DEPARTMENT OF PHYSICS AND ELECTRONICS

LACHOO MEMORIAL COLLEGE OF SCIENCE AND TECHNOLOGY (AUTONOMOUS)

JODHPUR

MEETING OF BOS-2019

ON MAY 20, 2019

PROPOSED SYALLABUS FOR

UG: PHYSICS AND ELECTRONICS (2019-2022)

PG: PHYSICS (2019-2021)

ANUXTURE- A1(1)

PAPERS SCHEME

B.Sc. (PHYSICS)

(2019-2022)

I SEMESTER

1. BSPH111: MECHANICS
2. BSPH112: ELECTROMAGNETICS
3. BSPH121: PHYSICS LAB

II SEMESTER

1. BSPH211: OPTICS
2. BSPH212: WAVES AND OSCILLATIONS
3. BSPH221: PHYSICS LAB

III SEMESTER

1. BSPH311: STATISTICAL AND THERMAL PHYSICS
2. BSPH312: (A) ELECTRONIC DEVICES AND CIRCUITS

   : (B) DATA COMMUNICATION AND NETWORKING

3 BSPH321: PHYSICS LAB

IV SEMESTER

1. BSPH411: ELECTRODYNAMICS
2. BSPH412: QUANTUM MECHANICS
3. BSPH421: PHYSICS LAB

V SEMESTER

1. BSPH511: ATOMIC AND MOLECULAR SPECTROSCOPY AND LASER PHYSICS
2. BSPH512: SOLID STATE PHYSICS
3. BSPH521: PHYSICS LAB

VI SEMESTER

1. BSPH611: NUCLEAR PHYSICS
2. BSPH612: (A) ANALOG AND DIGITAL ELECTRONICS

   :(B) PROGRAMMING IN C LANGUAGE

3. BSPH621: PHYSICS LAB

Note: The paper (B) of III and VI semesters are for the students who opted electronics as an optional subject.

ANUXURE –A1 (2)
SCHEME OF TEACHING AND EXAMINATION
BSc. I, II AND III YEAR (I-VI SEMESTERS)
SUBJECT: PHYSICS
(2019-2022)

"PHYSICS I SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSPH111	MEHANICS	3	3	20	80	100
BSPH112	ELECTROMAGNETICS	3	3	20	80	100
BSPH121	PHYSICS LAB	6	3	20	80	100
	Total					300

"PHYSICS II SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSPH211	OPTICS	3	3	20	80	100
BSPH212	WAVES AND OSCILLATIONS	3	3	20	80	100
BSPH221	PHYSICS LAB	6	3	20	80	100
	Total					300

"PHYSICS III SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSPH311	STATISTICAL AND THERMAL PHYSICS	3	3	20	80	100
BSPH312(A)	ELECTRONIC DEVICES AND CIRCUITS	3	3	20	80	100
BSPH312(B)	DATA COMMUNICATION AND NETWORKING	3	3	20	80	100
BSPH321	PHYSICS LAB	6	3	20	80	100
	Total					300

"PHYSICS IV SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSPH411	ELECTRODYNAMICS	3	3	20	80	100
BSPH412	QUANTUM MECHANICS	3	3	20	80	100
BSPH421	PHYSICS LAB	6	3	20	80	100
	Total					300

"PHYSICS V SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSPH511	ATOMIC AND MOLECULAR	3	3	20	80	100

	SPECTROSCOPY AND LASER PHYSICS					
BSPH512	SOLID STATE PHYSICS	3	3	20	80	100
BSPH521	PHYSICS LAB	6	3	20	80	100
	Total					300

"PHYSICS VI SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSPH611	NUCLEAR PHYSICS	3	3	20	80	100
BSPH612(A)	ANALOG AND DIGITAL ELECTRONICS	3	3	20	80	100
BSPH612(B)	PROGRAMMING IN C LANGUAGE	3	3	20	80	100
BSPH621	PHYSICS LAB	6	3	20	80	100
	Total					300

Note: The paper (B) of III and VI semesters are for the students who have opted electronics as an optional subject.

Grand Total Marks of Physics Papers for BSc. (I-VI Semester) = 1800

ANUXURE- B1(1)

SYLLABUS OF BSc. I YEAR (I AND II SEMESTERS)

SUBJECT: PHYSICS

(2019-2020)

BSc. I Year (I Semester)

Physics Paper I

BSPH111: MECHANICS

Unit I

Frames of Reference: Inertial and non-inertial frames of references, Components of displacement, velocity and acceleration in different coordinate system, Galilean transformation, Transformation of velocity and acceleration between rotating frames, Pseudo forces, Coriolis force and its application, Motion relative to earth, Foucault's pendulum.

Unit II

Special Theory of Relativity: Michelson Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Addition of velocities, Variation of mass with velocity, Mass-energy relation, Relativistic energy-momentum relation, Four vector, Momentum four vector.

Unit III

Motion under Central Forces: Motion under central forces, equation of motion of moving particle under central force, Law of conservation of angular momentum, total energy and areal velocity, Trajectories of moving bodies under inverse central force, Cases of elliptical and circular orbits, Kepler's laws.

Unit IV

Conservation Laws and Rigid Body Dynamics: Conservation forces, Rectilinear motion under conservative forces, Potential energy, Potential energy curve and motion of a particle, Centre of mass, Centre of mass frame of reference, Collision of two bodies in C-frame. Rigid body: Equation of motion of a rotating body, Inertial coefficients, Case of j not parallel to ω, Kinetic energy of rotation and idea of principal axes.

Unit V

Elastic Properties of Matter: Elasticity, Young's modulus, Bulk modulus, Modulus of rigidity, Poisson's ratio, Relation between elastic constants, Bending moment, Theory of bending of beam loaded at middle, Torsion of a cylinder, Experimental determination of elastic constants: Searle's two bar experiment, Statical and dynamical method.

Suggested Reading:

1. J.C. Upadhyaya: *Mechanics, Oscillation and Properties of Matter*, Ram Prasad & Sons Agra, 2004
2. D.S. Mathur: *Mechanic*, S. Chand & Company LTD, New Delhi,1996
3. J.C. Upadhyaya: *Mechanics, Oscillation and Properties of Matter* (Hindi), Ram Prasad & Sons, Agra, 2004
4. N.S. Saxena, S. Singh and S.S. Rawat: *Mechanics* (Hindi), CBH, Jaipur,2006.

BSc. I Year (I Semester)

Physics Paper II

BSPH112: ELECTROMAGNETICS

Unit I

Vector Fields: Scalar field and vector field, Gradient of a scalar function, Divergence of a vector function, Physical significance of divergence, Curl of vector function, Physical significance of curl, Gauss divergence theorem, Stoke's theorem, Gauss law in differential form, Poisson's and Laplace's equations.

Unit II

Electric Field and Electric Fields in Matter: Potential and electric field due to a quadrupole, The electric moments of an arbitrary charge distribution, Electrostatic energy of an uniformly charged sphere, Atomic and molecular dipoles, Permanent dipole moments, Potential and field due a polarized sphere, Dielectric sphere in a uniform field, Electric susceptibility and atomic polarizability.

Unit III

Force on Moving Charges and Magnetic Fields in Matter: Force on a moving charge in uniform electric field, Alternating electric field, Uniform Magnetic field and Transverse electric and magnetic field. Vector potential, Electric currents in atoms, Bohr Magneton, Electron spin, Magnetic moment, Magnetic susceptibility, Magnetic field due to magnetized matter.

Unit IV

Electromagnetic Induction and A.C. Circuits: Faraday's laws, Lenz' law, Self-induction and mutual induction, Coefficient of self and mutual induction, Energy stored in a coil, LCR Series and parallel circuits (using phasors), Resonance and sharpness, Bandwidth and quality factor, Anderson's bridge for inductance measurement, De- Sauty's bridge for capacitance measurement.

Unit V

Transient Current and Ballistic Galvanometer: Growth and decay of current in LR and RC circuits, Principle and working of Ballistic Galvanometer, Damping, Logarithmic decrement, Determination of Self Inductance by Rayleigh Method, High resistance by leakage method and measurement of magnetic field by search coil using ballistic galvanometer.

Suggested Reading:

1. S.I. Ahmed and K.C. Lal: *Electricity, Magnetism and Electronics*, Unitech House, Lukhnow, 1986.
2. K.K. Tiwari: *Electricity and Magnetism and Electronics*, S. Chand Publication, Delhi.
3. A.S. Majahan and A.A. Rangwala: *Electricity and Magnetism*, TMH, Delhi, 1997.
4. S.L. Kakani and C. Hemrajani: *Electromagnetism Theory and Problems*, CBS Publisher & Distributors, Delhi, 2004.
5. J.C. Upadhyaya, H.P. Sinha and S. C. Upadhyaya: *Electric, Magnetism and Electromagnetic Principle (Hindi)*, Ram Prasad & Sons, Agra, 2004.
6. M.L. Kalra, K.C. Bhandhari and S.L. Kakani: *Electromagetics (Hindi)*, Himanshu Publication Udaipur, 2004.

BSc. I Year (I Semester)

BSPH121: PHYSICS LAB

List of Experiments:

1. Study of bending of a beam and determination of Young's modulus.
2. Modulus of rigidity by Statical method (Horizontal method).
3. Modulus of rigidity by Statical method (Barton method)
4. Modulus of rigidity by Dynamical method (Maxwell's needle).
5. Elastic constants by Searle's method.
6. To determine the Poisson's ratio of a rubber tube.
7. Determination of surface tension of water by Jaegger's method.
8. Variation of magnetic field along the axis of circular coil.
9. Study of phase relations in CR circuit.
10. Study of phase relations in LCR circuit.
11. Study of Faraday's Law.

Suggested Reading:

1. M.G. Bhatawedekar, S.S. Choudhry and T.L. Dashora: *University Physics Practicals*, Ramesh Book Depot, Jaipur, 1987.
2. K.C. Bhandhari, *Practical Physics* (Hindi): Himanshu Publication, Udaipur, 2004.
3. S.L. Gupta and V. Kumar: *Practical Physics* (Hindi & English), Pragti Prakashan, Meerut, 1998.
4. Patitapaban Mishra and Jyotis Chandra Mohanti *: Advanced Physics Laboratory Manual*, South Ashian Publishers Pvt. Ltd., New Delhi, 2007.

BSc. I Year (II Semester)

Physics Paper I

BSPH211: OPTICS

Unit I

Geometrical Optics: Magnification, Abbe's Sine condition, Aplantic surfaces and aplantic points, Focal length of combination of two lens system separated by a distance, Cardinal points, Properties of Nodal points, Newton's formula, Huygens and Ramsden eye piece. Spherical and chromatic aberration (Qualitative only)

Unit II

Interference: Concept of Coherence, Interference in thin films (Parallel and Wedge shape), Newton's Rings and their applications, Michelson and Fabroy-Perrot Interferometers: Intensity of fringes and applications regarding wavelength and difference of close wavelengths determinations.

Unit III

Fresnel Diffraction: Concept of half period zones, Diffraction from a Zone plate, Circular aperture and circular disc (Plane wavefront), Cylindrical wavefront and half period strips, Diffraction from a straight edge, Rectangular slit.

Unit IV

Frounhoffer Diffraction: Plane transmission grating, Diffraction pattern and intensity calculation of fringes, Absent spectra, overlapping spectra, Dispersive power and wavelength determination, Concave Reflection Grating and its self- focusing action, Rayleigh criterion of resolution, Resolving power of plane transmission Grating, Comparison of grating and prism spectra.

Unit V

Polarization: Concept of polarization, Malus law and Brewster's law, Double refraction and its Huygens's theory, Different kind of polarized lights, Nicol prism, Quarter wave and half wave plate. Production and detection of different polarized lights, Rotatory polarization: Fresnel's laws, Fresnel theory of rotatory polarization, Half shade polarimeter and determination of specific rotation of sugar solution.

Suggested Reading:

1. N. Subramanyam and Brij Lal: *Optics*, S. Chand Publication, 1997.
2. Ajoy Ghatak: *Optics*, TMH, New Delhi, 1994.
3. M.L. Kalra, K.C. Bhandhari and S.L. Kakani: *Optics (Hindi)*, Himanshu Publication Udaipur, 2004.
4. J.C. Upadhyaya, S. C. Upadhyaya and S.K. Sharma: *Optics (Hindi)*, Ram Prasad & Sons, Agra 11th Edition, 2005.

BSc. I Year (IInd Semester)

Physics Paper II

BSPH212: WAVES AND OSCILLATIONS

Unit I

SHM: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Phase, Time period, Reference circle, Rotating vector Representation of SHM, Complex number and complex exponential representation.

Free Oscillations of Systems with One Degree of Freedom: Mass-spring systems, Simple pendulum, Oscillations in a U-Tube, Compound pendulum, oscillation of two masses connected by spring.

Fourier Method: Fourier theorem and its applications.

Unit II

Superposition of Two Collinear Harmonic Oscillations: Oscillations having equal frequencies and oscillations having different frequencies (Beats), Superposition of N collinear harmonic oscillations with equal phase differences.

Superposition of Two Perpendicular Harmonic Oscillations: Superposition of two mutually perpendicular simple harmonic motions with frequency ratio 1:1 and 1: 2 using graphical and analytical methods, Lissajous figures.

Unit III

System with Two Degrees of Freedom: Coupled oscillation of two pendulums, Normal coordinates and normal modes, energy transfer.

Damped Oscillations: Differential equation and its solution, Power dissipation and quality factor, Forced oscillations: Differential equation and its solution, Amplitude, Phase, Resonance and sharpness of resonance.

Unit IV

Wave Motion: Plane progressive waves, Longitudinal and transverse waves, Wave equation, Particle and wave velocities, Differential equation, Pressure of a longitudinal wave, Energy transport, Intensity of wave.

Velocity of Waves: Velocity of transverse vibrations of stretched strings, Velocity of longitudinal waves in a fluid in a pipe, Newton's formula for velocity of sound, Laplace's correction.

Unit V

Waves in the Bounded Medium: Rigid boundary and absolutely free boundary, Changes w.r.t position and time, Standing (Stationary) waves in a string: Fixed and free ends, Normal modes of stretched strings, Longitudinal standing waves and normal modes, Open and closed pipes, Flow of energy in stationary waves, Phase and group velocities.

Suggested Reading:

1. A.P. French: *Vibrations and Waves*, CBS Pub. & Distribution, 1987.
2. N.K. Bajaj: *The Physics of Waves and Oscillations*, Tata McGraw-Hill, 1988.
3. K. Uno Ingard: *Fundamentals of Waves & Oscillations* Cambridge University Press, 1988.

4. Daniel Kleppner and Robert J. Kolenkow: *An Introduction to Mechanics*, McGraw-Hill, 1973.
5. Franks Crawford: *Waves: BERKELEY PHYSICS COURSE (SIE)*, Tata McGraw Hill, 2007.
6. Suresh Grag, C.K. Ghosh and Sanjay Gupta: *Oscillations and Waves*, PHI Learning Private Limited, New Delhi, 2009.
7. N. Subrahmanyam and Brij Lal, *Waves and Oscillations*, Vikas Publishing House Pvt. Ltd., Noida, 2013.

BSc. 1 year (II Semester)

BSPH222: PHYSICS LAB

List of Experiments:

1. Specific rotation of sugar solution by half shade polarimeter.
2. Wavelength of mercury light by plane transmission grating.
3. Dispersive power of material of prism by spectrometer.
4. Wavelength of sodium light by Newton's ring method.
5. Determination of cardinal points of combination of two lenses using nodal slide assembly.
6. Verification of Malus law.
7. Resolving power of a telescope.
8. Measurement of capacitance by De-Sauty bridge.
9. Study of charging and discharging of CR circuit.
10. Low resistance by Carey Foster's bridge.
11. Study of coupled oscillations.

Suggested Reading:

1. M.G. Bhatawedekar, S.S. Choudhry and T.L. Dashora: U*niversity Physics Practicals*, Ramesh Book Depot, Jaipur, 1987.
2. K.C. Bhandhari, *Practical Physics* (Hindi): Himanshu Publication, Udaipur, 2004.
3. S.L. Gupta and V. Kumar: *Practical Physics* (Hindi & English), Pragti Prakashan, Meerut, 1998.
4. Patitapaban Mishra and Jyotis Chandra Mohanti*: Advanced Physics Laboratory Manual*, South Ashian Publishers Pvt. Ltd., New Delhi, 2007.

ANUXURE- B1(2)

SYLLABUS OF BSc. II (III AND IV SEMESTERS)

SUBJECT: PHYSICS

(2020-2021)

BSc. II Year (III Semester)

Physics Paper I

BSPH311: STATISTICAL AND THERMAL PHYSICS

Unit I

Introduction: Particles states, System states, Macrostates and microstates, Equilibrium and fluctuations, The equi-a–priori probability postulate, Statistical ensemble, Ensemble average and time average, Constraints, Accessible and inaccessible states, Phase space, States accessible to a particle in a momentum and energy interval, Entropy and law of increase of entropy.

Unit II

Canonical Ensemble: Canonical ensemble, Thermal interaction and condition of Equilibrium, Helmholtz free energy, Boltzmann entropy formula, Boltzmann canonical distribution law, Partition function, Adiabatic Interaction and condition of Equilibrium, Enthalpy, General Interaction and condition of Equilibrium, Gibb's free energy, Clausis- Clayperon equation.

Unit III

Maxwell Distribution and its Applications: Maxwell Distribution law for velocity and speed of an ideal gas, Average, root mean square and most probable velocity and speed. Partition function for an ideal gas, Specific heat and Entropy of an ideal gas, Gibb's paradox and its removal, Equation of state of an ideal gas, Specific heat of diatomic gas.

Unit IV

Grand Canonical Ensemble: Grand Canonical ensemble, Chemical potential, Grand potential, Grand canonical distribution law, Grand canonical partition function and its relation with various quantities, Chemical potential for translation mode of an ideal gas, Partition function for quantum particles, Fermi –Dirac and Bose-Einstein distribution function, Comparison between Maxwell-Boltzmann, Fermi-Dirac and Bose- Einstein statistics.

Unit V

Maxwell Equations and Low Temperature Methodologies: Second Law of Thermodynamics, Thermodynamics variables and potentials, Maxwell relations, Joule effect and Joule coefficient, Joule Thomson effects and Joule Thomson coefficient, Regenerative cooling, Cooling by adiabatic demagnetization of paramagnetic salt, Third law of thermodynamics and negative temperature.

Suggested Reading:

1. S. Lokanathan and R.S. Gambhir: *Statistical and Thermal Physics,* Prentice–Hall of India Private. Ltd., New Delhi, 1991.
2. F. Reif, *Statistical Physics: Barkely Physics Course, Vol. V*, Mc-Graw Hill, New York, 1967.
3. C. Kittel and H. Kroemer: *Thermal Physics*, W.H. Freeman, San Francisco, 1980.
4. Kapur Mal Jain: *Basic of Thermal and Statistical Physics*, South Assian Pub., New Delhi, 2004.
5. Satya Prakash and J.P. Agrawal: *Statistical Mechanics,* Kedar Nath Ram Nath & Co., Meerut, 2006.
6. H.P. Sinha: *Kinetic Theory, Thermodynamics & Statistical Physics*, Ram Prasad & Sons, Agra, 2008.

BSc. II Year (III Semester)

Physics Paper II (A)

BSPH312(A): Electronic Devices and Circuits

(For Students not having Electronics as an Optional Subject)

Unit I

Semiconductor: Metal, Semiconductor and insulators, Intrinsic semiconductors, Extrinsic semiconductors: N-type and P-type, Mobility of charge carriers, Recombination, Life time, Drift current, Diffusion current, Fermi levels, P-N junction diode, Formation of depletion layer, Derivation of barrier potential at thermal equilibrium, Depletion width and depletion capacitance, Forward and Reverse biasing, I-V characteristic, Band diagram, Zener and avalanche breakdown, Zener diode.

Unit II

Power Supply: Half and full wave rectifiers, Ripple factor and efficiency, Filters: Series Inductor, Shunt capacitor, L and π section, Voltage regulation using Zener diode.

Network Analysis: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Voltage division and current division, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

Unit III

Bipolar Junction Transistors (BJT): PNP and NPN transistors, Transistor action, CB, CE and CC configurations: Input and Output characteristics, Current gains and their relationship.

Field Effect Transistors (FET): JFET: Construction and working, Channel formation, Pinch-off voltage, MOSFET: Construction and working, I-V characteristics, Enhancement and depletion modes.

Unit IV

Transistor Biasing: Need for biasing, DC load line and operating point, Thermal instability, Stability factor, Fixed Bias, Voltage divider bias.

Small Signal Transistor Amplifiers, Frequency response, h-parameters- definitions, Analysis of transistor amplifier using h-parameters, Current gain, Voltage gain, Input-output impedance, Cascading of transistor amplifiers.

Unit V

Power Amplifiers: Need of power amplifiers, Classification of power amplifiers, Class A, Class B and Class C power amplifiers, Efficiencies, Push pull amplifiers, Transformer coupled amplifier

Books Suggested:

1. N.N. Bhargava, D.C. Kulshrestha and S.C. Gupta: *Basic Electronics and Linear Circuits*, T.T.T.I., Chandigarh, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1984.
2. V.K. Mehta and R. Mehta: *Principles of Electronics*, S. Chand and Company, Rev. Ed., 2010.

3. Allen Mottershead: *Electronic Devices and Circuits: An Introduction*, Prentice-Hall of India, 2005.
4. R. S Sedha: *A Textbook of Applied Electronics*, S. Chand and Company Ltd., 1990.

BSc. II Year (III Semester)

Physics Paper II (B)

BSPH312 (B): DATA COMMUNICATION AND NETWORKING

Unit I

Principle of Data Communication: General features of a Communication system, Need for modulation, Theory of amplitude modulation, General principles of frequency modulation and phase modulation, Evolution of computer networks, Elements of LAN, WAN, MAN LAN topologies: MESH, STAR, BUS and RING network.

Unit II

Network Models: Layered tasks, OSI model, Layers in the OSI model, TCP/IP protocol suite, Addressing, Digital Transmission: Digital Signals, Bit rate, Bit Length, Baseband transmission, Broadband transmission, Digital data to digital signal conversion, Line coding schemes.

Unit III

Transmission medium: Guided media: Twisted pair cable, Coaxial cable, Fiber optic cable, Unguided media: Wireless, Radio waves, Microwaves, Infra- red, Frequency Division Multiplexing, Time Division Multiplexing.

Unit IV

Switching: Concept of switching, Circuit-switched networks, Datagram networks, Network switching, Addressing, Efficiency.

Multiple access: Random access ALOHA, Carrier sense multiple access (CSMA).

Unit V

Error Detection and Correcting Codes: Types of errors, Redundancy, Detection versus correction, Block coding, Hamming codes, Cyclic codes: Cyclic Redundancy Check, Hardware Implementation, Polynomials, Parity generation and detection, CRC.

Books Suggested:

1. Wayne Tomasi: *Introduction to Data Communication and Networking, 1st Ed.*, Pearson 2007.
2. A.B. Forouzan: *Data Communication and Networking, 4th Ed.*, TMH, 2006.

BSc. II Year (III Semester)

BSPH321: PHYSICS LAB

List of Experiments:

Part 1 (For students not having Electronics as an optional subject)

1. Study of characteristics of a P-N junction and Zener diode.
2. Study of Lissajous Pattern Using CRO.
3. Voltage regulation using Zener diode
4. Determination of ballistic constant by condenser method.
5. Determination of ballistic constant by steady deflection method.
6. Determination of coefficient of self-induction by using ballistic galvanometer.
7. Determination of coefficient of mutual induction by using ballistic galvanometer.
8 Determination of high resistance by leakage method.
9. Measurement of inductance of coil by Anderson bridge.
10. Experimental verification of first law of thermodynamics by discharging of condenser.

Part 2 (For students having Electronics as an optional subject)

1. Study of Lissajous Pattern Using CRO.
2. Determination of coefficient of self-induction using Maxwell Bridge.
3. Experiments with Kelvin's Bridge.
4. Determination of ballistic constant by condenser method.
5. Determination of ballistic constant by steady deflection method
6. Determination of coefficient of self-induction by using ballistic galvanometer.
7. Determination of coefficient of Mutual induction by using ballistic galvanometer.
8. Determination of high resistance by leakage method.
9. Measurement of inductance of coil by Anderson bridge.
10. Experimental verification of first law of thermodynamics by discharging of condenser.

Suggested Reading:

1. M.G. Bhatawedekar, S.S. Choudhry and T.L. Dashora: *University Physics Practicals,* Ramesh Book Depot, Jaipur, 1988.
2. K.C. Bhandhari, *Practical Physics* (Hindi): Himanshu Publication, Udaipur, 2005.
3. S.L. Gupta and V. Kumar: *Practical Physics (Hindi & English),* Pragti Prakashan, Meruth, 1998.
4. Patitapaban Mishra and Jyotis Chandra Mohanti: *Advanced Physics Laboratory Manual*, South Ashian Publishers Pvt. Ltd., New Delhi, 2007.
5. M.P. Saxena, P.R. Singh, S.S. Rawat, N.S. Saxena and Sardar Singh: *Practical Physics (Hindi),* CBH, Jaipur, 1994.
6. M.N. Srinivasan, S. Balasubranian and R. Ranganathan: *A Text Book of Practical Physics*, S. Chand & Sons, New Delhi, 2009.

BSc. II Year (IV Semester)

Physics Paper I

BSPH411: ELECTRODYNAMICS

Unit I

Electromagnetic Waves: Displacement current, Maxwell's equations, Electromagnetic wave equation, Poynting theorem, Plane electromagnetic waves in free space, Wave impedance of free space, Propagation of plane electromagnetic waves in non-conducting and conducting medium, Skin depth, Scalar and vector potentials, Lorentz condition and D'Alembert's equations.

Unit II

Reflection and Reflection of Electromagnetic Waves: Boundary condition at the surface of discontinuity (without derivation), Reflection and reflection of electromagnetic waves at the interface of non-conduction media, Fresnel's equations, Reflection and transmission coefficients, Brewster's law and, Total internal reflection, Reflection from a conducting plane.

Unit III

Interaction of Electromagnetic Waves with Matter: Normal and anomalous dispersion of light, Empirical relations, Lorentz theory of dispersion in gases, Dispersion in solids, Clausius- Mossotti equation. Scattering of electromagnetic waves and scattering parameters, Thomson, Resonant and Rayleigh scattering cross-section.

Unit IV

Relativity Mechanics : Coordinate transformation, Contravariant and covariant vectors, Tensors of second and higher rank, Addition, Subtraction, Contraction, Outer and inner product of tensors, Covariance of tensor equations, Minkowski space, Geometrical interpretation of Lorentz transformation, Space like and time like vectors, Four vectors, Four dimensional gradient, Divergence and curl operators, Four-velocity, Four- acceleration, Four- momentum and four- force vectors.

Unit V

Relativistic Electrodynamics: Invariance of charge, Transformation of surface charge density, Electric field measured in different frames of reference, Transformation of volume-charge density and current density, Equation of continuity in the covariant form, Transformation of Electromagnetic potentials, Lorentz condition and D'Alembert's equations in four vectors. Electromagnetic field tensor.

Suggested Reading:

1. S.P. Puri: *Electrodynamics*, Tata Mc-Graw Hill, 1990.
2. J.D. Jackon: *Classical Electrodynamics*, John Wiley & Sons, Singapore, 1999.
3. B.B. Laud: *Electromagnetic*, New Age International (P) Limited, Publisher, New Delhi, 1987.
4. E.C. Jordon and K.G. Balmain: *Electromagnetic Waves and Radiating System*, PHI, 1968.
5. D.J. Griffiths: *Introduction to Electrodynamics*, Pearson Education, 2012.
6. S.I. Gupta, V. Kumar and S.P. Singh: *Electrodynamics*, Pragati Prakashan, Meerut, 1990.
7. F.T. Ulaby: *Fundamentals of Applied Electromagnetics*, Prentice Hall, Upper Saddle River, New Jersey, 1997.

BSc. II Year (IV Semester)

Physics Paper II

BSPH412: QUANTUM MECHANICS

Unit I

Development of Quantum Mechanics: Black body radiation spectrum, classical theory and its failure, Planck quantum hypothesis, Average energy of quantum oscillator, Density of quantum oscillators, Planck radiation formula and explanation of experimental results of black body radiation spectrum results, Photo electric effect and Compton's effect, Classical and quantum theories of photoelectric and Compton's effects.

Unit II

Matters Waves: Dual nature of radiations, De Broglie's hypothesis, Wave packet, Phase velocity and group velocity, Davison- Germer experiment.

Heisenberg Uncertainty Principle: Relations of Heisenberg uncertainty principle, Illustration of Heisenberg uncertainty principal by Gamma Ray Microscope, Single slit Diffraction and double slit interference experiment.

Unit III

Applications of Heisenberg Uncertainty Principal: Nonexistence of electrons in the nucleus, Ground state energy and radius of Hydrogen atom, Natural energy width, Zero point energy of harmonic oscillator, Mass of π- Mesons.

Schrodinger's Wave Equation: Need for a wave function, Born's and statistical interpretation of wave function, Time dependent and independent Schrodinger's wave equation.

Unit IV

Operators in Quantum Mechanics and their Applications: Definition of operator in quantum mechanics, Eigen function , Eigen value and Eigen value equation, Hermition operator, Parity operator, Exchange operator, Expected value, Normalization of wave function, Orthogonally of wave function, Stationary states.

Unit V

Application of Schrodinger's Wave Equation (One Dimension): Probability current density, Ehrenfest theorem, Bound states: Particle in infinite deep square potential well, Particle in finite square potential well, Free states: Scattering of particle from potential step and potential barrier.

Suggested Reading:

1. Mahesh C. Joshi: *Quantum Mechanics: A Textbook for Undergraduates Students*, PHI, 2007.
2. R. Eisberg and R. Resnick: *Quantum Physics of Atoms, Molecules, Solid, Nuclei and Particles*, John Wiley & Sons, Singapore, 1985.
3. Mahipal Singh: *Quantum Mechanics & Modern Physics*, Ram Prasad & Sons, Agra, 2008.
4. Mahipal Singh: *A Text Book of Quantum Mechanics and Relativity*, Ram Prasad & Sons, Agra, 2008.
5. R.C. Bhandari, Prabha Dashora and Deepika Bhandari: *Elementary Quantum Mechanics and Spectroscopy*, Ramesh Book Depot, 2006.

BSc. II Year (IV Semester)

BSPH421: PHYSICS LAB

List of Experiments:

1. Determination of γ by using Clement -Desorme method.
2. Determination of thermal conductivity of bad conductor by Lee's method.
3. Determination of temperature coefficient of platinum by using platinum resistance thermometer and Carry Foster bridge.
4. Verification of Rutherford-Soddy law by using statistical board and dices.
5. Verification of Gaussian distribution law by using statistical board and dices.
6. Determination of e/m by Thomson method.
7. Study of mechanical(air) damping in pendulum.
8. Study of electromagnetic damping in pendulum.
9. Determination of magnetic field between the pole pieces of electromagnet using search coil.
10. Determination of wavelength of sodium light using Michelson interferometer.
11. Determination of wavelength of sodium light using Fabory-Perrot etalon.

Suggested Reading:

1. M. G. Bhatawedekar, S.S. Choudhry and T.L. Dashora: *University Physics Practical*, Ramesh Book Depot, Jaipur, 1988.
2. K.C. Bhandhari: *Practical Physics (Hindi):* Himanshu Publication, Udaipur, 2005.
3. S. L. Gupta and V. Kumar: *Practical Physics (Hindi & English)*, Pragti Prakashan, Meruth, 1998.
4. Patitapaban Mishra and Jyotis Chandra Mohanti: *Advanced Physics Laboratory Manual*, South Ashian Publishers Pvt. Ltd., New Delhi, 2007.
5. M.P. Saxena, P.R. Singh, S.S. Rawat, N.S. Saxena and Sardar Singh: *Practical Physics (Hindi)*, CBH, Jaipur, 1994.
6. M.N. Srinivasan, S. Balasubranian and R. Ranganathan: *A Text Book of Practical Physics*, S. Chand & Sons, New Delhi, 2009.

ANUXURE- B1(3)

SYLLABUS OF BSc. III (V AND VI SEMESTERS)

SUBJECT: PHYSICS

(2021-2022)

BSc. III Year (V Semester)

Physics Paper I

BSPH511: ATOMIC AND MOLECULAR SPECTROSCOPY AND LASER PHYSICS

Unit I

Introduction: Bohr's theory of spectra of hydrogen like atoms, Origin of spectral series, Ritz combination rule, Effect of finite mass of the nucleus on the spectrum, Bohr's correspondence principle, Wilson-Sommerfield's quantum condition, Sommerfield's theory of elliptic orbit (qualitative idea); Relativistic correction, Frank and Hertz principle, Limitations of Bohr's theory.

Unit II

Vector Model of Atom and Stern-Gerlach Experiment: Angular momentum of electron, Stern–Gerlach experiment and its consequence, Space quantization, Spin orbit interaction energy, Total angular momentum, Coupling schemes, Fine structure of a spectral line, Selection rules, Spectral term and their notations.

Unit III

Effect of Magnetic and Electric Field on Spectral Lines: Angular momentum and magnetic moment, Zeeman Effect: Normal Zeeman effect its selection rules, Anomalous Zeeman effect and its selection rules, Paschen back effect and selection rules, Stark effect: Linear Stark effect.

Unit IV

X-rays: Origin of continuous and characteristic X-Rays, Absorption and emission spectrum, Energy levels and Moseley's law, Fine structure of X-ray levels, Auger effect, Comparison of optical and X-ray spectra.

Molecular Spectra: Classification of molecular spectra, Rotational spectra and Rotational-Vibrational spectra and selection rules.

Unit V

Lasers: Einstein theory of atomic transition, Pumping and population inversion, Laser action, Components of a laser system, Characteristics and properties of lasers, Ruby laser, He-Ne lasers, Semiconductor lasers, Principle of holography.

Suggested Reading:

1. S. N. Ghoshal: *Atomic Physics (Modern Physics)*, S. Chand & Comp. Ltd., New Delhi, 2004.
2. S.L. Gupta, V. Kumar and R.C. Sharma: *Elements of Spectroscopy*, Pragati Prakashan, Meerut, 1990.
3. Raj Kumar: *Atomic & Molecular Spectra: LASER*, Kedar Nath Ram Nath, Meerut, 2007.
4. Mahipal Singh: *Quantum Mechanics & Modern Physics*, Ram Prasad & Sons, Agra, 2008.
5. R. Eisberg and R. Resnick: *Quantum Physics of Atoms, Molecules, Solid, Nuclei and Particles*, John Wiley & Sons, Singapore, 1985.
6. Colin N. Banwell and Elaine M. Mccash: *Fundamentals of Molecular Spectroscopy*, Tata McGraw-Hill, New Delhi, 1995.

BSc. III Year (V Semester)

Physics Paper II

BSPH512: SOLID STATE PHYSICS

Unit I

Crystal Structure: Crystalline and amorphous solids, Space lattice, Basis, Crystal structure, Crystal translation vector, Primitive cell and unit cell, Fundamental types of lattices in three dimensional, Properties of cubic lattices, Miller indices, Inter- planer spacing, Diffraction of X-rays by crystals: Braggs Law, Von-Laue's equation, Reciprocal lattice (introduction only).

Unit II

Lattice Vibrations: Concept of Phonons, Vibration of monatomic lattice, Lattice with two atoms per primitive cell, Acoustical and optical modes.

Thermal properties: Specific heat of Solids, Einstein's theory of specific heat, Debye's model of specific heat.

Unit III

Free Electron Theory of Metals: Free electron gas model, Fermi- Dirac distribution, Density of states, Fermi energy, Specific heat of electron gas, Boltzmann transport equation for electrons, Sommerfield's theory of electrical conductivity, Hall effect.

Unit IV

Band theory of Solids: Formation of bands in solids and classification of solids on the basis of band gap, Periodic potential, Bloch theorem, Kroning-Penney model, Velocity and crystal momentum, Effective mass of an electron, Concept of holes, Negative effective mass.

Unit V

Magnetic Properties: Diamagnetic, Paramagnetic, Ferromagnetic materials, Classical Langevin's theory of diamagnetism and paramagnetism, Curie's law.

Superconductivity: Experimental Results: Zero resistance, Critical temperature, Effect of magnetic field, Meissner effect, Persistent current, Type I and type II superconductors, Isotope effect, Entropy, Specific heat, Energy gap, BCS theory (elementary ideas).

Suggested Reading:

1. Charles Kittel: *Introduction to Solid State Physics, 7th Edition*, John Wiley and Sons, 2009.
2. A.J. Dekker: *Solid State Physics*, Macmillan India Limited, 2005.
3. N. W. Ascroft and N. D. Mermin: *Solid State Physics*, Harcourt Asia, Singapore, 2003.
4. S.L. Gupta and V. Kumar: *Solid State Physics* , Kadar Nath & Co. Meerut, 2013
5. S. S. Rawat*: Solid State Physics (Hindi),* College Book House (CBH), Jaipur, 2008.

BSc. III Year (V Semester)

BSPH521: PHYSICS LAB

List of Experiments:

1. Determination of Planck constant using solar cell.
2. Determination of Stefan's constant using photocell.
3. Determination of e/m by helical method.
4. Determination of band gap of semiconductor using P-N junction diode.
5. Determination of Planck's constant by LED method.
6. Determination of coefficient of thermal conductivity of Copper using Searle's apparatus.
7. Study of electromagnetic damping in LCR circuit using metal plate.
8. Study of B-H curve using CRO.
9. Verification of Richardson's equation.
10. Study of characteristics of GM tube.
11. Study of variation of thermo e.m.f. with temperature.

Suggested Reading:

1. M.G. Bhatawedekar, S.S. Choudhry and T.L. Dashora: University Physics *Practical*, Ramesh Book Depot, Jaipur, 1988.
2. K.C. Bhandhari: *Practical Physics (Hindi)*, Himanshu Publication, Udaipur, 2005.
3. S.L. Gupta and V. Kumar: *Practical Physics (Hindi & English)*, Pragti Prakashan, Meruth, 1998.
4. Patitapaban Mishra and Jyotis Chandra Mohanti*: Advanced Physics Laboratory Manual*, South Ashian Publishers Pvt. Ltd., New Delhi, 2007.
5. M.P. Saxena, P.R. Singh, S.S. Rawat, N.S. Saxena and Sardar Singh: *Practical Physics (Hindi)*, CBH, Jaipur, 1994.
6. M.N. Srinivasan, S. Balasubranian and R. Ranganathan: *A Text Book of Practical Physics*, S. Chand & Sons, New Delhi, 2009.

BSc. III Year (VI Semester)

Physics Paper I

BSPH611: NUCLEAR PHYSICS

Unit I

General Properties: Rutherford scattering and Rutherford's scattering formula, Measurement of radius by Hofstadter experiment, Muonic X-ray method and Lifetime of alpha of emitters, Nuclear spin and parity, Magnetic dipole moment of nuclei, Basic idea about quadruple moment of nucleus, Measurement of magnetic moment by Rabi's method.

Unit II

Binding Energy and Semi-Empirical Mass Formula: Mass defect, Packing fraction and binding energy of nucleus, Variation of binding energy with mass number and prediction of stability of nuclei, Liquid drop model of nucleus, Semi-empirical mass formula (Volume, Surface, Coulomb, Asymmetry and Pairing energy terms), Prediction of stability against beta-decay for members of an isobaric family, Stability limits against spontaneous fission.

Unit III

Radioactivity: The law of radioactive decay, Statistical nature of radioactivity, Radioactive growth and decay, Successive disintegrations, Radioactive equilibrium; Transient and secular equilibrium.

Nuclear Reactions: Types of nuclear reactions, Conservation laws in nuclear reactions, The balance of mass and energy in nuclear reaction, Q value equation, Solution of the Q value equation.

Unit IV

Alpha Decay: Range of particles, Geiger Nuttal's law, Fine structure of the alpha-ray spectra; Gammow theory of alpha disintegration.

Beta Decay: Beta ray spectrum and its qualitative explanation using Neutrino hypothesis, Principle and working of Beta ray spectrometer.

Nuclear Energy: Fission chain reaction, Energy released in fission of U^{235}, Bohr-Wheeler theory of fission (qualitative idea), Neutron cycle in thermal reactor, Four factor formula.

Unit V

Radiation Detectors: Principle and working of Ionization chamber, Proportional counter and Geiger-Muller counter, Dead time, Recovery time and paralysis time of G.M counter.

Elementary Particles: Classification of elementary particles: Leptons, Mesons and Baryons, Conservation laws: Energy, Momentum, Angular momentum, Charge, Baryon number, Lepton numbers, Iso-spin, and Strangeness. Resonance states and elementary idea of Quark model.

Suggested Reading:

1. S.N. Ghoshal*: Nuclear Physics, 1st edition*, S. Chand Publication, Delhi, 2012.
2. D.C. Tayal*: Nuclear Physics, 4th edition*, Himalaya Publishing House, 1982
3. R.D. Evans: *The Atomic Nucleus*, Mc-Graw Hill, 1955.
4. N.S. Saxena, S. Singh and S.S. Rawat: *Nuclear Physics* (Hindi), College Book House, Jaipur, 2006.

BSc. III Year (VI Semester)

Physics Paper II

BSPH612 (A): Analog and Digital Electronics

(For Students not having Electronics as an Optional Subject)

Unit I

Feedback Amplifiers : Feedback concept, Positive and negative feedbacks and their properties, Sampling and mixing, Feedback topology: Voltage series, Voltage shunt, Current series, Current shunt, Effect of positive and negative feedback on gain of amplifier, Frequency response, Gain-stability, Noise, Distortions, Effect of negative feedback on input and output impedances of an amplifier, CE amplifier with current series feedback,

Unit II

Sinusoidal Oscillators: Classification of oscillators, Barkhausen criterion for sustained oscillations, R-C Phase shift oscillator, Hartley oscillator, Colpitts oscillators.

Non sinusoidal Oscillators: Transistor as a switch, Introduction to multivibrators, Astable (free running multivibrator).

Unit III

OPAMP and its Basic Applications: Differential Amplifier: Common mode and difference mode signals and their gains, CMRR, Emitter- Coupled differential amplifier.

Basic Operational Amplifier (Op-Amp): Ideal operational amplifier, Concept of virtual ground, Inverting and non-inverting OPAMP.

Applications of Op-Amp: Inverting Op-Amp as constant multiplier, Sign-Changer, Adder or summing amplifier, Integrator, Differentiator.

Unit IV

Number System : Decimal, Binary, Octal and Hexadecimal, Interconversion, Character codes, ASCII, BCD, Gray code, Logical operations, Boolean algebra, Simplification of boolean expression,

Gates: NOT, AND, OR, NAND, NOR and XOR gates, De-Morgans theorems, Universal gates, Logic circuits for boolean expressions

Unit V

Combinational Circuits: Half adder, Full adder, Parallel adder, Half subtractor, Full subtractor, Parallel subtractor,

Sequential Circuits: Flipflops; RS, D, JK, Clocked and edge triggered, PRESET and CLEAR, Counters: Synchronous and Asynchronous counter,

Books Suggested:

1. Allen Mottershed: *Electronic Devices and circuits,* PHI, 2005
2. Jacob Millman and Christos C. Halkias: *Electronic Devices and circuits*, TMH, 2000
3. A.P. Malvino and D.P. Leach: *Digital principle and applications IV Ed*. TMH, 1990.
4. M. Morris Mano: *Digital design*, IVth Ed., Pearson, 2001.

BSc. III Year (VI Semester)

Physics Paper II

BSPH612 (B): PROGRAMMING IN C LANGUAGE

(For Students having Electronics as an Optional Subject)

Unit I

Introduction to Computer Programming Concepts: Solving problem by using computer, Algorithm, Flow chart, Advantages of flowchart, Software and Hardware, System Software and applications software, Low level and high level languages, Interpreter and Compiler, Errors in programming, Debugging, Various programming languages.

Unit II

C Language Preliminaries: C character set, Identifiers and keywords, Data types, Declarations, Expressions, Statements and symbolic constants, Input-Output: getchar, putchar, scanf, printf, gets, puts, functions.

Unit III

Pre-processor Commands: #include, #define, #ifdef, Operators and Expressions: Arithmetic, Unary, Logical, Bit-wise, Assignment and conditional operators, Control Statements: While, Do-While, For statements.

Unit IV

Nested loops, If else, Switch, Break, Continue and goto statements, Comma operators.

Functions: Defining and accessing, Passing arguments, Function prototypes, Recursion, Library functions, Static functions

Unit V

Arrays: Defining and processing, Passing arrays to a function, Multi -dimensional arrays, Strings and pointers, operations on strings and pointers.

Suggested Reading:

1. K.R. Venugopal and S.R. Prasad: *Mastering C*, TMH, Delhi, 2006.
2. E. Balagurusamy: *C–Programming*, Tata Mc-Graw Hill, 2006.
3. R.G. Dromey: *How to solve it by Computer*, Pearson Education India, 2008.
4. B.S. Gottfried: *Schaums Outline of Theory and Problems of Programming with C*: Mc-Graw Hill, 1993.
5. B.W. Kerninghan and D.M. Ritchie: *C Programming Language*: Prentice Hall, 1988.
6. Ram Kumar and Rakesh Agarwal: *Programming in ANSI C*, West Pub. Co., 1992
7. Y.P. Kanetkar: *Let Us C*, Infinity Science Press, LCC, 2008.

BSc. III Year (VI Semester)

BSPH621: PHYSICS LAB

List of Experiments:

Part 1 (For the students not having Electronics as an optional subject)

1. Study of characteristics of PNP/NPN transistor in common emitter configuration.
2. Study of characteristics of PNP/NPN transistor in common base configuration.
3. Study of frequency response of R-C coupled singe stage amplifier.
4. Study of input and output impedance of a transistor amplifier.
5. Study of full wave rectifier with and without different filters (LC and π filters
6. Study of characteristics of FET.
7. Study of astable multivibrator
8. Study of phase shift oscillator.
9. Study of Hartley oscillator
10. Study of various logic gates and verification of Demorgan theorem (using IC's and logical circuits)
11. Study of flip flop by logic circuits.
12. Study of integrating and differentiating circuits,

Part 2 (For the students having Electronics as an optional subject)

Use C Language Programming to solve the followings.

1. Sum of odd and even numbers in a given range
2. Sum of prime numbers in a range.
3. Sum of a finite series.
4. Evaluation of sum of an AP and GP series by using C language.
5. Evaluation of factorial of a number by using C language.
6. Solution of quadric equation by using C language.
7. Evaluation of sum and difference of two square matrixes by using C language
8. Evaluation of product of two square matrixes by using C language.
9. Evaluation of value of a determinant.
10. Evaluation of inverse of a matrix.

Suggested Reading:

1. M.G. Bhatawedekar, S.S. Choudhry and T.L. Dashora: *University Physics Practicals*, Ramesh Book Depot, Jaipur, 1988.
2. K.C. Bhandhari: *Practical Physics (Hindi):* Himanshu Publication, Udaipur, 2005.

3. S.L.Gupta and V. Kumar*: Practical Physics (Hindi & English)*, Pragti Prakashan, Meruth, 1998.
4. Patitapaban Mishra and Jyotis Chandra Mohanti: *Advanced Physics Laboratory Manual*, South Ashian Publishers Pvt. Ltd., New Delhi, 2007.
5. M.P. Saxena, P.R. Singh, S.S. Rawat, N.S. Saxena and Sardar Singh: *Practical Physics (Hindi), CBH*, Jaipur, 1994.
6. M.N. Srinivasan, S. Balasubranian and R. Ranganathan: *A Text Book of Practical Physics*, S. Chand & Sons, New Delhi, 2009.
7. Allen Mottershed: *Electronic Devices and Circuits*, PHI, 2005.
8. Jacob Millman and Christos C. Halkias: *Electronic Devices and Circuits*, TMH, 2000.
9. A.P. Malvino and D.P. Leach: *Digital Principle and Applications 4th Ed*. TMH, 1990.
10. M. Morris Mano: *Digital Design*, 4th Ed., Pearson, 2001.
11. K.R. Venugopal and S.R. Prasad: *Mastering C*, TMH, Delhi, 2006.
12. E. Balagurusamy: *C–Programming*, Tata Mc-Graw Hill, 2006.
13. R.G. Dromey: *How to solve it by Computer*, Pearson Education India, 2008.
14. B.S. Gottfried: *Schaums Outline of Theory and Problems of Programming with C*: Mc-Graw Hill, 1993.
15. B.W. Kerninghan and D.M. Ritchie: *C Programming Language*: Prentice Hall, 1988.
16. Ram Kumar and Rakesh Agarwal: *Programming in ANSI C*, West Pub. Co., 1992
17. Y.P. Kanetkar: *Let Us C*, Infinity Science Press, LCC, 2008.

ANUXURE- A2(1)

PAPERS SCHEME

B.Sc. (ELECTRONICS)

(2019-2022)

I SEMESTER

1. BSEC111: CIRCUIT ELEMENTS AND NETWORK ANALYSIS
2. BSEC112: SEMICONDUCTOR DEVICES
3. BSEC121: ELECTRONICS LAB

II SEMESTER

1. BSEC211: AMPLIFIERS
2. BSEC212: MEASURING INSTRUMENTS
3. BSEC221: ELECTRONICS LAB

III SEMESTER

1. BSEC311: FEEDBACK SYSTEMS
2. BSEC312: COMMUNICATION ELECTRONICS
3. BSEC321: ELECTRONICS LAB

IV SEMESTER

1. BSEC411: OPERATIONAL AMPLIFIERS
2. BSEC412: WAVESHAPING AND LAB INSTRUMENTS
3. BSEC421: ELECTRONICS LAB

V SEMESTER

1. BSEC511: AUDIO AND VIDEO SYSTEMS
2. BSEC512: DIGITAL ELECTRONICS
3. BSEC521: ELECTRONICS LAB

VI SEMESTER

1. BSEC611: MICROPROCESSOR ARCHITECTURE
2. BSEC612: ADVANCED COMMUNICATION SYSTEMS
3. BSEC621: ELECTRONICS LAB WITH PROJECT

ANUXURE –A2 (2)
SCHEME OF TEACHING AND EXAMINATION
BSc. I, II AND III YEAR (I-VI SEMESTERS)
SUBJECT: ELECTRONICS
(2019-2022)

"ELECTRONICS I SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSEC111	CIRCUIT ELEMENTS AND NETWORK ANALYSIS	3	3	20	80	100
BSEC112	SEMICONDUCTOR DEVICES	3	3	20	80	100
BSEC121	ELECTRONICS LAB	6	3	20	80	100
	Total					300

"ELECTRONICS II SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSEC211	AMPLIFIERS	3	3	20	80	100
BSEC212	MEASURING INSTRUMENTS	3	3	20	80	100
BSEC221	ELECTRONICS LAB	6	3	20	80	100
	Total					300

"ELECTRONICS III SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSEC311	FEEDBACK SYSTEMS	3	3	20	80	100
BSEC312	COMMUNICATION ELECTRONICS	3	3	20	80	100
BSEC321	ELECTRONICS LAB	6	3	20	80	100
	Total					300

"ELECTRONICS IV SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSEC411	OPERATIONAL AMPLIFIERS	3	3	20	80	100
BSEC412	WAVESHAPING AND LAB INSTRUMENTS	3	3	20	80	100
BSEC421	ELECTRONICS LAB	6	3	20	80	100
	Total					300

"ELECTRONICS V SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSEC511	AUDIO AND VIDEO SYSTEMS	3	3	20	80	100
BSEC512	DIGITAL ELECTRONICS	3	3	20	80	100
BSEC521	ELECTRONICS LAB	6	3	20	80	100
	Total					300

"ELECTRONICS VI SEMESTER"

Code	Description	Pd/w	Exam	CIA	ESE	Total
BSEC611	MICROPROCESSOR ARCHITECTURE	3	3	20	80	100
BSEC612	ADVANCED COMMUNICATION SYSTEMS	3	3	20	80	100
BSEC621	ELECTRONICS LAB WITH PROJECT	6	3	20	80	100
	Total					300

Grand Total Marks of Electronics Papers for BSc. (I-VI Semester) = 1800

ANUXURE- B2 (1)

SYLLABUS OF BSc. I YEAR (I AND II SEMESTERS)

SUBJECT: ELECTRONICS

(2019-2020)

BSc. I Year (I Semester)

Electronics Paper I

BSEC111: CIRCUIT ELEMENTS AND NETWORK ANALYSIS

Unit I

Basic Circuit Elements: Basic Circuit Concepts: Classification of elements: Resistance, Types of resistors and their rating, Capacitance, Types of capacitors, Inductance, Types of inductors, Capacitive and inductive reactance,

Network definitions, Voltage and current sources, Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Voltage division and current division.

Unit II

AC Circuit Analysis: Sinusoidal voltage and current, Voltage-current relationship in resistor, Inductor and capacitor, Phasor diagrams, Complex impedance, Analysis of RL, RC and RLC circuits, Resonance: Series and parallel, Frequency response, Sharpness of resonance, Quality factor (Q) and bandwidth.

Unit III

Network Analysis: Mesh analysis and node analysis, Two port networks and their reduction, Reduction of a complicated circuit into T and π equivalents, Conversion between T and π configuration (Star-Delta conversion).

Unit IV

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Millers theorem, Maximum power transfer theorem, simple problems related to the theorems.

Unit V

Coupled Circuits: Self Inductance and Mutual Inductance, Coefficient of coupling, Transformers and its principle, Types of transformers, Equivalent circuit for transformer, Dot conventions, Transformer Efficiency, Losses in Transformers.

Books Suggested:

1. John. D. Ryder: *Networks, Lines and Fields*, Prentice Hall of India, New Delhi, 2003.
2. Robert L. Boylestad: *Essentials of Circuit Analysis*, Pearson Education, 10th Ed., 2004.
3. B. Grob: *Basic Electronics*, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1992.
4. N.N. Bhargava, D.C. Kulshrestha and S.C. Gupta: *Basic Electronics and Linear Circuits*, T.T. T. I, Chandigarh, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 1984.

BSc. I Year (I Semester)

Electronics Paper II

BSEC112: SEMICONDUCTOR DEVICES

Unit I

Semiconductor Basics: Energy band in solids (metal, semiconductor and insulators), Intrinsic semiconductors, Extrinsic semiconductors: N-type and P-type, Mobility of charge carriers, Recombination, Life time, Drift current, Diffusion current, Fermi levels.

Unit II

Diode: P-N junction diode, Formation of depletion layer, Derivation of barrier potential at thermal equilibrium, depletion width and depletion capacitance. Forward and reverse biasing, I-V characteristic, Band diagram, Diode equation, Zener and avalanche breakdown, Zener diode, Tunnel diode.

Unit III

Bipolar Junction Transistors (BJT): PNP and NPN transistors, Transistor action, CB, CE and CC configurations: Input and Output characteristics, Current gains and their relationship, Comparison of CB, CE and CC configurations.

Unit IV

Field Effect Transistors (FET): JFET: Construction and working, Channel formation, Pinch-off voltage, Transfer characteristics, MOSFET: Construction and working, I-V characteristics, Enhancement and Depletion modes, SCR, DIAC AND TRIAC.

Unit V

Opto-electronic Devices: Photoconductive cells, Solar Cell: Construction and working, Characteristics, Fill Factor, Efficiency and uses of solar cell, p-i-n Photodiode, Avalanche photodiode, LED.

Books Suggested:

1. N.N. Bhargava, D.C. Kurukshretha and S.C. Gupta: *Basic Electronics and Linear Circuits*, T.T.T.I., Chandigarh, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 1984.
2. V.K. Mehta and R. Mehta: *Principles of Electronics*, S. Chand and Company, Rev. Ed., 2010.
3. Allen Mottershead: *Electronic Devices and Circuits: An Introduction*, Prentice-Hall of India, 2005.
4. R. S. Sedha: *A Textbook of Applied Electronics*, S. Chand and Company Ltd., 1990.

BSc. I Year (I Semester)

BSEC121: ELECTRONICS LAB

List of Experiments:

1. Study of constant current source
2. Study of constant voltage source.
3. Study of maximum power transfer from source to load.
4. Characteristics of semiconductor diode and measurement of its forward static and dynamic resistance.
5. Characteristics of Zener diode and measurement of its reverse static and dynamic resistance.
6. Characteristics of DIAC and measurement of its breakdown voltage.
7. Characteristics of FET and determination of μ, r_d and g_m.
8. Characteristics of transistor in CE configuration and determination of its input and output resistance.
9. Characteristics of transistor in CB configuration and determination of its input and output resistance.
10. Characteristics of solar cell and determine its fill factor.

Books Suggested:

1. N.N. Bhargava, D.C. Kulshrestha and S.C. Gupta: *Basic Electronics and Linear Circuits*, T.T.T.I., Chandigarh, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 1984.
2. L.K. Maheshwari and H.M.S. Anand: *Laboratory Manual Introductory Electronics Experiment*, Wiely Eastern Ltd., New Delhi, 1990.
3. S.L. Gupta and V. Kumar: *Practical Physics (Hindi & English)*, Pragti Prakashan, Meruth, 1998.

BSc. I Year (II Semester)

Electronics Paper I

BSEC211: AMPLIFIERS

Unit I

Transistor Biasing and Stabilization: Transistor Biasing: Need for biasing, DC load line and operating point, Thermal instability, Stability factor, Fixed bias, Collector to base bias, Emitter bias, Voltage divider bias.

Unit II

Transistor Amplifiers: Small signal amplifier, Frequency response of amplifier and its band width, Small Signal hybrid equivalent circuit at low frequency, h-parameters: Definitions, Analysis of transistor amplifier using h-parameters, Current gain, Voltage gain, Input-output impedance and power gain.

Unit III

Multistage Amplifiers: Cascading of transistor amplifiers, R-C coupled amplifiers, Voltage gain at low, mid and high frequency, Effect of cascading on gain and bandwidth, Gain–Bandwidth product, FET amplifiers.

Unit IV

Power Amplifiers: Need for power amplifiers, classification of power amplifiers: Class A, Class B and Class C, Transformer coupled power amplifier, Efficiencies, Push pull amplifiers, Distortions in amplifiers, Transistor phase inverter, Class C tuned amplifier.

Unit V

Wide Band Amplifiers: Bandwidth requirement, High frequency hybrid π model for transistors, Pulse testing, Sag, Rise time, Various compensation techniques.

Books Suggested:

1. Allen Mottershead: *Electronic Devices and Circuits: An Introduction*, Prentice Hall of India, 2005.
2. V.K. Mehta and R. Mehta: *Principles of Electronics*, S. Chand and Company, Rev. Ed., 2010.
3. Jacob Millman and C.C. Halkias: *Integrated Electronics: Analog and Digital Circuits*, Tata Mc-Graw Hill Publishing Ltd., New Delhi, 1991.
4. N.N. Bhargava, D.C. Kulshrestha and S.C. Gupta: *Basic Electronics and Linear Circuits*, T.T.T.I., Chandigarh, Tata Mc-GrawHill Publishing Company Ltd., New Delhi, 1984.
5. R. S. Sedha: *A Textbook of Applied Electronics*, S. Chand and Company Ltd., 1990.

BSc. I Year (II Semester)

Electronics Paper II

BSEC212: MEASURING INSTRUMENTS

Unit I

Power Supplies: Rectifiers, Half and full wave, Ripple factor and their efficiency, Filters: Series inductor, Shunt capacitor, L and π section, Voltage regulation using Zener diode.

Unit II

Cathode Ray Oscilloscope: Construction of CRT, Deflection sensitivity, Block diagram of CRO, Vertical and horizontal deflection sections, Synchronization of sweep, Measurement of different parameters using CRO: Amplitude, Time period, Phase, Frequency, R.M.S. value and slope.

Unit III

Filters (Constant K-type passive filters): Characteristic Impedance, Symmetrical T and π circuits, Fundamental theorem on filters, Passive filters: Low pass, High pass, Band pass and band stop filter, cutoff frequencies, Impedance plots.

Unit IV

Measuring Instruments and Transducers: Galvanometer and its sensitivity, DC ammeter, Voltmeter, Voltmeter sensitivity, Multimeter, Rectifier type instruments, Electrodynamometer, Transducer: Resistive transducer, Resistance thermometer, Thermistor, Capacitive transducer, Piezoelectric transducer.

Unit V

Bridges: AC bridges, Balance conditions, Comparison bridges, Maxwell bridge, Hay bridge, Schering bridge, Wein bridge, Impedance bridge, Q-meter.

Books Suggested:

1. H.S. Kalsi: *Electronic Instrumentation*, Tata Mc-Graw Hill publishing Ltd., New Delhi, 3rd Ed, 2006.
2. D. A. Helfrick and D. William Cooper: *Modern Electronic Instrumentation and Measurement Techniques*, PHI, New Delhi, 1992.
3. Jacob Millman and C.C. Halkias: *Integrated Electronics: Analog and Digital Circuits*, Tata McGraw-Hill Publishing Ltd., New Delhi, 1991.
4. B. Grob: *Basic Electronics*, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 1992.

BSc. I Year (II Semester)

BSEC221: ELECTRONICS LAB

List of Experiments:

1. Frequency response of a single stage BJT amplifier and determine its bandwidth.
2. Frequency response of a single stage FET amplifier and determine its bandwidth.
3. Frequency response of a series resonance circuit and determine its resonance frequency, bandwidth and quality factor.
4. Frequency response of parallel resonance circuit and determine its resonance frequency and bandwidth.
5. Voltage regulation using Zener diode.
6. Study of HWR and FWR and measurement of ripple factor with and without filters.
7. Study of low pass, high pass and band pass filter and determine their cutoff frequencies.
8. SCR characteristics and measurement of holding voltage and current.
9. Study of CRO: Measurement of amplitude and frequency of a sine wave, triangular wave and pulse.
10. Measurement of input and output impedance of a BJT amplifier at a fixed frequency.

Books Suggested:

1. N.N. Bhargava, D.C. Kulshrestha and S.C. Gupta: *Basic Electronics and Linear Circuits*, T.T.T.I., Chandigarh, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 1984.
2. L.K. Maheshwari and H.M.S. Anand: *Laboratory Manual Introductory Electronics Experiment*, Wiely Eastern Ltd., New Dehli, 1990.
3. S.L. Gupta and V. Kumar: *Practical Physics (Hindi & English)*, Pragti Prakashan, Meruth, 1998.

ANUXURE- B2(2)

SYLLABUS OF BSc. II (III AND IV SEMESTERS)

SUBJECT: ELECTRONICS

(2020-2021)

BSc. II Year (III Semester)

Electronics Paper I

BSEC311: FEEDBACK SYSTEMS

Unit I

Classification of Amplifiers: Voltage amplifier, Current amplifier, Trans-conductance amplifier, Trans-resistance amplifier, Feedback concept, Feedback Factor, Positive and negative feedback, Advantages and Disadvantages, Sampling and mixing, Feedback topology: Voltage series, Voltage shunt, Current series, Current shunt. Comparison of different topologies

Unit II

Effect of Feedback: Effect of positive and negative feedback on gain of amplifier, Frequency response, Gain-stability, Noise, Distortions, Effect of negative feedback on input and output impedances of an amplifier.

Unit III

Analysis of Feedback Circuits: Method of analysis of feedback circuits, CE amplifier with current series feedback, CE amplifier with voltage shunt feedback, Emitter follower, Source follower, Darlington pair, Bootstrapping principle.

Unit IV

Sinusoidal Oscillators: Classification of oscillators, Principle of operation, Barkhausen criterion for sustained oscillations, R-C Phase shift Oscillator, Wein Bridge oscillator, Hartley oscillator, Colpitts oscillators, Crystal Oscillator.

Unit V

Non sinusoidal Oscillators: Transistor as a switch, Switching times in a transistor, Introduction to multivibrators, Astable (free running multivibrator), Monostable and bistable multivibrators, Mathematical analysis, Multivibrators using 555 timer.

Books Suggested:

1. Allen Mottershed: *Electronic Devices and Circuits*, PHI, 2005.
2. Jacob Millman and Christos C. Halkias: *Electronic Devices and Circuits*, TMH, 2000.

BSc. II Year (III Semester)

Electronics Paper II

BSEC312: COMMUNICATION ELECTRONICS

Unit I

Introduction to Electronic Communication: Introduction, Electronic communication systems, Modulation and demodulation, Need for modulation, Technique of modulation, Types of modulation: Analog, Digital and Pulse Modulation, Advantages and Disadvantages, Electromagnetic frequency spectrum, Bandwidth and Information capacity, Power measurements (dB).

Unit II

Amplitude Modulation, Transmission and Reception: Principle of amplitude modulation, Side bands, Power considerations, DSBSC, SSB transmission, AM modulating circuits: Collector and base modulating circuits, AM transmitters.

Demodulation of AM signals, Square law demodulation, Envelope detector, AGC, AM receiver.

Unit III

Angle Modulation, Transmission and Reception: Frequency and phase modulation, FM and PM waveforms, Mathematical analysis, Bandwidth requirement, FM by reactance variation method, Armstrong PM system, FM transmitter

FM demodulation, Foster-Seeley discriminator, Ratio detector, Amplitude limiter.

Unit IV

Transmission Lines: Propagation constant, Characteristics impedance, Reflections on a line not terminated in characteristics impedance, VSWR, Reflection coefficient, Open and short circuited lines, Stub matching.

Unit V

Propagation of Radio Waves: Surface wave propagation, Space wave propagation, Range of space wave, Sky wave propagation, Structure of ionosphere, Critical frequency, MUF, Skip distance, Fading, Duct propagation.

Books Suggested:

1. D. Roddy and J. Coolen: *Electronic Communication*, 4th Ed, PHI, 2004
2. Anokh Singh: *Principles of Communication Engineering*, S. Chand & Company, 2nd Ed. 2006
3. Wayne Tomasi: *Advanced Electronic Communication System*, Pearson, 1997.

BSc. II Year (III Semester)

BSEC321: ELECTRONICS LAB

List of Experiments:

1. Cascading of filter circuits to simulate transmission lines.
2. Current series negative feedback amplifier.
3. Study of RC phase shift oscillator.
4. Study of Hartley oscillator.
5. Study of Collpitts oscillator.
6. Study of astable multivibrator.
7. Measurement of input and output impedance of emitter follower.
8. Measurement of input and output impedance of source follower.
9. 555 Timer application as astable multivibrator.
10. Measurement of input and output impedance of an amplifier with and without feedback.

Books Suggested:

1. N.N. Bhargava, D.C. Kulshretha and S.C. Gupta: *Basic Electronics and Linear Circuits*, T.T.T.I., Chandigarh, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 1984.
2. L.K. Maheshwari and H.M.S. Anand: *Laboratory Manual Introductory Electronics Experiment*, Wiely Eastern Ltd., New Dehli, 1990.
3. S.L. Gupta and V. Kumar: *Practical Physics (Hindi & English)*, Pragti Prakashan, Meruth, 1998.
4. Allen Mottershed: *Electronic Devices and Circuits*, PHI, 2005.
5. J. Millman and C.C. Halkias: *Electronic Devices and Circuits*, TMH, 2000.

BSc. II Year (IV Semester)

Electronics Paper I

BSEC411: OPERATIONAL AMPLIFIERS

Unit I

Differential Amplifier: Common mode and difference mode signals and their gains, Common-Mode Rejection Ratio (CMRR) of differential amplifier, Emitter- Coupled differential amplifier, Differential amplifier circuit configurations, Cascaded differential amplifier.

Unit II

Basic Operational Amplifier (Op-Amp): Block diagram representation of a typical Op- Amp, Ideal operational amplifier, Equivalent circuit of OPAMP, Concept of virtual ground, Inverting and non-inverting OPAMP and their characteristics, Voltage-Series negative feedback OPAMP: Closed loop gain, Input and output impedance.

Unit III

Op-Amp Characteristics, DC parameters and their Measurements: Frequency-Response Curve of an Op-Amp, Band width of an Op-Amp, Input offset voltage, Input offset current, Input bias current, Output offset voltage, Differential input resistance, Input offset current drift, Input offset voltage drift, Power Supply Rejection Ratio (PSRR), Slew rate, Common-Mode Rejection Ratio (CMRR), Op-Amp IC-741 and its Pin-Connection.

Unit IV

Applications of Op-Amp: Inverting Op-Amp as constant multiplier, Sign-Changer, Adder or summing amplifier, Integrator, Integrator with adder, Differentiator, Subtractor, Divider, Log, Antilog, Filters (Qualitative idea only).

Unit V

Analog Computation: Basic building blocks of analog computer, Solution of linear differential equation with constant coefficient, Analog computer symbols, Time and amplitude scaling techniques, Combined time and amplitude scaling.

Books Suggested:

1. Ramakant A. Gayakwad: *Op-Amps and Linear Integrated Circuits*, Prentice Hall of India Private Limited, New Delhi, 2010.
2. Jacob Millman and Christos C. Halkias: *Integrated Electronics: Analog and Digital Circuits and Systems*, Tata Mc-Graw Hill Publishing Ltd., New Delhi, 1991.
3. R.F. Coughlin and F.F. Driscoll: *OPAMP and Linear Integrated Circuits*, PHI, 6th Ed., 1990.

BSc. II Year (IV Semester)

Electronics Paper II

BSEC412: WAVESHAPING AND LAB INSTRUMENTS

Unit I

Waveshaping: Step, Pulse, Ramp, Impulse, Square wave, High pass and low pass RC circuit and their response for step, pulse and square wave inputs, Differentiator, Integrator, Clipping and clamping circuits using diodes.

Unit II

Signal Conditioning: Schmitt trigger, UJT as saw tooth waveform generator, Time base signals, Simple voltage sweep and current sweep circuits, Errors in sweep signals: Slope error, Displacement error and transmission error and their relation.

Unit III

Controlled Rectification and Voltage Regulation: Half wave and full wave, SCR control, Current rating of SCR, DIAC and TRIAC; DIAC-TRIAC phase control circuits, Voltage regulation using transistors, OP-AMP and IC's.

Unit IV

Lab Equipments: Standard signal generators, FETVM, Digital voltmeter, Frequency counter, Harmonic distortion analyzer: Tuned circuit harmonic distortion analyzer, Heterodyne type harmonic distortion analyzer.

Unit V

Pulse Height Analysis: Single channel analyzer, multi-channel analyzer, Scintillation detectors, Radiation counter, Origin of bio-electric signals, ECG, Heart rate monitor, Sonography.

Books Suggested:

1. Allen Mottershed: *Electronic Devices and Circuits*, PHI, 1984.
2. J. Millman and C.C. Halkias: *Electronic Devices and Circuits*, TMH, 2000.
3. J. Millman and H. Taub: *Pulse, Digital and Switching Waveforms,3rd* Ed., 2011.

BSc. II Year (IV Semester)

BSEC421: ELECTRONICS LAB

List of Experiments:

1. Study of differential amplifier circuit.
2. Characteristics of OPAMP.
3. Study of clipping circuit.
4. Study of clamping circuit.
5. Study of UJT relaxation oscillator.
6. Study of Schmitt trigger.
7. Adder and subtractor using OPAMP.
8. Voltage regulation using OPAMP.
9. Study of integrator circuit.
10. Study of differentiator circuit.

Books suggested:

1. N.N. Bhargava, D.C. Kulshrestha and S.C. Gupta: *Basic Electronics and Linear Circuits*, T.T.T.I., Chandigarh, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1984.
2. L.K. Maheshwari and H.M.S. Anand: *Laboratory Manual Introductory Electronics Experiment*, Wiely Eastern Ltd., New Dehli.
3 S.L. Gupta and V. Kumar: *Practical Physics (Hindi & English)*, Pragti Prakashan, Meruth, 1998.
4 Ramakant A. Gayakwad: *Op-Amps and Linear Integrated Circuits*, Prentice Hall of India Private Limited, New Delhi, 2010.
5 Allen Mottershed: *Electronic Devices and Circuits*, PHI, 2005
6 J. Millman and C.C. Halkias: *Electronic Devices and Circuits*, TMH, 2000.

ANUXURE- B2(3)

SYLLABUS OF BSc. III (V AND VI SEMESTERS)

SUBJECT: ELECTRONICS

(2021-2022)

BSc. III Year (V Semester)

Electronics Paper I

BSEC511: AUDIO AND VIDEO SYSTEMS

Unit I

Radio Receiver: Characteristics and their measurements, Tuned radio frequency receiver, Frequency translation, Super-heterodyne receiver: Block diagram, Typical transistor receiver circuit, FM receiver.

Unit II

Television Transmission: Broadcast channels, Picture scanning, Frequency band and resolution, Bandwidth of video signal, Vestigial side band system, Composite video signal, Block diagram of monochrome transmitter and explanation of each block; Color transmission, Color burst signal, PAL and NTSC systems.

Unit III

Television Receiver: Scanning sequence and interlacing, Synchronization and blanking, Block diagram of monochrome receivers and explanation of each block, Block diagram of color receivers and explanation of each block; Picture tube: Monochrome and color.

Unit IV

Microphones: Characteristics of microphone, Carbon microphones, Crystal microphone, Moving coil microphone, Ribbon microphone, Capacitor microphone.

Loudspeakers: Ideal loudspeakers, Crystal loudspeakers, Electrostatic loudspeakers, Dynamic loudspeakers, Permanent magnet loudspeakers,

Unit V

Antennas: Antenna action, Radiation strength from short dipole, Power radiated and radiation resistance for short doublet, Half wave and quarter wave antenna, Vertically grounded antenna, Image antenna, Directive gain, Power gain, Directivity, Beam width, Bandwidth of antenna, Radiation patterns, Antenna arrays.

Books Suggested:

1. S.P. Bali and Rajeev Bali: *Audio & Video Systems*, Khanna Book Publishing, Delhi (2004)
2. A. M. Dhake: *Television and Video Engineering*, TMH, 1998
3. S.P. Sharma: *Basic Radio and Television*, TMH, 2nd Ed., 2010.

BSc. III Year (V Semester)

Electronics Paper II

BSEC512: DIGITAL ELECTRONICS

Unit I

Number System: Decimal, Binary, Octal and Hexadecimal, Interconversion, Character codes, ASCII, Binary Arithmetic: addition and subtraction, Binary Codes: Weighted and Non-Weighted Codes, 8421, Excess-3 Code, EBCDIC, BCD, Gray code.

Unit II

Boolean algebra, Logic Operations, AND, OR, NOT. Principle of Duality, Digital Circuits: Introduction to Combinational and Sequential Circuits, Gates- NOT, AND, OR, NAND, NOR and XOR gates, De-Morgans theorems, Universal gates, Logic circuits for Boolean expressions, Sum of Products (SOP) and Products of Sum (POS), Simplification of logical expression, Karnaugh maps: 2,3,4 Variable.

Unit III

Combinational Circuits: Half adder, Full adder, Parallel adder, Half subtractor, Full subtractor, Parallel Subtractor, 2's Compliment Adder-Subtractor. BCD adder, Multiplexers, De-Multiplexers, Decoders, Encoders, Magnitude Comparator.

Unit IV

Sequential Circuits I: Flipflops: RS using NAND and NOR Gates, D-Flip Flop, JK Flip-Flop, T Flip Flop, Timing Diagrams, clocked and edge triggered, PRESET and CLEAR, Active low and active high conditions, J-K Master Slave Flip-Flop.

Unit V

Sequential Circuits II: Counters: Asynchronous counters, Synchronous counter, Ripple up, Ripple down counters, Mod 'n' counter, Up-Down counter, Timing Diagrams, Registers: Buffer register, shift register, SISO, SIPO, PISO, PIPO registers.

Books Suggested:

1. A.P. Malvino and D.P. Leach: *Digital Principle and Applications 4th Ed*. TMH,
2. M. Morris Mano: *Digital Design, 4thEd*., Pearson,
3. Jain R. P.*:Modern Digital Electronics,* Tata Mc Graw Hill ,
4. Mano Morris : *Digital Design*, PHI, New Delhi
5. Bartee Thomas: *Digital Computer Fundamentals*, Mc Graw Hill.

BSc. III Year (V Semester)

BSEC521: ELECTRONICS LAB

List of Experiments:

1. Study of various logic gates and verification of De'Morgans theorems.
2. Study of flip flops.
3. Study of MUX (4-1) and DMUX(1-4)
4. Study of half adder and full adder.
5. Study of half and full subtractor.
6. Binary to gray code conversion and vice versa.
7. Study of encoder and decoder.
8. Study of shift registers.
9. Study of counters.
10. Study of MOD counters.

Books suggested:

1. N.N. Bhargava, D.C. Kulshrestha and S.C. Gupta: *Basic Electronics and Linear Circuits*, T.T.T.I., Chandigarh, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 1984.
2. L.K. Maheshwari and H.M.S. Anand: *Laboratory Manual Introductory Electronics Experiment*, Wiely Eastern Ltd., New Dehli, 1992.
3. S.L. Gupta and V. Kumar: *Practical Physics (Hindi & English)*, Pragti Prakashan, Meruth, 1998.
4. A.P. Malvino and D.P. Leach: *Digital Principle and Applications 4th Ed*. TMH., 1992.
5. M. Morris Mano: *Digital Design, 4th Ed.*, Pearson, 1993.

BSc. III Year (VI Semester)

Electronics Paper I

BSEC611: Microprocessor Architecture

Unit I

Micro-Computer Hardware: Microcomputer memory, Volatile and Non- Volatile memories Semiconductor memories, RAM, SRAM, DRAM, ROM, CPU: Instruction register and decoder, ALU, Control unit, Buses: Data, Address and control buses, Address space, Processor bus organization.

Unit II

Minimum microcomputer configuration, Interrupts: Maskable and Non-Maskable interrupts, Vectored and Non-Vectored interrupts, Call locations, Interrupt Service Subroutine (ISS), Multiple Interrupt and Priority, Interrupts of 8085 microprocessor, Elementary concept of I/O mapped and memory mapped I/O. LED Displays.

Unit III

Microprocessor 8085: Pin Diagram and description, Internal architecture of 8085 microprocessor, Fetch and execution of instruction, Bus multiplexing, Stack organization, Instruction format, D/A conversion: Using weighted resistors, Ladder method, A/D conversion: Successive approximation method.

Unit IV

Instruction set of 8085 microprocessor: Data transfer group, Arithmetic group, Logical group, Branches group, Stack related instructions, Mnemonics and operation codes, Addressing modes: Direct, Indirect, Immediate, Register and Implicit, Assembly language programming: Programs related to data transfer, addition, subtraction, multiplication and division of 8-bit numbers, largest and smallest from a given string.

Unit V

Data Transfer: Data transfer to and from I/O devices, Types of data transfer: Processor controlled and peripheral controlled, Interrupt driven data transfer, Handshaking, DMA, 8257 DMA Controller, 8255 programmable peripheral interface and its modes, 8279 keyboard-display interfaces.

Books Suggested:

1. B. Ram: *Fundamental of Microprocessors and Microcomputers*, Dhanpat Rai Publications, New Delhi, 2010.
2. R. S. Gaonkar: *Microprocessor Architecture Programming and Applications with the 8085*, CBS Publishers, 2011
3. Morris Mano: Computer System Architecture, Pearson, 3rd Edition.

BSc. III Year (VI Semester)

Electronics Paper II

BSEC612: ADVANCED COMMUNICATION SYSTEMS

Unit I

Pulse Modulation: Introduction, Sampling theorem, Pulse amplitude modulation, Pulse code modulation, Quantization and the binary code, Dynamic range, Coding efficiency, Quantization error, Noise in PCM signals, Companding.

Unit II

Digital Modulation Techniques: Information capacity, Bit rate, Baud, Bandwidth, Encoding a signal, Amplitude shift keying, Frequency shift keying, Phase shift keying, Quadrature phase shift keying, Constellation diagrams.

Unit III

Optical Fiber Communication: Introduction, Light propagation in fibers, Total internal reflection, Numerical aperture of a given fiber, Fiber index profiles, Step index and graded index fiber, Fiber optic communication link.

Unit IV

Radar System: Basic Radar system, Radar range equation, Pulsed radar system, Doppler's effect, CW Doppler Radar system, Moving target Indicator principle, FM radar.

Unit V

Satellite Communication: Kepler's Laws, Satellites orbital patterns, Geo-synchronous satellites, Apogee, perigee, Angle of inclination, Antenna look angles, Satellite systems link modules: Uplink Model, Transponder, Downlink Model.

Books Suggested:

1. D. Roddy and J. Coolen: *Electronic Communication, 4th Ed.*, PHI, 2004.
2. Wayne Tomasi: *Advanced Electronic Communication System*, Pearson, 2007.
3. M.I. Scholnik: *Introduction to Radar Systems, 2nd Ed.*, TMH, 2006.

BSc. III Year (VI Semester)

BSEC621: ELECTRONICS LAB WITH PROJECT

List of Experiments:

Part A: Assembly Language Programming Lab using 8085 Microprocessor.

1. Data transfer using direct and indirect addressing.
2. Block data transfer.
3. Addition.
4. Subtraction.
5. Multiplication.
6. Division.
7. Array addition.
8. Binary to decimal and decimal to binary.
9. Binary to BCD and BCD to binary.
10. Largest and smallest from a set of numbers.
11. Sorting (Ascending and descending).
12. BCD addition and subtraction.

Part B: Project

Aim of the Course

- Equip the students to carry out working project independently.
- Design new circuits according to the need and trouble shooting

  Useful projects should be produced. Students are advised to search for better projects. Projects must include electronic hardware and the demonstration is compulsory.

Books Suggested:

1. N.N. Bhargava, D.C. Kulshrestha and S.C. Gupta: *Basic Electronics and Linear Circuits*, T.T.T.I., Chandigarh, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 1984.
2. L.K. Maheshwari and H.M.S. Anand: *Laboratory Manual Introductory Electronics Experiment*, Wiely Eastern Ltd., New Dehli, 1990.
3. S.L. Gupta and V. Kumar: *Practical Physics (Hindi & English)*, Pragti Prakashan, Meruth, 1998.
4. B. Ram: *Fundamental of Microprocessors and Microcomputers*, Dhanpat Rai Publications, New Delhi, 2010.
5. R S Gaonkar: *Microprocessor Architecture Programming and Applications with the 8085*, CBS Publishers, 2011.

PROPOSED SYALLABUS AS PER UGC

CHOICE BASED CREDIT SYSTEM (CBCS)

FOR

MSc PHYSICS (2019-2021)

GUIDELINES FOR CHOICE BASED CREDIT SYSTEM IN M. Sc. PHYSICS

1. Preamble

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching–learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students. Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades. The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

2. Applicability of the Grading System

These guidelines shall apply to all undergraduate and postgraduate level degree, diploma and certificate programs under the credit system awarded by the Central, State and deemed to be universities in India.

3. DEFINITIONS OF KEY WORDS:

3.1. **Academic Year**: Two consecutive (one odd + one even) semesters constitute one academic year.

3.2. **Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed elective and skill courses. A student needs to select **two elective papers** offered by the Department in which he/she is doing core course. This shall be part of core programme during third and fourth semester. Each student has to complete **four skill courses;** two within the Department and two from other Department within the college or from the other college/Universities approved by college.

3.3. Course: Usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/ project work/ self-study etc. or a combination of some of these.

3.4. Credit Based Semester System (CBSS): Under the CBSS, the requirement forwarding a degree is prescribed in terms of number of credits to be completed by the students.

3.5. **Credit Point**: It is the product of grade point and number of credits for a course.

3.6. Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one period of teaching (lecture or tutorial) or two periods of practical work/field work per week.

3.7. Cumulative Grade Point Average (CGPA): It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

3.8. Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.

3.9. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters O, A^+, A, B^+, B, C, P and F.

3.10. Programme: An educational programme leading to award of the Postgraduate Degree in the Core subject in which he/she is admitted.

3.11. Semester Grade Point Average (SGPA): It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

3.12. **Semester**: Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to November/ December and even semester from December/January to May. Odd semester University examination shall be during last week of November/ first week of December and even semester University examination shall be during first/ second week of May. The Department shall conduct the Practical examinations with a board of internal and external examiners prior to commencement of end semester theory examination.

3.13. Transcript or Grade Card or Certificate: Based on the grades earned, a statement of grades obtained shall be issued to all the registered students after every semester. This statement will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

4. Semester System and Choice Based Credit System

The Indian Higher Education Institutions have been moving from the conventional annual system to semester system. Currently many of the institutions have already introduced the choice based credit system. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning, It is desirable that the HEIs move to CBCS and implement the grading system.

5. Types of Courses:

Courses in a programme may be of three kinds: Core, Elective and Foundation.

5.1. Core Course

There may be a Core Course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

5.2. Elective Course

Elective course is a course which can be chosen from a pool of papers. It may be:

- Supportive to the discipline of study.
- Providing an expanded scope.
- Enabling an exposure to some other discipline/domain.

- Nurturing student's proficiency/skill.

An elective may be "Generic Elective" focusing on those courses which add generic proficiency to the students. An elective may be "Discipline centric"or may be chosen from an unrelated discipline. It may be called an "Open Elective."

5.3. Foundation Course:-

The Foundation Courses may be of two kinds: Compulsory Foundation and Elective foundation. "Compulsory Foundation" courses are the courses based upon the content that leads to Knowledge enhancement. They are mandatory for all disciplines. Elective Foundation courses are value-based and are aimed at man-making education.

6. Examination and Assessment

The HEIs are currently following various methods for examination and assessment suitable for the courses and programmes as approved by their respective statutory bodies. In assessing the performance of the students in examinations, the usual approach is to award marks based on the examinations conducted at various stages (sessional, mid-term, end-semester etc.,) in a semester. Some of the HEIs convert these marks to letter grades based on absolute or relative grading system and award the grades. There is a marked variation across the colleges and universities in the number of grades, grade points, letter grades used, which creates difficulties in comparing students across the institutions. The UGC recommends the following system to be implemented in awarding the grades and CGPA under the credit based semester system.

6.1. Letter Grades and Grade Points:

i. Two methods -relative grading or absolute grading– have been in vogue for awarding grades in a course. The relative grading is based on the distribution (usually normal distribution) of marks obtained by all the students of the course and the grades are awarded based on a cut-off marks or percentile. Under the absolute grading, the marks are converted to grades based on pre-determined class intervals. To implement the following grading system, the colleges and universities can use any one of the above methods.

ii. The UGC recommends a 10-point grading system with the following letter grades as given below:

Table 1: Grades and Grade Points

Letter Grade	Grade Point
O (Outstanding)	10
A^+(Excellent)	9
A(Very Good)	8
B^+(Good)	7
B(Above Average)	6
C(Average)	5
P (Pass)	4
F(Fail)	0
Ab (Absent)	0

Grade Point assignment

= and > 95 % marks Grade Point 10.0
90 to less than 95 % marks Grade Point 9.5
85 to less than 90 % marks Grade Point 9.0
80 to less than 85 % marks Grade Point 8.5
75 to less than 80 % marks Grade Point 8.0
70 to less than 75 % marks Grade Point 7.5

65 to less than 70 % marks Grade Point 7.0
60 to less than 65 % marks Grade Point 6.5
55 to less than 60 % marks Grade Point 6.0
50 to less than 55 % marks Grade Point 5.5
45to less than 50 % marks Grade Point 5.0
41 to less than 45 % marks Grade Point 4.5
= to 40 % marks Grade Point 4.0

iii. A student obtaining Grade F shall be considered failed and will be required to reappear in the examination.

iv. For non credit courses 'Satisfactory' or "Unsatisfactory' shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

v. The Universities can decide on the grade or percentage of marks required to pass in a course and also the CGPA required to qualify for a degree taking into consideration the recommendations of the statutory professional councils such as AICTE, MCI, BCI, NCTE etc.,

vi. The statutory requirement for eligibility to enter as assistant professor in colleges and universities in the disciplines of arts, science, commerce etc., is a minimum average mark of 50% and 55% in relevant postgraduate degree respectively for reserved and general category. Hence, it is recommended that the cut-off marks for grade B shall not be less than 50% and for grade B^+, it should not be less than 55% under the absolute grading system. Similarly cut-off marks shall be fixed for grade B and B^+ based on the recommendation of the statutory bodies (AICTE, NCTE etc.,) of the relevant disciplines.

6.2 Fairness in Assessment:

Assessment is an integral part of system of education as it is instrumental in identifying and certifying the academic standards accomplished by a student and projecting them far and wide as an objective and impartial indicator of a student's performance. Accordingly the Departments of the Faculty of Science resolve the following:

a. All internal assessments shall be open assessment system only and that are based on Quizzes, term test and seminar.

b. Attendance shall carry the prescribed marks in all papers and Practical examination internal assessment.

c. In each semester as far as possible, two out of four theoretical component University examinations shall be undertaken by external examiners from outside the university conducting examination, who may be appointed by the competent authority.

6.3 Grievances and Redressal Mechanism

a. The students will have the right to make an appeal against any component of evaluation. Such appeal has to be made to the Head/Principal of the College or the Chairperson of the University Department concerned as the case may be clearly stating in writing the reason(s) for the complaint / appeal.

b. The appeal will be assessed by the Chairman and he/she shall place before the Grievance Redressal Committee (GRC), Chaired by the Dean, Faculty of Science, comprising all HODs of the Faculty and if need be Course Teacher(s) be called for suitable explanation; GRC shall meet at least once in a semester and prior to CCA finalization.

c. The Committee will consider the case and may give a personal hearing to the appellant before deciding the case. The decision of the Committee will be final.

7. Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$\textbf{SGPA}\ (Si) = \Sigma(Ci \times Gi) / \Sigma Ci$$

where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\textbf{CGPA} = \Sigma(Ci \times Si) / \Sigma Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

8. Illustration of Computation of SGPA and CGPA and Format for Transcripts

i. Computation of SGPA and CGPA

Illustration for **SGPA**

Course	**Credit**	**Grade letter**	**Grade point**	**Credit Point**
Course 1	4	A	8	4 X 8 = 32
Course 2	4	B^+	7	4 X 7 = 28
Course 3	4	B	6	4 X 6 = 24
Course 4	4	O	10	4 X 10 = 40
Course 5	4	C	5	4 X 5 = 20
Course 6	4	B	6	4 X 6 = 24
Total	**24**			**168**

Thus, **SGPA =168/24 =7.00**

Illustration for **CGPA**

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**
Credit : 24 SGPA: 7.00	Credit : 24 SGPA:6.58	Credit : 24 SGPA:6.65	Credit : 24 SGPA: 6.89

Thus, **CGPA =** $\dfrac{24 \times 7.00 + 24 \times 6.58 + 24 \times 6.65 + 24 \times 6.89}{96}$ = **6.78**

ii. Transcript (Format): Based on the above recommendations on Letter grades, grade points and SGPA and CCPA, the HEIs may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

Evaluation scheme

(A) Theory (100 marks)

The performance of the student will be evaluated through two components

(1) **CCA** (continuous comprehensive assessment)_____30 marks

(2) **ESE** (End semester examination)_____70 marks

Total_____100 marks

(1) Format for CCA (30 marks)

CCA will have the following components

(a) **Two quiz** of 30 marks each of 1 hour duration (total of 60 marks)
Quiz will include multiple choice questions, fill in the blank, true or false and short answer questions
(b) **One Subjective test** (20 marks)
(c) **Attendance*** (10 marks)
Total marks =90
(The scored marks will be then converted out of 30)

(2) Format for ESE (70 marks)

The paper for ESE examination will be divided in to three parts

(a) **Part A:** ten short answer type questions (20-30 words approx) of 2 marks each, two questions from each unit (total of 20 marks)

(b) **Part B:** Five short answer type questions (250 words approx) of 4 marks each, one question from each unit with internal choice (total of 20 marks)

(c) **Part C:** Five descriptive answer type questions, one from each unit. Each questions will carry 10 marks each, student is required to answer any three out of these five questions (total of 30 marks)

(B) Practical

The **CCA** (30 marks) will be based on **attendance*** (10 marks) and **practical records** (20 marks).

The **ESE** (70 marks) where in the marks distribution will be as under

DURATION OF EXAM: 04 Hours

(i)	**EXPERIMENT:**		**40**
	1. Formula or theory and explanation of symbols used:	05	
	2. Block Diagram/ Diagram or Circuit Diagram:	05	
	3. Observations:	15	
	4. Calculations:	10	
	5. Results with units and graphs:	05	
(ii)	**VIVA-VOCE:**		**30**
	TOTAL		**70**

(C) PROJECT (100 marks)

	CCA :	**30**
	ESE :	**70**
1.	Contents:	15
2.	Sequence of content	15
3.	Project report	15
4.	Presentation	25

***Attendance marks:** Each student will have to attend a minimum of 75% Lectures / Tutorials / Practicals. A student having less than 75% attendance will not be allowed to

appear in the End-Semester Examination (ESE). Attendance shall have 10 marks and will be awarded by following the system proposed below:

Those having greater than 75% attendance (for those participating in Co-curricular activities, 25% will be added to per cent attendance) will be awarded CCA marks as follows:-

75% to less than 80%	=	2 marks
80% to less than 85%	=	4 marks
85 to less than 90%	=	6 marks
90% to less than 95%	=	8 marks
> =95%	=	10 marks

Condonation of Shortage of attendance shall be governed in accordance with the provisions in the Act and Statute of the University vide Ordinance 78 to Ordinance 80 as amended from time to time.

SEMESTER-WISE NOMENCLATURE OF THEORY PAPERS/ PRACTICALS/ SKILL COURSES

SEMESTER I

COARSE TYPE	COARSE CODE	NAME OF COURSE	LEC./ TUT./ PRAC. PER WEEK $	NO. OF CREDITS	CCA #	ESE *	TOTAL
Core Course 1	MSPH111	CLASSICAL MECHANICS	4-0-0	4	30	70	100
Core Course 2	MSPH112	MATHEMATICAL PHYSICS	4-0-0	4	30	70	100
Core Course 3	MSPH113	COMPUTATIONAL PHYSICS	4-0-0	4	30	70	100
Core Course 4	MSPH114	SEMICONDUCTOR DEVICES AND CIRCUITS	4-0-0	4	30	70	100
Core Course 5	MSPH121	COMPUTATIONAL LAB	0-0-8	4	30	70	100
Core Course 6	MSPH122	ELECTRONICS LAB	0-0-8	4	30	70	100
Skill Course 1	MSPHSC131 (A/B)!!	(A) INTRODUCTION TO ASTROPHYSICS (B) INTRODUCTION TO NONLINEAR OPTICS	2-0-2	-	-	-	-
TOTAL				**24**	**180**	**420**	**600**

$ Lectures/Tutorials/Practical per week
 # Continuous Comprehensive Assessment
*** End Semester Examinations**
!! Choose A or B

SEMESTER II

COARSE TYPE	COARSE CODE	NAME OF COURSE	LEC./ TUT./ PRAC. PER WEEK$	NO. OF CREDITS	CCA#	ESE*	TOTAL
Core Course 1	MSPH211	DIGITAL ELECTRONICS AND MICROPROCESSOR	4-0-0	4	30	70	100
Core Course 2	MSPH212	QUANTUM MECHANICS-I	4-0-0	4	30	70	100
Core Course 3	MSPH213	SOLID STATE PHYSICS	4-0-0	4	30	70	100
Core Course 4	MSPH214	STATISTICAL AND PLASMA PHYSICS	4-0-0	4	30	70	100
Core Course 5	MSPH221	GENERAL PHYSICS AND SOLID STATE LAB	0-0-8	4	30	70	100
Core Course 6	MSPH222	DIGITAL ELECTRONICS AND MICROPROCESSOR LAB	0-0-8	4	30	70	100
Skill Course 2	MSPHSC232	ELECTRONICS INSTRUMENTATION	2-0-2	-	-	-	-
TOTAL				**24**	**180**	**420**	**600**

$ Lectures/Tutorials/Practical per week
 # Continuous Comprehensive Assessment
*** End Semester Examinations**

SEMESTER III

COARSE TYPE	COARSE CODE	NAME OF COURSE	LEC./ TUT./ PRAC. PER WEEK $	NO. OF CREDITS	CCA #	ESE *	TOTAL
Core Course 1	MSPH311	CLASSICAL ELECTRODYNAMICS	4-0-0	4	30	70	100
Core Course 2	MSPH312	QUANTUM MECHANICS-II	4-0-0	4	30	70	100
Core Course 3	MSPH313	NUCLEAR PHYSICS-I	4-0-0	4	30	70	100
Core Course 4	MSPH314 (A/B)!!	ELECTIVE PAPER –I	4-0-0	4	30	70	100
Core Course 5	MSPH321	GENERAL PHYSICS LAB	0-0-8	4	30	70	100
Core Course 6	MSPH322	NUCLEAR PHYSICS LAB	0-0-8	4	30	70	100
Skill Course 3	MSPHSC333 (A/B)!!	(A). RENEWABLE ENERGY RESOURSES (B). INTRODUCTION TO COMPUTER SIMULATION IN PHYSICS	2-0-2	-	-	-	-
TOTAL				**24**	**180**	**420**	**600**

$ Lectures/Tutorials/Practical per week
 # Continuous Comprehensive Assessment
*** End Semester Examinations**
!! Choose either A or B

SEMESTER IV

COARSE TYPE	COARSE CODE	NAME OF COURSE	LEC./ TUT./ PRAC. PER WEEK$	NO. OF CREDITS	CCA#	ESE*	TOTAL
Core Course 1	MSPH411	NUCLEAR PHYSICS-II	4-0-0	4	30	70	100
Core Course 2	MSPH412	ATOMIC AND MOLECULAR SPECTROSCOPY	4-0-0	4	30	70	100
Core Course 3	MSPH413	NANOMATERIALS	4-0-0	4	30	70	100
Core Course 4	MSPH414 (A/B)!!	ELECTIVE PAPER-II	4-0-0	4	30	70	100
Core Course 5	MSPH421 (A/B)!!	ELECTIVE PAPER LAB	0-0-8	4	30	70	100
Core Course 6	MSPH422	PROJECT WORK	0-0-8	4	30	70	100
Skill Course 4	MSPHSC434	BASICS OF NANOSCIENCE	2-0-2	-	-	-	-
TOTAL				**24**	**180**	**420**	**600**

$ Lectures/Tutorials/Practical per week
 # Continuous Comprehensive Assessment
*** End Semester Examinations**
!! Choose either A or B

ANUXURE- B1(1)

SYLLABUS OF MSc. I YEAR (I AND II SEMESTERS)

SUBJECT: PHYSICS

(2019-2020)

MSc. Physics (I Semester)

Core Course 1

MSPH111: CLASSICAL MECHANICS

Unit I

Langrangian Dynamics: Constraints, Generalized coordinates, Concept of virtual work, D'Alembert principle, Langrange equation from D'Alambert principle, Velocity dependent potential, Expression for kinetic energy of a system in terms of Generalized coordinates, Cyclic coordinates, Symmetry properties and conservation theorems.

Unit II

Hamiltonian dynamics: Hamiltonian function H and conservation of energy: Jacobi's integral and its significance, Hamilton's equation, Routhian.

Hamilton's variation principle, Derivation of Langrange equation, Extension of Hamilton's Principle, to non-holonomic system, A hoop rolling without slipping on an inclined plane, Modified Hamilton's Variation principle, Derivation of Hamilton's equation from variation principle, Δ- variations, Principle of least actions in various forms.

Unit III

The Two Body Central Force Problem: Central force and motion in a plane, Reduction of a two body central force to equivalent one body problem, Equation of motion and first integral, Differential equation for an orbit, Equivalent one dimensional problem and classification of orbits for some specific potential.

Integral power law potential, Virial theorem, Relation between kinetic and potential energy.

Kepler's Problems: Equation of orbit and the kind of the orbit, Motion in time.

Unit IV

The kinematics of rigid body motion: Independent co-ordinate of a rigid body, Orthogonal transformation, Formal properties of transformation matrix, Eular angles, Eular's theorem, Finite rotation, Infinitesimal rotations (contact transformation).

Angular momentum, Moment of inertia tensor, Product of inertia, Inertia tensor, Principal moment of inertia: Principal axis, Kinetic energy of motion of a rigid body about a point.

Unit V

Canonical transformation and Hamilton Jacobi theory: Canonical transformation, Legendre transformation, Generating functions, Conditions for canonical transformation, Bilinear invariant condition.

Poisson's brackets, Langrange brackets, Invariance of Poission bracket under canonical transformation, Angular momentum Poission bracket relation.

Hamilton Jacobi equation for Hamilton's principal function, Harmonic oscillator problem by Hamilton Jacobi method, Hamilton's characteristic function.

Suggested Readings:

1. H. Goldsteen: *Classical Mechanics*, Narosa Publishing House, 2001.
2. N. C. Rana and P. S. Joag: *Classical Mechanics*, Tata Mc-Graw Hill, New Delhi, 1991.
3. J. C. Upadhyaya: *Classical Mechanics*, Himalaya Publishing, 2006.
4. P. V. Panat: *Classical Mechanics*, Narosa Publishing House, 2000.
5. S. L. Gupta, V. Kumar, H. V. Sharma: *Classical Mechanics*, Pragati Prakashan, Meerut, 2009.

MSc. Physics I Semester

Core Course 2

MSPH112: MATHEMATICAL PHYSICS

Unit I

Complex Variables: Analytical functions, Cauchy Riemann conditions, Cauchy's integral theorem, Cauchy's integral formula, Taylor and Laurent's Series expansions, Cauchy's residue theorem, Simple examples of contour integration.

Unit II

Fourier and Laplace Transforms: Fourier transform, Convolution theorem, Laplace transforms, Laplace transform of derivatives, Substitution properties of Laplace transform, Properties of gamma function, Error function and Dirac delta functions.

Unit III

Curvilinear Coordinates: Orthogonal coordinate systems, Gradient, Curl, Divergence and Laplacian in orthogonal coordinate systems, Spherical, Polar and Cylindrical co-ordinates, Poisson's and Laplace Equations, Green's theorem.

Probability Theory: Elementary probability theory, Random variables, Binomial, Poisson and normal distributions.

Unit IV

Coordinates Transformation in N- dimensional Space: Contravariant and covariant tensor, Jacobian, Relative tensor, Pseudo tensors (Example: charge density, angular momentum), Riemann space(Example: Euclidean space and 4D Minkowski space), Christoffel symbols, Transformation of Christoffel symbols, Covariant differentiation ,Ricci's theorem , Divergence, Curl and Laplacian tensor form, Stress and strain tensors, Hook's law in tensor form.

Unit V

Special Functions: Series solution of linear differential equations with variable coefficients, Legendre, Bessel, Hermite, Laguerre, Associated Laguerre polynomials and their generating functions, Recurrence relations, Orthogonal properties and Rodrigue's formula.

Suggested Reading:

1. B.D. Gupta: *Mathematical Physics*, Vikas Publication House, 1986.
2. H.K. Das: *Advanced Engineering Mathematics*, S. Chand Pub., 2008.
3. George Arfken and H.J. Weber: *Mathematical Physics*, Academic Press, 2005.
4. B.S. Rajput: *Mathematical Physics*, Pragti Prakashan, Meerut, 1997.
5. L.A. Pipes: *Applied Mathematics for Engineers & Physicists*, Mc-Graw Hill, 1970.
6. M.C. Potter and J.L Goldberg: *Mathematical Methods*, Prentice Hall of India, 1978.

MSc. Physics I Semester

Core Course 3

MSPH113: COMPUTATIONAL PHYSICS

Unit I

General Concepts of Programming : Algorithm, Flowchart, Programming language, High level and low level language, Compiler, Errors in programs and their removal, Data, Record and file.

Numeric Computing: Process of numeric computing, Characteristics of numeric computing, Significant digits, Accuracy, Precision, Types of errors, Absolute error and relative error, Errors propagations, Conditioning and stability, Iterative process and its convergence, Error estimation.

Unit II

C Language Preliminaries: C character set, Identifiers and keywords, Data types, Declarations, Expressions, Statements and symbolic constants.

Input-Output: getchar, putchar, scanf, printf, gets, puts, functions.

Pre-processor Commands: #include, #define, #ifdef.

Operators and Expressions: Arithmetic, Unary, Logical, Bit-wise, Assignment and conditional operators.

Unit III

Control Statements: While, Do-While, For statements, Nested loops, If else, Switch, Break, Continue and goto statements, Comma operators.

Functions: Defining and accessing, Passing arguments, Function prototypes, Recursion, Library functions, Static functions.

Arrays: Defining and processing, Passing arrays to a function, Multi -dimensional arrays.

Strings: Defining and operations on strings.

Pointers: Declarations, Passing pointers to a function, Operations on pointers, Pointer arithmetic, Pointers and arrays, Arrays of pointers, Function pointers.

Unit IV

Solution of Transcendental and Polynomial Equation in one Variable: Newton Raphson, Successive bisection, False position methods, Convergence of these methods.

Solution of Simultaneous Linear Equations: Gauss elimination method, Gauss elimination with pivoting, Gauss -Seidel method, Eigen value and Eigen vectors of matrices, Finding Eigen value and Eigen vector by Jacobi method and power method.

Numerical Differentiation: Forward difference and central difference methods, Differentiations of tabulated functions

Unit V

Numerical Integrations: Newton-Cotes method, Trapezoidal rule, Simpson's 1/3 and 3/8 rules, Guass-Quadrature Method, Error estimates, Monte Carlo method of numerical Integration.

Solution of Ordinary Differentials Equations: Euler and Runga-Kutta Methods, Predictor-corrector method.

Curve Fitting: Interpolation, Polynomial forms, Linear interpolation, Interpolation with equidistance points, Regression, Fitting of linear equation, Least square regression, Fitting transcendental equation.

Suggested Reading:

1. E. Balagurusamy: *Numerical Methods*, TMH, New Delhi, 2006
2. Suresh Chandra: *Computer Application in Physics with FORTRAN, BASIC and C, 2nd edition.* Narosa Publishing House, New Delhi, 2006.
3. E V Krishnamurthy and S K Sen: *Numerical Algorithms: Computations in Science and Engineering, 11th edition*, Affiliated East-West Press Private Limit., New Delhi, 2007.
4. Seymour Lipschutz and Arthur Poe: *Theory and Problems of Programming with Fortran, Schaum's Outline Series*, Mc-Graw Hill Comp., Singapore, 1982.
5. R.C. Verma: *Computer Simulation in Physics*, Anamaya Publishers, New Delhi, 2004.
6. K. P. N. Murthy: *Monte Carlo Methods in Statistical Physics*, University Press, Hyderabad, 2004.
7. K.R. Venugopal and S.R. Prasad: *Mastering C*, TMH, Delhi, 2006.
8. E. Balagurusamy: *C–Programming*, Tata Mc-Graw Hill, 2006.
9. R.G. Dromey: *How to solve it by Computer*, Pearson Education India, 2008.
10. B.S. Gottfried: *Schaums Outline of Theory and Problems of Programming with C*: Mc-Graw Hill, 1993.
11. B.W. Kerninghan and D.M. Ritchie: *C Programming Language*: Prentice Hall, 1988.
12. Ram Kumar and Rakesh Agarwal: *Programming in ANSI C*, West Pub. Co., 1992.
13. Y.P. Kanetkar: *Let Us C*, Infinity Science Press, LCC, 2008.

M.Sc. Physics I Semester

Core Course 4

MSPH114: SEMICONDUCTOR DEVICES AND CIRCUITS

Unit I

Semiconductors: Elemental and compound semiconductor, Direct and indirect band gap, Non-degenerate and degenerate semiconductor, Generation and recombination of carriers, Types of recombination, Life time, Carrier drift and diffusion,

P-N Junction: Diffusion of impurities, Formation of junction, Electric field and potential, Junction capacitance, Diffusion capacitance, I-V characteristics, Switching and reverse recovery,

Unit II

Bipolar Junction Devices: Bipolar junction transistor, I-V characteristics, Switching action, Thyristors and UJT.

Metal semiconductor devices and FETs, Metal semiconductors barrier, Schottky effect, MOS diode, Energy band and I-V characteristics, MOSFET, LED: materials, Configurations and efficiency, LASER principle, Semiconductor and He–Ne lasers, PN junction solar cells.

Unit III

Feedback circuits: Feedback concept, positive and negative feedback, Barkhausen criterion, RC phase shift oscillator, Wein bridge oscillator, Hartley and Colpitt's oscillators, Nyquist criterion, Multivibrators: astable, monostable and bistable multivibrator, UJT relaxation oscillator, Schmitt Trigger, 555 timer based astable multivibrator,

Unit IV

Differential amplifier: Dual input, Balanced output differential amplifier, DC analysis, CMRR, constant currents bias, Level translator, Block diagram of typical OP-Amp, Characteristic of OP-Amp, Open and closed loop configuration, Inverting and non-inverting amplifiers, Voltage series feedback, Effect of feedback on closed loop gain, Input resistance, Bandwidth, Total output voltage, Applications of OPAMP- sign changer, scale changer, adder, integrator, differentiator.

Active Filters: first and second order Butterworth filters- Low pass, High pass, band pass and band reject filters

Unit V

Controlled Rectification and Voltage Regulation: Half wave and full wave, SCR control, Current rating of SCR, DIAC and TRIAC, DIAC-TRIAC phase control circuits, Voltage regulation using transistors, OP-AMP voltage regulator and regulator IC's.

Suggested Reading:

1. S.M. Sze: *Physics of Semiconductor Devices*, 2nd edition, Wiley India, 2004.
2. Ramkant A. Gayakwad*: Op-Amps and Linear Integrated Circuits*, PHI, New Delhi, 4th Ed., 2004.
3. John P. Mckelvey: *Solid State and Semiconductor Physics*, Krieger Pub Co., Harper International Edition, 1966.

4. A.G. Milnes: *Semiconductor Device and Integrated Electronics,* Van Nostrand Reinhold Publisher, 1980.
5. John Gower: *Optical Communication Systems.* PHI, New Delhi, 2nd Ed., 1993.
6. S.M. Zee: *Semiconductor Devices: Physics and Technology, 2nd Ed.,* Wiley India, 2002.
7. Allen Mottershed: *Electronic Devices and Circuits*, PHI, 2005.

MSc. Physics I Semester

Core Course 5

MSPH121: COMPUTATIONAL PHYSICS LAB

List of Experiments:

(Use C Language in this lab)

1. Determination of roots by Newton's Rapshon method.
2. Determination of roots by Bisection method.
3. Determination of roots by False- Position method.
4. Numerical integration by Trepozoidal method.
5. Numerical integration by Simpson's 1/3 method.
6. Numerical integration by Simpson's 3/8 method.
7. Integration by Guass-Quadature method.
8. Solution of differential equation by Runga- Kutta second order method.
9. Solution of differential equation by Runga- Kutta fourth order method.
10. Using Monte-Carlo methods integrate numerically the given function of one variable.
11. Curve fitting by least square method.

MSc. Physics I Semester

Core Course 6

MSPH122: ELECTRONICS LAB

List of Experiments:

1. Study of effect of negative feedback on frequency response and input and output impedance of a BJT amplifier.
2. Study of wave shapes generated by astable multivibrator and determination time constant.
3. Study of differential amplifier and determination of CMRR.
4. Life time measurement by reverse recovery method.
5. Life time measurement by open circuit voltage decay (OCVD) method.
6. Sawtooth wave generation using UJT and determination of time constant.
7. Study of RC phase shift oscillator and measurement of time period.
8. First and second order low pass filters.
9. First and second order high pass filters.

MSc. (I Semester)

Skill Course –I(A)

MSPHSC131(A): INTRODUCTION TO ASTRONOMY AND ASTROPHYSICS

Formation of Planets: Making of planets, Chemistry and Origin of Planets, Lunar eclipse, sun eclipse, Jupiter and Saturn, a different model.

Dead world in Solar System:- The moon's orbit, rotation, size and mass, The moon's physical properties, tides due to moon, moon's environment, craters, mercury's orbit, rotation, size, mass and density, mercury's environment and magnetic field.

Planet Earth: Mass, density, interior, age and magnetic field of Earth, Earth's Atmosphere with the extinction, ALBEDO, Green House effect, earth quack and mountain continental drift.

High energy Astrophysics: large scale distribution of matter and radiation in Universe, The Galaxies, star, stellar evaluation, the interstellar Media, Age of the Galaxy, Binary stars and stellar evaluation, white dwarf, Neutron stars and black hole.

X-ray binaries and γ-ray burst : Different types of binary stars; Importance of binary systems; Roche lobe overflow, Chandrasekhar limit, Accretion in Binary system, accretion disk, LMXBS, HMXBS, X-ray mission (elementary idea), γ-ray burst, GRB Telescopes (elementary idea), origin of cosmic rays.

Suggested Readings:

1. Stephen A. Gregory , Michael Zeilik and Elske V. Smith, Introductory Astronomy and Astrophysics, Saunders College Publishing, 1992
2. Micheal Zeilik, Astronomy the Evolving Universe, Cambridge University Press, 2002
3. E.W. Kolb and M.S. Turner, The Early Universe, Westview Press, 1994
4. Basu Baidyanath , Chattopadhyay Tanuka, Biswas Sudhindra Nath, An Introduction to Astrophysics, PHI publication, 2nd Edition, 2013
5. M.S. Longair, High energy Astrophysics, Cambridge University Press, 2006
6. Juhan Frank, Andrew king and Derek Raine, Accretion Power in Astrophysics, Cambridge University Press, 2002
7. Alain Mazure, Stephane Basa: Exploding Superstars, Understanding Supernovae and Gamma-Ray Bursts, Springer Praxis Books, 2009.

INTRODUCTION TO ASTRONOMY AND ASTROPHYSICS LAB WORK

1. Determine outburst in LMXB'S/ HMXB'S using ASM curve (RXTE data).
2. Detection of Quasi Periodic Oscillation (QPO) in light curve of X-ray Binaries.
3. Determine average magnetic field of celestial compact object using HEASOFT.
4. Determination of Temperature of GRB.
5. Determination of frequency of fluctuation in light curve of GRB.
6. Determination of delay time (lags) between energy bands of GRBs.
7. Determination of multi peaks in light curve of GRB.
8. Measurement of depth of craters of the moon by telescope.
9. Measurement of counting of sunspots over the month by telescope.
10. Measurement of temperature of the sun by Pyrometer.

MSc. (I Semester)

Skill Course –I(B)

MSPHSC131(B): INTRODUCTION TO NONLINEAR OPTICS

Lasers: Gas lasers, He-Ne, Solid state lasers: Ruby, Nd: YAG, Ti –Sapphire, Organic dye laser, Semiconductor lasers: Diode laser, p-n-junction laser, GaAs Laser

Introduction to Nonlinear Optics: Refractive index, Frequency and intensity dependent refractive index, Wave propagation in an anisotropic crystal, Polarization response of materials to light, Second harmonic generation, Sum and difference frequency generation, Phase matching.

Multiphoton Processes: Two photon process, Theory and experiment , Three photon process parametric generation of light, Oscillator, Amplifier, Stimulated Raman scattering, Intensity dependent refractive index, Optical Kerr effect, Photorefractive, Electron optic effects.

Nonlinear Optical Materials: Basic requirements, Inorganics, Borates, Organics, Urea, Nitro aniline, Semi organics, Thiourea complex, Kurtz test, Laser induced surface damage threshold.

Fiber Optics: Step Graded index, Fiber wave propagation, Fiber modes, Single and multimode fibres, Numerical aperture, Dispersion, Fiber bandwidth, Fiber loss, Attenuation coefficient, Material absorption.

Suggested Readings:

1. B.B. Laud, Lasers and Nonlinear Optics, New Age International (P) Ltd., New Delhi, 1991.
2. Robert W. Boyd, Nonlinear Optics, Academic Press, New York, 2003.
3. Govind P. Agarwal, Fiber-Optics Communication Systems, John Wiley & Sons, Singapore 2003.
4. William T. Silvast, Laser Fundamentals, Cambridge University Press, Cambridge, 2003.
5. Nonlinear Optics, Basic Concepts D.L. Mills, Springer, Berlin, 1998.

INTRODUCTION TO NONLINEAR OPTICS LAB WORK

1. Study of characteristics of LED and PIN Photo Detector.
2. Study of frequency response of optical receiver.
3. To study attenuation in optical fibers.
4. To find numerical aperture of optical fibers.
5. Study of noise in an optical receiver.
6. Diffraction of light by cross wire/fine wire mesh.
7. Gaussian nature of laser beam/beam spot measurement/ divergence measurement.
8. Characteristics of light dependent resistor (LDR), LED, photo diode and photo transistor, solar cell.

MSc. Physics (II Semester)

Core Course 1

MSPH211: DIGITAL ELECTRONICS AND MICROPROCESSOR

Unit I

Digital Circuits: Logic gates, De-Morgans theorems, Universal Gates, Karnaugh Maps.
Various logic families: Transistor as a switch, Fan-in and Fan-out, Propagation delay, Tri-state logic, RTL, DTL, TTL, NMOS, CMOS.
Flipflops, One bit memory, RS flipflop, D flipflop, JK flipflop, Edge triggered, Preset and Clear.

Unit II

Counters and Registers: Asynchronous counters, up-down counter, Synchronous counter, MOD counters, Registers, Shift registers, Parallel loading, Universal shift registers, Applications of shift registers: Serial to parallel convertor, Parallel to serial convertor, Digital to analog convertor(D/A), Analog to digital convertor(A/D).

Unit III

Micro-Computer Hardware: Semiconductor memories, RAM, SRAM, DRAM, ROM, CPU: Instruction register and decoder, ALU, Control unit, Buses: Data, Address and control buses, Minimum microcomputer configuration, Interrupts, Concept of I/O mapped and memory mapped I/O.

Unit IV

8085 Microprocessor: Microprocessor 8085: Organization of 8085 microprocessor, Fetch and execution of instruction, Bus multiplexing, Interrupts : Maskable and non-maskable, Call locations, Interrupt service subroutine, Instruction set of 8085 Microprocessor: Data transfer group, Arithmetic group, Logical group, Branches group, Stack related instructions, Mnemonics and operation codes, Addressing modes: Direct, Indirect, Immediate, register, and implicit, Assembly language programming.

Unit V

Data Transfer, Peripheral devices and Interfacing: Types of data transfer, Direct Memory Access, 8257 DMA controller, LED displays, I/O ports, 8255 programmable peripheral interface, 8253 programmable interval timer, 8279 keyboard-display interface, 8259 Programmable interrupt controller.

Suggested Reading:

1. A.P. Malvino and D.P. Leach: *Digital Principle and Applications 4th Ed.*, TMH, 1975.
2. B. Ram: *Fundamental of Microprocessors and Microcomputers*, Dhanpat Rai Publications, New Delhi, 2010.
3. R. S. Gaonkar: *Microprocessor Architecture Programming and Applications with the 8085*, CBS Publishers, 2011
4. M. Morris Mano: *Digital Design, 4th Ed.*, Pearson, 1992.

MSc. Physics II Semester

Core Course 2

MSPH212: QUANTUM MECHANICS-I

Unit I

General Formalism: Historical background, Stern-Gerlach experiment leading to concept of vector space, Ket and bra notation for vector space, Inner product, Norm of a vector, Orthonormality and linear independence, Basis and dimension, Outer product, Projection operator, Completeness (closure property), Hilbert space, Operator, Hermition operator, Eigen value and eigen function, Representation theory, Change of basis, Unitary operator, Matrix elements, Unitary transformation, Diagonalization, Coordinate and momentum representation.

Unit II

Measurements in Quantum Mechanics: Expectation values, Compatible and incompatible observable, Base kets as simultaneous eigen kets of maximal set of commuting observable, Examples, Heisenberg uncertainty principle, Gaussian wave packet, Schrödinger picture, Heisenberg picture and interaction picture.

Invariance Principle and Conservation Laws: Symmetry and conservation laws, Displacement in space-conservation of linear momentum, Displacement in time –conservation of energy, Rotations in space-conservation of angular momentum, Space- inversion parity.

Unit III

Solution of Schrodinger Equation: One dimensional simple harmonic oscillator: Eigen function and Eigen value by solving Schrödinger equation and also by operator method, Creation and annilation operators.

Operators for Orbital Angular Momentum: Orbital angular momentum operators L^2, L_x, L_y and L_z, Spherical harmonics, Solution of Schrödinger equation for Hydrogen atom-energy levels and stationary state wave functions.

Unit IV

Angular Momentum: Spin angular momentum and total angular momentum, Ladder operators, Matrix representation of Operators J_x, J_y, J_z, and J^2, Pauli spin matrices, Addition of two angular momentums, Clebsch- Gorden coefficients, Selection Rules and simple applications.

Unit V

Approximation Methods: WKB approximation: Principle, WKB wave function, Criterion for the validity of the approximation, Connection formulas, Applications to the one dimensional bound system, Penetration of potential barrier. Variational method: Principle and applications to linear harmonic oscillator, Time independent perturbation theory: Non degenerate case, Application to anharmonic oscillator (X^4) and linear harmonic oscillator.

Suggested Reading:

1. J.J. Sakurai: *Modern Quantum Mechanics,* Addison Wesley, 2010.
2. V.K. Thankappan: *Quantum Mechanics, 2nd edition,* New Age International (P) Limited, Publishers, New Delhi, 2010.
3. A. Ghatak and S. Loknathan: *Quantum Mechanics: Theory and Application*, 4th edition, Macmillan, 1999.
4. D.J. Griffith: *Introduction to Quantum Mechanics,2nd edition*, Pearson Education, 2005.

5. L.I. Schift: *Quantum Mechanics, 3rd edition*, Mc-Graw Hill, 1968.
6. B.S. Rajput: *Advanced Quantum Mechanics*, Pragti Prakashan, Meerut, 1994.

MSc. Physics II Semester
Core Course 3
MSPH213: SOLID STATE PHYSICS

Unit I

Crystal Physics: Diffraction of waves by crystals, Reciprocal lattice and its application to diffraction technique, Laue, Powder and rotating crystal method, Crystal structure factor and atomic form factor.
Lattice Vibrations: Quantization of elastic waves, Phonon momentum and inelastic scattering by phonons.
Defects in Crystal: Point defects, Colour centres, F-centres, Line defects and planer defects, Role of dislocations in crystal growth.

Unit II

Ferroelectrics: Classification of ferroelectric crystals, Theory of the ferroelectric displacive transitions: Polarization catastrophe, Soft optical phonon, Thermodynamics of ferroelectric transition, Ferroelectric domains, Antiferroelectric, Piezoelectric and pyroelectric material.
Phase Transition: First and second order transition, Long range order, Short range order and Bragg William model.

Unit III

Superconductivity: Basic phenomena, Meissner effect, Critical field, Type- I and Type- II superconductors, Heat capacity, Isotope effect, London equations, Coherence length, BCS theory of superconductivity, Flux quantization, Normal tunnelling, dc and ac Josephson Effect, SQUID, High temperature superconductors.

Unit IV

Ferromagnetism: Weiss theory of ferromagnetism, Exchange interaction: Heisenberg model, Ferromagnetic domains, Origin of domains, Anisotropy energy, Bloch wall, Curie-Weiss law for susceptibility, Antiferromagnetic, Ferrimagnetic order, Spin wave and magnons.

Unit V

Band Theory of Solids: Electrons in periodic lattice, Bloch theorem, Nearly free electron model, Tight-binding approximation, Fermi surface, de Hass-Van Alphen effect, Cyclotron resonance, Magneto-resistance, Quantum Hall effect.
Optical Properties: Refractive index, Electronic polarization, Optical absorption, Photoconductivity, Relationship between absorption coefficient and band gap recombination.

Suggested Reading:

1. C. Kittel: *Introduction of Solid State Physics*, 7th edition, John Wiley & Sons, 2004.
2. J.P. Shrivastava: *Elements of Solid State Physics, 2nd edition*, PHI, New Delhi, 2006.
3. L.V. Azaroff*: Introduction to Solids*, TMH edition, 1996.
4. N.W. Ashcroff N.D. Mermin: *Solid State Physics*, Holt, Rinehart and Winston, 1976.
5. A.J. Dekker: *Solid State Physics*, Prentice Hall, 1957.

MSc. Physics II Semester

Core Course 4

MSPH214: STATISTICAL AND PLASMA PHYSICS

Unit I

Ensembles Theory and Boson gas: Micro canonical, Canonical and grand canonical ensembles, Phase spacing of classical system, Liouville's theorem and its consequence, Quantum state and phase space, Chemical potential near absolute zero, Thermodynamics behavior of an ideal Boson gas, Bose- Einstein condensation, Liquid ^{4}He, Phase relation of Helium, Quasiparticles and superfluidity of ^{4}He, Superfluid phases of ^{3}He.

Unit II

Fermi Gas: Strongly degenerate Fermions gas and its thermodynamics, Ground state of Fermi gas, density of states, heat capacity of electron gas, Fermi gas in metals, Magnetism of free electron gas in weak and strong magnetic field, Landu diamagnetism, Ultra cold Fermi gas, White dwarf stars, Nuclear matter, Statistical model of an atom.

Unit III

Basic Properties and Occurrence of Plasma: Definition of plasma, Criteria for plasma behavior, Plasma oscillation, Quasi-neutrality and Debye Shielding, Plasma parameters, Natural occurrence of plasma, Astrophysical plasmas, Plasma in Magnetosphere and Ionosphere, Plasma production and diagnostics, Thermal ionization, Saha equation, Brief discussion of methods of laboratory plasma production, Steady stage glow discharge, Microwave breakdown and induction discharge, Double plasma machine, Elementary ideas about plasma diagnostics, Electrostatic and magnetic probes.

Unit IV

Plasma Fluid Equations: Fluid equations; Convective, Two fluid and single fluid equations, Fluid drifts perpendicular to B diamagnetic drift.

Diffusion and Resistivity: Collision and diffusion parameters, Decay of a plasma by diffusion, Ambipolar diffusion, Diffusion across magnetic field, Collision in fully ionized plasma, Plasma resistivity, Diffusion in fully ionized plasmas, Solution of diffusion equation.

Unit V

Equilibrium and Stability: Hydromagnetic equilibria, Concept of magnetic pressure, Equilibrium of a cylindrical pinch, Benner pinch, Diffusion of magnetic field into plasma, Classification instabilities, Two stream instability, Gravitational instability. Resistive drift waves.

Suggested Reading:

1. R.K. Pathria: *Statistical Physics*, Elsevier India Pvt. Ltd., New Delhi, 2011.
2. F. Reif: *Statistical Physics (Vol. V)*, TMH, New Delhi, 2006.
3. David J. Griffiths: *Introduction to Electrodynamics*, Pearson Education, Delhi, 2003.
4. J.D. Jackson: *Classical Electrodynamics, 2nd edition*, Wiley Eastern Ltd., New York, 1985.
5. Satya Prakash: *Electromagnetic Theory and Electrodynamics*, Kedar Nath Ram Nath & Co., Meerut, 1995.

MSc. Physics II Semester

Core Course 5

MSPH221: GENERAL PHYSICS AND SOLID STATE LAB

List of Experiments:

1. To determine Plank's constant.
2. To determine paramagnetic susceptibility of given material (solution).
3. To determine Young's modulus of glass by Cornu's method.
4. To determine critical potentials with the help of Franck Hertz's experiment.
5. Study of coupled oscillators and finding the beat frequency.
6. Verification of Cauchy's Dispersion relation and calculation of Cauchy's constant.
7. To determine electrical resistivity of semiconductor by Four Probe method.
8. Study of absorption coefficient of $KMnO_4$.
9. Verification of Hartmann Dispersion relation.

MSc. Physics II Semester

Core Course 6

MSPH222: DIGITAL ELECTRONICS LAB.

List of Experiments:

1. Study of RC phase shift oscillator.
2. Study of square wave generator.
3. Study of Schmitt trigger.
4. Study of flip flops.
5. Study of half adder and full adder.
6. Study of half and full subtractor.
7. Study of shift registers.
8. Study of counters.
9. Study of MOD counters.
10. Assembly language programming on 8085 microprocessor: Data transfer using direct and indirect addressing, Addition, Subtraction.
11. Assembly language programming on 8085 microprocessor: Multiplication, Division, Array Addition, Largest and smallest from a set of numbers.

MSc. (II Semester)

Skill Course –II

MSPHSC232: ELECTRONICS INSTRUMENTATION

Analog and digital signals, Block diagram of regulated DC power supply and its use in biasing the electronics circuits, Block diagram of digital multimeter and its uses in voltage, current and resistance measurements.

Block diagram of function generators (sine, square and triangular wave) and their characteristics, Block diagram of frequency counter and its working and uses, Block diagram of various cathode ray oscilloscopes and their uses in frequency, phase and voltage measurement

Origin of bio-electric signals associated with various organs, Electric cardio gram (ECG) and its application in heart functioning, Sonography (ultrasound imaging) and its application in diagnosis

Suggested Readings:

1. A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques,PHI.
2. R. S. Khandpur, Handbook of Biomedical Instrumentation, TMH.

ELECTRONICS INSTRUMENTATION PHYSICS LAB WORK

1. Measurements of voltage, current and resistance by DMM
2. Study of waves generation by function generator
3. Study of waves using CRO
4. Use of digital storage oscilloscope (DSO) in waveform study
5. Study of DC power supply
6. Study of function generator
7. Study of ultra sound generation and its application

ANUXURE- B2(2)

SYLLABUS OF MSc. II YEAR (III AND IV SEMESTERS)

SUBJECT: PHYSICS

(2020-2021)

MSc. Physics III Semester

Core Course 1

MSPH311: CLASSICAL ELECTRODYNAMICS

Unit I

Electrostatics: Poisson and Laplace equations, Green's Theorem, Uniqueness of the solution with the Dirichlet or Neumann boundary conditions, Formal solutions of electrostatics boundary value problem with Green's function, Electrostatics potential energy density.

Boundary value problems in Electrostatics: Method of images, Point charge in the presence of grounded conducting sphere, Point charge in the presence of a charge insulated conducting sphere, Point charge near a conducting sphere at fixed potential, Conducting sphere in uniform electric field by method of images.

Unit II

Maxwell Equations, Vector and scalar potentials, Gauge transformations, Lorentz gauge, Coulomb gauge, Green functions for wave Equation, Derivation of equations of macroscopic electromagnetism, Poynting theorem and conservation of energy and momentum for a system of charged particles, Poynting theorem in linear dispersive media with losses, Poynting theorem for harmonic field.

Unit III

Radiating Systems, Multipole Fields and Radiation: Fields and radiation of a localized oscillating source, Electric dipole fields and radiation, Magnetic dipole and electric quadrupole fields, Center fed linear antenna, Multipole expansion of the electromagnetic fields, Properties of multipole fields.

Collisions, Energy Loss and Scattering of Charged Particles: Energy transfer in a Coulomb collision between heavy incident particle and stationary free electron, Energy transfer to a harmonically bound charge, Thomson scattering, Cherenkov radiation.

Unit IV

Radiation by Moving Charges: Retarded time and retarded potential, Lienard–Wiechert potentials and fields for a moving point charge, Electromagnetic fields of a uniformly moving point charge, Total power radiated by an accelerated charge: Larmor's formula and its relativistic generalization, Angular distribution of radiation emitted by an accelerated charge, Radiation emitted by a charge in arbitrary and extremely relativistic motion, Distribution in frequency and angle of energy radiated by accelerated charges.

Unit V

Dynamics of Relativistic Charged Particle: Langrangian and Hamiltonian for a relativistic charged particle in external electromagnetic fields, Covariance of equation of motion, Euler-Lagrange equation, Motion of charged particle in uniform static magnetic field, Combined uniform static electric and magnetic fields, Motion of charged particle in non-uniform static magnetic fields. Adiabatic invariance of flux through the orbit of particle.

Suggested Reading:

1. J.D. Jackson: *Classical Electrodynamics*, 2nd edition, John Wiley, 1985.
2. D.J. Griffith: *Introduction to Electrodynamics*, 3rd edition, Pearson Pub., New Delhi, 2003
3. Panofsky and Phillips: *Classical Electricity and Magnetism, 2nd edition*, Addison Wesley, 1962.

4. L.D. Landau and E.M. Lifshitz: *Classical Theory of Field*, *4th edition*, Pergamon Press, 2003.
5. L.D. Landau and E.M. Lifshitz: *Electrodynamics of Continuous Media*, Pergamon Press, 1995.
6. J.R. Reitz, F.J. Milford R.W. Christry: *Foundation of Electromagnetic Theory*, 4th edition, Pearson Education, 2009.

MSc. Physics III Semester

Core Course 2

MSPH312: QUANTUM MECHANICS-II

Unit I

Theory of Scattering-I: The scattering experiments, Relationship of cross-section and wave function, Scattering amplitude; Partial wave analysis: Expansion of a plane wave in terms of partial waves, Scattering by central potential, Zero energy scattering; Scattering by a square well potential, Effective range, Resonant scattering.

Unit II

Theory of Scattering-II: Born approximation, Integral equation for scattering, Born's first approximation, Spherically symmetric potential, Criterion for validity of Born approximation, Scattering of electrons by atoms, Rutherford scattering.

Unit III

Identical Particles: Principle of indistinguishability, Symmetry of wave functions, Spin and statistics, Pauli's exclusion principle, Construction of wave function of two electrons in L-S and j-j coupling, Allowed states, Ortho and para helium; Exchange force; Scattering of identical particles, Cases of spin half and spin zero particles.

Unit IV

Time Dependent Perturbation Theory: Constant perturbation, Transition to continuum, Fermi's golden rule, Harmonic perturbation, Radiative transitions; Adiabatic approximation, Sudden approximation.

Semi-Classical Theory of Radiation: Einstein coefficients, Atom field interaction, Interaction energy, Dipole matrix elements, Stimulated emission rate, Spontaneous emission rate, Selection rules.

Unit V

Relativistic Wave Equation: Klein Gordan equation, Dirac equation, Properties of Dirac matrices, Free Dirac particle, Equation of continuity, Non-relativistic limit, Spin-orbit coupling, Hole theory.

Suggested Reading:

1. J.J. Sakurai: *Modern Quantum Mechanics,* Addison Wesley, 2010.
2. V.K. Thankappan: *Quantum Mechanics, 2nd edition,* New Age International (P) Limited, Publishers, New Delhi, 2010
3. A. Ghatak and S. Loknathan: *Quantum Mechanics: Theory and Application*, 4th edition, Macmillan, 1999.
4. D.J. Griffith: *Introduction to Quantum Mechanics,2nd edition,* Pearson Education, 2005
5. L.I. Schift: *Quantum Mechanics, 3rd edition,* Mc-Graw Hill, 1968.
6. B.S. Rajput: *Advanced Quantum Mechanics,* Pragti Prakashan, Meerut, 1994.

MSc. Physics III Semester

Core Course 3

MSPH313: NUCLEAR PHYSICS-I

Unit I

General Properties of the Nucleus: Nuclear Size, Nuclear Spin, Parity of the Nuclei, Statistics of Nuclei, Magnetic dipole moment, Electric Quadrupole moment, Iso-spin, Size determination by Muonic X-ray Method and Life time of alpha emitters, Measurement of nuclear spin by Zeeman effect of hyperfine lines and by molecular spectra method, Magnetic dipole moment by Rabi's method.

Unit II

Nuclear Models: Introduction to nuclear models, Fermi gas model, Shell model of the nucleus: Harmonic potential, Spin-orbit interaction, Existence of shells, Application of shell model. Limitations of the shell models, Collective model: Rotational and vibration states, Nilson's model and explanation of ground states of the nuclei.

Unit III

Energy Spectrum of α and β rays: Discrete energy spectrum of α particles, Geiger-Nuttal's law, Gammow theory of α decay, Continuous spectrum of β particles, Pauli's neutrino hypothesis, Fermi theory of β decay, Coulomb correction, Screening effect, Kurie's plot, Selection rules in β decay, Orbital electron capture, Parity violation in β decay.

Unit IV

γ –ray spectrum: γ –ray spectra and nuclear energy levels, Irradiative transition in nuclei, Nuclear isomerism, Internal conversion, Internal pair creation, Selection rules of γ–ray transitions.

Mössbauer Effect: Nuclear resonance, Recoil energy, Thermal broadening, Doppler broadening, Heisenberg, Natural line width, Recoil free fraction, Velocity modulation, Isomer shift, Quadrupole splitting, Magnetic Hyperfine splitting.

Unit V

Nuclear Accelerators: Particle accelerators: Linear accelerators, Cyclic accelerators, Fixed target machines and colliders, Synchrotron: Principle of phase stability, Synchrotron radiations.

Basic principles of particle detectors: G.M counter, Solid state and semiconductor detectors, Cherenkov counter, Scintillation Counters.

Suggested Reading:

1. K.S. Krane: *Introductory Nuclear Physics*, Wiley, New York. 1987,
2. D. Griffiths: *Introduction to Elementary Particle Physics*, Harper and Row, New York. 1987,
3. R.R. Roy and B.P. Nigam: *Nuclear Physics*, New Age International, New Delhi, 1983.
4. I. Kaplan: *Nuclear Physics*, 2nd Edition, Narosa Pub. House, New Delhi, 1983.
5. H.A. Enge: *Introduction to Nuclear Physics*, Addison Wesley, London, 1975.
6. Y.R. Waghmare: *Introductory Nuclear Physics*, Oxford-IBH, New Delhi, 1981.
7. S. N. Ghoshal*: Atomic and Nuclear Physics*, Volume 2. , 2001.
8. J.M. Longo: *Elementary Particles*, Mc-Graw-Hill, New York, 1971.

9. R.D. Evans: *Atomic Nucleus*, Mc-Graw Hill, New York, 1955.
10. B.L. Cohen*: Concepts of Nuclear Physics*, TMH, New Delhi, 1971.
11. M.K. Pal: *Theory of Nuclear Structure*, Affl. East-West, Chennai, 1982.
12. W.E. Burcham and M. Jobes: *Nuclear and Particle Physics*, Addison-Wesley, Tokyo, 1995.

MSc. Physics III Semester

Elective core course- I

Group A: ELECTRONICS

MSPH314(A): COMMUNICATION TECHNOLOGY

Unit I

Analog Communication: Modulation: Amplitude modulation-generation of AM waves, Demodulation of AM waves –DSBSC modulation, Generation of DSBSC waves, SSB modulation, Generation of SSB, Vestigial sideband modulation and frequency division multiplexing (FDM), Frequency modulation, Mathematical analysis, Generation of FM.

Demodulation: Demodulation of AM signals, Demodulation of FM signals: Foster Seeley discriminator, Ratio detector

Unit II

Digital Communication: Sampling theorem, PAM Channel BW for a PAM signal, Natural sampling. Flat top sampling, Pulse code modulation, Quantization and the binary code, Dynamic range, Coding efficiency, Quantization error, Noise in PCM signals, Companding,

Digital modulation techniques: ASK, FSK, BFSK, BPSK, QPSK,

Unit III

Transmission Lines: Voltage and current equations of transmission lines, Characteristic impedance, Propagation constant, Reflection coefficient, VSWR, Impedance transformation, Smith chart, Impedance matching by single stub and double stub.

Optical Fiber : Light propagation in fibers, Total internal reflection, Numerical aperture of a given fiber, Fiber index profiles, step index and graded index fiber, Modes of propagation, Number of propagated modes in step-index fibers.

Unit IV

Radars and Satellite: Radar System: Radar block diagram and operation, Radar frequencies, Pulse consideration radar range equation, Minimum detectable signal, Receiver noise, Signal to noise ratio, Integration of radar pulses, Radar cross section, Pulse repetition frequency, Pulsed radar system, Doppler's effect, CW Doppler Radar system, Moving target Indicator principle, FM radar.

Satellite Communication: Orbital satellites, Geo- stationery satellite, Orbital patterns, Look angles, Orbital spacing, Satellite systems link modules.

Unit V

Data Communication and Networking: Elements of LAN, WAN, MAN, Network topologies: STAR, BUS and RING network, Network Models: Layered tasks, OSI model, Layers in the OSI model, TCP/IP protocol suite, Switching: Concept of switching, circuit-switched networks, Datagram networks, Network switching, Addressing, Efficiency, Error Detection and Correcting Codes: Types of errors, Redundancy, Block coding, Hamming codes, Cyclic codes: Cyclic Redundancy Check, Hardware Implementation, Polynomials, Parity generation and detection,

Books Suggested:

1. Wayne Tomasi*: Introduction to Data Communication and Networking, 1st Ed.*, Pearson 2007.
2. Forouzan: *Data Communication and Networking, 4th Ed.*, TMH, 2006.
3. Roddy and Coolen: *Electronic Communication, 4th Ed.*, PHI, 2004.
4. Anokh Singh: *Principles of Communication Engineering,* S. Chand & Company, 2nd Ed. 2006.
5. Wayne Tomasi: *Advanced Electronic Communication System*, Pearson, 2009.

MSc. Physics (III Semester)

Elective Core Course-I

Group B: MATERIAL SCIENCE

MSPH314(B): MATERIAL SYNTHESIS AND CHARACTERIZATION

UNIT I

Introduction to Crystal Growth: Theories of crystal growth: Surface energy theory, Diffusion theory, Adsorption layer theory, Screw dislocation theory, Crystal growth techniques: Solid growth, Solution growth, Crystal growth from melt, Vapour phase growth.

UNIT II

Solid States and Solution Routes: Mechanical mixing, Grinding, Solid solution technique, Combustion method, Top seeded solution growth; Sol-gel techniques; Hydrothermal, Melt methods: Czechorlskii methods, Skull melting, Sono-chemical and Photo-chemical synthesis.

Unit III

X-ray, Electron and Neutron Diffraction Methods: XRD equipment, Powder method, Debye-Scherrer camera, Examination of typical XRD pattern, Crystal structure determination, Indexing XRD pattern, Scherrer formula for estimation of particle size, Lattice parameters calculations and other uses, Electron diffraction and its uses.

Unit IV

Basics of Thermal Analysis Techniques: TGA, DTA, DSC principles and applications.
Electron Imaging Techniques and their Applications: Principle and working of SEM, TEM, AFM.

Unit V

Spectroscopic Techniques: Mass spectroscopy, Principle and applications, Secondary ions mass spectroscopy, Special surface techniques: Electron spectroscopy for chemical analysis (ESCA), Ultraviolet photo electron spectroscopy (UPS), X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES).

Suggested Reading:

1. Ichiro Sunagawa: *Crystals: Growth, Morphology and Perfection*, Cambridge University Press, Cambridge, 2005.
2. J. W. Mullin: *Crystallization*, Elsevier Butterworth-Heinemann, London, 2004.
3. J. C. Brice: *Crystal Growth Processes*, John Wiley and Sons, New York, 1986.
4. H. H. Willard*: Instrumental methods of Analysis*, CBS Publishers, 1986.
5. B. D. Cullity: *Elements of X-ray Diffraction*, Addison Wesley Publishing Co., 1967.
6. Sam Zhang, Lin Li and Ashok Kumar: *Materials Characterization Techniques*, CRC Press, 2008.
7. Yang Leng: *Materials Characterization: Introduction to Microscopic and Spectroscopic Methods*, Wiley & Sons, 2008.
8. Elton N. Kaufmann: *Characterization of Materials, Vol.1*, Wiley & Sons, 2003.
9. R.A. Laudise: *Growth of Single Crystals*, Prentice Hall, 1973.
10. G. Dhanaraj, K. Byrappa, V. Prasad and M. Dudley (Eds.), *Springer Handbook of Crystal Growth*, Springer Verlag, 2010.

MSc. Physics (III Semester)

Core Course 5

MSPH311: GENERAL PHYSICS LAB

List of Experiments:

1. To determine and compare slit width from the study of Fraunhoffer's Diffraction pattern.
2. To measure Brewster angle and hence to find the refractive index of given material.
3. To determine basic laser beam parameters of a given laser.
4. To study Magneto- Optic effect and hence to determine Verdet constant of a given material.
5. To study Electro- Optic effect and to determine the value of half wave voltage.
6. To study the Special Coherence using laser beam with double slit.
7. To Study the dissociation spectrum of Iodine.
8. Study of Balmer lines in Hydrogen atom.
9. Study of X-ray simulator.
10. Determination the diameter of Lycopodium powder using Corona ring.

MSc. Physics (III Semester)

Core Course 6

MSPH322: NUCLEAR PHYSICS LAB.

List of Experiments:

1. To study of the characteristics of a GM tube and determination of its operating voltage, Plateau length and Slope.
2. Verification of inverse square law for gamma rays.
3. Study of nuclear statistics.
4. Linear and mass attenuation co-efficient using gamma/beta ray source.
5. Estimation of efficiency of G.M. detector for gamma and beta ray source.
6. Study of energy resolution characteristics of a scintillation spectrometer as a function of applied high voltage and to determine the best operating voltage.
7. Study of Cs-137 spectrum and calculation of FWHM and resolution for a given scintillation detector.
8. Study of Co-60 spectrum and calculation of resolution of detector in terms of energy.
9. Energy calibration of gamma ray spectrometer (study of linearity).
10. Calculation of unknown energy of a radioactive isotope.
11. Variation of energy resolution with gamma energy.

MSc. (III Semester)

Skill Course –III(A)

MSPHSC333(A): RENEWABLE ENERGY RESOURSES

Introduction to Renewable Energy Systems: Need for renewable energy sources, Different types of renewable energy sources, Advantages and limitations of renewable energy sources (non-conventional energy sources).

Sun as a source of energy, Solar radiation fundamentals, Estimation of radiation, Measurement of solar radiation, Direct energy conversion (Solar Photovoltaic): Semiconductors , Photoconduction, Solar cell fundamentals, Solar cell structure, Solar cell characteristics, I-V characteristics, Tracking-maximum power point tracking. Energy loss and efficiency, Maximizing the performance, Classification of solar cell, Solar cell fabrication technology, Solar cell PV module, PV panel, Testing of PV system, Array Construction, Small grid technology, Solar PV applications.

Wind Energy and Other Renewable Energy Sources: Power in the wind, Wind measurement techniques and instrumentation, Wind energy conversion, Wind mill, Basic components of wind mill conversion system, Types of wind mills, Performance and efficiency.

Suggested Readings:

1. B. H. Khan, Non-Conventional Energy Resources, The McGraw Hill, 2001.
2. G. D. Ray, Non-Conventional Energy Sources, Khanna Publications, 2001.
3. S.P. Sukhatme, Solar Energy, Mc Graw Hill, 1997.
4. S. P. Sukhatme and J.K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw-Hill, New Delhi, 1989.
5. Garg, Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill, 1993.
6. C.S. Solanki, Solar Photovoltaics: Fundamental, Technologies and Applications, Prentice Hall of India, 2011.
7. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood, Chichester, 1984.
8. John Twidell and Tony Weir, Renewable Energy Resources, 2nd edition, Fspon & Co., 1990.
9. Solar Energy, Fundamentals and Applications, Garg, Prakash, Tata McGraw Hill
10. Erich Hau, Wind Turbines Fundamentals: Technologies, Application, Economics, Springer Verlag Berlin, Heidelbeg, 2000.
11. Gary L. Johnson, Wind Energy System, Printice Hall Inc, New Jersy, 1985.
12. S.N. Bhadra, D. Kastha and S. Banerjee, Wind Electrical Systems, Oxford Univ Press 2005.

RENEWABLE ENERGY RESOURSES LAB WORK

1. Study of the voltage and current of the solar cells in series and parallel combinations.
2. Study of the voltage and current of the solar cells.
3. Study of both the current–voltage characteristic and the power curve to find the maximum power point (MPP) and efficiency of a solar cell.
4. To calculate the efficiency (η) of solar cell.
5. Measurement of voltage and current of wind energy based DC supply with change in angle of blades.
6. Measurement of voltage and current of wind energy based DC supply with change in direction of wind.
7. Measurement of voltage and current of wind energy based DC supply with change in speed of wind imposed on the blades.

MSc. (III Semester)

Skill Course –III(B)

MSPHSC333(B): INTRODUCTION TO COMPUTER SIMULATION IN PHYSICS

Introduction to Computer Simulation: The importance of computer simulation, Programming languages and object- oriented techniques, Tools for simulations.

Random numbers, Generation of random numbers, Monte Carlo method of simulation and Molecular dynamics methods.

Simulation of particle motion in one dimension.

Simulation in wave, optics and electromagnetic: Simulation of a plane wave, Dispersion of light waves, Electric field due to a point charge, Motion of charge particle in uniform magnetic field.

Suggested Readings:

1. H. Gould, J. Tobochnik and W. Christian, An Introduction to Computer Simulation Method, Pearson, New York, 1953.
2. R.C. Verma, Computer Simulation in Physics, Anamaya Publisher, New Delhi, 2004.

INTRODUCTION TO COMPUTER SIMULATION IN PHYSICS LAB WORK

1. Simulation of one dimensional simple harmonic motion.
2. Simulation of construction of a standing wave.
3. Simulation of interference of two waves.
4. Simulation of motion of electron in cathode ray tube.
5. Simulation of motion of electron in combined electric and magnetic field.
6. Generation of random numbers.

MSc. Physics (IV Semester)

Core Course 1

MSPH411: NUCLEAR PHYSICS-II

Unit I

Nuclear Forces: Two body problem, Ground state of deuteron, Magnetic moment, Quadruple moment, Tensor forces, Meson theory of nuclear forces, Yukawa potential, Nucleon-nucleon scattering, Low energy n-p scattering, Effective range theory, Spin dependence, Charge independence and charge symmetry of nuclear forces.

Unit II

Nuclear Reactions: Scattering and reaction cross sections, Compound nucleus, Reciprocity theorem, Breit-Wigner one level formula, Resonance Scattering, Continuum theory, Optical model.

Unit III

Neutron Physics and Reactor Physics: Neutron production, Slowing down power and moderating ratio, Neutron detection, Reactor operations, Power and breeder type reactors.

Nuclear Fusion: Introduction, Thermonuclear reactions and energy production, Fusion in hot medium, Progress in fusion power production, Stellar burning.

Unit IV

Basic interaction of various particles with matter: Interaction of Charge particles with matter; Bohr-Bethe formula, Interaction of electrons, Interaction of γ–rays with matter: Photo electric, Compton effects and pair production.

Unit V

Particle Physics: Classifications of elementary particles, Isospin, Isospin quantum numbers, Strangeness and hyper charge, Hadrons, Baryons, Leptons, Invariance principles and symmetries, Invariance under charge-parity(CP), time(T) and CPT, CP violation in neutral K-meson decay, Tau-Theta puzzle, Feynman diagrams, Quark model, SU(3) symmetry, Gell-Mann-Nishijma formula, Neutrinos of different flavour, Charm, Bottom and Top quarks, QCD formulated, Evidence for gluon field.

Suggested Reading:

1. K.S. Krane: *Introductory Nuclear Physics*, Wiley, New York. 1987.
2. D. Griffiths: *Introduction to Elementary Particle Physics*, Harper and Row, New York. 1987.
3. R.R. Roy and B.P. Nigam: *Nuclear Physics*, New Age International, New Delhi, 1983.
4. I. Kaplan: *Nuclear Physics*, 2nd Edition, Narosa, New Delhi, 1983.
5. J.S. Lilley, John Wiley & Sons Ltd., UK, 2001.
6. S. N. Ghoshal*: Atomic and Nuclear Physics*, Volume 2. , 2001.
7. R.D. Evans: *Atomic Nucleus*, Mc-Graw Hill, New York, 1955.
8. B.L. Cohen*: Concepts of Nuclear Physics*, TMH, New Delhi, 1971.

9. M.K. Pal: *Theory of Nuclear Structure*, Affl. East-West, Chennai, 1982.
10. W.E. Burcham and M. Jobes: *Nuclear and Particle Physics*, Addison Wesley, Tokyo, 1995.

MSc. Physics (IV Semester)

Core Course 2

MSPH412: ATOMIC AND MOLECULAR SPECTROSCOPY

Unit I

Atomic Spectroscopy: General discussion in Hydrogen spectra, Relativistic correction to spectra of Hydrogen atom, Spectra of monovalent atoms, quantum defect, Introduction to electron spin, Spin-orbit interaction and fine structure, Spectra of divalent atoms: Singlet and triplet states of divalent atoms, L-S and j-j coupling, Branching rule, Hyperfine structure in spectra of monovalent atoms.

Unit II

Microwave Spectroscopy: Pure rotational spectra of diatomic molecules, Isotopic effect, Non-rigid rotator, Poly-atomic molecules, Study of linear molecules and symmetric top molecules, Stark effect, Quadrupole hyperfine interaction, Microwave spectrometer, Information from rotational spectra.

Unit III

Infrared Spectroscopy: Vibrational spectroscopy of diatomic and simple polyatomic molecules, Harmonic Oscillator, Anharmonic Oscillator, Rotational vibrators, Normal modes of vibration of polyatomic molecules, IR spectrometer: FTIR Spectrometer, Applications of infrared spectroscopy: H_2O and CO_2 molecules.

Unit IV

Raman Spectroscopy: Raman effect, Classical and Quantum theory of Raman effect, Vibrational Raman spectra, Rotational Raman spectra, Vibrational-Rotational fine structure, Raman Spectrometer, Structure determinations from Raman and Infra-red spectroscopy.

Electronic Spectra: Electronic structure of diatomic molecules, Intensity of spectral lines, Frank-Condon principle, Dissociation energy, Rotational fine structure of electronic-vibration transitions.

Unit V

NMR and ESR Techniques: Theory of NMR, Relaxation effect, Theory of dipolar interaction and chemical shifts, Indirect spin-spin interactions, Experimental set up of NMR. Applications of NMR to quantitative measurements (Idea only).

ESR: Quantum mechanical treatment of ESR, Nuclear interaction and hyperfine structure, Relaxation effects, ESR spectrometer, Applications of ESR method.

Suggested Reading:

1. Willard, Merritt, Dean, Settle: *Instrumental Methods of Analysis*, CBS Publishers & Distributors, Delhi, 6th Ed. 1986.
2. Colin N. Banwell and Elaine M. McCash*: Molecular Spectroscopy,* Mc-Graw Hill College; 4th Sub. Ed., 1994.
3. B. H. Bransden and Joachain: *Physics of Atoms and Molecules*, Longman, 1983.
4. V. Rajendran and A. Marikani: *Applied Physics*, TMH publication, 4th Ed., 2002.
5. P. F. Bernath: *Spectra of Atoms and Molecules*, Oxford University Press, 1995.

6. Raymond Chang: *Basic Principles of Spectroscopy*, Mc-Graw Hill, 1971.
7. P. W. Atkins: *Molecular Quantum Mechanics*, Oxford University Press, 1983.
8. B. B. Laud: *Lasers and Non-Linear Optics*, Wiley Eastern Ltd., 1991.
9. H. E. White: *Introduction to Atomic Spectra*, Tata Mc-Graw Hill. 1934.
10. G. Herzberg: *Molecular Spectra and Molecular Structure* Vol. 1, 2 & 3, Krieger Publishing Company, Malabar, 1989 & 1991.
11. D. A. Long: *Raman Spectroscopy*, Mc-Graw Hill, 1977.
12. G. M. Barrow: *Introduction to Molecular Spectroscopy*, Mc-Graw Hill, Tokyo, 1962.
13. J. M. Brown: *Molecular Spectroscopy*, Oxford University Primer, 1998.
14. J. M. Holias*: Modern Spectroscopy*, John Wiley & Sons, England, 1987.

MSc. Physics (IV Semester)

Core Course 3

MSPH413: NANOMATERIALS

Unit I

Introduction: Nano size scale, History of Nanotechnology, Quantum Mechanics and Fluctuation in nanostructure systems, Size and surface effect, Surface area to volume ratio, Surface energy, chemical potential as a function of surface curvature, Electrostatic stabilization and Steric stabilization, Idea of zero, one and two dimension nanostructures, Vacancies and dislocations in nanocrystals, Effect of nanoscale dimensions on various properties.

Unit II

Structure and Phase Transitions in Nanocrystals: Introduction, Crystalline phase transitions in nanocrystals: Phase transitions and grain size dependence, Elementary thermodynamics of the grain size dependence of phase transitions, Influence of the surface or interface on nanocrystals, Modification of transition barriers, Geometric evolution of the lattice in nanocrystals: Grain size dependence theory, Influence of the nanocrystal surface or interface on the lattice parameter, Continuous variation of the crystal state within nanocrystals .

Unit III

Synthesis of Nanomaterials: Physical methods: High energy ball milling, Melt mixing, Lithography: Photolithography, Electron beam lithography, X-ray lithography, Chemical methods: Colloidal and sol-gel methods, Other methods: Self-assembly method, Bio-induced nanomaterials (using microorganism and plant extract).

Unit IV

Physical Properties of Nanomaterials: Melting point and lattice constants, Mechanical properties, Optical properties; Surface Plasmon effect, Quantum size effect, Electrical conductivity; Surface Scattering, Change of Electronic structure, Quantum Transport, Effect of microstructure, Ferroelectric and dielectrics, Superparamagnetism.

Unit V

Applications of Nanomaterials: Application in molecular and nano-electronics, Biological applications (imaging, drug delivery), Quantum well and quantum dot devices, Energy application of nanomaterials; Photochemical cell, Lithium–ion battery, Hydrogen storage and thermo-electrics, Environmental application, Photonic crystals.

Suggested Reading:

1. Guozhong Cao and Ying Wang: *Nanostructures and Nanomaterials: Synthesis, Properties and Applications, 2nd Ed.*, World Scientific, Singapore, 2011.
2. S.M. Lindsay: *Introduction to Nanoscience*, Oxford University Press, New York, 2010.
3. B.K. Parthasarthy (Edited): *Nanoscience and Nanotechnology*, Isha Books, Delhi, 2007.
4. Mark Ratner and Daniel Ratner*: Nanotechnology: A Gentle Introduction to Next Big Idea*, Pearson Education, 2008.
5. Gregory Timp (Edited): *Nanotechnology*, Springer, New York, 1999.
6. Charles P. Poole Jr. and Frank J. Owens*: Introduction to Nanotechnology*, Wiley Interscience, 2003.

7. Catherine Brechignac, Philippe Houdy and Marcel Lahmani, Spinger Berlin Heidelberg: *Nanomaterials and Nanochemistry*, New York, 2006.
8. Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan (Edited): *Nanoscale Science and Technology*, John Wilet & Sons Limited, England, 2005.
9. Yury Gogotsi (Edited): *Nanomaterials Handbook*, CRC, Taylor & Francis, New York, 2006.

MSc. Physics (IV Semester)

Core Elective Course-II

Group A: ELECTRONICS

MSPH414(A): NETWORK ANALYSIS AND MICROWAVE ELECTRONICS

Unit I

Network Analysis and Laplace Transform Method: Analysis of simple L, C, R –circuits by solving differential equations, Laplace transform method, transient and steady state AC response; Transform functions of step, Delayed step, Rectangular pulse, Impulse and ramp; Application to simple circuits.

Unit II

S-Plane Analysis: Transform impedance and admittance functions, Thevenin and Norton theorems, Two port networks, Driving point impedance, Transfer functions, Poles and zeros of network functions, Restrictions on poles and zeros of driving point impedance and transfer functions, Time domain response from pole zero configuration.

Frequency Response Plots: Magnitude and phase plots, Complex loci, Plots from s-plane phasors, Bode plots.

Unit III

Introduction: Microwave frequency bands; Limitations of conventional devices at microwave frequencies.

Wave Guides: Wave propagation between parallel planes, Modes of propagation, Rectangular and circular wave guides, Impedance concept in wave guide, Impedance measurement by VSWR, Measurement of dielectric constant at microwave frequency, Cavity resonator, Measurement of frequency.

Unit IV

Microwave Components: Scattering matrix, Phase shifters, Directional couplers; E-plane, H-plane and Hybrid Tees; Ferrite isolators, Circulator.

Microwave Tubes: Velocity modulation, Basic principles and characteristics of two cavity klystron and reflex klystron; Magnetrons; Slow wave structure, Helix travelling wave tube, Wave modes, Gain.

Unit V

Semiconductor microwave devices: Microwave tunnel diodes; HEMT; Transfer electron devices, Gunn effect, Principle and modes of operation; Read diode, IMPATT and TRAPATT; Varactor, Parametric converters, Manley Rowe relations, Up converter and negative resistance amplifier.

Suggested Reading:

1. S.Y. Liao: *Microwave Devices and Circuits,3rd Ed.,* Prentice Hall of India, 1992.
2. G. Kennedy: *Electronic Communication Systems*, Tata Mc-Graw Hill, 1991.
3. R.E. Collins: *Foundations of Microwave Engineering*, Mc-Graw Hill, 1981.
4. E. Jordan and K.G. Balmain*: Electromagnetic Waves and Radiating System*, Prentice Hall of India, 1968.
5. F.E. Terman*: Electronic and Radio Engineering 4th Ed..*, Mc-Graw Hill, 1957.
6. G.S. Raghuvanshi*: Microwave Engineering,* CL India, 2012.

MSc. Physics (IV Semester)

Core Elective Course -II

Group B: MATERIAL SCIENCE

MSPH414(B): THIN FILMS

Unit I

Preparation of Thin Films: Study of thin film vacuum coating unit, Construction and uses of vapor sources wire, Sublimation Furnaces and Crucible sources.

Physical Vapor Deposition: Hertz Knudsen equation, Mass evaporation rate, Knudsen cell, Evaporation of elements, Compounds, Alloys, Raoult's law, Electron beam, Pulsed laser, Ion beam evaporation, Glow Discharge and plasma.

Unit II

Sputtering: Sputtering mechanisms and yield, DC and RF sputtering, Magnetron sputtering, Bias sputtering, Reactive sputtering, Evaporation versus Sputtering, Hybrid and modified PVD processes-Ion plating, Reactive Evaporation, Ion beam assisted deposition.

Unit III

Chemical Vapor Deposition: Thermodynamics of CVD, Gas transport, Film growth kinetics, Thermal CVD, LPCVD, MOCVD, laser and Plasma-enhanced CVD processes.

Chemical Methods: Qualitative study of preparation of thin films by electroplating, Anodization, Spray pyrolysis, Electro-deposition, Sol-Gel and LB techniques.

Unit IV

Nucleation and Growth: Homo, heterogeneous nucleation, Capillarity theory, Nucleation rate, Atomistic and kinetic models of nucleation, Basic modes of thin film growth, Amorphous thin films.

Epitaxy: Homo, Hetero epitaxy, Lattice misfit and imperfections in epitaxial films, Epitaxy of compound semiconductors, Methods for depositing Epitaxial semiconductor thin films.

Unit V

Deposition Monitoring and Control: Microbalance, Crystal oscillator thickness monitor, Thickness measurement: Fringes of equal thickness (FET) method, Multiple beam interferometer, Fringes of equal chromatic order (FECO) method-Ellipsometry.

Scope of Devices and Applications: Thin film resistors, Thin film capacitors, Thin film field effect transistors, Thin film solar cells, Antireflection coatings.

Books Suggested:

1. Milton Ohring: The *Materials Science of Thin Films,* Academic Press, California 1992.

2. K. L Chopra: *Thin Film Phenomena,* Krigger publishing company, Huntington, New York 1979.

3. L.I. Maissel and R. Glange: *Hand Book of Thin Film Technology*, Mc-Graw Hill, New York, 1970.

4. Donald Smith: *Thin-Film Deposition: Principles and Practice*, Mc-Graw Hill**,** 1st Ed., 1995.

MSc. Physics (IV Semester)

Core Elective Lab-I

Group A: ELECTRONICS

MSPH421(A): ELECTIVE PAPER LAB

List of Experiments:

1. Characteristics of Reflex Klystron
2. Measurement of VSWR and impedance
3. Measurement of dielectric constant
4. Amplitude modulation and demodulation
5. Pulse amplitude modulation and demodulation
6. Optical fiber communication
7. A/D conversion
8. D/A Conversion
9. Pulse width modulation and demodulation

MSc. Physics (IV Semester)

Core Elective Lab-I

Group B: MATERIAL SCIENCE

MSPH421(B): ELECTIVE PAPER LAB

List of Experiments:

1. Experiments with introductory Nano Kit.(Understanding nano scaling and demonstrating atomic arrangement).
2. Experiments based on Nano TiO_2 Solar Cell Trainer Kit.(Four experiments).
3. Experiments based on ferro-fluid demonstrator. (Three experiments).
4. Measurement of dielectric constants at microwave frequency.
5. Experiments with lattice dynamics kit.
6. Study of electron spin resonance in a paramagnetic crystal and calculation of Lange-g-factor.
7. Study of Curie temperature in a ferroelectric crystal and determination of dielectric constant.
8. Measurements of various magnetic parameters using hysteresis loop tracer.
9. Measurement of dielectric constant of a liquid/film using LCRQ meter.
10. Study of Hall effect in semiconductor crystals.

MSc. Physics (IV Semester)

Core Course 6

MSPH422: PROJECT

All the students have to carry out a project. The project work may be experimental or theoretical. Each student has to carry out his individual project. At the end of the semester each student has to submit a report of the work. The assessment of the project work will be done by the presentation of the work by the students.

MSc. (IV Semester)

Skill Course –IV

MSPHSC434: BASICS OF NANOSCIENCE

Introduction to Nanoscience: The nanoscale, History of Nanoscience and Technology, Differences between micro and nano type materials, Quantum confinement, Size dependent properties, Surface to volume ratio, Classification of nanomaterials.

Synthesis of Nanomaterials: Bottom-Up and Top-Down approach with examples, Sol-gel method, Mechanical-ball milling, Colloidal synthesis and capping of nanoparticles, biological synthesis, Characterization techniques: SEM, TEM, XRD.

Properties of Nanomaterials: Mechanical, Electrical, Thermal, Optical, Magnetic, Melting point, Application of Nanomaterials: Chemical, Environmental, Information and Communication, Nanoelectronics, Nano biotechnology, Drug delivery system.

Suggested Readings:

1. Nanotechnology: Principles and practices, S. K Kulkarni, Capital Publ. Co., New Delhi (2007).
2. Nanomaterials, A.K. Bandyopadhyay, New Age International Publications, 2009.
3. Nanomaterials: Synthesis, Properties and Applications, A.S. Edelstein and R.C. Cammearata, eds., Institute of Physics Publishing, Bristol and Philadelphia, 1996.
4. Nanoscale characterisation of surfaces & Interfaces, N John Dinardo, Weinheim Cambridge, Wiley-VCH, 2000.
5. Guozhong Cao and Ying Wang: *Nanostructures and Nanomaterials: Synthesis, Properties and Applications, 2nd Ed.*, World Scientific, Singapore, 2011.

BASICS OF NANOSCIENCE LAB WORK

1. Experiments with introductory Nano Kit. (Understanding nano scaling and demonstrating atomic arrangement).
   (Two Experiments)
2. Experiments based on Nano TiO_2 Solar Cell Trainer Kit
   (Four experiments)
3. Experiments based on ferro-fluid demonstrator.
   (Three experiments)
4. Some simple experiments on synthesis of few nanomaterials.