KOLHAN UNIVERSITY,
CHAIBASA

Proposed syllabus For M.Sc. PHYSICS UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

Academic Session 2017-2018

Credit distribution and weightage of hours to different courses spread over different semesters. One Lecture / Tutorial is of 1 hr. duration.

Table - 1

Semester –I			Course Credits	Hours / Week		
S. No.	Course Code	Course Name		L	T	P
1	FCPHY101	Computer Applications in Physics	5	5	1	0
2	CCPHY102	Mathematical Methods and Solid State Physics	5	5	1	0
3	CCPHY103	Quantum Mechanics–I and General Electronics	5	5	1	0
4	CCPHY104	Gen. Electronics, Atomic & Nuclear Physics Lab.	5	0	0	10

Table - 2

Semester –II			Course Credits	Hours / Week		
S. No.	Course Code	Course Name		L	T	P
1	ECPHY201	Research Methodology	5	5	1	0
2	CCPHY202	Quantum Mechanics –II	5	5	1	0
3	CCPHY203	Statistical Physics	5	5	1	0
4	CCPHY204	Optics and Spectroscopy Lab.	5	0	0	10

Table - 3

Semester –III			Course Credits	Hours / Week		
S. No.	Course Code	Course Name		L	T	P
1	CCPHY301	Spectroscopy	5	5	1	0
2	CCPHY302	Nuclear Physics –I	5	5	1	0
3	ECPHY303	Any one from the Module A, B and C: Part -I (**Annexure –I**)	5	5	1	0
4	ECPHY304	Lab. of the Elective Paper ECPHY303	5	0	0	10

Table - 4

Semester –IV			Course Credits	Hours / Week		
S. No.	**Course Code**	**Course Name**		**L**	**T**	**P**
1	CCPHY401	Nuclear Physics – II	5	5	1	0
2	ECPHY402	Any one from the Module A, B and C: Part –II (Same module as in Part –I) **Annexure –I**	5	5	1	0
3	ECPHYS403	Lab. of the Elective Paper ECPHY403	5	5	1	0
4	ECPHY404	Dissertation	5	0	0	10

Annexure –I: List of Discipline Specific Elective Coerces for Semester – III and Semester -IV

Table - 5

Elective Modules: Part –I, Sem-III			Elective Modules: Part –II, Sem-III & IV		
A	1	Electronics and Communication	A	1	Electronics and Communication
	2	Lab. on Electronics		2	Lab. on Electronics
B	1	Condensed Matter Physics	B	1	Condensed Matter Physics
	2	Lab. of CMP		2	Lab. of CMP
C	1	Nanophysics and Nano materials	C	1	Nanophysics and Nanomaterials
	2	Lab. on Nanophysics		2	Lab. on Nanophysics

SEMESTER – I

FCPHY101: COMPUTER APPLICATIONS IN PHYSICS

Credit: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

UNIT I

Introduction to Computer operating systems and C Programming:

Computer Fundamentals: Basic components of a computer system-CPU, and Output devices and Memory, Storage devices, Fundamentals of computer operation and self -system diagnostics, Representation of characters, Integers, Fractions in computers, Decimal to Binary conversion, error detecting codes.

3 lectures

Operating System: Familiarity with various operating systems like DOS, OSII, GUI like Windows, UNIX/LINUS. Details of one operating system like UNIX: Multitasking, multiuser capabilities, UNIX basics, Files and Directories, Understanding the UNIX shell, Text processing in the UNIX environment, editors like Vi, EMAC, SED . 7 **Lectures**

Computer Programming with C: Elements of C Programming: Constants, variables, data types, and operators Decision-making and branching: GO TO, IF, IF-ELSE, Nesting, Switch statements. Decision making and looping: WHILE, DO and FOR statements.

Arrays: One and multidimensional. Pointers: Concept of Pointers and their applications. Handling of character strings: String manipulation and string handling functions. User-defined functions: Forms, Category, Nesting, Recursion, Functions with arrays, Parameter passing. Structure and unions: Arrays of structures, Arrays within structures, Structures within structures, Unions and structures, Structure and functions. Concept of object-oriented programming (OOP).

30 lectures

UNIT II

Data Communication and Modeling:

Data Communication: Introduction to a line system, Basic communication theory, Communication lines, Multiplexers, Statistical multiplexers, Concentrators and front end processors, Network configuration, Terminals and PCs, Modems and Interfaces, Local Area Network, Internet, WWW, Creating web pages, Introduction to voice and video conferencing, Introduction to network protocols.

16 Lectures

Modeling: Introduction to techniques of modeling, State-variable models of systems, Model parameters and simulators and simulation using MATLAB/ SIMULINK, Time domain and frequency domain analysis of systems using MATLAB, Spice modeling of semiconductor devices (p-n diode, BJTπ and programming methodology, Circuit simulation using P Spice.

16 Lectures

Books Suggested:

1. C Programming : Dannis Ritchie
2. C Programming: E Balaguruswamy
3. Let us C: Kanitkar
4. Introduction to Mathematica: Wolform
5. Spice for Circuits and Electronics using Pspice: Rashid
6. Latex Document Preparation System: Laslie P

CC PHY 102: MATHEMATICAL METHODS AND SOLID STATE PHYSICS

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

UNIT I

Mathematical Methods

Matrices and Tensors: Introduction of matrices through rotation of co-ordinate systems, Orthogonal, Hermitian, Unitary, Null and Unit matrices, Singular and Non-singular matrices, Inverse of a matrix, Trace of a matrix, Eigenvalues and Eigenvectors, Diagonalization. Tensorial character of physical entities, Covariant, Contravariant and Mixed tensors, Contraction, Quotient rule, Differentiation, Kronecker tensor, Pseudotensor, Symmetric and Anti symmetric tensors. **15 Lectures**

Green's Function: Introduction Construction of the Green's function for 1d, 2d and 3d problems. Solution of some standard problems using Green's function technique. **5 Lectures**

Group Theory: Definition and examples of physically important finite groups, Basic symmetry operations and their matrix representations, Multiplication table, Cyclic groups and subgroups, Classes. Reducible and Irreducible representation, Schur's lemma, Orthogonality theorem, Character of a representation, Construction character tables. **15 Lectures**

UNIT II: Solid State Physics

Crystal Physics: Laue theory of X-ray diffraction, Geometrical structure factor and intensity of diffraction maxima. Calculation of structure factor for bcc, fcc and diamond structure, Intensity of diffraction maxima, Extinction due to Lattice centering. **10 Lectures**

Electronic Properties: Electron in a Periodic lattice, Block Theorem, Band Theory, Tight Binding, Cellular and Pseudopotential method, Fermi surface, de Haas van Alphen Effect, Cyclotron resonance, Magnetoresistance, Quantum Hall Effect. **15 Lectures**

Magnetism: Exchange interaction, Heisenberg model and molecular field theory, spin waves and magnons, Ferri and Antiferromagnetic order, Domains and Bloch Wall energy. **10 Lectures**

Superconductivity: Basic properties of superconductors, Josephson Effect, BCS theory, High temperature superconductivity. **5 Lectures**

Books Suggested:

1. Mathematical Methods for Physicists, G.BArfken, H.J.Waber, E.E. Harris, 2013, 7thEdn., Elsevier.
2. Boas, M.L., “Mathematical Methods in Physical Sciences”, Wiley International Editions.
3. Group Theory and Quantum Mechanics, M.Timkham.
4. Matrices and Tensors: A. W. Joshi
5. Mathematical Physics: Das and Sharma.
6. Mathematical Physics: A.K.Ghatak, I.C.Goyal& S.J. Chua.
7. Mathematical Methods for Physicist & Engineers: Pipes &Harvel.
8. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
9. Mathematical Methods for Scientists and Engineers: D.A.McQuarrie, 2003, Viva Book.

10. Advanced Engineering Mathematics: D.G.Zill and W.S.Wright, 5-Ed, 2012, Jones and Bartlett Learning.
11. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
12. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press.
13. Kittel,C., "Solid-State Physics",
14. Arun Kumar, "Introduction to Solid State Physics", PHI Learning
15. Aschroft, N.W. and Mermin, N. D., "Solid-State Physics"
16. Verma and Srivastava, Crystallography for Solid State Physics.
17. S. O. Pillai, "Solid State Physics", New Age International.

CCPHY103: QUANTUM MECHANICS-I AND GENERAL ELECTRONICS

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

UNIT I: Quantum Mechanics-I

Mathematical Foundation of Quantum Mechanics: Vectors and Linear vector space, Closure property, Linear independence of vectors, Bases and dimensions. Some examples of linear vector spaces, Dirac's notations, Bra and Ket vectors, Combining bras with kets, Inner product and inner product space, Orthonormality of vectors, Gram Schmidt orthogonalization of vectors in a linear vector space, Schwartz inequality, Arbitrary Vectors in an orthonormal basis, Completeness condition, Outer product, Hilbert spaces, Operator on a linear vector space, Algebra of linear operators, , Hermitian operators and their properties, Unitary, Projection, Commuting operators and related theorems, Complete set of commuting operators. **20 Lectures**

Hilbert Space Formalism of Quantum Mechanics: Postulates, Expectation values and probabilities, Explicit representation of operators, The general uncertainty relationship, The minimum uncertainty product. **5 Lectures**

Quantum Dynamics: The equation of motion- The Schrodinger; the Heisenberg and the Interaction pictures; Applications to linear harmonic oscillator and the hydrogen atom. Linear harmonic oscillator using Creation and annihilation operator. **15 Lectures**

Heisenberg Matrix Mechanics: Matrix representation of states and operators, Matrix transformation, Diagonalizability of matrix, Application to linear harmonic oscillator problem. **5 Lectures**

Angular Momentum: Commutation relations for angular momentum operators, Eigenvalues and eigenvectors, Pauli spin matrices and spin eigenvectors, Addition theorem, Clebsch-Gordon co-efficient, Angular momentum and rotation, Motion in a centrally symmetric field. **5 Lectures**

Invariance Principle and Conservation Laws: Space-time symmetries and conservation Laws for linear momentum, Angular momentum, Energy and Parity. **5 Lectures**

UNIT II

General Electronics

Microwave Components / Devices: Attenuators, phase shifters, directional couplers, T junction, Magic Tee, Standing wave detectors and cavity resonators (circular). Reflex klystron, TWT, Velocity modulation. **10 Lectures**

Photonic Devices: Radiative and non-radiative transitions, optical absorption, bulk and thin film photoconductive devices (LDR), diode photo detectors, solar cell (open circuit voltage and short circuit current, fill factor), LED (high frequency limit, effect of surface and indirect recombination current, operation of LED). **10 Lectures**

Books Suggested:

1. Mathews, P.M., & Venkatesan, K., "A Text Book of Quantum Mechanics", TMH.
2. Merzbacker, E., "Quantum Mechanics", John Wiley
3. Messiah, A., "Quantum Mechanics", North-Holland Publishing Co.
4. Schiff, L.I., "Quantum Mechanics", Tata McGraw-Hill, 3rd Edition 2010
5. Ghatak, A., Quantum Mechanics", Narosa Publishing House, New Delhi.
6. Agarwal, B. K., "Quantum Mechanics', PHI
7. Landau, L.D. &Lifshitz, E.M., "Quantum Mechanics", Pergman Press
8. Quantum Mechanics for Scientists and Engineers, D. A. B. Miller 2008, Cambridge University Press
9. Introductory Quantum Mechanics, Richard L. Liboff, Pearson Education, New Delhi.
10. Quantum Mechanics, B.H. Bransden and C.J.Joachin, Pearson Education, New Delhi.
11. Allen, Optoelectronics, Theory & Practical, McGraw Hill
12. Pallabh Bhattacharya, Semiconductor Optoelectronics Devices, PHI
13. Jordon & Balmain, Electromagnetic Waves & Radiating System, PHI
14. Kulkarni, Microwave & Radar Engineering, Umesh Publication
15. Optical Electronics, Ajoy Ghatak and K. Thyagarajan, Cambridge University Press.
16. Dinesh C Dube, "Microwave Devices & Applications", Narosa Publishing House.
17. Chattopadhay & Rakshit. "Electronic Fundamentals and Applications", New Age techno Press.

CCPHY104 EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

: GENERAL ELECTRONICS AND ATOMIC & NUCLEAR PHYSICS LAB.

Credits: 05, Hrs. per week: 10

Total Marks: 100 **Time 6 hrs.**

1. ‘e/m’ measurement by Braun’s tube and by Magnetron valve method.
2. ‘e’ measurement by Millikan oil drop apparatus.
3. Design and characteristics of passive attenuators (T- and π-types)
4. BJT based voltage amplifier: design and performance study with and without negative feedback.
5. JFET based voltage amplifier: design and performance study.
6. Half- and Full wave rectifier with and without filters
7. Series and shunt voltage regulators using Zener diode.
8. Verification of Truth table of Logic circuit using NAND gates and its DC characteristics.
9. Characterization of Photo –resister.
10. Determine the plateau characteristics of the given GM counter.
11. Verification of Inverse Square Law for Gamma-rays.
12. To measure the absorption coefficient of gamma rays in Aluminum or Copper.
13. To plot the Gaussian or normal distribution curve for background radiation.
14. Determination of dead time of the GM Counter.

15.Experiment with Frank Hertz experiment.

Distribution of Marks in Practical Exam

Experiment: 70
Note book: 10
Viva-Voce: 20

SEMESTER – II

AEPHY201: RESEARCH METHODOLOGY

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

CS 102 – COMPUTER FUNDAMENTALS

Unit I: Introduction of Computer

1.1 What is computer.
1.2 Function Unit of a Computer.
1.3 Basic Function of a Computer.
1.4 Classification of Computers: Supercomputer, Mainframe Computer, Mini Computer, Micro Computer.
1.5 Generation of Computers: First Generation, Second Generation, Third Generation, Fourth Generation, Fifth Generation.
1.6 Computer Applications.

Unit II: Input Output Devices

2.1 Input Devices: Keyboard, Tough Screen, Mouse.
2.2 Output Devices: Monitor, Types of Monitor, Printer.
2.3 Central Processing Unit (CPU).
2.4 Component of Central Processing Unit.

Unit III: Memory Organization

3.1 What is Memory.
3.2 Memory Hierarchy.
3.3 Primary Memory: RAM, ROM, PROM, EPROM, EEPROM.
3.Secondary Memory: Magnetic Disk, Magnetic Tape, Floppy Disk, Optical Disks, Memory card, Pen Drive.

Unit VI: Software and Network of Computer

4.1 Introduction of Computer software.
4.2 Classification of Computer software: System software, Application Software.
4.3 What is Computer Network.
4.4 Types of Network: LAN, MAN, WAN.
4.5 Introduction of Internet.
4.6 Internet Services: E-mail, Chatting, E-newspaper, WWW, Online shopping.

Unit V: Introduction to Algorithm and Programming Languages

5.1 What is Algorithm.
5.2 Key features of Algorithm: Sequence, Decision, Repetition.
5.3 Introduction of Flowchart: Significant of flowchart, advantages, Limitation.
5.4 Generation of Programming languages: Machine language, Assembly language, High-level language.
5.5 Programming language: Introduction to C, Structure of C, Writing of C program.

PAPER – RESEARCH METHODOLOGY

Objectives: *The objective of this subject is to acquaint and enhance the knowledge of Research and also to provide insights as to to how research is conducted..*

Unit No.	***Topics***	***No. of lecturers***
1	***Introduction to Research:*** *Meaning, Characteristics, Objectives and Importance of research, Motivation and objectives – Research methods vs Methodology. Types and Methods of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.*	***6***
2	***Research Formulation:*** *Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.*	***8***
3	***Research design****: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.*	***8***
4	***Data Collection and analysis:*** *Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation.*	***8***
5	***Research Report:*** *Types of research reports – Brief reports and Detailed reports; Report writing: Structure of the research report- Preliminary section, Main report, Interpretations of Results and Suggested Recommendations; Report writing: Formulation rules for writing the report: Guidelines for presenting tabular data, Guidelines for visual Representations, Illustrations and tables - Bibliography, referencing and footnotes.*	***10***

REFERENCES

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. ***An introduction to Research Methodology****, RBSA Publishers.*

2. Kothari, C.R., 1990. ***Research Methodology: Methods and Techniques****. New Age International.*

3. Sinha, S.C. and Dhiman, A.K., 2002. ***Research Methodology****, Ess Ess Publications. 2 volumes.*

4. Trochim, W.M.K., 2005. ***Research Methods: the concise knowledge base****, Atomic Dog Publishing.*

CCPHY202: QUANTUM MECHANICS – II

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

Approximation Methods: The WKB approximation and its applications to one dimensional bound system and barrier penetration problem, The vibrational method (Ritz method) and its application to linear harmonic oscillator and helium atom, Stationary perturbation theory, non-degenerate and degenerate cases and applications to an-harmonic oscillator; linear Stark effect; Zeeman effect and spin-orbit coupling in the hydrogen atom. Time-dependent perturbation theory, constant perturbation and Fermi Golden rule, harmonic perturbation (Einstein's A and B co-efficient). **30 Lectures**

Theory of Scattering: Scattering amplitude and cross-section, Partial wave analysis, Born approximation and its validity with application to Rutherford's α-particle scattering. **10 Lectures**

Identical Particles: Many particle Schrodinger equation,The In-distinguishability principle, Symmetric and anti-symmetric wave functions, Pauli exclusion principle, Importance of symmetry character of wave function in the dynamics of bound system (helium atom), Hydrogen molecule (Heitler-London theory). **15 Lectures**

Relativistic Quantum Mechanics: Klein-Gordon equation for free particle, Dirac equation, Properties of Dirac matrices, Probability and current densities, Covariance of Dirac equation, Free particle solution and negative energy states, magnetic moment and spin of electron, Dirac equation for central field, Energy states of the hydrogen atom. **15 Lectures**

Second Quantization: Number representation of fermions and bosons, Creation and annihilation operators, Electromagnetic field in vacuum. **05 Lectures**

Books Suggested:

1. Thankappan, V.K., "Quantum Mechanics", Wiley Eastern
2. Mathews, P.M., &Venkatesan, K., "A Text Book of Quantum Mechanics", TMH.
3. Merzbacker, E., "Quantum Mechanics", John Wiley
4. Messiah, A., "Quantum Mechanics", North-Holland Publishing Co.
5. Schiff, L.I., "Quantum Mechanics", McGraw-Hill
6. Ghatak, A., Quantum Mechanics", Narosa Publishing House, New Delhi.
7. Agarwal, B. K., "Quantum Mechanics', PHI
8. Landau, L.D. &Lifshitz, E.M., "Quantum Mechanics", Pergman Press
9. Introduction to Quantum Mechanics by D. i. Griffiths. II Edn., pearson Education
10. Also the books recommended earlier in Quantum Mechanics Course – I.

CCPHY203: STATISTICAL PHYSICS

Credits: 5, Lectures: 70

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

Quantum Ensemble Theory: Micro-canonical Canonical and Grand Canonical ensembles, Phase space, Distribution functions, Partition function and relationship tothermodynamic quantities, Fluctuations in energy, particle density, Pressure and volume, Equivalence of ensembles. **10 Lectures**

Quantum Statistics: Equation of state of ideal Fermi and Bose gases, Degenerate electron gas and specific heat, Degenerate Bose gas, Bose-Einstein condensation, Evaluation of constant α and β and its thermodynamics interpretation, Thermal properties of Bose-Einstein gas and liquid He^4, The Lambda transition, The two fluid model, Black body distribution law.Density matrix and classical limit for N-particles partition function. **15 Lectures**

Imperfect Gases: Classical and Quantum cluster expansion, Virial equation of state, Virial coefficients in classical limit, Second Virial coefficients for hard-sphere and square-well potentials. **10 Lectures**

Phase Transitions: Ising model, Bragg-Williums Approximation, Mean field theories of the Ising model In three, two and one dimensions, Exact solutions in one dimension, Landau theory of phase transition, Critical indices, Scale transformation and dimensional analysis.

10 Lectures

High-Density Gases: Thermo-ionic and photoelectric emission, Spin Para-magnetism, Landau Diamagnetism, Equation of state at very high density, Equilibrium of bodies of large mass, Chandrasekhar mass limit, White dwarf and neutron stars. **10 Lectures**

Non-Equilibrium Statistical Mechanics: Boltzman Transport equation, Boltzman H-theorem, Equations of motion in classical mechanics, Time correlation function, Linear response theory, Electrical conduction, Langevin's equation and Brownian motion, Debye theory of dielectric relaxation. Motion due to fluctuating force. The Fokker-Planck Equation, Solution on Fokker-Planck Equation. **15 Lectures**

Books Suggested:

1. Sinha, S.K., "Statistical Mechanics",
2. Kerson& Huang, "Statistical Mechanics",
3. Friedman, H.L., "A Course in Statistical Mechanics",
4. McQuarrie, D.A., "Statistical Mechanics",
5. Landau, L, &Liefshitz, "Statistical Mechanics", Pergaman Press.
6. Statistical Mechanics, R.K.Patharia, Bufferworgh Heinemann
7. Fundamental of Statistical and Thermal Physics, F.Rief, McGraw Hill International Edition.
8. Fundamental of Statistical Mechanics, B.B. Laud, New Age International Pub.
9. R.K.Srivastava&J.Ashok, "Statistical Mechanics".
10. Hill, T.L., "Statistical Mechanics",
11. Gupta & Kumar, "Statistical Mechanics",
12. Agrawal, B.K., Statistical Mechanics.
13. PrakashSatya&Agrawal J.P., "Thermodynamics Statistical Physics & Kinetics"

CCPHY204: OPTICS, LASER AND SPECTROSCOPY LAB.

Credits: 05, Hrs. per week: 10

Total Mars: 100 **Time: 6 Hrs.**

1. Studies with Michelson's Interferrometer.
   (a) Determination of wavelength separation of sodium D-lines.
   (b) Determination of thickness of mica sheet.
2. Studies with Fabre-Perot Etalon.
3. Studies with Edser-Butler Plate.
4. Studies of phenomena with polarized light:
   (a) Verification of Brewster's law.
   (b) Verification of Fresnel's law of reflection of plane polarized light.
   (c) Analysis of elliptically polarized light using $\lambda/4$ plate and Babinet's compensator.
5. Verification of Rayleigh's criterion for the limit of resolution of spectral lines using
   (a) prism spectrum and (b) grating spectrum.
6. Determination of optical constants of metal in thin film form.
7. Studies on Zeeman effect.
8. Young's modulus determination by optical method.
9. Experiments using He-Ne laser source:
   (a) Determination of laser parameters.
   (b) Measurement of the angle of a wedge plate using Heidinger fringes.
   (c) Determination of grating pitch using phenomena of self-imaging.
   (d) Determination of wavelength with a vernier caliper.

Distribution of Marks in Practical Exam

Experiment: 70
Note book: 10
Viva-Voce: 20

SEMESTER – III

CCPHY301: SPECTROSCOPY

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

Atomic Spectra: Space quantization, Relation between angular momentum and magnetic moment, Bohr magnetron. Fine structure of spectral lines, Term symbols of alkali and alkaline earth atoms. LS and JJ coupling. Quantum theory of Zeeman effect (normal and anamolous),Paschen-Back effect, Stark effect (linear and non-linear). Hyperfine structure of spectral lines, X-ray spectra characteristics and absorption. **15 Lectures**

The Rotation of the Molecule: Rotational spectra-Rigid diatomic molecule, Theintensities of spectral lines, Effect of isotopic substitution, the non-rigid rotator, Simple harmonicoscillator, The an-harmonic oscillator, Diatomic vibrating rotator, BornOppenheimer approximation, Techniques and instrumentation applications. **15 Lectures**

Molecular Spectra: Infrared and Raman spectra of diatomic molecules using an-harmonic oscillator, non-rigid rotator and vibrating rotator as models. Electronic states and electronic transitions in diatomic molecules, Frank Condon principle. **15 Lectures**

Resonance Spectroscopy: Nature of spinning particle, Interaction between spin and a magnetic field, Larmor Precession, Theory of NMR, Chemical shift-relaxation Mechanism, experimental study of NMR, Theory and experimental study of NQR, Theory of ESR, Hyperfine structure and fine structure of ESR, Experimental studies and applications, Mossbauer spectroscopy, Principle-Isomer shift, Quadrupole effect, effect of magnetic field, Instrumentation applications. **15 Lectures**

Laser and Holography: Spontaneous and stimulated emission, Einstein A and B coefficients, Basic Principles of Laser, Population Inversion-Two level and Three level Laser system, optical pumping-rate equation, modes of resonator and coherence length, The Nd^{3+}, YAG laser, The Neodymium Glass laser, The CO2 Laser, Organic Dye lasers, Semi-conductor Laser, Liquid Laser, Principle of Holography, Theory Practical applications including data storage.

15 Lectures

Books Suggested:

1. Kuhn, "Atomic Spectctra".
2. Arun Kumar, ``Introduction to Solid State Physics'', PHI Learning Pvt. Ltd.
3. Ghatak&Loknathan, "Quantum Mechanics".
4. Herzberg, Spectra of diatomic molecules
5. Elements of Spectroscopy: Gupta, Kumar and Sharma, PragatiPrakashan.
6. Fundamentals of Molecular Spectroscopy: Colin and Elaine, TMH.
7. Laser and Non-linear Optics: B.B.Laud, New Age Publications.

CCPHY302: NUCLEAR PHYSICS – I

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

Fundamental Properties of Nuclei: Electric moments and magnetic moments of nucleous, Measurement of magnetic moment of neutron, proton and nuclear magnetic moments, Parity and statics of nucleus, i-spin formalism.

15 Lectures

Two-Nucleon Forces: Theory of ground state of the deuteron, Partial wave analysis of low energy n-p and p-p scattering, Effective range theory of low energy n-p and p-p scattering, Coherent n-p scattering and spin dependence of nuclear force, Exchange forces and tensor forces, Meson theory of nuclear force,Yukawa interaction, Charge independence and charge symmetry of nuclear forces. **15 Lectures**

Nuclear Structure (models): Single particle shell model and its successes, Semi-empirical formula of Weizsaker energy, β-activity of isobars, Liquid-drop model and Bohr-Wheeler theory of fission, Collective model of Bohr and Mottelson. **15 Lectures**

Nuclear Interactions and Nuclear Reactions: Compound nucleus theory, Resonance reaction,Breit Wigner dispersion formula for l=0 neutrons, Weak interaction-phenomenon of β-decay; Fermi's theory; selection rules for β transition; parity non-conservation in β decay.Experimental demonstration.

15 Lectures

Particle Physics: Fundamental interactions, Conservation laws, Discrete symmetries - parity; charge conjugation and time reversal; G parity and CPT theorem, Internal symmetries -Isospin formalism; SU2 and SU3 groups and their applications to multiplet mesons and baryons; Quark model -Gell Mann - Okubo mass formula for octet and decuplet hadrons - charm, bottom and top quarks, Gluons as mediators of strong interaction. **15 Lectures**

Books Suggested:

1. Introductory nuclear Physics by Kenneth S. Krane, Wiley India Pvt. Ltd., 2008.
2. Concepts of nuclear physics by Bernard L. Cohen, Tata Mcgraw Hill, 1998.
3. Introduction to Elementary Particles by D. Griffith, John Wiley & Sons
4. Introductory Nuclear Physics by S.S.M. Wong, PHI
5. Theoretical Nuclear Physics by J.M. Blatt, & V.F. Weisskoff, John Wiley
6. Introduction to Nuclear Physics by H.A. Enge, Addison Wesley
7. Nuclear Physics by R.R. Roy, &B.P.Nigam, John Wiley
8. Introductory Nuclear Theory by L.R.B Elton, Sir Isaac Pitman & Sons Ltd.
9. Physics of the Nucleus byM.A. Preston, Addison Wesley
10. Quarks and Leptons by F. Halzen and A.D. Martin, Wiley India, New Delhi
11. Basic ideas and concepts in Nuclear Physics - An Introductory Approach byK. Heyde (IOP- Institute of Physics Publishing, 2004).
12. Introduction to the physics of nuclei & particles by R.A. Dunlap. Thomson Asia, 2004.
13. The Atomic Nucleus by R.D. Evans, TMH

ECPHY303: NANOPHYSICS AND NANO MATERIALS– I

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

Nanophysics: Introduction to nanophysics and quantum size effect, Dimensionallities and density of states, Optical and transport properties of two-dimentional electron gas formed at heterostructures and within novel grapheme monolayers with enternalfoelds, Quantum Hall effects, Physics of one-dimentional electron systems including carbon nanotubes and semiconductor nanowires, Fundamental Physics of zero-dimentional electron system, Single electron effects, Quantum dots and nanocrystals, Fundamental principles and applications of scanning tunneling microscopy in the study of nanophysics.

25 Lectures

Synthesis of Nano materials: Top down and Bottom up approach, Synthetic procedures and their significance, Types of nano materials synthesis processes, ROHS and WEEE guideness, Physics method, Photolithography, Advanced Ceramics (Solid State reaction method), Ball milling method, Chemical method, Co-precipitation technique, So-gel method, Soft chemical technique (citrate tertarate, etc.), Hydrothermal method, Bio-chemical method, Thin film technology, Thermal Evaporation method, Sputtering (RF and DC), Spray pyrolysis method, Spin coating method, Pulsed laser deposition method, Vaccum arc discharge, Chemical vapor deposition method (CVD), MOCVD, MBE, Ion beam deposition, Electron-beam lithography. MBE growth of quantum dots. **30 Lectures**

Characterization Technique: Introductory remarks, Structural, X-ray and neutron diffraction, XPS, Electron beam techniques, Scanning Electron Microscope, Transmission Electron Microscope, Scanning Tunneling Microscope, Atomic Force Microscope, Photo luminescence Cathodo-luminescence, Electro-luminescence, UV-visible and Fourier transformed infrared spectrophotometry, Thermal analysis, Thermogravimetry analysis, Differential Scanning Calorimeter, Dielectric and Impedance analysis, Magnetic measurements. **20 Lectures**

Books Suggested:

1. C.P.Poole, Jr. Frank J.Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.)
2. S.K.Kulkarni, Nanotechnology, Principle & Practices (Capital Publishing Company).
3. K.K.Chatopadhyay and A.N.Banerjee, Introduction to Nanoscience& Technology (PHI Learning Private Limited)
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).
5. M. Hosokawa, K. Nogi, M. Natia, T.Yokoyama, Nanoparticle Technology Hanbook (Elsevier, 2007)
6. Bharat Bhushan, Springer Handbook of Nanotechnology (Springer-Verlag, Berlin, 2004).

ECPHY303: ELECTRONICS AND COMMUNICATION – I

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

Operational Amplifier: Operational amplifier (op amp) types, salient features, parameters and modeling, Voltage op amp based circuits such as:

- Instrumentation amplifier (IA)
- Negative impedance converter (NIC)
- Inductance simulation
- Precision rectification
- Active Butterworth low pass, high pass and band pass 2nd order filters

- Simulation of differential equations
- Analog multiplier and its use in integer power generation, frequency multiplication, divider and generation of fractional powers
- D/A and A/D converters **20 Lectures**

Current Conveyor: Current conveyor types, their salient features, modeling and simple applications in realizing bandwidth independent gain amplifier, Current conveyor based differentiator, integrator, adder and instrumentation amplifier, Advantages of current conveyor based circuits over the conventional voltage op amp based circuits. **08 Lectures**

BJT Logic Families: TTL logic NAND gate circuit, ECL logic OR/NOR gate circuit, analysis and evaluation of logic parameters. **08 Lectures**

MOS Logic Families: NMOS inverter circuit and its analysis with linear and non-linear loads, CMOS inverter. **06 Lectures**

Radar: Basic arrangement of radar system, Azimuth and range measurement, Operating characteristics of a radar system, Derivation of radar range equation.

08 Lectures

Antenna: Antenna action, Short electric doublet, Linear array of n isotropic sources of equal amplitude and spacing, Broad-side array, Ordinary end-fire array, End fire array with increased directivity, Beam width of the main loab, Yagi antenna, Resonant and non-resonant array arrangement **15 Lectures**

Satellite Communication: Orbital and geostationary satellites, Orbital patterns, Look angles, Satellite system, Link modules. **10 Lectures**

Books Suggested:

1. A first course in Electronics, A.A.Khan &K.K.Dey, Prentice Hall India.
2. Basic Electronics, Arun Kumar, Bharati Bhawan
3. Millman&Brabel, "Microelectronics", McGraw-Hill (International Students' Edition).
4. Mitchell & Mitchell, "Introduction to Electronics Design", Prentice-Hall of India.

5. Nagrath, “Electronics: Analog and Digital”, Prentice-Hall of India.
6. Soclof, “Design and Applications of Analog Integrated Circuits”, Prentice-Hall of India.
7. Gayakwad, “Op-Amps and Linear Integrated Circuits”,3/e, Prentice-Hall of India
8. Sedra& Smith, “Microelectronic Circuits”, 3/e, Sounders College Publishing.
9. Microwave and Radar Engineering Kulkarni, Umesh Publication.
10. Electromagnetic Waves and Radiating Systems: Jordan, PHI
11. Hand Book of Electronics, Gupta & Kumar, PragatiPrakashan, Merrut.
12. Electronics Communications: RoddyCoolen, PHI
13. Electronic Communication: Kennedy & Davis, TMH

ECPHY303: CONDENSED MATTER PHYSICS – I

Credits: 5, Lectures: 70

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

X-ray Diffraction Theory: Coherent and incoherent scattering, Derivation of Laue equations and expression for structure factor, Data reduction.

08 Lectures

Crystal Structure Determination: The phase problem in crystallography, Electron density as Fourier transform of structure factor and vice versa, Techniques to solve the phase problem – Fourier and Patterson methods, Heavy atom technique, The Single Isomorphous Replacement (SIR) and Multiple Isomorphous Replacement(MIR) techniques, Anomalous scattering technique, Direct methods. **20 Lectures**

Experimental Techniques: The Weissenberg and Precession methods, The Diffractometer, Area Detector and Image Plate. **07 Lectures**

Fermi Surface: Construction of Fermi surface, Zone schemes, Electron, hole and open orbits, Cyclotron resonance. *Determination of Fermi surface* – Quantization of orbits in magnetic field; de-Hass – van-Alfen effect; External orbits; Outline of other methods. **10 Lectures**

Phonons: *Harmonic crystals,* Crystal potential; Harmonic and adiabatic approximations; Normal modes and phonons; Phonon spectrum by neutron scattering; Crystal momentum. *Anharmonic crystals,* Anharmonicity, Lattice thermal conductivity,Umklapp process; Second sound. **10 Lectures**

Magnetism: Interaction of solids with magnetic fields, Magnetization density and susceptibility, Calculation of atomic susceptibility, Susceptibility of insulators (Larmor diamagnetism), Ground state of ions with partially filled shells (Hund's rule), van Vleckparamagnetism, Curie laws for free ions and solids, Pauli paramagnetism, Conduction electron diamagnetism, Exchange interaction, Ferromagnetic domains, Anisotropy energy, Thickness and energy of Bloch walls, Ising model, Bragg-Williams approximation, Solution of Ising problem for a linear chain. **15 Lectures**

Books Suggested:

1. Arun Kumar, ``Introduction to Solid State Physics'', PHI Learning Pvt. Ltd.
2. Philips, "An Introduction to Crystallography",
3. Woolfson, M.M., "An Introduction to X-ray Crystallography",
4. International Tables for X-ray Crystallography, Vol. I
5. Verma, A. R. & Krishna, P., "Polymorphism and Polytypism",
6. Kittel,C., "Solid-State Physics",
7. Raghavan, V., "Material Science and Engineering".

8. Aschroft, N.W. and Mermin, N. D., "Solid-State Physics".
9. Bunger, M.J., "Crystal Structure Analysis".
10. Bunger, M.J., "X-ray Crystallography".
11. Staut& Jenson, "A Practical Guide to X-ray Crystal Structure Determination"

ECPHY304: Nanophysics And Nano materials Lab I

Credits: 5 Hrs. per week: 10

Total Marks: 100 **Time: 6 Hrs**

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticle.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. To prepare composite of CNTs with other materials.

Distribution of Marks in Practical Exam

Experiment: 70
Note book: 10
Viva-Voce: 20

ECPHY304: Electronics And Communication Lab I

Credits: 5 Hrs. per week: 10

Total Marks: 100 **Time: 6 Hrs.**

1. Operational amplifier parameters measurements and their dependence on frequency.

2. Basic operational amplifier configurations: inverting amplifier, non-inverting amplifier, voltage follower, differentiator, integrator and instrumentation amplifier.
3. Butterworth second order active low pass and high pass filters.
4. Studies on second order band-pass and band-elimination active filters.
5. Precision rectification: half- and full- wave.
6. Design and study of Wein bridge oscillator circuit.
7. Design and study of op amp based square wave oscillator.
8. To draw the characteristic curve of SCR and to determine its holding voltage, holding current and break-over voltage
9. Use of IC 555 timer.
10. To simulate electronic circuits using PSpice.
11. BCD adder and subtractor.
12. DIAC and TRIAC characteristics and applications.

Distribution of Marks in Practical Exam

Experiment: 70
Note book: 10
Viva-Voce: 20

ECPHY304: CONDENSED MATTER PHYSICS LAB I

Credits: 5 Hrs. per week: 1

Total Marks: 100 **Time**: 6 Hrs.

Studies on semiconductors: 4-Probe method for the determination of band gap and the dependence of resistivity on temperature.

1. Hall Effect study: Hall co-efficient, carrier concentration and carrier mobility.
2. Electrical properties of thin film samples.
3. ESR study.

4. Determination of magnetic parameters of some minerals using hysteresis loop tracer.
5. Crystal structure analysis using 3D – X-ray diffraction data (Data supplied).
   (a) Use of heavy atom technique.
   (b) Use of Direct Methods.
   (c) Computation of 3 –D Fourier and its interpretation.
   (d) Computation of Bond length, bond angle and H-bond & other geometrical parameters of known structures.
   (e) ORTEP plot of molecule.
6. Ionic conductivity of sodium chloride.
7. Determination of polarazibality of sugar solution.

Distribution of Marks in Practical Exam

Experiment: 70
Note book: 10
Viva-Voce: 20

SEMESTER – IV

ECPHY401: NUCLEAR PHYSICS – II

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus, equally distributed over all the units as far as practicable.

Nuclear Radiation Detectors

Detection: Simple model of of detector, energy measurement, position and time measurement.

Solid State Detectors: Semiconductor detectors, Surface barrier detectors, Scintillation counters: Organic and inorganic scintillators, Photomultiplier tubes, Gamma Ray Scintillation Spectrometer.

High Energy Particle Detectors: General principles, Nuclear emulsions, Cloud chambers, Bubble chamber.

Nuclear Electronics: Pulse shaping, Linear amplifiers, Pulse height discriminators, Single channel and Multichannel analyzer. **25 Lectures**

Nuclear Reactor Theory

Fundamentals of Nuclear Fission: Fission fuels, Prompt and delayed neutrons, Chain reaction, Multiplication factor, Condition for criticality, Breading phenomena.

Diffusion of neutrons: Neutron current density, The equation of continuity, Fick's law, The diffusion equation, Measurement of diffusion parameters.

15 Lectures

Neutron Moderation: Moderation without absorption, Energy loss in elastic collisions, Average logarithmic energy decrement, slowing down power and moderating ratio of a medium. Slowing down densities, Moderation- Space dependent slowing down, Fermi's age theory, Moderation with absorption

15 Lectures

Criticality of an Infinite Homogenous Reactor: The critical equation, Optimum reactor shapes, Material and geometrical bucklings, Neutron balance in a thermal reactor, Four factor formula, Calculation of critical size and composition in simple cases. **15 Lectures**

Power Reactor: Fast breeder reactors, Thermo-nuclear reaction, nuclear fusion in stars, Concept of fusion reactor. **05 Lectures**

Books Suggested:

1. Segre, E., "Experimental Nuclear Physics", John Wiley
2. Singru, R.M., "Introduction to Experimental Nuclear Physics", John Wiley & Sons, 1974.
3. W.R. Leo, "Techniques for Nuclear and Particle Physics Experiments"
4. Kapoor S.S and Ramamurthy V.S., "Nuclear Radiation Detectors", New Age International Publishers 1986.
5. Syed Naeem Ahmed , "Physics and Engineering of Radiation Detection", Academic
   Press, Elsevier, 2007.
6. Glasstone, S. and Edlund, M. C., "The Elements of Nuclear Reactor Theory", Van
   Nostrand Co., 1953.
7. Stacey, W. M., "Nuclear Reactor Physics"
8. Lamarsh, J. R., "Introduction to Nuclear Reactor Theory', Addison Wesley, 1966
9. Murray, L., "Introductions of Nuclear Engineering".

10. Varma, J. "NUCLEAR Physics Experiments", New Age International Publishers 2001.
11. Singru, R.M., "Introduction to Experimental Nuclear Physics" Wiley Eastern Pvt. Ltd.

ECPHY402: Nanophysics And Nano materials-II

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all of will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus equally distributed over all the units as far as practicable.

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 Nano crystals, Quantitative treatment of quasi-particles and excitons, charging effects, Radiative processes, General formalization, absorption, emission and luminescence, Optical properties of hetero-structure and nanostructures.

15 Lectures

Electron Transport: Electrical properties of Polymers, Ceramics, Dielectrics and Amorphous Materials, Electrical conduction in Metals, Alloys and Semiconductors, Band structure, Carrier transport in nanostructures, Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity, Defects and impurities, Deep level and surface defects. **20 Lectures**

Magnetic Properties of Materials: Classification of magnetic materials, Magnetic materials of technical importance, Magnetization processes, Superparamagnetism, Magnetic domain structure, Superconductivity, Phenomenology of superconductivity. **10 Lectures**

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 hetero-structure lasers, optical switching and optical data storage. Magnetic quantum well, magnetic dots – magnetic data storage, Micro Electromechanical systems (NEMS), Nano, Electromechanical Systems (NEMS).Integrated optical devices, SQUIDS, Spintronic devices, Ferroelectric, Pyro-electric, Piezoelectric and electro-optic devices. **25 Lectures**

Books Suggested:

SAME AS IN ECPHY-303

ECPHY402: ELECTRONICS AND COMMUNICATION – II

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all of will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus equally distributed over all the units as far as practicable.

Transmission line: Types of transmission line, distributed parameters, voltage and current relations on a radio frequency transmission line with respect to sending and receiving ends, propagation constant (γ), attenuation constant (α) and phase constant (β), expressions for α and β, transmission line distortion and attenuation, conditions for no distortion, low distortion and low loss, line termination across a short circuit, open circuit pure resistance and complex impedance, quarter wave and half wave lines and their impedance matching properties. **20 Lectures**

Wave Guide: Field expression for propagatingTE and TM waves in hollow circular cylindrical wave guides, Impossibility of TEM waves in hollow wave guide, Attenuation in wave guides and Q-factor. **10 Lectures**

Fiber Optic Communication: Principle of light transmission in a fiber. Light sources for fiber optic communication, Effect of index profile on propagation, Modes of propagation, Number of modes a fiber may support, Single mode fiber (SMF), Losses in fibers. **15 Lectures**

Microprocessor Architecture: 8085 Microprocessor Architecture, Real Mode and protected modes of memory addressing, memory paging.

Addressing Modes: Data addressing modes, Program memory addressing modes, stack memory addressing modes.

Instruction Set: Data movement instructions, arithmetic and logic instructions, Program control instruction, Assembler details.

Interrupts: Basic interrupt processing, Hardware interrupt. Expanding the interrupt structure 8259A PIC.

Direct Memory Access: Basic DMA operation, 8237 DMA controller, Shared Bus operation Disk Memory systems. **30 Lectures**

Books Suggested:

1. Miah, "Fundamentals of Electromagnetic", TMH
2. Mano, "Computer System Architecture", Prentice-Hall of India.
3. Goankar, Microprocessors Architecture, Programming & Applications with 8085,
4. Senior, "Optical Fiber Communications: Principles and Practice", 2/e, Prentice-Hall.
5. Jordon &Balmain, "Electromagnetic waves and Radiating Systems", Prentice-Hall of India.

ECPHY402: CONDENSED MATTER PHYSICS – II

Credits: 5, Lectures: 75

Total Marks: 70 **Time: 3 Hours**

EIGHT questions in all of will be set in which question 1 will be objective type consisting of 10 questions of one mark each and is compulsory. Out of remaining seven questions of 15 marks each, 4 are to be answered. The questions will cover the entire syllabus equally distributed over all the units as far as practicable.

Phase Transformations and Diagram: Phase rule, Single component system, Binary phase diagrams, Lever rule, Nucleation and growth, Nucleation kinetics, Growth and overall transformation kinetics and applications to steel and glass.

10 Lectures

ESR: Basic theory, Relaxation mechanism, Effect of spin orbit coupling and crystal fields on g values, Fine and hyperfine structures. Ferromagnetic resonance (FMR): General features of FMR, Shape effect in FMR, Antiferromagnetic resonance. **10 Lectures**

NMR: Basic theory, Spin lattice relaxation, Bloch equation and their steady state solutions, General features of NMR spectra, Chemical shifts, Fine structure due to spin-spin coupling, Application to molecular structure and bondings. **10 Lectures**

Superconductivity: BCS theory of susceptibility, Cooper pairs, superconducting ground state, Flux quantization in superconducting ring, Quasi-particles and energy gaps, Temperature dependence of energy gap, London equation, Coherence length, Persistent current, Single particle tunneling Josephson tunneling, Josephson effects (AC and DC), Microscopic quantum interference, Qualitative idea of high temperature superconductors, Critical fields and moments. **15 Lectures**

Thin Films: Deposition techniques, Thermal, electron and sputtering methods, Metallic, semiconductor and insulator thin films and their electrical, electronic and optical properties. Magnetic and superconducting thin films and applications. **15 Lectures**

Dielectrics: Structure of dielectrics, Polarization mechanism, Effect of temperature and frequency, Conduction (ionic and electronic) in dielectrics, Dielectric losses and breakdown, Electrets and MIM. **15 Lectures**

Books Suggested:

1. Kittel,C., "Introduction to Solid-State Physics",
2. Arun Kumar, "Introduction to Solid State Physics", PHI Learning
3. Aschroft, N.W. and Mermin, N. D., "Solid-State Physics"
4. Raghavan, V., "Material Science and Engineering".
5. Goswami, A., "Thin Films Fundamentals"
6. Bunget, I, &Popescu, M., "Physics of Solid Dielectrics".

ECPHY403: NANOPHYSICS AND NANO MATERIALS LAB. – II

Credits: 5 Hrs. per week: 10

Total Marks: 100 **Time**: 6 Hrs.

1. Growth of quantum dots by thermal evaporation.
2. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering and study its XRD.
3. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.

4. Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.
5. Fabricate a PN diode by diffusing Al over the surface of N-type Si and study its V-I characteristic.

Distribution of Marks in Practical Exam

Experiment: 70
Note book: 10
Viva-Voce: 20

ECPHY403: ELECTRONICS AND COMMUNICATION LAB. – II

Credits: 5 Hrs. per week: 10

Total Marks: 100 **Time**: 6 Hrs.

1. Studies on the polar pattern of microwave transmitting horn antenna.
2. Familiarity with microwave components, microwave propagation in hollow rectangular wave-guide and measurement of dielectric constant in X-band.
3. Amplitude modulation and demodulation.
4. Studies on Phase Locked Loop (PLL) IC 565 and its use in frequency multiplication.
5. Design, construct and test electronically regulated power supplies using Zener diode, 3-pin regulators (78xx/79xx) and IC 723.
6. Design and study of the characteristics of TTL logic NAND gate and the evaluation of its parameters.
7. Familiarity with circuit simulation and fundamentals of PSpice commands and circuit programming.
8. Simulation of amplifier, oscillator and TTL logic NAND gate circuits. Analog computation using PSpice: solution of differential equations.

Distribution of Marks in Practical Exam

Experiment: 70
Note book: 10
Viva-Voce: 20

ECPHY403: CONDENSED MATTER PHYSICS LAB. – II

Credits: 5 Hrs. per week: 10

Total Marks: 100 **Time**: 6 Hrs.

1. Determination of magnetic susceptibility using Guoy's method.
2. Determination of Curie temperature by dielectric constant apparatus.
3. Determination of modulus of rigidity and internal friction by modulus of rigidity apparatus.
4. Study of impedance spectrometry of a given sample using LCR meter.
5. Study of temperature dependence of Hall coefficient.
6. Synthesis of materials under different stoichiometric ratio.
7. Study of dielectric constant of polar and non-polar molecules.
8. Study of absorption pattern of a given sample using FTIR spectrometer.

Distribution of Marks in Practical Exam

Experiment: 70
Note book: 10
Viva-Voce: 20

ECPHY404: DISSERTATION

Full Marks: 100 Time: 6 Hrs.

For Theoretical Project: 50 Marks on the Documentation/Write-up of the Project and 50 Marks on Viva based on the Project.

For Project with Working Model: 20Marks on the write-up, 30 Marks on the Model and 50 Marks on Viva based on the Project.

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