Kumaun University Nainital
M. Sc. Syllabi in Physics
(Session 2017-18 Onwards)
(Total Marks = 2000)

Semester System Course Structure

(Total Four Semesters, 100 marks in each Paper followed by practical carrying 100 marks each in each Semester and Grade system in dissertation/project)

(100=75 marks external+ 25 marks internal for each paper)

Semester–wise Distribution of Papers with Marks

I. First Semester :

Paper 1: Mathematical Methods	(PHY-4911)	100 Marks
Paper 2: Classical Mechanics	(PHY-4912)	100 Marks
Paper 3: Quantum Mechanics	(PHY-4913)	100 Marks
Paper 4: General Theory of Relativity and Cosmology	(PHY-4914)	100 Marks
Paper 5: Communication Electronics	(PHY-4915)	100 Marks
Practical	(PHY-5181)	100 Marks
	Total =	600 Marks

II. Second Semester :

Paper 6: Statistical Mechanics	(PHY-4921)	100 Marks
Paper 7: Atomic and Molecular Spectra	(PHY-4922)	100 Marks
Paper 8: Electrodynamics	(PHY-4923)	100 Marks
Paper 9: Digital Electronics and Computer Architecture	(PHY-4924)	100 Marks
Practical	(PHY-5281)	100 Marks
	Total =	500 Marks

III. Third Semester :

Paper 10: Advanced Quantum Mechanics	(PHY-4931)	100 Marks
Paper 11: Nuclear Physics	(PHY-4932)	100 Marks
Paper 12: Elementary Particle Physics	(PHY-4933)	100 Marks

Paper 13: Condensed Matter Physics	(PHY-4934)	100 Marks
Paper 14: Plasma Physics	(PHY-4935)	100 Marks
Practical	(PHY-6381)	100 Marks
	Total =	600 Marks

IV. Fourth Semester :

Paper 15: Special Paper (Part I)		
(a) Advanced Electronics I	(PHY-4941)	100 Marks
(b) High Energy Physics I	(PHY-4942)	100 Marks
(c) Spectroscopy I	(PHY-4943)	100 Marks
(d) Astrophysics I	(PHY-4944)	100 Marks
(e) Advanced Condensed Matter Physics I	(PHY-6405)	100 Marks

Paper 16: Special Paper (Part II)

(a) Advanced Electronics II	(PHY-4951)	100 Marks
(b) High Energy Physics II	(PHY-4952)	100 Marks
(c) Spectroscopy II	(PHY-4953)	100 Marks
(d) Astrophysics II	(PHY-4954)	100 Marks
(e) Advanced Condensed Matter Physics II	(PHY-4955)	100 Marks

Paper 17: Dissertation / Project work with Grade System (Out of Maximum 100 marks)

Marks	Grade
91 or above	**A+**
81 to 90	**A**
71 to 80	**B+**
61 to 70	**B**
51 to 60	**C+**
41 to 50	**C**
40 or Less	**FAIL**

Practical 100 Marks

Total = 300 Marks

Note: Only those special papers will be allowed where at least three experiments are available.

IMPORTANT- Educational tour for scientific laboratories and physics research institutes has been included as per university

norms in the syllabus of M. Sc. (Physics). A Tour report will be submitted to the HOD after visit.

M.Sc. Physics Syllabus (Semester System 2017-18 Onwards)
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M. Sc. (Physics) IInd Semester

Paper 6: Statistical Mechanics

Paper 7: Atomic and Molecular spectra

Paper 8: Electrodynamics

Paper 9: Digital Electronics & Computer Architecture

Practical

Syllabus for M. Sc. Physics II Semester
Paper 6
(PHY-4921) Statistical Mechanics 75 marks

Unit-I : **Foundation of Statistical Mechanics**

Microscopic and macroscopic states, Density of states, Micro-canonical, Canonical and grand canonical ensembles, Canonical ensemble and Gibb's distribution, Boltzmann–Planck method, Partition function and statistical definition of thermodynamic quantities, Computation of partition functions of some standard systems.

Unit-II: **Statistical Properties**

System of linear harmonic oscillators in the canonical ensemble; Grand canonical ensemble and its partition function; Chemical potential; Partition function and distribution for perfect gas; Gibb's paradox; Free energy, entropy, Equation of state and specific heat determination of perfect gas.

Unit-III: **Statistical models**

Theory of phase transitions, First order phase transition, Second order phase transitions and higher order phase transitions (elementary discussion), Ising model, One dimensional (with exact solution), Two dimensional (with exact solution) & three dimensional model (elementary idea), Landau theory of phase transition, Weiss theory of Ferro-magnetism, Heisenberg model. Virial equation of states.

Unit-IV: **Quantum Statistics**

Bose-Einstein and Fermi- Dirac distributions, Degeneracy, Gas degeneration, Degenerate Bose gas, Bose Einstein condensation, Highly degenerate B-E and F-D gases; examples of Molecular Hydrogen, liquid helium and electron gas in metals.

Books Recommended:

Quantum Mechanics - A.S. Davidov
Quantum Mechanics - B.S. Rajput
Quantum Mechanics - Paul Roman
Theoretical Chemistry - Glastohn
Statistical Mechanics - Landau and Lifshitz
Statistical Mechanics - Pathira
Statistical Mechanics - Huang

Syllabus for M. Sc. Physics II Semester
Paper 7
(PHY-4922) Atomic and Molecular Spectra 75 Marks

UNIT- I

Fine structure of hydrogen spectrum, L- S and J- J coupling, Spectroscopic terms**,** Hund's rule and time reversal, Pauli's exclusion principle.

UNIT- II

Alkali spectra, Spin-orbit interaction and fine structure in alkali Spectra, Equivalent and non-equivalent electrons, Normal and anomalous Zeeman effect, Paschen Back effect, Stark effect, Hyperfine structure (qualitative).

UNIT- III

Molecular spectra of diatomic molecules, Born Oppenheimer approximation, elementary idea of quantization of rotational and vibrational energy, rotational spectra for rigid and non rigid rotations, vibrational spectra (harmonic and an-harmonic), intensity and selection rules and molecular constants.

UNIT- IV

Atomic Polarizability, Raman spectra, Quantum theory of Raman spectra, Determination of molecular structure, Electronic spectra, band system, Progression and sequences, band head formation, Condon parabola, Franck Condon Principle, dissociation energy and its determination.

Books Recommended:

C. B. Banwell: Fundamentals of Molecular Spectroscopy
Walker and Stranghen: Spectroscopy Vol. I, II, & III
G.M. Barrow: Introduction to Molecular Spectroscopy
Herzberg: Spectra of diatomic molecules
Jeanne L Mchale: Molecular Spectroscopy
J. M. Brown: Molecular Spectroscopy
P. F. Bemath: Spectra of atoms and molecules
J. M. Holias: Modern Spectroscopy
K. Thyagrajan and A.K. Ghatak: Lasers: Theory and applications
A Yariv: Quatum Electronics
M. D. Levenson: Intoduction to non-linear laser spectroscopy
B. B. Laud: Laser and non-linear optics

Syllabus for M. Sc. Physics II Semester
Paper 8
(PHY-4923) Electrodynamics 75 Marks

Unit-I: **Electromagnetism**

Basic equations; Electrostatics; Magnetostatics; Different Systems of Units, Preliminary notations, Four- vectors, Lorentz transformations, Time, Space and light like separations, Lorentz invariants, Energy and Momentum.

Unit-II: **Maxwell's equations**

Maxwell's equation, Displacement current, Electromagnetic waves in conducting and non-conducting medium, Poynting theorem, Boundary condition at the interface of conducting and non conducting media, Propagation between parallel conducting plates. Electromagnetic wave equations.

Unit-III: **Four-Vector formalism of Maxwell's Equations**

Four vector potential, electromagnetic field tensor, Lorentz invariance, Lorentz force, Covariant form of Maxwell's equations, Four vector current, Continuity equation, Gauge invariance of Maxwell equation, electromagnetic energy- momentum tensor, Motion of charge particle in electromagnetic field, Lorentz force.

Unit-IV: **Electromagnetic Radiation**

Lienard-Witchert potential, Conventional potential, Quantization of electromagnetic energy (virtual photon), Radiation from an Accelerated Charge, Fields of an accelerated charge; angular and frequency distributions of the emitted radiation, Special cases of acceleration-parallel and perpendicular (circular orbit) to velocity; Larmor's formula and its relativistic Generalization; Bremstrahlung, Cerenkov radiation.

Book recommended:

Jackson: Classical electrodynamics; Wiley Eastern, New Delhi
Landau and Lifshitz: Classical theory of fields; Pergameon Press
Thide : Electromagnetic field Theory
Panofsky and Phillips : Classical Electricity and Magnetism
Landau & Lifshitz : Electrodynamics of Continuous Media

Syllabus for M. Sc. Physics II Semester
Paper 9
(PHY-4924) Digital Electronics & Computer Architecture 75 Marks

Unit-I: **Digital Circuit & Microprocessor**

Elementary idea of combinational and sequential circuits, Overview of Microcomputer organization and operation, Microprocessor evolution and types, Fundamental knowledge of Microprocessor (8085/8086), Architecture and its operation, Basic idea of logic devices for interfacing 8085/8086.

Unit-II: **Computer Organization and Architecture**

Central Processing Unit, Computer organization, Instruction formats (e.g. Three address, Two address etc), Addressing modes, Timing diagram, Interconnection of different units, I/0 to processor and processor to memory communication, Interrupt structures, Multiprogramming, Processor features RISC, CISC, Cache memory, Real and virtual memory.

Unit-III: **Data Communication**

Computer and Communications, Need for communication networks, Internet and World Wide Web, communication protocols, Local Area Networks, Interconnecting networks, Future of Network Technology.

Unit-IV: **Computer Network**

Characteristics of communication channels, Allocation of Channels, Physical Communication media, Public Switched Telephone Network, Cellular Communication Path, ATM networks,

Books Recommended:

Computer system Architecture : Morris Mano (PHI) (Eastern Economy Edition)
Fundamentals of computers: V. Rajaraman (Prentice Hall of India)
Computer system architecture: Morries Mano (Estern Economy Edition)
Computer fundamental-architecture and organization: B. Ram (New Age International Publishers)
Computer Network: Tenan Bomm
Microprocessor, Architecture, programming and application with the 8085: Ramesh Gaonkar
Microprocessor programming and Interfacing Intel 8085 and 8086: Hafizer Rehaman

M.Sc. Physics Syllabus (Semester System 2017 -18 Onwards)
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II Semester

List of Experiments

1. Study of the Phase measurement by superposition of voltages with LCR Circuits.
2. Study of different oscillators (Hartely, colpit, Weinbridge oscillators etc.).
3. Study of an electronically regulated power supply.
4. Study of negative Feed- back Amplifier.
5. Determination of wavelength (λ) and wavelength difference ($\Delta\lambda$) by Michelson Interferometer.
6. Study of different type of Resistances and Diodes.
7. Study of Photo Voltaic Cell.
8. e/m by Zeeman effect .
9. Stefan's Constant
10. FET characteristics
11. Fresnel's Law
12. Cauchy Formula
13. Lattice Dynamic Kit
14. Study of Logic gates
15. Detection Efficiency of Diode
16. Fabry – Perot Interferometer
17. Four Probe method