DEPARTMENT OF PHYSICS

SIDO KANHU UNIVERSITY, DUMKA

SYLLABUS OF M.Sc. PHYSICS (under CBCS)

W.E.F. SESSION 2020 - 2021

SYLLABUS FOR M.Sc.(PHYSICS), W.E.F. SESSION 2020 – 2021. (CBCS)

Semester – I

Mathematical Physics ,Comp. Method and GTR Astrophsics

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory(short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY -C01 (Mathematical Physics ,Comp. Method and GTR & Astrophysics)

Unit-1 : Mathematical Physics:

Special Functions : Legendre, Bessel, Hermite and Laguerre differential equations solution and their physical applications, Generating function, recursion relations, Rodrigue's formula. [Lectures 10]

Unit-2 :Integral Transform :

Laplace transform, 1^{st} and 2^{nd} shifting theorems, inverse LTs by partial fractions, LT of derivative and integral of function., solving differential equation using LT , Fourier integral and transforms, FT of delta function.(10 lectures).

Unit-3 : General Theory of Relativity and Astrophysics:

Equality of Gravitational and inertial masses, Equivalence principle, Principle of general covariance:

Geodics: Equation of motion of particles, Weak fields and Newtonian approximation, time and distance in general theory, gravitational Red and Blue shift, Experimental verification, Determination of mass, radius, luminosity, temperature of a star, Steller classification and its interpretation, H.R. diagrams of clusters. Empirical mass-Luminosity relation, Hubble's law, Hubble's constant, Age of universe.(20 lectures).

Unit-4 : Elements of Computational Techniques:

Root of functions, Iteration method, Gauss elimination method, Eigen values and eigen functions of matrices, interpolation, extrapolation, curve fitting methods, Least square

fitting, integration by trapezoid and Simpson's rule, Solution of First order differential equation using Runge-Kutta method. Finite difference method. Fundamental of Fortran and C++ Programming.(20 Lectures)

Reference Books :

Applied Mathematics for Engineers and Physicists : L.A. Pipes and R. Rarvill.
Mathematical Physics : A.K. Ghatak and I. Goyal.
Mathematical Physics : Satya Prakash.
Mathematical Physics : B.S.Rajput
Mathematical Physics : H. K.Dass
Mathematical Physics : G. Arfken.
Special functions: W.W. Bell
Numerical Methods (Problem and Solutions): M.K.Jain, S.R.K. Iyengar, R.K. Jain, New Age Intl.
Introductory Methods of Numerical Analysis : S.S.Sastry (PHI)
Numerical Analysis: B.S. Grewal
Fortran Programming: Rajaramanna.
Let us C++: Yeswant Kanetkar.

Semester – I

Classical mechanics and Quantum Mechanics I:

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory (short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY C- 02 (Quantum Mechanics I and Classical mechanics)

Classical Mechanics: (30 Lectures)

Lagrangian and Lagrange's equation, Hamiltonian and Hamilton's equation and their applications, Hamilton's principle and characteristic function, Hamilton – Jacobi equation. Canonical transformation, generating functions, infinitesimal generators, Poisson bracket, Poisson theorems, angular momentum, Principle of Least action . Small oscillation, Normal mode of vibration, Coupled oscillator.

Quantum Mechanics - I [30 Lectures]

Unit-1

Harmonic Oscillator by Schrodinger equation and by operator method, Dirac Delta function, bra and ket notations, matrix representation of an operator, unitary transformation. [6 Lectures]

Unit-2

Schrodinger, Heisenberg and interaction pictures, their applications to linear harmonic oscillator [4 Lectures]

Unit-3

Motion in centrally symmetric field, Hydrogen atom.

Angular Momentum: Commutation relations for angular operators, Eigen values and Eigenvectors, Pauli spin matrices and spin eigenvectors, addition theorem, Clebsch – Gordon coefficients, angular momentum and rotation. [20 Lectures]

Reference Books :

Classical Mechanics: Herbert Goldestien , Pearson Education N.Delhi.
Classical Mechanics: S.L.Gupta, V.Kumar & H.V.Sharma – Pragati Prakashan.
Classical Mechanics of Particles & Rigid Bodies , Kiran C. Gupta Wiley Eastern Ltd.
Classical Mechanics: Rana and Joag.
Classical Mechanics: J.C.Upadhyaya
Classical Mechanics : Yashwant R. , Waghmare (PHI 1990)
Mechanics: Simon.
Mechanics mechanics: Landau and Lifshtz.
Quantum mechanics: D.J. Griffiths
Quantum mechanics: L.I. Schiff (Mc Graw Hill)
Quantum mechanics: T K Thankappan
Quantum mechanics: B. Crasman and J D Powell
Quantum mechanics: Mathews and Venketesan.
Quantum mechanics: Ghatak and Loknathan
Modern Quantum mechanics: J J Sakurai

Semester – I

Electrodynamics and Plasma Physics

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory(short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY C- 03 (Electrodynamics and Plasma Physics)

Electrodynamics (30 Lectures)

Unit-1

Electromagnetic Vector and Scalar Potential , Wave equation. Lorentz condition. Non – Uniqueness of electromagnetic potentials and concept of gauge.[6 lectures]

Unit-2

Electrodynamics of a moving charge and radiating systems: Lienard – Wiechert potentials and derivation of LW potential of a moving point charge .Electric and Magnetic fields due to uniformly moving point charge and accelerated charge. Angular Distribution of Radiation emitted by accelerated charge. Radiation Damping: Abraham Lorentz formula.[15 Lectures]

Unit-3

Relativistic Electrodynamics: Four Vectors, Four vectors of charge , current density and E.M. Potentials . Covariance of Continuity equation and Lorentz condition. Transformation equations for the electromagnetic potentials. Invariance of Maxwell field equation. Maxwell's equation in covariance Four Tensor Form. [09 Lectures]

Plasma Physics:[30 Lectures]

Unit-4

General properties of plasma and introductory idea of different states of matter.Kinetic theory of plasma: Boltzmann's equation, Boltzmann – Vlasov Equation, Derivation of moment equations.[10 Lectures}

Unit-5

Plasma Characteristics: Fundamental equations of MHD, Debye Shielding and plasma parameter. Expression of Alfven Velocity.[10 Lectures}

Unit-6

Plasma confinement: Pinch effect and confinement of plasma. Waves in cold plasma, Wave propagation in magnetized cold Plasma – Appleton – Hartee equation, Atmospheric Whistler , Helicons and Faraday rotation.[10 Lectures]

Reference Books :

Electrodynamics:

1.Electromagnetic Theory , Chopra & Agarwal

2. . Electrodynamics – Gupta , Kumar & Singh

3. .Electromagnetic Theory & . Electrodynamics , Satyaprakash

4. Classical Electrodynamics , Jackson (Wiley)

5. Electromagnetic : B.B.Laud (New Age International Publ.)

6. . Classical Electrodynamics : P. Sengupta(New Age International Publ.)

7. Electrodynamics; Griffiths

Plasma Physics:

Plasma Physics: Francis F. Chen (Plenum Press)

Introduction 0f Plasma Physics:B.N. Chakraborty.

Plasma Physics: Bittencourt

Magnetohydrodynamics : S.N Sen

Semester – I

Practical Physics

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

Time : 3 hours.

PHY C/P- 04 (Practical Physics)

Time: 6 hours

1 Determination of wavelength of Laser light using Grating .
2 Determination of thickness of thin wire using Laser light/microscope .
3 Verification of Brewster's Law using spectrometer.
4 Determination of wavelength of Sodium light using Michelson Interferometer.
5 Determination of wavelength of Sodium light using Fabry – Perot interferometer
6 Resolving Power of Telescope
7 Solar cell characteristics.
8 Resolving power of Prism
9 Experiments based on Microwave.
10 . Experiments based on Holography..
11 . Experiments on computer(C++)
(a)Determination of Maxima and Minima.
(b) Least square fitting.

SYLLABUS FOR M.Sc.(PHYSICS) , W.E.F. SESSION 2020 – 2021. (CBCS)

Semester – II

Skill Development Course: Electronic Appliances

Regulation:

This paper consists of two parts- Theory and Practical, each of 50 marks. Out of these 50 marks in each, 15 marks will come from Sessional exams. (10 marks) and attendance and general discipline (5 marks) and the remaining 35 marks will form the basis of End-semester exam. In the theory portion of End-semester exam., examinee will have to answer 05 (five) out of 09 (nine) questions of 07 marks each. The question will be set covering the entire syllabus. The Practical will be based on the theory portion of the syllabus.
Time : 3 hours.

PHY S – 05T (Skill Development Course: Electronic Appliances)

Unit – I

Passive Devices – Resistors – types and characteristics – color coding – capacitors – type – characteristics –color coding star and delta connections of resistors and capacitors – chokes – transformers – testing of diodes, transistors and ICs – Multimeter (analog ang Digital) – CRO – waveforms and Lissajous figures – AF and RF oscillators – usage of bread board.

Unit – II

Semiconductor diode – Zener diode – Transistor – Transistor configuration – diode rectifier – half wave and full wave – Bridge rectifier – Diode voltage doubler and multiplier.
Regulated power supply, Zener diode voltage regulator [Series and Shunt type] IC Voltage regulators; fixed positive – fixed negative – adjustable.

Unit - III

Basic concepts of radio transmitter and receiver – Basic concepts of TV transmitter and receiver – TV antennas; Resonance antennas and their characteristics – Dipole antenna – Folded dipole – Yagi antenna – Yagi antenna design – Dish antenna – DTH system – Mobile communication system MODEM.

References :

Principles of Electronics – V K Mehta S Chand & Co. 5th Ed. 2001.
Functional Electronics – Ramanan.
Elements of Electronics – Bagde and Singh.
Monochrome and Colour TV – Gulati.
Basic Electronics, 6th Ed. – B. Grob, Mc. Graw Hill NY 1989.

PHY S – 05P (Skill Development Course: Electronic Appliances Practical)

The Practical will be based on the theory portion of the syllabus.

Semester – II

Quantum Mechanics II and Nano Physics

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory (short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY C- 06 (Quantum Mechanics II and Nano Physics)

Quantum Mechanics II (45 Lectures)

Unit-1

Approximation method in QM : Time independent perturbation theory – non –degenerate and degenerate cases, Stark effect, Time dependent perturbation theory and Fermi's golden rule, Einstein A and B coefficients. variational methods Application to ground state of Hydrogen atom and first excited state of harmonic oscillator.[15 Lectures].

Unit-2

Theory of Scattering : Collision in 3D and α – scattering, Laboratory and Centre of mass reference frames, scattering amplitude, differential scattering cross section and total scattering cross section. Scattering by spherically symmetric potentials, partial wave analysis and phase shifts, Born approximation, Rutherford Scattering.[15 lectures]

Unit-3

Relativistic QM: Klein – Gordon equation and its merit and demerit, Dirac equation, probabilities and current densities, Magnetic moment and spin of electron, free particle solution of Dirac equation and interpretation of negative energy states.[15 Lectures]

Nano – Physics [15 Lectures]

Unit-4

Properties of individual nanoparticles : Metal nanoclusters, magic numbers, modelling of nanoparticles, Bulk to nano transitions, Methods of synthesis, RF Plasma, chemical methods, thermolysis, pulse LASER methods.

Unit-5

Carbon Nanostructures: Nature of carbon clusters, discovery of C_{60}, Carbon Nanotubes synthesis, electrical and mechanical properties.

Unit-6

Quantum Wells, Wires and Dots : Preparation of quantum nanostructures, size effects, conduction electron and dimensionality, properties dependent on density of states.

Reference Books:

Quantum Mechanics:

Quantum Mechanics: L.I. Schiff (Mc Graw Hill)

Quantum Mechanics: T.K. Thankappan

Quantum Mechanics: B. Crasman and J.D. Powell (Addison Wesley)

Quantum Mechanics: Mathews and Venkateshan

Quantum Mechanics : Ghatak and Loknathan

Modern Quantum Mechanics : J.J.Sakurai

Quantum Mechanics : G. Aruldhas

Quantum Mechanics : S. N. Biswas

Nano – Physics :

Introduction to Nanotechnology : Pook and Owen

Quntum Dots : Jack, Hawylak and Wojs.

Introduction to Nanotechnology: Charles P. Poole, Frank J. Owens Wiley Intrersc.

Nanotechnology: Basic Sciences and emerging technologies , Mick Wilson,Kamali Kannangara, Geo T. Smith.

Semester – II

Atomic and Molecular Physics (Quantum Approach):

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory(short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY C- 07 (Atomic ,Molecular and Laser Physics)

Atomic Physics (Quantum Approach):

Unit-1

Quantum states of an electron in an atom, Stern – Gerlach experiment, Hydrogen atom spectrum, spectrum of Helium and Alkali atoms, Fine Structures, Relativistic correction for energy levels of Hydrogen, Spectroscopic terms and selection rules, Hyperfine structure and isotopic shift. Two electron system, Lande's 'g' factor, Landes interval rule, equivalent and in-equivalent electronic states of two electron systems. Singlet and triplet series of two electron system, Hartee - Fock equation, Series spectra in alkali elements and alkaline earth elements, L – S and J – J coupling, Width of spectral line, Normal and anomalous Zeeman effect, Paschen – Back effect, Stark effect. [35 lectures].

Molecular Spectra (Quantum Approach):

Unit-2

Rotational and Vibration spectra for diatomic molecules: Electronic spectra of diatomic molecules, Vibrational analysis of band system, Frank Condon principle, Infrared spectra and Raman spectra of diatomic molecules.[Lectures 15]

Unit-3

Basic principles of X- Ray X-Ray emission and absorption.[Lectures 5]

Unit-4

Electron Spin Resonance (ESR) , and Nuclear Magnetic Resonance (NMR).[Lectures 5]

LASER [26 Lectures]

Requisites for producing LASER light, Q – Switching, rate equations (four level LASER and three level LASER), propagation of a LASER pulse through a dispersive medium. [10 Lectures]

Unit-5

Basic principles and different LASER's: principles and working of Ruby Laser, He-Ne Laser Solid state laser, semiconductor laser CO_2 LASER and qualitative description of longitudinal and TE- LASER systems, Excimer LASER, Dye LASER, Roman LASER, Plasma recombination LASER.[09 Lectures]

Unit-6

Non Linear interaction of light with matter : LASER induced multiphoton process and their application, second order Harmonic generation.[7 Lectures]

Suggested books:

1. Atomic Spectra; White

2.Atomic Spectra and Atomic Structure, Gerhard Hertzberg .

3.Molecular Structure & Spectroscopy , G. Aruldhas: Prentice Hall of India, New Delhi.

4. Fundamental of molecular spectroscopy,Colin N Banwell & Elaine & M. McCash, Tata Mc Graw- Hill publishing company Limited.

5. Introduction to Atomic, molecular and Laser Physics. D.K. Roy & S.N. Thakur.

6. Introduction to Atomic & Molecular Physics by B. Narayan

7.LASER Fundamentals : Silfvast (Cambridge University , Press)
8.LASER's : Siegman (Univ. Science Books , USA)
9.Elements of Quantum Optics : Meystre and Sargent(Spriger – Verlag)
10.LASER Physics : Srgent, Scully and Lamb .
11.Essentials of LASER and non – linear optics : Baruah Pragati Prakashan, Meerut)

Semester – II

Electronics Physics Practical

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

PHY C/P- 08 (Electronics PhysicsPractical)

Time : 6 hours.

1.ZENER DIODE – CHARACTERISTICS & STABILISATION

2. FET – Characteristics.

3. MOSFET - Characteristics.

4.Unijunction Transistor – Characteristics.

5.Transistor characteristics and Amplifier (CE – Mode)(pnp and npn)

6. Basic Logic gates and from Universal Gates.

7. Op – Amplifier – Differentiator & Integrator.

8. Logarithmic Amplifier.

9. Characteristics of SCR.

10. Half and full Adder.

Semester – III

Basic Applied Physics

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory (short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY A-09: Open Elective: Basic Applied Physics

Unit-1

Basic Electronics: Idea of intrinsic and extrinsic semiconductors, p-n junction diode, Zener diode, LED, BJT, FET with their applications, Elementary Boolean algebra, conversion of decimal numbers into binary numbers, Basic and Universal logic gates. [Lectures 20]

Unit-2

Laser Physics: Principle of laser action, properties of laser, Idea of He-Ne laser, Ruby laser, CO_2 laser, Dye laser, p-n diode laser with their applications. [Lectures 20]

Unit-3

Nanophysics: Idea of nano-technology and nono-science, idea of size effects, idea of quantum well, quantum wires and quantum dots and carbon C_{60}, CVD and PLD methods for the synthesis of nano materials. [Lectures 10]

Unit-4

Solid State Physics: Crystalline state of matter, unit cells, symmetry operations, Bravais lattice, Miller indices, diffraction of X-rays by Bragg's law. [Lectures 10]

Recommended Books:

1. Physics of Semiconductor Devices, S. M. Sze, Wiley-Eastern Ltd (1981)
2. Electronic Devices, L. Floyd, Pearson Education New York (2004)
3. Integrated Electronics, J. Milman and C. C. Halkias, McGraw Hill (1972)
4. Semiconductor Devices and Applications, A.Mottershed, New Age Int Pub.
5. LASER Fundamentals : Silfvast (Cambridge University , Press)
6. LASER's : Siegman (Univ. Science Books , USA)
7. Elements of Quantum Optics : Meystre and Sargent(Spriger – Verlag)
8. LASER Physics : Sergent, Scully and Lamb .
9. Introduction to Nanotechnology : Pook and Owen
10. Quntum Dots : Jack, Hawylak and Wojs.
11. Introduction to Nanotechnology: Charles P. Poole, Frank J. Owens Wiley Intrersc.
12. Nanotechnology: Basic Sciences and emerging technologies, Mick Wilson, Kamali Kannangara, Geo T. Smith.
13. Crystallography and Solid State Physics, A. R. Verma and O. N. Srivastava
14. Solid State Physics, A. J. Deckker
15. Introduction to Solid State Physics, Kittel
16. Elements of Solid State Physics, J. P. Srivastava
17. Solid State Physics Theory, Applications and Problems, S. L. Kakani & C. Hemraja

Semester – III

Solid State Physics and Statistical Mechanics

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory (short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY C- 10 (Solid State Physics and Statistical Mechanics)

Solid State Physics: [25 lectures]

Unit-1

Lattice vibrations and thermal properties of solids: Phonons of monatomic one dimensional lattice. [Lectures 5]

Unit-2

Dielectrics and Ferroelectrics. Lorentz field equations, Dipole moment, Polarizability , Classification of ferroelectric materials , Landau's theory of phase transitions , anti-ferroelectricity, and piezoelectricity. [Lectures 10]

Unit-3

Superconductivity: Occurrence of superconductivity, Destruction of superconductivity by magnetic fields, Meissner effect. Thermodynamics of superconducting transitions, London equations.[Lectures 10]

Statistical Mechanics: [35 lectures]

Unit-1

Foundation of Quantum Statistics: Entropy of mixing and Gibb's Paradox, Liouvilles Theorem (Quantum Treatment). [Lectures 6].

Unit-2

Quantum Mechanical Ensemble Theory: Density Matrix, Statistical thermodynamics of gas in various [Micro Canonical, Canonical and Grand Canonical] quantum Mechanical Ensembles, Partition Functions, calculation of statistical quantities. [lectures 9]

Unit-3

Quantum Statistics: Properties of Ideal Bose and Fermi Gases, BE Condensation, Super fluidity in Liquid He II, Low temperature behaviour of Bose and Fermi Gases. [Lectures 14].

Unit-4

Statistical mechanics of interacting systems: Cluster expansion of classical gas, cluster expansion of quantum mechanical system. [Lectures 6]

Reference Books:

Solid State Physics:

1. Crystallography and Solid State Physics, A. R. Verma and O. N. Srivastava
2. Solid State Physics, M. Ali Omar
3. Solid State Physics, A. J. Deckker
4. Introduction to Solid State Physics, Kittel
5. Solid State Physics, R. L. Singhal
6. Elements of Solid State Physics, J. P. Srivastava
7. Solid State Physics Theory, Applications and Problems, S. L. Kakani & C. Hemraja
8. Solid State Physics, Ashcroft and Mermin.

Statistical Mechanics:

1. Statistical Mechanics : Satyaprakash and JP Agrawal
2. Statistical Mechanics : Gupta and Kumar
3. Statistical Mechanics: BK Agrawal and M Eisner
4. Fundamental of statistical and Thermal Physics : Rief
5. Statistical Mechanics: RK Patharia

Semester –III

Nuclear and Particle Physics & Electronics - General

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory (short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY C- 11 (Nuclear and Particle Physics & Electronics - General)

Nuclear and Particle Physics: [45 lectures]

Unit-1

Nuclear Physics

Nuclear Interactions: n-p & p-p scattering at low energy- General theory, Scattering Cross-Section, Scattering length, Effective Range theory, Meson theory of Nuclear Force, Yukawa interaction, Charge independence and Charge symmetry of Nuclear forces, Spin-dependence of Nuclear forces, Coherent and Non-coherent Scattering, Isospin formalism.[Lectures 15]

Unit-2

Nuclear Reactions: Type of Nuclear Reactions, Q values and Threshold energy, Conservation laws, Direct and Compound Nuclear reaction Mechanisms, Compound Nucleus theory, Resonance Scattering, BREIT-Wigner one level formula.[Lectures 10]

Unit-3

Nuclear Models: Liquid Drop Model & Shell Model- Introduction, Theory and Applications, Semi-empirical Mass Formula, Bohr-Wheeler theory of Fission.[Lectures 10]

Unit-4

Nuclear Decay: Beta Decay, Shape of the beta spectrum, Fermi's theory of Beta-decay, Parity violation and experimental verification. [Lectures 5]

Unit-5

Elementary Particle Physics

Introduction to Quark hypothesis, Quark model and Elementary particles (Hadrons and Leptons). Idea of Isospin and strangeness, Types of interactions. [Lectures 5]

Electronics – General: [15 lectures]

Unit-1

Digital Systems: Basic logic gates and logic families, Flip-flops (R-S type, T-type, D-type, J-K type, J-K edge triggered, J-K Master/Slave), Shift register, ripple counter, Synchronous counter.[Lectures 15]

Recommended Books:

Nuclear and Particle Physics

1. Nuclear Physics, D. C. Tayal
2. Nuclear Physics, S. N. Ghoshal
3. Nuclear Physics, I. Kaplan
4. Nuclear Physics, Roy and Nigam
5. Introduction to Nuclear Physics, S. B. Patel
6. Introduction to Particle Physics, M. P. Khanna
7. Elementary Particle Physics, D. J. Griffiths

Electronics - General

1. Physics of Semiconductor Devices, S. M. Sze, Wiley-Eastern Ltd (1981)
2. Solid state electronic devices, Ben G. Streetman, Prentice Hall, Englewood Cliffs. NJ (1999)
3. Semiconductor Devices, M. S. Tyagi, Wiley (India)
4. Electronic Devices, L. Floyd, Pearson Education New York (2004)
5. Transistors, Dennis Le Crissitte, Prentice Hall India Pvt. Ltd (1963)
6. Integrated Electronics, J. Milman and C. C. Halkias, McGraw Hill (1972)
7. Semiconductor Devices and Applications, A.Mottershed, New Age Int Pub.
8. Semiconductor Device Technology, M. Goodge, Mc Millan (1983)

Semester – III

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

PHY C/P- 12 (CMP Practical)

1. Determination of Magnetic field strength and Resonance frequency using E. S. R.

2. Determination of Operating voltage of G. M. Counter

3. Determination of Energy Band Gap using Four Probe method

4. Determination of Hall coefficient and Hall angle in Hall-effect

5. Determination of Planck's constant

6. Measurement of Dielectric constants of solid and liquid samples

7. Determination of Curie temperature

8. Study of Hysteresis loss in given sample

9. Free running Multivibrator

10. Determination of e/m by Helical method.

11. Lattice dynamics

Semester – IV

Electronics Special I

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory(short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY E - 13 A(Electronics Special)

Unit-1

Operational Amplifier : Differential Amplifier – Circuit Configuration, Dual Input, Balanced Output Differential Amplifier, DC and AC analysis, Inverting and Non – Inverting Inputs, CMRR , Constant Current , Bias Level Translator . Block Diagram of an Operational Amplifier. Open Loop Configuration. Inverting and Non – Inverting amplifiers. Op – amp with negative feed back. Voltage Follower. Input bias current, Input Offset current, Total output offset voltage, Adder, Substractor, Differentiator and Integrator.[Lectures 20]

Unit-2

Oscillators : Oscillators Principles – Types, Frequency, Stability Response. The Phase shift Oscillators. Wein Bridge Oscillatorble Oscillators. Multivibrators – Monostable, astable and Bistable. Comparators, Square wave and Triangular Wave Generators**. [Using Op – Amp only][** Lectures 10**]**

Unit-3

Communication Electronics : Amplitude Modulation, Generation of AM waves, Demodulation of AM waves, DSBSC Modulation, Generation of DSBSC waves, Coherent direction of DSNSC waves, SSB Modulation, Generation and Detection of SSB waves.Vestigal side band Modulator, Frequency Division Multiplexing (FDM).[Lectures 10]

Unit-4

Memory Devices : ROM , RAM and its applications, SRAM, DRAM, CMOS, NMOS, Non Volatile magnetic, Optical and Ferroelectric Memories, charge Coupled Devices.[Lectures 10]

Unit-5

Microwave Devices : Velocity Modulation, Two – Cavity Klystrons and Reflex Klystrons, Magnetrons, Travelling Wave Tubes, Wave Modes.[Lectures 10]

Semester – IV

Electronics Special II

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory(short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY E- 14A(Electronics Special)

Unit-1

Radar Systems : Radar Block Diagram, Radar Range Equation, Minimum detectable Signal, receiver Noise, Signal to noise ratio.[Lectures 8]

Unit-2

Satellite Communications : Introducing Satellite Orbits and Geostationary Satellites, Antenna Look Angles, Satellite Classifications, spacing and Frequency allocation, Satellite Link Models – Up Link , Down Link, Cross Link Models, satellite Link Equations.[Lectures 15]

Unit-3

Microprocessors : Introduction to Microprocessors, Microcontrollers and Microcomputers, Architecture and Internal operation of INTEL 8085. Instruction OP codes. Operands and Mnemonic Constructing Machine Language code for Instructions , Instructions Execution

Timing Diagram, Instruction Word Size and Addressing Modes, Instruction Set, Stacks, Subroutines and Interrupts. Machine and Assembly Language Programming. [Lectures 25]

Unit-4

Microwave Communications : Advantages of microwave Transmission, Loss in Free Space, Atmospheric Effects on Propagation, Ground reflection, Fading Sources.[Lectures 5]

Unit – 5

Wave Guides: Modes of propagation in wave guides, Rectangular wave guide, Cylindrical wave guide and characteristics of propagation of electromagnetic waves. Simple idea of optical-fibres.[7 Lectures]

Reference Books :

1. A handbook of Electronics – Gupta and Kumar.
2. Advanced Electronic Communication System – Wayne Tomasi.
3. Digital Principles and Applications – A.P. Malvino and Donald P. Leach.
4. Microprocessor Architecture ,Programming and Applications with 8085/8086 – Ramesh S. Gaonkar.

PHY E – 15/P [Special Electronics Practical]

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

1. Study of Converters- A to D and D to A

2. Study of waveform of Monostable Multivibrator using Oscilloscope

3. Study of waveform of Bistable multivibrator using Oscilloscope

4. Study of Pulse Amplitude Modulation & Demodulation

5. Study of BCD to seven segments

6. Addition, Subtraction, Multiplication using 8085/8086

7. Optical Fibre- Measurement of loss in dB of patchcords

8. Study of Active filters

9. Waveform generation & Storage Amplifier

10. Network Analysis- Thevenin’s & Norton’s theorem.

Semester – IV

CONDENSED MATTER PHYSICS (CMP) Special-I

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory(short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.

Time : 3 hours.

PHY E – 13B (CONDENSED MATTER PHYSICS (CMP) Special-I)

Lattice Dynamics and Optical Properties of Solids: Vibration of crystals with monatomic basis, dispersion, Brillouin zones, phase and group velocities. Vibration (one dimensional) of crystals with diatomic basis, dispersion, Brillouin zones, acoustic and optical modes of vibration, frequency gap and effect of mass ratio on it, quantization of elastic waves, phonons, vibration in three dimensional lattice, phonon density and states Van Hove singularities, coupled oscillators, scattering of neutrons by phonons.

Interaction of solid with e.m. field: Drude model, macroscopic theory of optical constants, dispersion and absorption, dispersion formula.

Dielectrics, Plasmons, Polarons and Polaritons: Macroscopic dielectric constant, Mechanism of polarization, electronic polarisability, ionic polarisability, molecular field in a dielectric, Clausius-Mossotti equation, frequency dependence of different polarizabilities, dielectric constant and alternating fields, Clausius-Mossotti catastrophe, permanent polarization and ferroelectricity, classification of ferroelectric crystals, their properties and applications, plasma oscillations and plasmons, experimental setup for plasma excitation, ionic polarization, long wavelength limiting frequency of optical modes in crystals, Interaction of e.m. waves with optical modes (polaritons), electron-phonon interaction in ionic crystals (polarons).

Magnetic properties of solids: Quantum theories of diamagnetism, paramagnetism and ferromagnetism, Curie point and Neel temperature, Weiss Molecular field theory, Heisenberg's exchange, Interaction in ferromagnets, non-integral values of magnetization in Fe, Co and Ni, antiferromagnetism, ferrimagnetism, direct exchange and superexchange, spin waves and magnons, ferrites, their properties and applications, soft and hard magnetic materials.

Semester – IV

CONDENSED MATTER PHYSICS (CMP) Special-II

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

End Semester Exam: 70 marks. The end semester exam will consist total nine questions and question number one will be compulsory(short answer type each to be answered in about 50 words). Candidates will be required to answer any four questions from remaining eight long answer type questions. All questions will carry equal marks.
Time : 3 hours.

PHY E- 14B (CONDENSED MATTER PHYSICS (CMP) Special)

Electronic Properties of Solids: Nearly free electron model and energy bands in one dimension, Tight-binding approximation, Wigner-Seitz cellular method, orthogonalized plane wave method, pseudopotential method, Effective mass. Fermi surface and its experimental determination: Magnetoresistance, cyclotron resonance, de Haas- Van Alphen effect, Analomas Skin effect, magneto-acoustic effect, quantum Hall effect, quantum wells and superlattices.

Crystal Imperfection: Importance and types of imperfections, point defects, vacancy defects in elemental solids, Schottky defect in ionic crystals, self interstitial defect in elemental solids, colour or F-centres, excitons, Dislocations, edge and screw dislocations, interpretation of slip, dislocation identity, estimation of dislocation density from X-ray diffraction measurements, energies of dislocations, stability of a dislocation loop, critical radius, role of dislocation in crystal growth and plastic deformation, solid solutions.

Superconductivity: manifestations of energy gap, Cooper pairing due to phonons, BCS theory of superconductivity, Ginzsburg-Landau theory and application to Josephson effect: d-c Josephson effect, a-c Josephson effect, Macroscopic quantum interference, Vortices and type II superconductors, high temperature superconductivity (elementary). Flux quantization, properties of high T_c superconductors, Cuprate superconductors and their theories, SQUID MAGLEV and principle of high speed trains, superconducting magnets.

REFERENCE BOOKS:

1. Ashcroft & Mermin, *Solid State Physics.(Mcgraw Hill Education 1976)*
2. C. Kittel, *Introduction to Solid State Physics.*
3. C.Kittel, *Quantum Theory of Solids.*
4. A. J. Dekker, *Solid State Physics.*
5. M. Ali Omar, *Elementary Solid State Physics.*
6. J.P. Srivastava, *Elements of Solid State Physics.*
7. J. Callaway, *Quantum Theory of Solids.*

8. Principles of the theory of solids by J M Ziman (Cambridge univ. Press 2000)
9. Introduction to superconductivity by Tinkham (Dover publication 2004)

PHY E – 15/P [Special CONDENSED MATTER PHYSICS (CMP) Practical]

Regulation:

Each Paper (Theory & Practical) carries a full marks of 100, out of which Sessional exam (Internals) will carry 30 marks and End Semester Exam (External) will carry 70 marks.

Sessional Exam : 20 marks and General awareness , Attendance and General Discipline: 10.

1. Measurement of resistance of a semiconductor by four probe method at different temperatures and determination of band gap.
2. (i) Measurement of hall coefficient of given semiconductor.
   (ii) Identification of semiconductor and estimation of charge carrier concentration.
3. Determination of Planck's constant.
4. Determination of Lande's g-factor using ESR spectrometer.
5. Determination of Dielectric constants of Solids and Liquids.
6. Study of Hysteresis loss in given sample.
7. Determination of e/m by Millicon oil drop method.

Studies in Superconductivity- (i) Meissner Effect, (ii) Critical Field.

Semester IV

PHY D – 16 [Dissertation] Full Marks : 100

This course will be based on preliminary research oriented topics both in theory and experiments. The teachers who will act as supervisors for the project will float projects and any one of them will be allocated to the student at the end of semester-II. At the completion of the project by the semester end the student will submit Project Report in the form of dissertation which will be examined by the examiners. The examination shall consist of

(a)Presentation and (b) Comprehensive viva-voce.

The examiners of the project report will comprise one external and one internal/Project supervisor. The distribution of marks for the project work will be as follows.

(a) Dissertation- 50 Marks
(b) Presentation- 25 marks
(c) Viva-voce examination- 25 marks