School of Basic and Applied Sciences

Class	M.Sc. Physics (Previous)			
Semester/Year	II Year			
Subject & Subject Code	Physics Practical - MPHYS20Y106			
Paper	Paper - III & Paper - IV, Practical			
Max. Marks	60(ETE) + 40(IA) = 100			
Credit			Total Credits	
L	T	P	4	
0	0	4		

PRACTICALS

List of Experiments:

1 Design a Double stage R.C. Couped amplifier and study:

i. Frequency response.

ii. The amplitude characteristics.

2 Determine the capacitance, resistance and inductance of a coil at radio frequency and to study the variations of Z with frequency

3 Determine the gm & rp of a triode by bridge method and study the variation of these quantities with grid voltage

4 Study the series and parallel response circuit:

i. To plot the frequency response curve characteristics of series circuit.

ii. To plot the frequency response of parallel tuned circuit.

5 To design and study the frequency response of a cathode power.

6 To study the waveform characteristics of a stable multivibrator.

i. To design C.R.O. and determine its frequency by varying C&R.

7 To design and calibrate a Hartley Oscillator.

8 To study frequency response of phase characterstics of:

i. Low pass filter.

ii High pass filter.

9 To design & study the Dynatron oscillator.

10 Any other experiment of equivalent standard can be added.

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<table>
<tr><td colspan="4">Class</td><td>M.Sc. Physics (Final)</td></tr>
<tr><td colspan="4">Semester/Year</td><td>II Year</td></tr>
<tr><td colspan="4">Subject & Subject Code</td><td>Physics - MPHYS20Y201</td></tr>
<tr><td colspan="4">Paper</td><td>Advanced Quantum Mechanics & Quantum field Theory, Paper - I</td></tr>
<tr><td colspan="4">Max. Marks</td><td>60</td></tr>
<tr><td colspan="3">Credit</td><td>Total Credits</td><td></td></tr>
<tr><td>L</td><td>T</td><td>P</td><td rowspan="2">4</td><td rowspan="2"></td></tr>
<tr><td>4</td><td>0</td><td>0</td></tr>
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Course Objective
To make understanding of fundamentals of Advanced Quantum Mechanics and Quantum Field Theory.

Course Outcome
Student will understand –
1. Concept and Knowhow of Non-relativistic Scattering, Relativistic formulation and Direct equation related to Quantum mechanics.
2. Symmetries of Dirac equation and Quantum Field Theory.
3. S-Matrix Expansion and related scattering phenomena.

Student learning outcome
Student will able to -
1. Demonstrate a rigorous understanding of Advanced Quantum Mechanics involved in theories & principles of physics.
2. Sharpen his skill and knowledge and utilize/apply his knowledge in further research and science.

Unit	Syllabus	Periods
UNIT - I	Scattering (Non-relativistic)-: Differential and total scattering cross section, solution of scattering problem by the method of partial wave analysis, expansion of a plane wave into a spherical wave and scattering amplitude, optical theorem applications: scattering from the delta potential, square well potential and hard sphere, scattering of identical particles, energy dependence and resonance scattering, Breit Wigner formula, quasi stationary state, Lippman Schwinger equation and the Green's function approach for scattering problem, Born approximation and its validity for scattering problem, Coulomb scattering problem under first Born approximation in elastic scattering.	15
UNIT - II	Relativistic Formulation and Direct equation: Attempt for relativistic formulation of quantum theory, Klein-Gordon equation, probability density and probability current density, solution of free particle K.G. equation in momentum representation, interpretation of negative probability energy solutions, Dirac equation for a free particle, properties of Dirac matrices and algebra of gamma matrices, non-relativistic correspondence of the Pauli equation (inclusive of electromagnetic interaction), Solution of the free particle, Dirac equations, orthogonality & completeness relation for Dirac spinors, interpretation of negative energy solutions & hole theory.	15

Shama Nidhi

Unit	Syllabus	Periods
UNIT - III	Symmetries of Dirac Equation: Lorentz boost, Lorentz covariance of Dirac equation, Proof of covariance & derivation of Lorentz transformation matrix and rotation matrices for Dirac spinors, projection operators involving four momentum & spin, parity (P), charge conjugation (C), time reversal (T) and CPT operators for Dirac spinors, bilinear covariant and their transformation behavior under Lorentz transformation, P, C, T & CPT, expectation values of coordinate & velocity involving only positive energy solutions, Zitter Bewegung, Klein paradox.	15
UNIT - IV	Photon as a quantum mechanical excitations of radiation field, fluctuations and the uncertainty relation, validity of classical description, matrix element for emission and absorption, spontaneous emission in the dipole approximation, Rayleigh scattering, Thomson scattering & Raman effect, Radiation damping & resonance florescence. Quantum Field Theory:- Scalar and vector fields, Classical Lagrangian field theory, Euler Lagrange's equation, Lagrangian density for electromagnetic field, occupation number representation for simple harmonic oscillator, linear array of coupled oscillators, second quantization of systems of identical bosons, second quantization of real Klein-Gordan field and complex Klein-Gordan field, meson propagator, second quantization of systems of identical bosons.	15
UNIT - V	Occupation number representation for Fermions, second quantization of the Dirac field, Fermion propagator the e. m interaction & gauge invariance, covariant quantization of the free electromagnetic field, photon propagator. S-Matrix: S-matrix expansion, Wick's theorem, diagrammatic representation in configuration space, momentum representation, Feynman rules of QED, Feynman diagrams of basic processes, Application of s-matrix formalism, Coulomb scattering, Bhabha scattering, Moller scattering, Compton scattering and Pair production.	15

References:

1 Quantum mechanics, A modern approach-Ashok Das & A.C. Melissions (Gordon & Breach Science Publishers).

2 Quantum Mechanics (second edition)-E. Merzbeker (John Wiley)

3 Relativistic Quantum Mechanics -Bjorken & Drell (Mc Graw hill)

4 Advanced Quantum Mechanics -J.J. Sakurai (John Wiley & Sons)

5 Quantum mechanics-Thankpapn V.K. (Wiley Eastern ltd. New Delhi)

6 Quantum field Theory-F. Mandal & G Shaw (John Wiley)

7 Elements of Advanced Quantum Theory- J.M. Ziman (Cambridge)

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School of Basic and Applied Sciences

Class				**M.Sc. Physics (Final)**
Semester/Year				**II Year**
Subject & Subject Code				**Physics - MPHYS20Y202**
Paper				**Nuclear Physics, Paper - II**
Max. Marks				**60(ETE) + 40(IA) = 100**
Credit			**Total Credits**	
L	**T**	**P**	**4**	
4	**0**	**0**		

Course Objective

1. To make understanding of fundamentals of Nuclear Physics in order to deepen the understanding of nuclear particles, their interactions, Different nuclear models.
2. To make understanding of Radioactive decays and its related phenomenon. And the working and function of detectors.

Course Outcome

Student will understand –

1. Nuclear interactions among nucleons.
2. Nucleon-Nucleon scattering and potentials
3. Different nuclear models for understanding of Nucleus and related topics.
4. Radioactive decay viz. Gama and beta decay, transition probability and related rules.
5. Theories of nuclear reactions & Interaction of Neutrons, EM Radiation and Charged Particles with Matter.
6. Experimental techniques involved in different detectors. Nuclear emulsions techniques of measurement and analysis of tracks, proton synchrotron, electron accelerator and neutron generators, acceleration of heavy ions.

Student learning outcome

Student will able to -

1. Demonstrate a rigorous understanding of Advanced Quantum Mechanics involved in theories & principles of physics.
2. Sharpen his skill and knowledge and utilize/apply his knowledge in further research and science.

Unit	**Syllabus**	**Periods**
UNIT - I	Two Nucleon System and Nuclear Forces: General nature of the force between nucleons, saturation of nuclear force, charge independence & spin dependence, general forms of two nucleon interaction, central, non-central & velocity dependent potential, analysis of the ground state (3S1) of deuteron using a square well potential, range depth relationship, excited states of deuteron, discussion of the ground state of deuteron under non central forces.	15

Unit	Syllabus	Periods
UNIT - II	Nucleon-Nucleon Scattering & Potentials: Partial wave analysis of two neutron-proton scattering at low energy assuming a central potential with square well shape, concept of the scattering length, Coherent scattering of neutrons by protons in (ortho & para) hydrogen molecule, conclusion of these analysis regarding scattering lengths, range & depth of the potential, effective range theory (in neutron- proton scattering) and shape independence of nuclear potential, A qualitative discussion of proton-proton scattering at high energy, hard core potentials and Red hard core and soft core potentials, main features of the One Boson Exchange Potential (OBEP) (no derivation).	15
UNIT - III	Nuclear shell Model: Single particle & collective motions in nuclei, assumption & justification of the shell model, average shell potential, spin orbit coupling, single particle wave functions and level sequence, magic numbers, shell model predictions for ground state parity, angular momentum and their comparison with experimental data, configuration mixing, single particle transition probability according to the shell model, selection rules, approximate estimates for transition probability and Weisskopf units, nuclear isomerism. Collective nuclear models: Collective variables to describe the collective models of nuclear motion, Parameterization of nuclear surface, A brief description of the collective model Hamiltonian (in the quadratic approximation), vibrational modes of spherical nuclei, collective modes of deformed even- even nucleus and moments of inertia, collective spectra and electromagnetic transitions in even nuclei and comparison with experimental data, Nilsson model for the single particle states in deformed- nuclei.	15
UNIT - IV	Nuclear Gamma & Beta Decay: Electric & Magnetic multipole moments and gamma decay probabilities in nuclear system (no derivation), reduced transition probability, selection rules: internal conversion & zero-zero transition. General characteristics of weak interactions, Nuclear beta and lepton capture, electron energy spectrum and Fermi-Kurie plot. Fermi theory of beta decay (parity conserved selection rules Fermi and Gamow Teller) for allowed transition : ft-values, general interaction Hamiltonian for beta decay with parity conserving and non conserving terms, forbidden transition, experimental verification of parity violation. Nuclear Reactions: Theories of nuclear reactions, partial wave analysis of reaction cross section: compound nucleus formations & break-up, resonance, scattering & reaction, Breit Wigner dispersion. formula for S-Wave (l=0), continuum cross section: statistical theory of nuclear reactions, evaporation probability and cross section for specific reactions, electric quadruple & magnetic dipole moments, state mixture. The optical model, stripping and pickup reactions and their simple theoretical description (Butler Theory) using plane wave Born approximation (PWBA), short comings of PWBA, nuclear structure studies with deuteron proton stripping (d,p) reaction.	15

Shama

Unit	Syllabus	Periods
UNIT - V	Interaction of Neutrons, EM Radiation and Charged Particles with Matter: Law of absorption and attenuation coefficients, slowing down & law for neutron capture photoelectric effect, Compton Scattering, pair production, Klein Nishima cross section for polarized & unpolarized radiation, angular distribution of scattered photon & electrons, energy loss of charged particles due to ionization, Bremsstrahlung energy, target and projectile dependence of all three processes range energy curves straggling. Experimental techniques: Gas filled counters, BF counter, scintillation counters, solid state detectors, surface barrier detectors, neutron activation detector, electronic circuits used with typical nuclear detector properties, chambers Nuclear emulsions techniques of measurement and analysis of tracks, proton synchrotron, electron accelerator and neutron generators, acceleration of heavy ions.	15

References:

1 Theoretical Nuclear Physics: J.M. Blatt & V.E. WeissKipf.
2 Introductory Nuclear theory: -L.R.B. Elton, ELBS Publs. London 1959.
3 Nuclear physics: - B.K. Agarwal, Lok Bharti Prakashn. Allahabad 1989.
4 Nuclear Structure: -M. K. Pal, Affiliated East West Press, 1982.
5 Nuclear physics: - R.R. Roy & B.P. Nigam. Willy Basten, 1979
6 Structure of the Nucleus: - M.A. Preston & R.K. Bhaervi, Addison Wesley.
7 Introductory Experimental Nuclear Physics: - R.M. Singru Wiley Easten pvt. Ltd.
8 Nuclear Physics: - Techniques of Nuclear Structure (vol. I) England.
9 The Atomic Nucleus: - R.D. Evans Mc Graw Hill, 1955.
10 Introduction to Nuclear Physics:-H. Enge. Addison Wesley, 1970.
11 Elements of Nuclear Physics: - W.E. Burcham, ELBS Longman, 1988.
12 Concepts of Nuclear Physics: - B.L. Cohen, Tata Mc Graw Hill, 1988.
13 Nuclei & Particles -E. Segre, Benjamin 1972.
14 Nuclear Physics: - I. Kaplan, Addison Wesley 1963
15 Introductory Nuclear Physics:-D.Halliday Willey 1955
16 Introduction of Nuclear Physics & Chemistry:-Harvey.
17 The Physics of Nuclear Reactions:-W.M. Gibson, Pergamum Press.
18 Nuclear Interaction: - S. De Benedetti, Wiley 1955.

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School of Basic and Applied Sciences

Class				**M.Sc. Physics (Final)**
Semester/Year				**II Year**
Subject & Subject Code				**Physics - MPHYS20Y203**
Paper				**Solid state Physics, Paper- III**
Max. Marks				**60(ETE) + 40(IA) = 100**
Credit			**Total Credits**	
L	**T**	**P**	**4**	
4	**0**	**0**		

Course Objective

1. To make understanding of fundamentals of Solid State Physics in order to deepen the understanding of Lattice vibrations, Band theory.
2. To make understanding of defects, nano science and technology.
3. Student will learn and understand the concept, theory and applications of Semiconductors and superconductivity.

Course Outcome

The students are expected to acquire the knowledge of the following:

1. Lattice vibrations and thermal properties of Solids.
2. Theory of metals and band theory of metals.
3. Working and functioning of semiconductors and its related phenomenon.
4. Introduction to nano-science and technology.
5. Imperfection in solids.
6. Quantum Statistics and Elementary Excitations of Electron Gas.
7. Group theory, (i) Representation of the triangle and space group of a crystal along with Normal modes of vibration of O_3 molecule.

Student learning outcome

Student will able to -

1. Demonstrate an understanding of Solid state physics, involved in theories & principles of physics.
2. Sharpen his skill and knowledge and utilize/apply his knowledge in further research and science.

Unit	Syllabus	Periods

Shama Neelam

Unit	Syllabus	Periods
UNIT - I	**Lattice Vibrations and Thermal Properties:** Lattice specific heat, theoretical estimates of Einstein and Debye temperatures, Wave mechanics of phonons, Creation and annihilation operators, Elastic waves and lattice vibration in one dimensional crystal, Long range forces and the reciprocal lattice method, Lattice vibration of a diatomic linear chain, Dispersion relation for three dimensional crystals, Born- Von Karmon boundary conditions and density of states, Experimental observation of phonon frequencies, equation of state of the crystal lattice, Thermal Conductivity of insulators.	15
UNIT - II	Theory of Metals: Fermi Dirac Distribution Function, density of states, temperature dependence of Fermi energy, Specific heat, Boltzmann equation and mean free path, relaxation time and scattering processes, thermal conductivity and electrical conductivity (using F-D statistics). Widemann-Franz ratio, susceptibility, Drude's theory of light absorption in metals, Hall effect. Band theory of metals: Bloch theorem, Kronig-penny model, Effective mass of electrons. Wigner-seitz approximation, nearly free electron model, tight binding method and calculation of density of states for S-band in simple cubic lattice, Cyclotron Resonance and Hall effect, de-Hass van Alphen effect, Experimental methods in determination of band structure, Limitations of band theory.	15
UNIT - III	Semiconductors: Law of mass action, calculation of impurity conductivity, ellipsoidal energy surfaces in Si and Ge, Hall effect recombination mechanism, Optical transitions and Shockley Read theory, excitons, photoconductivity, photo luminescence. Nano-Science and Nano-Technology: Introduction to nano-science, nano-technology and nano- materials, evolution of nano-technology from micro-technology. Imperfection in solids: Point, line planer and defects, colour centers, F-Centre and aggregate centers in alkali halides, John Teller effect, Single crystal growth, crystal whiskers.	15
UNIT - IV	Magnetism: Larmor diamagnetism, paramagnetism, Curie Langevin classical theory, Quantum theory of paramagnetism, susceptibility of rare and transition metals, Ferromagnetism: Weiss theory Quantum theory of Ferromagnetism, origin of domains, Bloch Walls, Anti ferromagnetism, Ferrites, Magnons, magnetic resonance, Nuclear magnetic resonance, magnetic materials. Superconductivity: Electromagnetic Properties, Thermal properties, isotope effect and electron phonon interaction, microscopic theory of superconductivity, Mc Millan's formula (no derivation), High temperature superconductivity in cuprates, fullerenes (basic ideas), Organic supper conductors (basic ideas), Superconducting tunneling, application of super conductivity.	15

Shama

Unit	Syllabus	Periods
UNIT - V	Quantum Statistics and Elementary Excitations of Electron Gas: Simple harmonic oscillator, Annihilation and creation Operators, coupled oscillators, linear chain, Bosons, Fermions, second Quantization, Hamiltonian for two particles, Fermions Boson Interaction, Landau theory of Fermi liquids. Group theory: Group, Group Multiplications table, Representation of group (i) Representation of the triangle group (ii) Representation of the space group of a crystal. (iii) Normal modes of vibration of O_3 molecule.	15

References:

1 Intermediate Quantum theory of solids- A.D. E .Animalu, (Prentice Hall).
2 Solid state Physics-Kittel, (John Wiley 7th ed.).
3 Quantum theory of Solids- Kittel, (John Wiley).
4 Solid State Physics Source books- S.P. Parker, (Mc. Graw Hill).
5 Quantum Solid State Physics-S. V. Vonsovsky & M.I. katsnelson, (Springer Verlag)
6 High. T. Superconductivity- Sinha, (Nova Science, New York USA)

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Class	**M.Sc. Physics (Final)**
Semester/Year	**II Year**
Subject & Subject Code	**Physics - MPHYS20Y204**
Paper	**Solid State Electronics, Paper - IV**
Max. Marks	**60(ETE) + 40(IA) = 100**

Credit			Total Credits
L	**T**	**P**	**4**
4	**0**	**0**	

Course Objective
To understand of fundamentals of Solid state electronics

Course Outcome
The students are expected to acquire the knowledge of the following:
1. Semiconductor Physics
2. Poly crystalline and Amorphous Semiconductors
3. Semiconductor Diodes
4. Bipolar Transistors and Thyristors & JFETS, MESFETS and MOSFETS
5. Interaction of electrons with acoustic and optical phonons, polarons, Superconductivity

Student learning outcome
Student will able to -
1. Demonstrate an understanding of Solid state Electronics.
2. Sharpen his skill and knowledge and utilize/apply his knowledge in further research and science.

Unit	Syllabus	Periods
UNIT - I	Semiconductor Physics: Energy band diagrams of actual semiconductors likes Si, Ge and GaAs, impurity doping and impurity energy levels, Calculation of Fermi level and conductivity of semiconductors, Injection of carriers, diffusion, Drift and continuity equation (band to band), trap assisted and Auger recombination, low injection and high injection, quasi Fermi levels.	15
UNIT - II	Poly crystalline and Amorphous Semiconductors: Semiconductor surfaces, surface charge and surface barrier, poly crystalline semiconductor, properties of grain boundaries, poly silicon as gate material, electrical conduction in amorphous semiconductors, mobility edge band, details and dangling band States.	15

Unit	Syllabus	Periods
UNIT - III	Semiconductor Diodes: PN junction, Depletion region capacitance, current voltage relation, recombination in space charge region and diode ideality factor, junction breakdown and avalanche multiplication, a-c response, diffusion capacitance, switching properties, reverse recovery, PINB diode hetro junctions, metal semiconductor barrier, Schottky thermionic and diffusion currents and measurement of barrier height.	15

Unit	Syllabus	Periods
UNIT - IV	Bipolar Transistors and Thyristors: General characteristics of Bipolar junction transistors, voltage rating, factors controlling current gain, frequency performance, power transistors, switching of bipolar transistor, basic concept of PNPN structures, thyristor's turn on, turn off and power consideration triacs. JFETS, MESFETS and MOSFETS: JFET modeling including saturation velocity effects, GaAs MESEFT, MOS diodes, surface space charge regions, surface states, MOSEFT, surface space charge region under no equilibrium condition channel conductance, basic characteristics, current voltage and device parameters.	15
UNIT - V	Interaction of electrons with acoustic and optical phonons, polarons, Superconductivity : Manifestations of energy gap, Cooper pairing due to phonons, BCS theory of superconductivity, Ginzsburg – Landau theory and application to Josephson effect : d-c-Josephson effect, a-c Josephson effect, macroscopic quantum interference. Vortices and type II superconductors, high temperature superconductivity (elementary).	15

References:

1 Semiconductor Physics-K Seeger, Springer-Verlag

2 Solid state and Semiconductor Physics- John p. McKinley, Harper & Row

3 Semi-Conductors Devices- G Mnnes, Integrated Electronics Van Nostrand

4 Physics of Semiconductor Devices- S. M. Sze. Wiley

5 Solid State Physics : Kittel

6 Elementary Solid State physics : M. Ali Omar

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Class				M.Sc. Physics (Final)
Semester/Year				II Year
Subject & Subject Code				Physics Practical - MPHYS20Y205
Paper				Paper - I & Paper - II, Practical
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	4	
0	0	4		

PRACTICALS

List of Experiments:

1 Determine fine structure constant using sodium doublet

2 Verify Cauchy's relation & determination of constants.

3 To determine e/m for an electron by Zeeman effect.

4 Determine the dissociation energy of Iodine molecule.

5 Study the characteristics curve of klystron.

6 Determine the dielectric constant of turpentine oil with the help of Leacher wire system.

7 Determination of energy of a given ray from Re-De source.

8 Find out the percentage resolution of given scintillation spectrometer using Cs-137.

9 Find out the energy of a given X-ray source with the help of a scintillation spectrometer.

10 Plot the Gaussian distribution curve for a radioactive source.

11 To study the frequency and phase characteristics of band phase filter.

12 Study the wave from characteristics of transistorized a stable symmetrical multivibrator using CRO & determines its frequency by various C & R.

13 Artificial transmission line.

14 To study the mode characteristics of reflex klystron and hence to determine mode number, Transmit time, Electronic, Tunning range, electronic tunning sensitivity.

15 To study the E-plane radiation of pattern of pyramidal horn antenna and compute the beam width of the antenna.

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School of Basic and Applied Sciences

Class				M.Sc. Physics (Final)
Semester/Year				II Year
Subject & Subject Code				Physics Practical - MPHYS20Y206
Paper				Paper - III & Paper - IV, Practical
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	4	
0	0	4		

PRACTICALS

List of Experiments:

1 To determine the e/m of an electron by magnetron valve method.

2 To determine the velocity of waves in water using ultrasonic interferometer.

3 To determine the magnetic susceptibility of two given samples by Gouy's method.

4 Determination of Land's 'g' factor for IRRH crystal using electron spin Resonance

5 To determine e/k using transistor characteristics.

6 To study dark and illumination characteristics of p-n junction solar cell and to determine

i. its internal series resistance

ii. Diode ideality factor.

7 To study the characteristics of following semiconductor devices

i. VDR

ii. Photo transistor

iii. Thermistor

iv. IED

8 To study the characteristics of MOSTET and MOSFET amplifier.

9 To study dark and illumination characteristics of p-n junction solar cell and to determine its.

i. maximum power available

ii. Fill factor.

10 Any other experiments of the equivalent standard can be set.

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