Mid Western University (MWU)

Birendranagar, Surkhet, Nepal

M.Sc. in Physics

Course of Study

2018

Introduction:

Mid-Western University (MWU) is an autonomous and public institution of higher learning with the mission to serve the people of Nepal and enrich the global learning community by extending the advantages of higher education. MWU has been offering Bachelor's degrees in physics since 2012. Physics is the most fundamental subject that explains how and why things work and intersects with all scientific areas of research. In order to fulfill the need of students seeking for graduate program in physics of highest academic standards and to produce human resources required for creation and dissemination of knowledge through teaching and research MWU announces Master's degree in physics.

Objectives:

- To offer Master's degree in physics with the highest academic standards
- To produce students with knowledge of frontiers of physics
- To produce physics graduates capable of disseminating knowledge through teaching and research leading to meaningful enhancement of the society

Admission criterion:

M.Sc. in Physics course is intended for students who have completed a Bachelor's degree in physics securing minimum 2.00 CGPA (or of 50%) that is recognized by MWU. The candidates will be selected after an entrance examination conducted by the Faculty of Science and Technology of MWU.

Course structure:

The course duration will be 2 years and offered in total of 4 semesters. Students must complete 75 credit courses (Compulsory 59 credit, Electives 16 credit) Theoretical 44 credit and Lab/Research oriented 31 credit courses. 1 credit course in theoretical subjects implies 1 hour of class activity throughout a semester that runs for a minimum duration of 15 weeks. For lab works 1 credit implies 3 hours of experimental activity throughout the semester. The semester-wise course division is shown in Table 1.

Table 1: Semester-wise course division of M.Sc. in Physics at MWU

Semester	Subject (Credit)					Total Credit
I	Phy 511 Mathematical Physics-I (3)	Phy 512 Classical Mechanics (3)	Phy 513 Quantum Mechanics-I (3)	Phy 514 Electronics (3)	Phy 515 Laboratory-I (6)	18
II	Phy 521 Mathematical Physics-II (3)	Phy 522 Quantum Mechanics-II (3)	Phy 523 Statistical Mechanics (3)	Phy 524 Electrodynamics-I (3)	Phy 525 Laboratory-II (6)	18
III	Phy 531 Condensed Matter Physics (3)	Phy 532 Quantum Mechanics-III (3)	Phy 53x* Elective-AI (4)	Phy 53y* Elective-BI (4)	Phy 533 Research Methodology (5)	19
IV	Phy 541 Nuclear and Particle Physics (3)	Phy 542 Electrodynamic s-II (3)	Phy 54x* Elective-AII (4)	Phy 54y* Elective-BII (4)	Phy 543 Computational Physics (6)	20

*Elective courses are offered based on need and availability of Faculties/Facilities from the following pool of subjects and the dissertation. Students are required to confirm their selection at the beginning of III Semester and the criterion for allocation dissertation will be decided by the respective department.

Elective Courses:

Astrophysics	Optoelectronics
Biophysics	Plasma Physics
Geophysics	Seismology
Material Science	Solid State Physics
Nanotechnology	Dissertation

Evaluation:

Evaluation of a student's performance will be done on the basis of in-semester (internal) evaluation and end-semester (final) evaluation. The weightage will be 50% each for the in-semester and end-semester evaluation in the following mode of evaluation.

In-semester evaluation (50% weightage): The in-semester evaluation of any course will be administered by the faculty responsible for the course, based on the performance of students in the indicators: Class Attendance and performance, Assignments / Homeworks, Term Tests, and Seminars. Concerned Faculty will decide and is supposed to announce the exact weightage division and basis/mode of evaluation in the beginning of the Semester. Students must pass each course at each semester separately in before appearing in the end-semester examination.

End-semester evaluation (50% weightage): The end-semester examination will be administered by the Controller of Examination of MWU. For theoretical courses the duration of final examination will be at least 2 hours for 3 Credit courses. For Lab oriented courses the duration of final examination will be 6 hours. Students have to pass each course at each semester separately in the end-semester evaluation.

Students failing in 2 or less subjects at any semester will have to appear in make-up exam before continuing the next semester.

Grading system: Total marks (obtained in in-semester plus obtained in end-semester examinations) secured will be graded on a four point scale as follows.

Marks secured (%)	Grade	Grade point	Remarks
90 - 100	A	4.0	Distinction
80 - 89.99	B	3.5	Excellent
70 - 79.99	C	3.0	Good
60 - 69.99	D	2.5	Fair
50 - 59.99	E	2	Satisfactory
below 50	F	0	Fail

Mathematical Physics I

Course No.: Phy 511 Semester: I
Nature of the Course: Theory Credit: 3

1. **Tensor Analysis and Differential Geometry:** Cartesian tensors in three-space, Curves in three-spaces; Frenet formulas, General Tensor Analysis [10]

2. **Integral Transforms:** Fourier Series, Fourier Transforms, Laplace Transforms, Applications of Integral Transforms [5]

3. **Reviews of Vectors and Matrices:** Linear vector space, Linear operators, Coordinate transformations, eigenvalue problems, Diagonalization of matrices, spaces of infinite dimensionality [4]

4. **Partial Differential Equations:** Examples, General Discussions, Separation of variables, Integral Transform methods [6]

5. **Eigen functions, eigen values & Green's functions:** Simple examples of eigenvalue problems, general discussion, solutions of Boundary-value problems as eigenfunction expansions, Inhomogeneous problems, Green's functions, Green's functions in electrodynamics [10]

6. **Introduction to groups and group representations:** Introduction; definitions, subgroups and classes, Group representations, characters, physical applications, infinite groups, Irreducible representations of SU(2) & SU(3) [10]

Text Books:

1. Mathew, J. & Walker, R. – **Mathematical Methods in Physics,** Benjamin, Menlo Park, Second Edition (1970).
2. Arfken G. B., Weber H. J. and Harris F. E. – **Mathematical Methods for Physicists**, 7th Ed., Academic Press, Amsterdam (2013).

References:

1. Spiegel Murray R. – **Theory and Problems of Statistics (Schaum Series),** McGraw Hill, London (1992).
2. Riley K. F., Hobson M. P. and Bence S. J. – **Mathematical Methods for Physics and Engineering**, 3rd Ed., Cambridge University Press, New York (2006).
3. Copson, E. T. – **An Introduction to the Theory of Functions of Complex Variable,** Oxford Clarendon Press (1935).
4. Margenu & Murphy – **Mathematics for Physicist and Chemist**, East, West Press Pvt. Ltd., New Delhi (1964).
5. Morse, P. M. & Feshbach H. – **Methods of Theoretical Physics,** Part I & II, McGraw Hill, New York (1953).

Classical Mechanics

Course No.: Phy 512 Semester: I
Nature of the Course: Theory Credit: 3

1 Review of Lagrangian formulation: Constraints, Generalized coordinates, D'Alembert's principle and Langrange's equations, Velocity-dependent potentials and the dissipation function, Applications of the Langrangian formulation [6]

2 Variational principles and Langrange's equations: Hamilton's principle, Calculus of variations, Langrange's equations from Hamilton's principle, Hamilton's principle for nonholonomic systems, Conservation theorems and symmetry properties, Energy function and the conservation of energy [7]

3 The Hamilton equations of motion: Legendre transformations and the Hamilton equations of motion, Cyclic coordinates and conservation theorems, Routh's procedure, The Hamiltonian formulation of relativistic mechanics, Derivation of Hamilton's equations from a variational principle, The principle of least action [8]

4 Canonical transformations: The equations of Canonical transformations, Examples of canonical transformations, The harmonic oscillator, The symplectic approach to canonical transformations, Poisson brackets and other canonical invariants, Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation, The angular momentum Poisson bracket relations, Symmetry groups of mechanical systems, Liouville's theorem [9]

5 Hamilton-Jacobi theory and action-angle variables: The Hamilton-Jacobi equation for Hamilton's principal function, The harmonic oscillator problem, The Hamilton-Jacobi equation for Hamilton's characteristic function, Separation of variables in the Hamilton-Jacobi equation, The Kepler problem, Action-angle variables and the Kepler problem [9]

6 Introduction to the Lagrangian and Hamiltonian formulations for continuous systems and fields: The transition from a discrete to a continuous system, The Lagrangian formulation for continuous systems, Hamiltonian formulation, Noether's theorem [6]

Textbook:

1. Classical Mechanics by H. Goldstein, C. Poole and J. Safko, Pearson Education, Delhi

References:

1. Classical Mechanics by W. Greiner, Springer
2. Classical Mechanics by N. C. Rana and P. S. Joag, Tata Mc-Graw Hill Publishing Company Limited, New Delhi.

3. Introduction to Classical Mechanics by R. G. Takawale and P. S. Puranik, Tata Mc-GrawHill Publishing Company Limited, New Delhi.
4. Classical Mechanics by J. C. Upadhyaya, Himalaya Publishing House
5. Schaum's Outline of Theory and Problems of Theoretical Mechanics by M. R. Spiegel, Mc-Graw Hill

Quantum Mechanics I

Course No.: Phy 513 Semester: I
Nature of the Course: Theory Credit: 3

1. **Recalling basic concept:** The quantization of physical quantities; Light quanta, the photoelectric effect, the Compton effect, the Ritz combination principle, the Frank-Hertz experiment, the Stern-Gerlach experiment, The Radiation Laws; A preview of the Radiation of bodies, Cavity Radiation, The Rayleigh-Jeans law, Planck's radiation law, Wave aspects of matter; Diffraction of matter waves, Mean value in quantum Mechanics, The Heisenberg Uncertainty principle [8]

2. **Mathematical foundations of Quantum Mechanics:** Properties of Operators, Combining two operators, Bra & Ket notation, Measurability of different observables at Equal times, Uncertainty relations for Arbitary Observables, Kinetic energy, total energy Eigen differentials and the normalizations of eigenfunctions for continuous Spectra, Expansion into eigenfunctions, Problems [12]

3. **The Schroedinger Equation:** The conservation of particle numbers in Quantum Mechanics, properties of stationary states, The Harmonic Oscillator: Description of Harmonic Oscillator by creation ($\hat{a}^+$) & annihilation operators ($\hat{a}$), interpretation of $\hat{a}$ & $\hat{a}^+$ [6]

4. **Charged Particles in Magnetic Fields:** Coupling to electromagnetic field, The Hydrogen atom, three dimensional electron densities, the spectrum of hydrogen atom, currents in hydrogen atom, the magnetic moment, hydrogen like atom [8]

5. **Perturbation Theory:** Stationary perturbation theory, Degeneracy, The Ritz variational method, Time dependent perturbation theory, Time independent perturbation, transition between Continuum states [11]

Text Books:

1. Greiner W. - **Quantum Mechanics An Introduction** (4th ed.), Springer-Verlag, Germany
2. Agrawal B. K. and Hari Prakash **- Quantum Mechanics**, Prentice Hall of India (1977).

References:

1. Weinberg, Steven – **The Quantum Theory of Fields** Vol. I, Cambridge Univ Press (2005).
2. Greiner, Walter – **Field Quantization,** Springer (2006).
3. Zee, Tony – **Quantum Field Theory in a Nutshell,** Princeton University Press (2003).
4. Nair, V. P. – **Quantum Field Theory: A Modern Perspective,** Springer (2005).
5. Griffiths, David – **Introduction to Elementary Particles**, Wiley (1987).
6. Wachter A. – **Relativistic Quantum Mechanics**, Springer (2011).

Electronics

Course No.: Phy 514 Semester: I
Nature of the Course: Theory Credit: 3

1 Review: Diode circuits and applications, Transistors biasing and applications, Amplifiers, JFETs, MOSFETs, Number systems, Logic gates, Boolean algebra [4]

2 Linear Op-Amp circuits: Inverting and noninverting amplifier circuits, Differential amplifiers, Instrumentation amplifiers, Summing amplifier circuits, Current boosters, Voltage-controlled current sources, Automatic gain control, Single-supply operation [4]

3 Active filters: Ideal responses, Approximate responses, Passive filters, Low-pass and high-pass filters, Band-pass and band-stop filters, All-pass filters [4]

4 Nonlinear Op-Amp circuits: Comparators, The integrator, Waveform conversion and generation, Active diode circuits, The differentiator [5]

5 Oscillators: The Wien-Bridge and RC oscillators, The Colpitts and LC oscillators, Quartz crystals, The 555 timer and circuits, The phase-locked loops, Function Generator [4]

6 Regulated power supplies : Shunt and series regulators, Monolithic linear regulators, Current boosters, DC to DC converters, Switching regulators [5]

7 Functions of combinational Logic: Adders, Comparators, Decoders, Encoders, Multiplexers, De-multiplexers, Parity generators/checkers, Glitches in decoder circuits [4]

8 Flip-Flops: Latches, Edge-triggered flip-flops, Master-slave flip-flops, Flip-flop operating characteristics, Flip-flop applications [6]

9 Counters: Asynchronous counter operation, Synchronous counter operation, Up/down synchronous counters, Design of synchronous counters, Cascaded counters, Counter decoding, Counter applications [6]

10 Shift Registers: Serial in/serial out, Serial in/parallel out, Parallel in/serial out, Parallel in/parallel out shift resisters, Bidirectional shift resisters, Shift resister counters, Shift resister applications [6]

Textbooks:

1. Electronic Principles by A. P. Malvino and D. J. Bates, McGraw-Hill Education
2. Digital Fundamentals by R. P. Jain and T. L. Floyd, Pearson Education, Delhi

Reference Books:

1. Network, Lines and Fields by J. D. Ryder, Prentice Hall of India
2. Electronics Devices and Circuits by T. F. Bogart, Universal Book Stall, New Delhi
3. Digital Principles and Application by, A. P. Malvino and D. P. Leach, Tata McGraw Hill Publishing Company Ltd., New Delhi

Physics Laboratory-I

Course No.: Phy 515 Semester: I
Nature of the Course: Practical Credit: 6

Experimental classes are given importance to develop the student's ability to understand and interpret results in reasonable valid experimental evidences. The Physics Laboratory class will provide knowledge of the physical world, and it helps them to relate theoretical knowledge to everyday life. On the other hand it can also call for a new theory, or new way of looking into problems. This course will provide students with skill in the experimental physics and to present their findings in a logical order which is expected to train them to deal with problems in practical applications in the future. The duration of lab work is 15 hours per week and students are expected to complete at least 2 experiments in a week. For every experiment performed the students are required to prepare a report and submit to responsible faculties within 2 weeks after completion of the experiment. The evaluation scheme for the in-semester (50% weightage) will be based on daily lab performance and number of experiments completed successfully. End-semester evaluation (50% weightage) will be administered by the Controller of Examination of MWU in which the students will perform allocated experiments and prepare final report. The duration of the final examination will be 6 hours.

List of experiments:

1. Review: Graphical methods, Curve fitting, Data plot and analysis using computational software
2. To determine the half-life of given radioactive source
3. To study the phenomenon of back-scattering of beta particles
4. To study the phenomenon of absorption of gamma rays
5. To study the phenomenon of hysteresis loss
6. To study Lissajous pattern and determine the frequency of an unknown source
7. Construct and study universal gates (TTL)
8. To study the characteristic of a FET
9. To study the working of half adder and full adder
10. To study differential amplifier and determine the CMRR
11. Construct and study Ex-OR and Ex-NOR gates using universal gates
12. To study operational amplifier for its input-output waveform and use it as an integrator and differentiator
13. To determine the wavelength of a given source using a Fresnel biprism
14. To determine the wavelength of mercury light using Lloyd's mirror
15. To measure the thickness of a thin mica sheet by wedge shape method
16. To study the variation of refractive index of sugar solution using a hollow prism

Books:

1. B.Sc. Practical by C. L. Arora, S. Chand and Co., India
2. Numerical Mathematical Analysis by W. Scarborough and J. B. Scarborough, The Johns Hopkins University Press

Mathematical Physics II

Course No.: Phy 521 Semester: II
Nature of the Course: Theory Credit: 3

1. **Complex Variables:** Complex Variables and Functions, Cauchy – Riemann conditions: Analytic Functions, Derivatives of Analytic Functions, Cauchy Integral Theorem, Formula and Applications; Laurent Expansion, Singularities: Poles, Branch Points, Analytic Continuation, Calculus of Residues and Applications, Evaluation of Definite Integrals, Evaluation of Sums, Mapping and Conformal Transformations, Method of Steepest Descents, Dispersion Relations [15]

2. **Probability and Statistics:** Review of Probability, Random Variables: Discrete Probability, Mean and Variance, Moments of Probability, Covariance and Correlation, Marginal and Conditional Probability, Distribution functions: Binomial, Poisson and Gauss Normal Distributions, Transformation of Random Variables, Error Propagation, Fitting Curves to Data, The χ^2 Distribution, Student-t- Distribution, Confidence Intervals, Error Analysis [15]

3. **Integral equations:** Classification, Degenerate kernels, Neuman and Fredholm series, Schmidt-Hilbert theory, Miscellaneous devices, Integral equations in dispersion theory [8]

4. **Numerical Methods:** Interpolation, Numerical integration, Numerical solution of differential equations, Roots of equations [7]

Text Books:

1. Mathew, J. & Walker, R. – **Mathematical Methods in Physics,** Benjamin, Menlo Park, Second Edition (1970).
2. Arfken G. B., Weber H.J. and Harris F. E. – **Mathematical Methods for Physicists**, 7th Ed., Academic Press, Amsterdam (2013).

References:

1. Spiegel Murray R. – **Theory and Problems of Statistics (Schaum Series),** McGraw Hill, London (1992).
2. Riley K.F., Hobson M.P. and Bence S. J., **Mathematical Methods for Physics and Engineering**, 3rd Edn., Cambridge University Press, New York (2006).
3. Copson, E.T. – **An Introduction to the Theory of Functions of Complex Variable,** Oxford Clarendon Press (1935).
4. Margenu & Murphy – **Mathematics for Physicist and Chemist**, East, West Press Pvt. Ltd., New Delhi (1964).
5. Morse, P.M. & Feshbach H. – **Methods of Theoretical Physics,** Part I & II, McGraw Hill, New York (1953).

Quantum Mechanics II

Course No.: Phy 522 Semester: II
Nature of the Course: Theory Credit: 3

1. **Mathematical Foundations of quantum Mechanics II:** Representation theory, Representation of operators, The eigenvalue problem, unitary transformations, The S matrix, Schroedinger equation in Matrix form, Representations: Schroendinger, Heisenberg & Interaction [10]

2. **Spin:** Doublet splitting, The Einstein-de Hass Experiment, Mathematical description of spin, wave functions with spin, Pauli equation, Linearization of the Schroedinger equation, particles in an external field and the Magnetic moment, The Pauli principle, exchange degeneracy, The Slater determinant [15]

3. **Molecules:** Basics of Born Oppenheimer Method**,** H_2^{+} ion, Hydrogen Molecule, Main Features of Bonding, Quantum Resonance [5]

4. **A Realistic Picture of Hydrogen Atom:** Mass correction, Spin-orbit interaction, Fine structure, Zeeman Effect: Weak Magnetic Field, Paschen-Back Effect: Strong Magnetic Field, Intermediate Field case, Hydrogen Atom in an Electric Field: Stark Effect, Hyperfine Structure [8]

5. **Spectra of Diatomic Molecule:** Electronic Spectra, Vibration: Anharmonic Oscillator, Morse potential, Vibration-Electronic Spectra: Progression, Frank-Condon Principle, Rotational Fine Structure, Rotation Vibration Spectra, Fortrat Diagram, Vibrational Raman Spectra [7]

Text Books:

1. Quantum Mechanics An Introduction: Walter Greiner, 4^{th} ed., Springer-Verlag, Germany
2. Agrawal B. K. and Hari Prakash - Quantum Mechanics, Prentice Hall of India (1977).

References:

1. Weinberg, Steven – **The Quantum Theory of Fields**, Vol. I. Cambridge University Press, (2005).
2. Greiner, Walter – **Field Quantization,** Springer (2006).
3. Zee, Tony – **Quantum Field Theory in a Nutshell,** Princeton University Press (2003).
4. Nair, V. P. – **Quantum Field Theory: A Modern Perspective,** Springer (2005).
5. Griffiths, David – **Introduction to Elementary Particles**, Wiley (1987).
6. Wachter A. – **Relativistic Quantum Mechanics**, Springer (2011).

Statistical Mechanics

Course No.: Phy 523 Semester: II
Nature of the Course: Theory Credit: 3

1. **Classical statistical mechanics:** Review of Thermodynamics , Statistical basis of thermodynamics, Macroscopic and microscopic states, Phase space and ensemble, Liouville's theorem, Postulate of statistical mechanics, Microcanonical ensemble: Derivation of thermodynamics, Classical ideal gas: Gibb's paradox and its resolution, Harmonic Oscillator in Microcanonical ensemble, Concept of negative temperature, Canonical Ensemble: Partition function, Energy fluctuation in canonical ensemble, Grand canonical ensemble: Grand Partition function, Energy and density fluctuations in grand canonical ensemble, Classical ideal gas in canonical and grand canonical ensemble, Equivalence of various ensembles, Generalized equipartition theorem – theorem of equipartition of energy and virial theorem [15]

2. **Quantum statistical mechanics**: Postulates of quantum statistical mechanics, Density matrix and its properties, Ensembles in quantum statistical mechanics – microcanonical, canonical, and grand canonical ensembles, Partition functions with examples including (I) an electron in magnetic field (II) a free particle in a box (III) a linear harmonic oscillator, Third law of thermodynamics, Symmetric and Antisymmetric wave functions, The ideal gases: Microcanonical & grand canonical ensemble, Occupation number, Partition functions for diatomic molecule [12]

3. **Application of Ideal Bose and Fermi systems**: Thermodynamical behavior of ideal Bose gas, Photons –Black body radiation and Planck's law of radiation, thermodynamics of weakly degenerate Bose gas, thermodynamics of strongly degenerate Bose gas – Bose-Einstein condensation and liquid helium[4], Phonons in solids, specific heat of solids, Thermodynamical behavior of ideal Fermi gas – weakly and strongly degenerate Fermi gas, Free electron in metals, Thermodynamic properties of relativistic Fermi gas, The theory of white dwarf stars [14]

4. **Phase Transitions, Criticality and Universality:** Condensation of van der Waals gas, A dynamical model of phase transitions, Ising model in zeroth approximation [4]

Text book:

1. Kerson Huang - **Statistical Mechanics**; John Wiley (1987)

Reference books:

1. R. K. Pathria & Beale- **Statistical Mechanics, 3rd ed.** Butter Worth Heinemann, New Delhi, India (2001)
2. A. Mc Quarrie - **Statistical Mechanics**, Harper and Row, New York (1973)

3. R. Reif - **Fundamental of Statistical and Thermal Physics,** McGraw-Hill Book Company, New York (1965)
4. *L. D. Landau* & E. M. Lifshitz - *Statistical Physics*, Vol. 5, Pergamon Press (1969)

Electrodynamics-I

Course No.: Phy 524 Semester: II
Nature of the Course: Theory Credit: 3

1 Review of Electrostatics and Magnetostatics: Coulomb's Law, Electric Field, Gauss's Law, Poisson and Laplace Equations, Green's Theorem, Dirichlet or Neumann Boundary Conditions, Magnetostatics, Faraday's Law, Biot and Savart Law, Ampere's Law, Scalar and Vector Potentials [4]

2 Boundary-Value Problems in Electrostatics: Method of Images, Point Charge in the Presence of a Grounded Conducting Sphere, Point Charge in the Presence of a Charged, Insulated, Conducting Sphere, Point Charge Near a Conducting Sphere at Fixed Potential, Conducting Sphere in a Uniform Electric Field by Method of Images, Green Function for the Sphere; General Solution for the Potential, Conducting Sphere with Hemispheres at Different Potentials, Orthogonal Functions and Expansions, Separation of Variables; Laplace Equation in Rectangular Coordinates, Laplace Equation in Spherical Coordinates, Boundary-Value Problems with Azimuthal Symmetry [8]

3 Multipoles, Electrostatics of Macroscopic Media, Dielectrics: Multipole Expansion, Multipole Expansion of the Energy of a Charge Distribution in an External Field, Elementary Treatment of Electrostatics with Ponderable Media, Boundary-Value Problems with Dielectrics, Molecular Polarizability and Electric Susceptibility, Models for Electric Polarizability, Electrostatic Energy in Dielectric Media [6]

4 Magnetostatics, Faraday's Law, Quasi-Static Fields: Magnetic Fields of a Localized Current Distribution, Magnetic Moment, Force and Torque on and Energy of a Localized Current Distribution in an External Magnetic Induction, Macroscopic Equations, Boundary Conditions on **B** and **H**, Methods of Solving Boundary-Value Problems in Magnetostatics, Uniformly Magnetized Sphere, Magnetized Sphere in an External Field; Permanent Magnets, Magnetic Shielding, Faraday's Law of Induction, Energy in the Magnetic Field, Energy and Self- and Mutual Inductances, Quasi-Static Magnetic Fields in Conductors; Eddy Currents; Magnetic Diffusion [10]

5 Maxwell Equations, Macroscopic Electromagnetism, Conservation Laws: Maxwell's Displacement Current; Maxwell Equations, Vector and Scalar Potentials, Gauge Transformations, Lorenz Gauge, Coulomb Gauge, Green Functions for the Wave Equation, Poynting's Theorem and Conservation of Energy and Momentum for a System of Charged Particles and Electromagnetic Fields [5]

6 Plane Electromagnetic Waves and Wave Propagation: Plane Waves in a Nonconducting Medium, Linear and Circular Polarization; Stokes Parameters, Reflection and Refraction of Electromagnetic Waves at a Plane Interface Between Two Dielectrics, Polarization by

Reflection, Total Internal Reflection, Frequency Dispersion Characteristics of Dielectrics, Conductors, and Plasmas, Simplified Model of Propagation in the Ionosphere and Magnetosphere, Magnetohydrodynamic Waves [8]

7 Waveguides: Fields at the Surface of and Within a Conductor, Cylindrical Cavities and Waveguides, Waveguides, Modes in a Rectangular Waveguide, Energy Flow and Attenuation in Waveguides, Perturbation of Boundary Conditions **[**4]

Textbook:

Classical Electrodynamics by J. D. Jackson, John Wiley and Sons

Reference Books:

1. Introduction to Electrodynamics by David J. Griffith, Prentice-Hall of India, New Delhi
2. Foundations of Electromagnetic Theory by J. R. Reitz, F. J. Milford and R. W., Christy, Narosa Publishing House, New Delhi

Physics Laboratory-II

Course No.: Phy 525 Semester: II
Nature of the Course: Practical Credit: 6

The duration of lab work is 15 hours per week and students are expected to complete at least 2 experiments in a week. For every experiment performed the students are required to prepare a report and submit to responsible faculties within 2 weeks after completion of the experiment. The evaluation scheme for the in-semester (50% weightage) will be based on daily lab performance and number of experiments completed successfully. End-semester evaluation (50% weightage) will be administered by the Controller of Examination of MWU in which the students will perform allocated experiments and prepare final report. The duration of the final examination will be 6 hours.

List of experiments:

1. To study series and parallel LCR circuits
2. Construct a regulated power supply using Zener diode
3. To study CE amplifier
4. To study CC amplifier and estimate input and output impedances
5. To construct astable multivibrator using 555 timer and study its performance.
6. To determine the Planck's constant using a photocell
7. To study the characteristics of RS and J-K flip-flop
8. To construct and study the working of a monostable multivibrator
9. To construct a voltage doubler
10. Use K-map to solve given equation and construct the circuit
11. To study the temperature dependence of resistance of a given semiconductor
12. To construct D/A converter and study its working

Books:

2. B.Sc. Practical by C. L. Arora, S. Chand and Co., India

2. Numerical Mathematical Analysis by W. Scarborough and J. B. Scarborough, The Johns Hopkins University Press