal MOS and Flat Band voltage. SiO_2-Si based MOS. MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, CMOS. Charge coupled devices. Tunnel diode. **15 L**

Power supply and Filters: Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Shortcircuitprotection **3 L**

Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters. 3 L

Multivibrators: Astable and Monostable Multivibratorsusingtransistors. **3 L**

Phase Locked LoopPLL: Basic Principles, Phase detectorXOR& edge triggered, Voltage Controlled Oscillator Basics, varactor. Loop Filter– Function, Loop Filter Circuits, transient response, lock and capture. Basic idea of PLL IC 565or4046. **5 L**

Processing of Devices: Basic process flow for IC fabrication, Electronic grade silicon. Crystal plane and orientation. Defects in the lattice. Oxide layer. Oxidation Technique for Si. Metallization technique. Positive and Negative Masks. Optical lithography. Electron lithography. Feature size control and wet anisotropic etching. Lift off Technique. Diffusion andimplantation. **12 L**

Digital Data Communication Standards:

Serial Communications: RS232, Handshaking, Implementation of RS232 on PC.

Universal Serial Bus USB: USB standards, Types and elements of USB transfers. Devices Basic idea of UART.

Parallel Communications: General Purpose Interface Bus GPIB, GPIB signals and lines, Handshaking and interface management, Implementation of a GPIB on a PC. Basic idea of sending data through aCOM port. **4 L**

Introduction to communication systems: Block diagram of electronic communication system, Need for modulation. Amplitude modulation. Modulation Index. Analysis of Amplitude Modulated wave. Sideband frequencies in AM wave. CE Amplitude Modulator. Demodulation of AM wave using Diode Detector. basic idea of Frequency, Phase, Pulse and Digital Modulation including ASK,PSK,FSK. **15 L**

ReferenceBooks:

- Physics of Semiconductor Devices, S.M. Sze & K.K. Ng, 3rd Ed.2008, JW &Sons
- Electronic devices and integrated circuits, A.K. Singh, 2011, PHI Learning Pvt.Ltd.
- Op-Amps & Linear Integrated Circuits, R.A.Gayakwad,4 Ed. 2000,PHI Electronic Devices and Circuits, A. Mottershead, 1998, PHI Learning Pvt.Ltd.
- Electronic Communication systems, G. Kennedy, 1999, Tata McGrawHill.
- Introduction to Measurements & Instrumentation, A.K. Ghosh, 3rd Ed., 2009, PHI
- PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, PHI India

PRACTICAL- DSE LAB: PHYSICS OF DEVICES AND INSTRUMENTS

60 Lectures

1. To design a power supply using bridge rectifier and study effect ofC-filter.
2. To design the active Low pass and High pass filters of givenspecification.
3. To design the active filter wide band pass and band reject of givenspecification.
4. To study the output and transfer characteristics of aJFET.
5. To design a common source JFET Amplifier and study its frequencyresponse.
6. To study the output characteristics of aMOSFET.
7. To study the characteristics of a UJT and design a simple RelaxationOscillator.
8. To design an Amplitude Modulator usingTransistor.
9. To design PWM, PPM, PAM and Pulse code modulation usingICs.
10. To design an Astablemultivibrator of given specifications usingtransistor.
11. To study a PLL IC Lock and capturerange.
12. To study envelope detector for demodulation of AMsignal.
13. Study of ASK and FSKmodulator.
14. Glow an LED via USB port ofPC.
15. Sense the input voltage at a pin of USB port and subsequently glow the LED connected with another pin of USBport.

SPICE/MULTISIM simulations for electrical networks and electronic circuits

1. To verify the Thevenin and NortonTheorems.
2. Design and analyze the series and parallel LCRcircuits
3. Design the inverting and non-inverting amplifier using an Op-Amp of givengain
4. Design and Verification of op-amp as integrator anddifferentiator
5. Design the 1st order active low pass and high pass filters of given cutofffrequency
6. Design a Wein`s Bridge oscillator of givenfrequency.
7. Design clocked SR and JK Flip-Flop`s using NANDGates
8. Design 4-bit asynchronous counter using Flip-FlopICs
9. Design the CE amplifier of a given gain and its frequencyresponse.
10. Design an Astablemultivibrator using IC555 of given dutycycle.

Reference Books:

- Basic Electronics:A text lab manual, P.B. Zbar, A.P. Malvino, M.A.Miller,1994, Mc-Graw Hill
- Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-GrawHill.
- Electronics : Fundamentals and Applications, J.D. Ryder, 2004, PrenticeHall.
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4thedn., 2000, PrenticeHall.
- Introduction to PSPICE using ORCAD for circuits & Electronics, M.H. Rashid, 2003, PHILearning.
- PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall ofIndia

PHYSICS-DSE: Nuclear and Particle Physics

Credits: Theory-05, Tutorials-01 Theory: 75 Lectures

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density matter density, binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclearexcitesstates. **10 L**

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model degenerate fermion gas, nuclear symmetry potential in Fermi gas, evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.
12 L

Radioactivity decay:a Alpha decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. b β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. c Gamma decay: Gamma rays emission & kinematics, internal conversion. **9 L**

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scatteringRutherfordscattering. **8 L**

Nuclear Astrophysics: Early universe, primordial nucleosynthesis particle nuclear interactions, stellar nucleosynthesis, concept of gamow window, heavy element production: r- and s-processpath. **5 L**

Interaction of Nuclear Radiation with matter: Energy loss due to ionization Bethe-Block formula, energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interactionwithmatter. **6 L**

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube PMT. Semiconductor Detectors Si and Ge for charge particle and photon detection concept of charge carrier and mobility,neutrondetector. **6 L**

Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator Tandem accelerator, Linear accelerator,Cyclotron,Synchrotrons. **5 L**

Particle physics: Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum numberandgluons. **14 L**

Reference Books:

- Introductory nuclear Physics by Kenneth S. Krane Wiley India Pvt. Ltd.,2008.
- Concepts of nuclear physics by Bernard L. Cohen. Tata Mcgraw Hill,1998.

- Introduction to the physics of nuclei & particles, R.A. Dunlap. Thomson Asia,2004.
- Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ.Press
- Introduction to Elementary Particles, D. Griffith, John Wiley &Sons
- Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, NewDelhi
- BasicideasandconceptsinNuclearPhysics-AnIntroductoryApproachby

K. Heyde IOP- Institute of Physics Publishing, 2004.

- Radiation detection and measurement, G.F. Knoll John Wiley & Sons,2000.
- Physics and Engineering of Radiation Detection, Syed Naeem AhmedAcademic Press, Elsevier, 2007.
- Theoretical Nuclear Physics, J.M. Blatt &V.F.Weisskopf Dover Pub.Inc.,1991

PHYSICS-DSE: Astronomy & Astrophysics Credits: Theory-05, Tutorials-01

Theory: 75 Lectures

Astronomical Scales: Astronomical Distance, Mass and Time, Scales, Brightness, Radiant Flux and Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, Stellar Temperature. **Basic concepts of positional astronomy:** Celestial Sphere, Geometry of a Sphere, Spherical Triangle, Astronomical Coordinate Systems, Geographical Coordinate Systems, Horizon System, Equatorial System, Diurnal Motion of the Stars, Conversion of Coordinates. Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Calendar. Basic Parameters of Stars: Determination of Distance by Parallax Method; Brightness, Radiant Flux and Luminosity, Apparent and Absolute magnitude scale, Distance Modulus; Determination of Temperature and Radius of a star; Determination of Masses from Binary orbits; Stellar Spectral Classification, Hertzsprung-RussellDiagram. **22 L**

Astronomical techniques: Basic Optical Definitions for Astronomy Magnification Light Gathering Power, Resolving Power and Diffraction Limit, Atmospheric Windows, Optical Telescopes Types of Reflecting Telescopes, Telescope Mountings, Space Telescopes, Detectors and Their Use with Telescopes Types of Detectors, detection Limits withTelescopes.

Physical principles: Gravitation in Astrophysics Virial Theorem, Newton versus Einstein, Systems in Thermodynamic Equilibrium, Theory of Radiative Transfer Radiation Field, Radiative Transfer Equation, Optical Depth; Solution of Radiative Transfer Equation, LocalThermodynamicEquilibrium **6 L**

The sun Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Basics of Solar Magnetohydrodynamics. Helioseismology. **The solar family** Solar System: Facts and Figures, Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets.

Stellar spectra and classification Structure Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram,LuminosityClassification **7 L**

Stellar structure: Hydrostatic Equilibrium of a Star, Some Insight into a Star: Virial Theorem, Sources of Stellar Energy, Modes of Energy Transport, Simple Stellar Model, Polytropic Stellar Model. **Star formation: B**asic composition of Interstellar medium,

Interstellar Gas, Interstellar Dust, Formation of Protostar, Jeans criterion, Fragmentation of collapsing clouds, From protostar to Pre-Main Sequence, Hayashi Line. **8 L**

Nucleosynthesis and stellar evolution: Cosmic Abundances, Stellar Nucleosynthesis, Evolution of Stars Evolution on the Main Sequence, Evolution beyond the Main Sequence, Supernovae. **Compact stars:** Basic Familiarity with Compact Stars, Equation of State and Degenerate Gas of Fermions, Theory of WhiteDwarf,

Chandrasekhar Limit, Neutron Star Gravitational Red-shift of Neutron Star, Detection of Neutron Star: Pulsars, Black Hole. **The milky way**: Basic Structure and Properties of the Milky Way, Nature of Rotation of the Milky Way Differential Rotation of the Galaxy and Oort Constant, Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral Arms, Stars and Star Clusters of the Milky Way, Properties of and around the GalacticNucleus **11 L**

Galaxies: Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies The Intrinsic Shapes of Elliptical, de Vaucouleurs Law, Stars and Gas. Spiral and Lenticular Galaxies Bulges, Disks, Galactic Halo The Milky Way Galaxy, Gas and Dust in the Galaxy, Spiral Arms,ActiveGalaxies **5 L**

Active galaxies: 'Activities' of Active Galaxies, How 'Active' are the Active Galaxies? Classification of the Active Galaxies, Some Emission Mechanisms Related to the Study of Active Galaxies, Behaviour of Active Galaxies Quasars and Radio Galaxies, Seyferts, BL Lac Objects and Optically Violent Variables, The Nature of the Central Engine, Unified Model of the VariousActiveGalaxies **8 L**

Large scale structure & expanding universe: Cosmic Distance Ladder An Example from Terrestrial Physics, Distance Measurement using Cepheid Variables, Hubble's Law Distance- Velocity Relation, Clusters of Galaxies Virial theorem and Dark Matter, Friedmann Equation and its Solutions, Early Universe and Nucleosynthesis Cosmic Background Radiation, Evolving vs. SteadyStateUniverse **8 L**

Reference Books:

- Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley PublishingCo.
- Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4th Edition, Saunders CollegePublishing.
- The physical universe: An introduction to astronomy, F.Shu, Mill Valley: University ScienceBooks.
- Fundamental of Astronomy Fourth Edition, H. Karttunen et al.Springer
- K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International p Ltd, NewDelhi,2002.
- BaidyanathBasu, 'An introduction to Astro physics', Second printing, Prentice - Hall of India Private limited, NewDelhi,2001.
- Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, NarosaPublication.

PHYSICS-DSE: Nano Materials and Applications

Credits: Theory-04, Practicals-02 Theory: 60 L

NANOSCALE SYSTEMS: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures nanodots, thin films, nanowires, nanorods, Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equation- Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences. **10 L**

SYNTHESIS OF NANOSTRUCTURE MATERIALS: Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition PVD: Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition CVD. Sol-Gel. Electro deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth ofquantumdots. **8 L**

CHARACTERIZATION: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning TunnelingMicroscopy. **8 L**

OPTICAL PROPERTIES: Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures and charging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrcturesandnanostructures. **14 L**

ELECTRON TRANSPORT: Carrier transport in nanostrcutures. Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level andsurfacedefects. **6 L**

APPLICATIONS: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices LED, solar cells. Single electron devices no derivation. CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage. Micro Electromechanical Systems MEMS, Nano ElectromechanicalSystemsNEMS. **14 L**

Reference books:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology Wiley India Pvt.Ltd..
2. S.K. Kulkarni, Nanotechnology: Principles & Practices Capital PublishingCompany
3. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscienceand Technology PHI Learning PrivateLimited.
4. Richard Booker, Earl Boysen, Nanotechnology John Wiley andSons.
5. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook Elsevier,2007.
6. Bharat Bhushan, Springer Handbook of Nanotechnology Springer-Verlag, Berlin,2004.

PRACTICALS-DSE LAB: Nano Materials and Applications 60 Lectures

1. Synthesis of metal nanoparticles by chemicalroute.
2. Synthesis of semiconductornanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visiblespectrophotometer.
4. XRD pattern of nanomaterials and estimation of particlesize.
5. To study the effect of size on color ofnanomaterials.
6. To prepare composite of CNTs with othermaterials.
7. Growth of quantum dots by thermalevaporation.
8. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study itsXRD.
9. Fabricate a thin film of nanoparticles by spin coating or chemical routeand study transmittance spectra in UV-Visibleregion.
10. Prepare a thin film capacitor and measure capacitance as a function of temperature orfrequency.
11. Fabricate a PN diode by diffusing Al over the surface of N-type Si and study its V-Icharacteristic.

Reference Books:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology Wiley India Pvt.Ltd..
2. S.K. Kulkarni, Nanotechnology: Principles & Practices Capital PublishingCompany.
3. K.K. Chattopadhyay and A.N. Banerjee, Introduction to Nanoscience & Technology PHI Learning PrivateLimited.
4. Richard Booker, Earl Boysen, Nanotechnology John Wiley andSons.

PHYSICS-DSE: Medical Physics

Credits: Theory-04, Practicals-02 **Theory: 60 Lectures**

PHYSICS OF THE BODY-I

Mechanics of the body: Skeleton, forces, and body stability. Muscles and the dynamics of body movement, Physics of body crashing. **Energy household of the body:** Energy balance in the body, Energy consumption of the body, Heat losses of the body, **Pressure system of the body:** Physics of breathing, Physics of cardiovascular system. 10 L

PHYSICS OF THE BODY-II

Acoustics of the body: Nature and characteristics of sound, Production ofspeech, Physics of the ear, Diagnostics with sound and ultrasound. **Optical system of the body:** Physics of the eye. **Electrical system of the body:** Physics of the nervous system, Electrical signals andinformationtransfer. **10 L**

PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-I

X-RAYS: Electromagnetic spectrum – production of x-rays – x-ray spectra-Brehmsstrahlung- Characteristic x-ray – X-ray tubes – Coolidge tube – x-ray tubedesign – tube cooling stationary mode – Rotating anode x-ray tube – Tube rating – quality and intensity of x-ray. X-ray generator circuits – half wave and full wave rectification – filament circuit – kilo voltage circuit – high frequency generator – exposure timer – HT cables. **7 L**

RADIATION PHYSICS: Radiation units - exposure - absorbed dose – units: rad, gray-relative biological effectiveness - effective dose - inverse square law - interaction of radiation with matter - linear attenuation coefficient. Radiation Detectors -Thimble chamber- condenser chambers – Geiger counter – Scintillation counter – ionization chamber – Dosimeters – survey methods – area monitors – TLD and semiconductor detectors. **7 L**

MEDICAL IMAGING PHYSICS: X-ray diagnostics and imaging, Physics of nuclear magnetic resonance NMR – NMR imaging – MRI Radiological imaging – Radiography – Filters – grids – cassette – X-ray film – film processing – fluoroscopy – computed tomography scanner – principle function – display – generations– mammography. Ultrasound imaging – magnetic resonance imaging – thyroid uptake system – Gamma camera Only Principle, function anddisplay 9 L

RADIATION THERAPY PHYSICS: Radiotherapy – kilo voltage machines – deep therapy machines – Telecobalt machines – Medical linear accelerator. Basics of Teletherapy units – deep x-ray, Telecobalt units, medical linear accelerator – Radiation protection – external beam characteristics – phantom – dose maximum and build up – bolus – percentage depth dose – tissue – air ratio – back scatter factor. **6 L**

RADIATIONANDRADIATIONPROTECTION: Principlesofradiationprotection – protective materials-radiation effects – somatic, genetic stochastic & deterministic effect, Personal monitoring devices – TLD film badge – pocket dosimeter. Radiation dosimetry, Natural radioactivity, Biological effects of radiation, Radiation monitors. 6 L

PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-II

Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging, Radioisotope imaging equipment, Single photon and positron emission tomography. Therapeutic nuclear medicine: Interaction between radiation and matter Dose and isodose inradiationtreatment **5 L**

Reference Books:

- Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley1978
- Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi2003
- Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins1990
- Physics of the human body, Irving P. Herman, Springer2007.
- Physics of Radiation Therapy : F M Khan - Williams and Wilkins, 3rd edition2003
- The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition2002
- The Physics of Radiology-H E Johns andCunningham.

PHYSICS-DSE LAB: Medical Physics

Credits: Practicals-02 **LAB: 60 Lectures**

1. Understanding the working of a manual Hg Blood Pressure monitor and measure the BloodPressure.
2. Understanding the working of a manual optical eye-testing machine and to learn eye-testingprocedure.
3. Correction of Myopia short sightedness using a combination of lenses on an opticalbench/breadboard.
4. Correction of Hypermetropia/Hyperopia long sightedness using a combination of lenses on an opticalbench/breadboard.
5. To learn working of Thermoluminescent dosimeter TLD badges and measure the backgroundradiation.
6. Familiarization with Geiger-Muller GM Counter and to measure background radiation.
7. Familiarization with Radiation meter and to measure backgroundradiation.
8. Familiarization with the construction of speaker-receiver system and to design a speaker-receiver system of givenspecification.

Reference Books:

- Basic Radiological Physics, Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi2003
- Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins1990
- Physics of Radiation Therapy : F M Khan - Williams and Wilkins, 3rd edition2003
- The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition2002
- The Physics of Radiology-H E Johns andCunningham.

PHYSICS-DSE: Bio-Physics

Credits: Theory-05, Tutorials-01 **Theory: 75 Lectures**

Building Blocks & Structure of Living State: Atoms and ions, molecules essential for life, what is life. **Living state interactions:** Forces and molecular bonds, electric & thermal interactions, electric dipoles, casimir interactions, domains of physics in biology. **18 L**

Heat Transfer in biomaterials: Heat Transfer Mechanism, The Heat equation, Joule heating of tissue. **Living State Thermodynamics:** Thermodynamic equilibrium, flrst law of thermodynamics and conservation of energy. Entropy and second law of thermodynamics, Physics of many particle systems, Two state systems, continuous energy distribution, Composite systems, Casimir contribution of free energy, Protein foldingandunfolding. **19 L**

Open systems and chemical thermodynamics: Enthalpy, Gibbs Free Energy and chemical potential, activation energy and rate constants, enzymatic reactions, ATP hydrolysis & synthesis, Entropy of mixing, The grand canonical ensemble, Hemoglobin.

Diffusion and transport Maxwell-Boltzmann statistics, Fick's law of diffusion, sedimentation of Cell Cultures, diffusion in a centrifuge, diffusion in an electric field, Lateral diffusion in membranes, Navier stokes equation, low Reynold's Number Transport, Active and passivemembranetransport. **19 L**

Fluids: Laminar and turbulent fluid flow, Bernoulli's equation, equation of continuity, venture effect, Fluid dynamics of circulatory systems, capillary action. **Bioenergetics and Molecular motors:** Kinesins, Dyneins, and microtubule dynamics, Brownian motion, ATP synthesis in Mitochondria, Photosynthesis in Chloroplasts, Light absorption in biomolecules, vibrational spectraofbio-biomolecules. **19 L**

Reference Books:

- Introductory Biophysics, J. Claycomb, JQP Tran, Jones &BartelettPublishers
- Aspects of Biophysics, Hughe S W, John Willy andSons.
- Essentials of Biophysics by P Narayanan, New AgeInternational

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