

M.Sc. (FINAL) PHYSICS, 2022

Scheme of examination :

Four Theory Papers Max. Marks 300

Practical Max. Marks 150

Paper-V : Condensed Matter Physics 3 hrs. duration 75 marks

Paper-VI : Nuclear And Particle Physics 3 hrs. duration 75 marks

Paper-VII A : Electronics, Digital Electronics &
Communication Electronics 3 hrs. duration 75 marks

OR

Paper-VII B : Analog, Digital Systems & Communication 3 hrs. duration 75 marks

OR

Paper-VII C : Medical Physics - I 3 hrs. duration 75 marks

Paper -VIII A : Physics of Lasers and Science &
Technology of Solar Hydrogen 3 hrs. duration 75 marks

OR

Paper-VIII B : Physics of Nanomaterials &
Environmental Physics 3 hrs. duration 75 marks

OR

Paper-VIII C : Medical Physics - II 3 hrs. duration 75 marks

Practical : Three laboratory each 5 hrs. duration, 150 marks (50+50+50)

General Lab : 50 marks (30+10+10)

Electronic Lab : 50 marks (30+10+10)

Project and Seminar : 50 marks (40+10)

Note: There will be one experiment of 5 hrs. duration for each lab on separate day for project and seminar. Supervisor for each student will be appointed in the beginning of the session and the viva-voice examination will be conducted by the Board consisting of two teacher one from the same college and other from the different university.

A candidate for pass the M.Sc. (Final) Physics examination shall be required to obtain at least 36% marks in aggregate both in four theory papers and practical separately. Apart from that candidate shall be required to obtain at least 25% marks in each individual theory paper.

If a candidate clears any paper (s) / practical after a continuous period of three years, than for the purpose of working out his/ her division, the minimum pass marks only viz 25% in case of theory (or 36% in case of practical) shall be taken into account in respect of such paper (s)/ practical.

Note: Non-collegiate candidates are not eligible to appear in the examination where practical is involved.

Work load: Each theory paper must be given 4 Hrs. (Or 6 periods) per week for theory and 1 pds per week for theory tutorial.

Practical must be given 30 periods per week per batch. Each laboratory batch for practical must not be of more than 10 students. This gives 120 Hrs. for each theory paper with 30 weeks of teaching every year.

M.Sc. PHYSICS (Paper V) :

CONDENSED MATTER PHYSICS

Time : 3 hrs.

Max. Marks : 75

Note: The question paper shall contain three sections. **Section A (20 marks)** shall contain 10 questions two from each Unit. Each question shall be of **2** marks. All the questions are compulsory. The answers should not exceed 50 words. **Section B (25 marks)** shall contain 5 questions (two from each unit with internal choice). Each question shall be of **5** marks. The

candidate is required to answer all 5 questions. The answers should not exceed 200 words. **Section C (30 marks)** shall contain 5 questions, one from each Unit. Each question shall be of **10** marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

Unit-01

Crystalline solids, unit cells and direct lattice, two and three dimensional Bravais lattices, closed packed structures.

Interaction of X-rays with matter, absorption of X-rays. Elastic scattering from a perfect lattice. The reciprocal lattice and its applications to diffraction techniques. The Laue, powder and rotating crystal methods, crystal structure factor and intensity of diffraction maxima.

Unit-02

Point defects, line defects and planer (stacking) faults. The role of dislocations in plastic deformation and crystal growth. The observation of imperfections in crystals, X-ray and electron microscopic techniques.

Electrons in a periodic lattice: Bloch theorem, band theory, classification of solids, effective mass. Tight-binding, pseudo potential methods.

Unit-03

Fermi surface, de Hass von Alfen effect, cyclotron resonance, magneto resistance, quantum Hall effect.

Paramagnetism- Langavlin theory, Weiss theory of ferromagnetism, Heisenberg model and molecular field theory. Spin waves and magnons. Curie-Weiss law for susceptibility, Ferri- and antiferro-magnetic order . Domains and Bloch-wall energy.

Unit-04

I Superconductivity : critical temperature, persistent current, Meissner effect, superconducting phase transitions, manifestations of energy gap. London theory, Cooper pairing due to phonons.

Unit-05

BCS theory of superconductivity, Ginzburg-Landau theory and application to Josephson effect : d-c Josephson effect, a-c Josephson effect, macroscopic quantum interference. Vortices and type II superconductors, high temperature superconductivity (elementary).

Text and Reference Books

Verma and Srivastava: Crystallography for Solid State Physics

Azaroff: Introduction to Solids

Omar: Elementary Solid State Physics

Aschroft & Mermin: Solid State Physics

Kittel: Solid State Physics

Chaikin and Lubensky: Principles of Condensed Matter Physics

Madelung: Introduction to Solid State Theory

Callaway: Quantum Theory of Solid State

Huang: Theoretical Solid State Physics

Kittel: Quantum Theory of Solids

M.SC. PHYSICS (Paper VI) :

NUCLEAR AND PARTICLE PHYSICS

Time : 3 hrs.

Max. Marks : 75

Note: The question paper shall contain three sections. **Section A (20 marks)** shall contain 10 questions two from each Unit. Each question shall be of **2** marks. All the questions are compulsory. The answers should not exceed 50 words. **Section B (25 marks)** shall contain 5 questions (two from each unit with internal choice). Each question shall be of **5** marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. **Section C (30 marks)** shall contain 5 questions, one from each Unit. Each question shall be of

10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Nucleon - nucleon interaction - Exchange forces and tensor forces - Meson theory of nuclear forces - Nucleon - nucleon scattering - Effective range theory - Spin dependence of nuclear forces - Charge independence and charge symmetry of nuclear forces - Isospin formalism - Yukawa interaction.

Direct and compound nuclear reaction mechanisms - Cross sections in terms of partial wave amplitudes - Compound nucleus - Scattering matrix - Reciprocity theorem - Breit - Wigner one -level formula - Resonance scattering.

UNIT-02

Liquid drop model - Bohr - Wheeler theory of fission - Experimental evidence for shell effects - Shell model - Spin - Orbit coupling - Magic numbers - Angular momenta and parities of nuclear ground states - Qualitative discussion and estimates of transition rates - Magnetic moments and Schmidt lines - Collective model of Bohr and Mottelson.

UNIT-03

Beta decay - Fermi theory of beta decay - Shape of the beta spectrum - Total decay rate - Angular momentum and parity selection rules - Comparative half - lives - Allowed and forbidden transitions - Selection rules - Parity violation - Two-component theory of neutrino decay - Detection and properties of neutrino - Gamma decay - Multipole transitions in nuclei - Angular momentum and parity selection rules - Internal conversion - Nuclear isomerism.

Unit-04

Ionizing radiations : Ionization and transport phenomena in gases, Avalanche multiplication.

Detector Properties : Detection, Energy measurement, Position measurement, Time measurement.

Gas Counters : Ionization chambers, - Proportional counters – Multiwire proportional counters -Geiger - Muller counters - Neutron detectors.

Solid State Detectors: Semiconductor detectors - Surface barrier detectors.

Scintillation counters: Organic and inorganic scintillators, Theory, characteristics and detection efficiency.

Unit-05

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

Types of interaction between elementary particles - Hadrons and leptons - Symmetry and conservation laws - Elementary ideas of CP and CPT invariance - Classification of hadrons - Lie algebra, SU(2) - SU(3) multiplets - Quark model - Gell - Mann - Okubo mass formula for octet and decuplet hadrons - Charm, bottom and top quarks.

Text and Reference Books

A. Bohr and B.R. Mottelson, Nuclear Structure, Vol. 1 (1969) and Vol.2, Benjamin, Reading, A, 1975.

Kenneth S.Kiane, Introductory Nuclear Physics. Wiley, New York,1988.

Ghoshal, Atomic and Nuclear Physics Vol. 2,

P. H. Perkins, Introduction to High Energy Physics, Addison-Wesley, London, 1982.

G. E. Brown and A. D. Jackson, Nucleon - Nucleon Interaction, North - Holland, Amsterdam, 1976.

S. de Benedetti, Nuclear Interaction, John Wiley and Sons, New York, 1964.

P. Marmier and E.Sheldon, Physics of Nuclei and Particles, Vol. I & II, Academic Press, New York, 1970.

H. A. Enge, Introduction to Nuclear Physics, Addison - Wesley, 1975.

S. S. Kapoor and V. S. Ramamurthy, Nuclear Radiation Detectors, Wiley - Eastern, New Delhi, 1986.

W. H. Tail, Radiation Detection. Butterworths, London, 1980.

W. J. Price, Nuclear Radiation Detection, Me Graw Hill, New York, 1964. R.M. Singru

M.SC. PHYSICS (Paper VII A) :

Electronics, Digital Electronics & Communication Electronics

Time : 3 hrs.

Max. Marks : 75

Note: The question paper shall contain three sections. **Section A (20 marks)** shall contain 10 questions two from each Unit. Each question shall be of **2** marks. All the questions are compulsory. The answers should not exceed 50 words. **Section B (25 marks)** shall contain 5 questions (two from each unit with internal choice). Each question shall be of **5** marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. **Section C (30 marks)** shall contain 5 questions, one from each Unit. Each question shall be of **10** marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

Unit-01

Differential amplifier - circuit configurations, dual input, balanced output differential amplifier, DC analysis , AC analysis, inverting and non inverting inputs CMRR , constant current bias level translator.

Block diagram of a typical Op-Amp-analysis. Open loop configuration inverting and non-inverting amplifiers. Op-amp with negative feedback, voltage series feed back, effect of feed back on closed loop gain input resistance output resistance bandwidth and output offset voltage, voltage follower.

Unit-02

Practical op-amp input offset voltage - input bias current - input offset current, total output offset voltage, CMRR frequency response.

DC and AC amplifier summing scaling and averaging amplifiers instrumentation amplifier, integrator and differentiator, Voltage regulators - fixed regulators - adjustable voltage regulators switching regulators

Unit-03

Oscillators principles, oscillator types, frequency stability, response, The phase shift oscillator. Wein bridge oscillator, LC tunable oscillators, Multivibrators - Monostable and Astable, comparators, square wave and Triangle wave generators.

Klystrons, Magnetrons and Traveling Wave Tubes, Velocity modulation, Basic principles of two cavity Klystrons and Reflex Klystrons, principles of operation of magnetrons.

Unit-04

Helix Traveling Wave Tubes, Wave Modes. Transferred electron devices, Gunn Effect, Principles of operation. Modes of operation, Read diode, IMPATT diode, TRAPATT Diode.

Advantages and disadvantages of microwave transmission, loss in free space, propagation of microwaves, atmospheric effects on propagation, Fresnel zone problem, ground reflection, fading sources, detectors, components, antennas used in MW communication systems.

Unit-05

Radar block diagram an operation, radar frequencies, pulse considerations. Radar range equation, derivation of radar range equation, minimum detectable signal, receiver noise, signal to noise ratio, Integration of radar pulses. Radar cross section. Pulse repetition frequency. Antenna parameters, system Losses and Propagation losses. Radar transmitters, receivers. Antennas, Displays.

Orbital satellites, geostationary satellites, orbital patterns, look angles, orbital spacing, satellite systems. Link modules.

Text and Reference Books

"Microelectronics" by Jacob Millman, Megraw-hill International Book Co., New Delhi, 1990

"Optoelectronics: Theory and Practice", Edited by Alien chappa). Me GrawHill Book Co., New York.

"Microwaves" by K.L. Gupta, Wiley Eastern Ltd., New Delhi, 1983

"Advanced Electronics Communications Systems" by Wayne Tomasi., Phi.Edn.

"Electronic Devices and circuit theory" by Robert Boylested and Louis Nashdsky PHI, New Delhi - 110001,1991

"OP-Amps & Linear integrated circuits," by Ramakanth A. Gayakwad PHI, Second Edition, 1991

"Digital principles and Applications" by A.P. Malvino and Donald P. Laach, Tata Megraw - Hill company. New Delhi,

1993. "Microprocessor Architecture, programming and Applications with 8085/8086 by Ramesh S. Gaonkar, Wiley - Eastern

Ltd., 1987 (for unit v)

M.SC. PHYSICS (Paper VII B) :

Analog, Digital Systems & Communication

Time : 3 hrs.

Max. Marks : 75

Note: The question paper shall contain three sections. **Section A (20 marks)** shall contain 10 questions two from each Unit. Each question shall be of **2** marks. All the questions are compulsory. The answers should not exceed 50 words. **Section B (25 marks)** shall contain 5 questions (two from each unit with internal choice). Each question shall be of **5** marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. **Section C (30 marks)** shall contain 5 questions, one from each Unit. Each question shall be of **10** marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Analog computation, active filters, comparators, logarithmic and anti-logarithmic amplifiers, sample and hold amplifiers, waveform generators. Square and triangular wave generators, pulse generator.

Read-only Memory (ROM) and applications. Random Access Memory (RAM) and applications.

Digital to-analog converters, ladder and weighted resistor types Analog to digital converters -counter type, successive approximation and dual slope converters, Applications of DACs and ADCs.

UNIT-02

Photo detectors : Photo detectors with external photo effect, photo detectors with internal photo effect, photo conductors and photo resistors, junction photo detectors.

Circuits with Light Emitting Diodes, Diode tester. Polarity and voltage tester, measuring instruments with LED indication, LED, Numeric and alphanumeric display units.

UNIT- 03

Semiconductor switches and potential isolation, The phototransistor as a switch in the optocouplers, steady state performance, dynamic performance, use of optocouplers.

Amplitude modulation - Generation of AM waves - Demodulation of AM waves - DSBSC modulation. Generation of DSBSC waves, Coherent detection of DSBSC waves, SSB modulation, Generation and detection of SSB waves. Vestigial sideband modulation. Frequency Division multiplexing (FDM).

Unit-04

The transistor as a switch, OR, AND and NOT gates, NOR and NAND gates, Boolean algebra, Demorgan's theorems, Exclusive OR gate, Decoder/Demultiplexer, Data selector/multiplexer, Encoder.

Flip - Flops : A I - bit memory, The RS Flip - Flop, JK Flip – Flop, JK master slave Flip – Flops, T Flip – Flop, D Flip – Flop, Shift registers, synchronous and asynchronous counters, cascade counters.

Unit-05

Introduction to microcomputers, memory, input/output, Interfacing devices 8085 CPU, Architecture, BUS timings, Demultiplexing the address bus generating control signals, Instruction set, addressing modes, Illustrative programmes, writing assembly language programmes looping, counting and indexing, counters and timing delays, stack and subroutine,

Text and Reference Books

"Electronic Devices and circuit theory" by Robert Boylested and Louis Nashdsky PHI, New Delhi - 110001,1991

"OP-Amps & Linear integrated circuits," by Ramakanth A. Gayakwad PHI, Second Edition, 1991

"Digital principles and Applications" by A.P. Malvino and Donald P. Laach, Tata Megraw - Hill company. New Delhi,

1993. "Microprocessor Architecture, programming and Applications with 8085/8086 by Ramesh S. Gaonkar, Wiley – Eastern Ltd., 1987

"Microelectronics" by Jacob Millman, Megraw-hill International Book Co., New Delhi, 1990

"Optoelectronics: Theory and Practice", Edited by Alien chappa). Me GrawHill Book Co., New York.

"Advanced Electronics Communications Systems" by Wayne Tomasi., Phi.Edn.

M.SC. PHYSICS (Paper VII C) :

MEDICAL PHYSICS - I

Time : 3 hrs.

Max. Marks : 75

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UNIT 1

Radiation Detection and Measurement

Principles of measurements of radiation and radioactivity. Gas filled Ionization chamber, proportional counters, GM counters, Scintillation detectors, semiconductor detectors, BF₃ counters for neutron detection.

TLD dosimetry: process and properties, glow curves and dose response, photon energy dependence, fading, physical form of TLD materials, residual TL and annealing for reuse, repeated read out of TLD's. TL instrumentation, ultrathin TLD's, graphite /boron carbide mixed TLD'S glow curve analysis.

UNIT 2

Ionization Dosimetry

Theoretical aspects of ionization dosimetry-Bragg-Gray theory-Models and equations-practical aspects of ionization dosimetry-characteristics of ionization chambers-polarity effect-stability and collection efficiency-principles of low current measurements.

Measurement of absorbed dose: calculation of absorbed dose from exposure-Bragg-gray cavity theory-.Other methods of measuring absorbed dose: calorimetry- Chemical dosimetry-solid state methods; -Silicon diodes-Radiographic film-Radiocromic film.

UNIT 3

Low and medium energy dosimetry and high energy Dosimetry

In phantom measurements–reference conditions-comparison with ICRU equations-in air measurements-comparison of two methods-Exposure and kerma calibrations(in air)-K-curves-D-curves-concept of CPE and TE-Determination of in water absorbed dose-Graphite dosimetric calibration.

Historical developments-High energy photon dosimetry-CSDM,SAM models-constants-development of electron beam dosimetry-concept of cavity gas calibration factor for high energy dosimetry-development of new high energy dosimetry formalism-reference depth-Gradient correction-saturation correction-average stopping power ratio-comparison of electron and photon dosimetry-electron beam dose transfer formalism.

UNIT 4

Dosimeters and survey meters

Dosimeters: Primary standard dosimeters, secondary standard dosimeters, Victoreen R meter, dosimeter based on current measurements, radio isotope calibrator, multi purpose

dosimeters -water phantom dosimetry systems, Brach therapy dosimeters. Calibration and maintenance of dosimeters.

Instruments for personal monitoring, digital pocket dosimeters using solid state devices, and GM counters, teledetectors, portable survey meters, gamma area (zone) alarm monitors, contamination monitors for alpha, beta and gamma radiations, scintillation monitors for X ray and gamma radiation –neutron monitors- tissue equivalent survey meter-flux meters, dose equivalent monitors.

UNIT 5

Standardization of electrons,x-ray and gamma rays beams

Determination of exposure and air kerma, conditions for the realization of exposure, ionization chamber for low, medium and high energy x-rays and gamma rays, determination of absorbed dose, Bragg Gray theory and its validity, Burlin's theory for measurement for radiation quantities,

Standardization of x-ray and high energy beams, design of free air chambers, characteristics of free air chambers and graphite chambers, intercomparison of standard chambers for ensuring traceability, standardization of electron beams used in radiotherapy – calibration of secondary standards.Details of IAEA and other protocols for dosimetry of photon beams.

Standardization of Brachy therapy sources and sealed source in terms their radiation output, calibration of protection level dosimeters in terms of dose equivalent units.

BOOKS FOR STUDY AND REFERENCE

H.E. Jones and J.R. Cunningham, The Physics of Radiology, Charles C.Thomas. New York (1980).

B.H. Brown, R.H. Smallwood, D.C. Barber, P.V. Lawford and D.R. Hose, Medical Physics and Biomedical Engineering, Overseas Press India Private Limited, New Delhi (2005).

The Physics of Radiation Therapy Faiz .M. Khan, Williams & Willkinds (2003).

IAEA Technical Reports Series Number 398, Vienna 2000.

Advanced Medical Radiation Doseimetry, Govindharajan; Prentice Hall of India(Pvt) Ltd 1992.

Physics of electron beam therapy: SC Klevenhagen, Medical physics handbooks 13; Adem Hilger Ltd,Bristol and Boston (1985) M.

M.SC. PHYSICS (Paper VIII A) :

PHYSICS OF LASERS AND SCIENCE & TECHNOLOGY OF SOLAR HYDROGEN

Time : 3 hrs.

Max. Marks : 75

Note: The question paper shall contain three sections. **Section A (20 marks)** shall contain 10 questions two from each Unit. Each question shall be of **2** marks. All the questions are compulsory. The answers should not exceed 50 words. **Section B (25 marks)** shall contain 5 questions (two from each unit with internal choice). Each question shall be of **5** marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. **Section C (30 marks)** shall contain 5 questions, one from each Unit. Each question shall be of **10** marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Laser Characteristics

Gaussian beam and its properties. Stable Two-Minor Optical Resonators, Longitudinal and Transverse Modes of Laser Cavity. Mode Selection, Gain in a Regenerative Laser Cavity. Threshold for 3 and 4 level Laser Systems. Mode Locking Pulse Shortening - Picosecond & femtosecond operation, Spectral Narrowing and Stabilization.

UNIT-02

Laser Fluorescence and Raman Scattering and their use in pollution studies, Non-Linear interaction of Light with matter, Laser induced multiphoton processes and their applications, Ultrahigh resolution Spectroscopy with lasers and its applications, Propagation of light in a medium with variable refractive index. Optical Fibers. Light wave communication. Qualitative treatment of Medical and Engineering applications of Lasers.

UNIT-03

Ruby Laser, Nd-YAG Laser, Semi Conductor Lasers, Diode-Pumped Solid State Lasers, Nitrogen Laser, Carbon-dioxide Laser, Excimer Laser, Dye Laser, High Power Laser Systems.

Fundamentals of photovoltaic Energy Conversion Physics and Material Properties Basic to Photovoltaic Energy Conversion: Optical properties of Solids. Direct and indirect transition semiconductors, interrelationship between absorption coefficients and band gap recombination of carriers.

UNIT-04

Types of Solar Cells, p n junction solar cell, Transport Equation, Current Density, Open circuit voltage and short circuit current, Brief descriptions of single crystal silicon and amorphous silicon solar cells, elementary ideas of advanced solar cells e.g. Tandem Solar Cells. Solid Liquid Junction Solar Cell.

Elements of Solar Thermal Energy, Wind Energy and Ocean Thermal Energy Conversion.

UNIT-05

Principles of Photoelectrochemical solar cells, Relevance in relation to depletion of fossil fuels and environmental considerations. Solar Hydrogen through Photoelectrolysis and Photocatalytic process. Physics of material characteristics for production of Solar Hydrogen.

Brief discussion of various storage processes, special features of solid state hydrogen storage materials, structural and electronic characteristics of storage materials. New Storage Modes.

Various factors relevant to safety, use of Hydrogen as Fuel, Use in Vehicular transport, Hydrogen for Electricity Generation, Fuel Cells, Elementary concepts of other Hydrogen Based devices such as Air Conditioners and Hydride Batteries.

Text and Reference Book

Svelto: Lasers

Yariv: Optical Electronics

Demtroder: Laser Spectroscopy

Letekhov: Non-Linear Laser Spectroscopy

Fonash : Solar Cell Devices – Physics

Fahrenbruch & Bube : Fundamentals of Solar Cells Photovoltaic Solar Energy

Chandra : Photoelectrochemical Solar Gells

Winter & Nitch (Eds.) : Hydrogen as an Energy Carrier Technologies Systems Economy

M.SC. PHYSICS (Paper VIII B) :

PHYSICS OF NANOMATERIALS & ENVIRONMENTAL PHYSICS

Time : 3 hrs.

Max. Marks : 75

Note: The question paper shall contain three sections. **Section A (20 marks)** shall contain 10 questions two from each Unit. Each question shall be of **2** marks. All the questions are compulsory. The answers should not exceed 50 words. **Section B (25 marks)** shall contain 5 questions (two from each unit with internal choice). Each question shall be of **5** marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. **Section C (30 marks)** shall contain 5 questions, one from each Unit. Each question shall be of **10** marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Free electron theory [qualitative idea] and its features, Idea of band structure, Metals, insulators and semiconductors, Density of state in bands, Variation of density of states with energy, Variation of density of state and band gap with size of crystal.

UNIT-02

Electron confinement in infinitely deep square well, confinement in two and one dimensional well, Idea of quantum well structure, Quantum dots, Quantum wires.

Determination of particle size, Increase in width of XRD peaks of nanoparticles, Shift in photoluminescence peaks, Variations in Raman spectra of nanomaterials

UNIT-03

Different methods of preparation of nanomaterials, Bottom up: Cluster beam evaporation, Ion beam deposition, Chemical bath deposition with capping techniques and Top down : Ball Milling.

Structure and thermodynamics of the atmosphere. Composition of air. Greenhouse effect. Transport of matter, energy and momentum in nature. Stratification and stability of atmosphere. Laws of motion, hydrostatic equilibrium. General circulation of the tropics. Elements of weather and climate of India.

UNIT-04

Physics of radiation. Interaction of light with matter. Rayleigh and Mie scattering. Laws of radiation (Kirchoffs law, Planck's law, Beer's law, Wien's displacement law, etc.). Solar and terrestrial spectra. UV radiation. Ozone depletion problem. IR absorption energy balance of the earth atmosphere system.

Elementary fluid dynamics. Diffusion. Turbulence and turbulent diffusion. Factors governing air, water and noise pollution. Air and water quality standards. Waste disposal. Heat island effect. Land and sea breeze. Puffs and plumes. Gaseous and particulate matters. Wet and dry deposition

UNIT-05

Energy sources and combustion processes. Renewable sources of energy. Solar energy, wind energy, bio-energy, hydropower, fuel cells, nuclear energy. Forestry and bioenergy.

Elements of weather and climate. Stability and vertical motion of air. Horizontal motion of air and water. Pressure gradient forces. Viscous forces. Inertia forces. Reynolds number. Enhanced Greenhouse Effect. Energy balance- a zero-dimensional Greenhouse model. Global climate models.

Text and Reference Books

Nanotechnology Molecularly designed materials by Gan-Moog Chow, Kenneth E. Gonsalves, American Chemical Society

Quantum dot heterostructures by D. Bimerg, M. Grundmann and N.N. Ledentsov, John Wiley & Sons, 1998.

Nano technology : Molecular speculations on global abundance by B.C. Crandall, MIT Press 1996.

Physics of low dimensional semiconductors by John H. Davies, Cambridge Univ. Press 1997. Physics of semiconductor nano structures by K.P. Jain, Narosa 1997.

Nano fabrication and bio system : Integrating materials science engineering science and biology by Harvey C. Hoch, Harold G. Craighead and Lynn Jelinski, Cambridge Univ. Press 1996.

Nano particles and nano structured films; Preparation characterization and applications Ed. J.H Fendler, John Wiley & Sons 1998.

Egbert Boeker & Rienk Van Groundelle : Environmental Physics (Joha Wiley).

J.T. Houghton : The Physics of Atmosphere (Cambridge University Press, 1977).

J.Twidell and J. Weir : Renewable Energy Resources (Elbs, 1988).

Sol Wieder : An Introduction to Solar Energy for Scientists and Engineers (John Wiley, 1982).

R.N. Keshavamurthy and M. Shanker Rao : The Phisics of Monsoons (Allied Publishers, 1992).

G.J. Haltiner and R.T. Williams : Numerical Weather Prediction (John Wiley, 1980).

M.SC. PHYSICS (Paper VIII C) :

MEDICAL PHYSICS -II

Time : 3 hrs.

Max. Marks : 75

Note: The question paper shall contain three sections. **Section A (20 marks)** shall contain 10 questions two from each Unit. Each question shall be of **2** marks. All the questions are compulsory. The answers should not exceed 50 words. **Section B (25 marks)** shall contain 5

questions (two from each unit with internal choice). Each question shall be of **5** marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. **Section C (30 marks)** shall contain 5 questions, one from each Unit. Each question shall be of **10** marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT 1

Biosignal acquisition, Bioelectric signal recording and Physiological assist devices

Physiological signal amplifiers-isolation amplifiers-differential amplifiers-bridge amplifiers-chopper amplifiers-noises and CMRR –medical preamplifier design, Bioelectric potentials-resting and action potentials-half cell potential-surface,needle and micro electrodes,electrical equivalent circuits-ECG,EMG,EEG recording circuits.

Cardiac pace makers-natural and artificial pace makers-pace maker batteries - defibrillator- AC/DC. Synchronised defibrillator-stimulators-bladder stimulators - heart lung machine.

UNIT 2

Clinical equipments, Operation theatre equipments, Biotelemetry and safety instrumentation

Various types of oxygenators - kidney machine-hemodialyzing units-peritoneal dialysis. Flame photometer- spectro-fluorophotometer - pH meters. Audiometers-endoscopes-electromagnetic and laser blood flow meters-ventilators –diathermy units-ultrasonic,micro wave diathermy techniques.

Design of a biotelemetry system, radiotelemetry with subcarrier-multiple channel telemetry systems-problems in implant telemetry-uses of biotelemetry-physiological effects of 50 HZ current –microshock and macro shock-electrical accidents in hospitals-devices to protect against electrical hazards.

UNIT 3

Radiation Protection Standards and Regulations

Need for protection, philosophy of radiation protection, basic radiation protection criteria, External and internal exposure, additive risk model and multiplicative risk model. Risk coefficients. Dose to the foetus. Dose limits for occupational exposure, for public and special exposure situations. ICRP and AERB recommendations. Basic safety standards. Source, practices, types of exposures, interventions. Atomic energy act, Radiation protection Rules, Notifications, Transport regulations, Waste disposal rules, Food irradiation rules, licensing, approval of devices, installations, sites and packages containing radioactive material. Source of radioactive waste and classification of waste, treatment techniques for solid, liquid and gaseous effluents, permissible limits for disposal of waste, sampling techniques for air, water and solids, ecological consideration, general methods of disposal, management of radioactive waste in medical and research institutions.

UNIT 4

Radiation Shielding

Shielding calculation for gamma radiation, choice of material, Primary and secondary radiation, source geometry, discrete sources, point, kernel method, introduction to Monte Carlo method, Beta shielding, Bremsstrahlung. Neutron shielding, scattering and absorption, activation of the shielding material, heat effects. Optimization of shielding, gamma, electron, neutron irradiation facilities. Transport and storage of containers for high activity sources. Shielding requirements for medical and research facilities including accelerator installations.

UNIT 5

Diffusion: (a) Ficks first law (b) diffusion related to viscosity (c) Ficks second law and applications Transport through semipermeable membranes; (a) Osmotic pressure (b) plasma exchange in capillaries (c) Edema: osmotic diuresis: Osmotic fragility of red blood cells (d) Volume transport ; solute transport: the artificial kidney (e) external factors on solute molecules; ionic solute and equilibrium electric fields in membranes (f) Ion movement in solution involving diffusion, solvent drag and electrical fields (g) Nernst-Planck equation and the Goldman equation

Books for Study and Reference

Jacobson and Webster; Medicine and clinical engineering, Prentice Hall of India, New Delhi, 1979

R.S.Khandpur, Hand book of biomedical instrumentation, Tata McGraw Hill, New Delhi, 1990

M.Arumugam, Biomedical instrumentation, Anuradha publishing Co, Kumbakonam, Tamilnadu 1992.

Richard Aston, Principles of biomedical instrumentation and measurements, Merrill publishing Co, London, 1990.

R.F.Mould, Radiation Protection in Hospital, Adam Hilger Ltd., Bristol, 1985.

The essential Physics of Medical Imaging; Jerrold. T. Bushberg et.al, Lippincott Williams & Wilkins 2002.

Faiz. M. Khan, The Physics of Radiationtherapy, Lippincott Williams & Wilkins, Philadelphia, 3rd edition 2003.

A.Martin and S.A.Harbison, An introduction to Radiation Protection, John Wiley & Sons Inc., New York, 1981.

ICRP Publications (ALL)

AERB Safety codes(ALL)

NCRP Publications(ALL)

Hobbie, Russell 1988, Intermediate physics for medicine and biology(Wiley, NY)

Guyton A.C.1976 Text book of medical physiology 5 th ed (W.B.Saunders co. Philadelphia)

Ganong W F 1975 Review of medical physiology 7 th ed (Lange Los Altos CA)

PRACTICALS

LIST OF EXPERIMENTS :

Number of experiments to be performed by the students during the academic session should be atleast eight from each Laboratory.

A. General Laboratory Course

1. To Study frequency versus energy curve using magnet-magnet interaction using air track.
2. To study potential energy curve of magnet-magnet interaction using air track.

3. To study parametric amplifier for different initial length and variation of damping with mass of bob.
4. To draw the characteristic curve of GM counter.
5. To determine the end point energy of a beta ray source.
6. To write and run program using microprocessor 8085A.
7. To determine Resolving Power of a Telescope.
8. To write numerical analysis program and solving them using BASIC.
9. To determine velocity of Sound in Air by Standing Wave Method.
10. To study modulus of rigidity with temperature using torsional pendulum.
11. To determine Dielectric constant of liquid using Lechar wire method.
12. To determine wavelength of laser beam and study beam divergence.
13. Determine fine structure constant using sodium doublet.
14. Verify Cauchy's relation & determination of constants.
15. To determine e/m for an electron by Zeeman effect.
16. Determine the dissociation energy of Iodine molecule.
17. Determine of energy of a given ray from Re-De source.
18. Find out the percentage resolution of given scintillation spectrometer using Cs_{137}
19. Find out the energy of a given X-ray source with the help of scintillation spectrometer.
20. Plot the Gaussian distribution for a radioactive source.
21. Determine the dielectric constant of turpentine oil with the Lecher wire system.
22. To determine velocity of waves in water using ultrasonic interferometer.
23. To determine the magnetic susceptibility of two given samples by Gouy's method.
24. Determine of Lande's 'g' factor for IRRH crystal using electron spin resonance spectrometer.

Any other experiments of the equivalent standard can be set

B. Electronic Devices Laboratory Course

1. To Study LC Transmission Line
2. To Study Wide Band Amplifier.
3. To study RF oscillator using Hartley and Colpitts Method.
4. To study Wein bridge Oscillator.

5. To study Phase Shift Oscillator.
 6. To study RS & JK Flip Flop Circuits and to verify the Truth Tables.
 7. To study the SCR circuit.
 8. To study Absorption Coefficient of a Liquid using Photovoltaic cell.
 9. To study Fourier Analysis.
 10. To study Decade and Binary Counters.
 11. To study Two-input Multiplexer and to verify its Truth Table.
 12. Create a Pspice model of square wave generator/ Wein bridge oscillator using 741 Op-amp.
 13. To determine e/m of an electron by magnetron valve method.
 14. To determine e/k using transistor characteristics.
 15. To study dark and illumination characteristic of p-n junction solar cell and to determine (i) Its internal series resistance (ii) Diode ideality factor
 16. To study the characteristics of following semiconductor devices (i) VDR (ii) photo transistor (iii) Thermistor (iv) IED
 17. To study the characteristics of MOSTET and MSSFET amplifier.
 18. To study dark and illumination characteristics of p-n junction solar cell and to determine its (i) Maximum power available (ii) Fill factor.
 19. To study the frequency and phase Characteristic of band pass filter.
 20. Study the wave form characteristic of transistorized astable symmetrical multivibrator.
 21. CRO & determine its frequency by various C& R.
 22. Artificial transmission line.
- Any other Experiments of the equivalent standard can be set.

C. Special Lab/Project and Seminar :

1. To study the characteristic curve of Klystron.
2. To study the mode characteristics of reflex Klystron and hence to determine mode number, Transmit time, electronics, tuning range, electronic tuning sensitivity.
3. To study the E-Plane radiation pattern of pyramidal horn antenna and compute the beam

width of Antenna.

4. To study the H-plane radiation pattern of pyramidal horn antenna and compute the Directional gain of the Antenna.
5. To determine the dielectric constant of a given sample at Microwave frequency.
6. To determine the dielectric constant of a Benzene using plunger technique at room temperature.
7. To determine the unknown impedance using slotted line section Smith chart in the K-band.
8. To study the microwave absorption in dielectric sheets.

Any other experiments of the equivalent standard can be set.

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