DEPARTMENT OF PHYSICS
ANDHRA UNIVERSITY

Common for M.Sc. Physics and M.Sc. Space Physics
II Semester (w.e.f 2009-10 batch)

		MARKS
P 201.	**ELECTRODYNAMICS**	**85+15=100**
P 202.	**STATISTICAL MECHANICS**	**85+15=100**
P203	**ATOMIC AND MOLECULAR PHYSICS**	**85+15=100**
P 204.	**NUCLEAR AND PARTICLE PHYSICS**	**85+15=100**
P205	**Modern Physics lab - II Practical -75 + record-25**	**100**
P206	**ELECTRONICS LAB –II Practical -75 + record-25**	**100**
	TOTAL MARKS	**600**

Choice Based Paper for other Departments in University Campus only

	INTRODUCTORY ATMOSPHERIC AND SPACE PHYSICS	

For Each Theory Paper 85 marks for semester end exam and 15 marks for internal assessment

SCHEME OF EXAMINATION

Theory pass minimum **40%**
Practical pass minimum **50%**
Aggregate **50%**

SCHEME OF INSTRUCTION :

Teaching Hours **4 Periods per week**
Tutorial **1 Period per week**
Practical **6 Periods per week**

DEPARTMENT OF PHYSICS
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II Semester
(w.e.f 2009-10 batch)
P201,SP201: ELECTRO DYNAMICS.

UNIT-I: Gauss Theorem, Poission's equation, Laplaces equation, solution to Lapalaces equation in cartesian coordiantes, spherical coordinates, cylidrical coordinates, use of Laplaces equation in the solutions of electrostatic problems. **6Hrs**

Ampere's circuital law, magnetic vector potential, displacement current, Faraday's law of electromagnetic inducation, **4Hrs**

UNIT-II; Maxwell's equations, differential and integral forms, physical significance of Maxwell's equations. **4 Hrs**

Wave equation, plane electromagnetic waves in free space , in nonconducting isotropic medium, in conducting medium, electromagnetic vector and scalar potentials, uniqueness of electromagnetic potentials and concept of gauge, Lorentz gauge, Coulomb gauge, **6Hrs**

charged particles in electric and magnetic fields: charged particles in uniform electric field, charged particles in homogerous magnetic fields, charged particles in simultaneous electric and magnetic fields, charged particles in nonhomogeneous magnetic fields. **6Hrs**

UNIT-III: Lienard-Wiechert potentials, electromagnetic fields from Lienard-wiechert potentials of a moving charge, electromagnetic fields of a uniformly moving charge, radiation due to non-relativistic charges, radiation damping, Abraham-Lorentz formula, cherenkov radiation, radiation due to an oscillatory electric dipole, radiation due to a small current element. Condition for plasma existence, occurrence of plasma, magneto hydrodynamics, plasma waves **10 Hrs**

UNIT-IV: Transformation of electromagentic potentials, Lorentz condition in covariant form, invariance or covariance of Maxwell field eqations in terms of 4 vectors, electromagnetic field tensor, Lorentz transformation of electric and magnetic fields. **12 Hrs**

Text books:

1. Classical Electrodynamics : - J.D. Jackson
2. Introduction to Electrodynamics : - D.R. Griffiths
3. .Electromagnetic Theory and Electrodynamics - Satyaprakash
4. Electrodynamics - KL Kakani

DEPARTMENT OF PHYSICS
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Common for M.Sc. Physics and M.Sc. Space Physics
IISemester
(w.e.f 2009-10 batch)
P202,SP202: STATISTICAL MECHANICS

UNIT-I : Basic Methods and Results of Statistical Mechanics: **13 Hrs**

Specification of the state of a system, phase space and quantum states,
Liouvilles theorem, Basic postulates, Probability calculations, concept of ensembles, thermal interaction, Mechanical interaction, quasi static process, distribution of energy between systems in equilibrium, statistical calculations of thermo dynamic quantities, Isolated systems(Microcanonical ensemble). Entropy of a perfect gas in microcanonical ensemble. Canonical ensemble - system in contact with heat reservoir, system with specified mean energy, connection with thermodynamics, Energy fluctuations in the canonical ensemble . Grand canonical ensemble, Thermodynamic function for the grand canonical ensemble. Density and energy fluctuations in the grand canonical ensemble. Thermodynamic equivalence of ensembles. Reif Ch:2, 3.3,3.12 Ch:6

UNIT-II : Simple Applications of Statistical Mechanics: **12 Hrs**

Partition functions and their properties. Calculation of thermo dynamic quantities to an ideal mono atomic gas. Gibbs paradox, validity of the classical approximation. Proof of the equipartition theorem. Simple applications – mean K.E. of a molecule in a gas. Brownian motion. Harmonic Oscillator, Specific heats of solids (Einstein and Debye model of solids), Paramagnetism, Partition function for polyatomic molecules, Electronic energy, vibrational energy and rotational energy of a diatomic molecule. Effect of Nuclear spin-ortho and para Hydrogen. Reif Ch:7, Ch:9.12

UNIT-III: Quantum Statistics: **15 Hrs**

Formulation of the statistical problem. Maxwell–Boltzmann statistics. Photon statistics, Bose-Einstein statistics, Fermi–Dirac statistics, Quantum statistics in the classical limit, calculation of dispersion for MB, BE & FD statistics Equation of state of an Ideal Bose Gas, Black body radiation, Bose-Einstein condensation, Equation of state for a weakly degenerate and strongly degenerate ideal Fermi gas. Thermionic emission. The theory of white dwarf stars. Reif Ch:9

UNIT-IV: Non Ideal Classical Gas: **10 Hrs**

Calculation of the partition function for low densities. Equation of state and virial coefficients (Van Der Walls equation) Reif Ch:10.3,10.4

Phase Transitions and Critical Phenomena:

Phase transitions , conditions for Phase equilibrium, First order Phase transition – the Clausius–Clayperon equation, Second order phase transition, The critical indices, Van der Waals theory of liquid gas transition. Order parameter, Landau theory. Sinha Ch:10

Text Books

1. Fundamentals of Statistical and Thermal Physics F. Reif
2. Statistical Mechanics, Theory and Applications S.K. Sinha
3. Statistical Mechanics R.K. Pathria

DEPARTMENT OF PHYSICS

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Common for M.Sc. Physics and M.Sc. Space Physics

II Semester (w.e.f 2009-10 batch)

P203,SP203: ATOMIC AND MOLECULAR PHYSICS.

UNIT-I 12 Hrs

ONE ELECTRON ATOMS : Quantum numbers, Term values . Relation between Magnetic dipole moment and angular momentum of an orbiting electron. Stern–Gerlach experiment and electron spin . Spin- orbit interaction, relativistic kinetic energy correction and dependence of energy on J value only. Selection rules. Fine structure of Balmer series of Hydrogen and Fowler series of ionized Helium. Hyperfine structure of Hα line of hydrogen (I = ½) .

ONE VALENCE ELECTRON ATOMS: Modified term values (quantum defect) due to lifting of orbital degeneracy by core penetration (penetrating orbits) and core polarization (non-penetrating orbits) by nl electrons. Term values and fine structure of chief spectral series of sodium. Intensity rules and application to doublets of sodium. Hyperfine structure of ^2P-^2S of sodium (I= 3/2).

UNIT-II 10 Hrs

MANY ELECTRON ATOMS : Indistinguishable particles, bosons, fermions. Pauli's principle. Ground states. LS coupling and Hund's rules based on Residual coulombic interaction and spin-orbit interaction. Lande's interval rule. Equivalent and non-equivalent electrons. Spectral terms in LS and JJ coupling (ss,s^2 ,pp,p^2 configurations). Exchange force and Spectral series of Helium.

Lasers- spontaneous emission, stimulated emission, population inversion, Einstein coefficients, metastable levels, resonance transfer and population inversion in He-Ne laser.

UNIT- III 8 Hrs

ATOMS IN EXTERNAL MAGNETIC FIELD: Quantum theory of Zeeman and Paschen-Back effects and application to ^2P-^2S, ^3P-^3S, transitions.

ATOMS IN EXTERNAL ELECTRIC FIELD: Linear stark pattern of Hα line of hydrogen and Quadratic stark pattern of D_1 and D_2 lines of Sodium.

UNIT-IV 20 Hrs

DIATOMIC MOLECULES: Molecular quantum numbers. Bonding and anti-bonding orbitals from LCAO's. Explanation of bond order for N_2 and O_2 and their ions. Rotational spectra and the effect of isotopic substitution. Effect of nuclear spin functions on Raman rotation spectra of H_2 (Fermion) and D_2 (Boson). Vibrating rotator. Spectrum. Combination relations and evaluation of rotational constants (infrared and Raman). Intensity of vibrational bands of an electronic band system in absorption.(The Franck-Condon principle). Sequences and progressions. Deslandre's table and vibrational constants.

MOLECULAR VIBRATIONS : Symmetry operations and identification of point Groups of HCN, CO_2 , BH_3 , NH_3 , H_2O molecules. Properties of irreducible representations and C_{2v} character table. Reducible representation and symmetry of fundamental vibrations of H_2O

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BOOKS :

1. Atomic and Molecular Spectra - Rajkumar
2. Fundamentals of Molecular Spectroscopy - C.N.Banwell.
3. Group Theory - K.V.Raman.
4. Introduction to Atomic Spectra - H.E.White.

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Common for M.Sc. Physics and M.Sc. Space Physics
IISemester
(w.e.f 2009-10 batch)
P204,SP204: NUCLEAR AND PARTTICLE PHYSICS

UNIT - I

INTRODUCTION :
Objective of Studying Nuclear Physics, Nomenclature, nuclear radius, mass & Binding energy, angular momentum, magnetic dipole moment, Electric quadrupole moment, parity and symmetry, domains of instability, Energy levels, mirror nuclei.

NUCLEAR FORCES : Simple theory of the deuteron, scattering cross-sections, qualitative discussion of neutron- proton and proton- proton scattering, charge independence and charge symmetry of nuclear forces ,exchange forces, Yukawa's Potential, Characteristics of Nuclear Forces.

UNIT - II

NUCLEAR MODELS . Liquid drop model:, Weissacker's semi-emperical mass formula, Mass – parabolas. Nuclear shell model : Spin orbit interaction, magic numbers, prediction of angular momenta and parities for ground states, Collective model., More-realistic models

NUCLEAR DECAY : Alpha decay process, Energy release in Beta-decay, Fermi's Theory of β - decay, selection rules, parity violation in β -decay, Detection and properties of neutrino, . Energetics of gamma deacay, selection rules, angular correlation, Mossbauer effect.

NUCLEAR REACTIONS : Types of reactions and conservation laws, the Q – equation, Optical model, heavy ion Reactions

UNIT - III

NUCLEAR ENERGY Stability limit against spontaneous fission, Characteristics of fission, delayed neutrons, Four factor formula for controlled fission, Nuclear fusion, prospects of continued fusion energy.

ELEMENTARY PARTICLE PHYSICS: Particle interactions and families, symmetries and conservation laws (energy and momentum, angular momentum, parity, Baryon number, Lepton number, isospin, strangeness quantum number(Gellmann and Nishijima formula) and charm), Elementary ideas of CP aand CPT invariance, SU(2), SU(3) multiplets, Quark model.

UNIT - IV

DETECTING NUCLEAR RADIATION: Interaction of radiation with matter. Gas filled counters, scintillation detectors, semiconductor detectors, energy measurements, coincidence measurements and time resolution, magnetic spectrometers.

ACCELERATORS: Electrostatic accelerators, cyclotron accelerators, synchrotrons, linear accelerators, colliding beam accelerators.

APPLICATIONS OF NUCLEAR PHYSICS: Trace Element Analysis, Rutherford Back-scattering, Mass spectrometry with accelerators, Diagnostic Nuclear Medicine, Therapeutic Nuclear Medicine.

TEXT BOOKS :. "Introductory Nuclear Physics" Kenneth S. Krane

Reference Books:

1. "Introduction to Nuclear Physics " Harald A.Enge
2. "Concepts of Nuclear Physics " Bernard L.Cohen.
3. " Introduction to High Energy physics" D.H. Perkins
4. " Introduction to Elementary Particles" D. Griffiths

Department of Physics, Andhra University

Introductory Atmospheric and Space Physics

(Choice based course to be offered in the Department of Physics during II Semester with a minimum intake of 15 and maximum 25)
With effect from 2009-2010 admitted batch)

Target aspirants: PG students from departments of Meteorology and Oceanography, Geophysics, Environmental sciences, Geography, Geo-engineering and Electronics and Communication engineering)

Unit I : The Neutral atmosphere, atmospheric nomenclature, the Hydrostatic equation, geopotential height, expansion and contraction, fundamental forces in the atmosphere, apparent forces, atmospheric composition, solar radiation interaction with the neutral atmosphere, climate change.

Unit II: Electromagnetic radiation and propagation of waves: EM Radiation, fundamentals of EM waves, effects of environment, Antennas- basic considerations, types of antennas. Propagation of waves: ground wave, sky wave, and space wave propagation, troposcatter communication and extra terrestrial communication.

Unit III: The Ionosphere, morphology of ionosphere, the D, E and F-regions, chemistry of the ionosphere, ionospheric parameters, E and F region anomalies and irregularities in the ionosphere.

Unit IV: Global Positioning systems (GPS)- basic concepts, overview of GPS system, augmentation services, GPS system segment, GPS signal characteristics, GPS errors, multi path effects, GPS performance, satellite navigation system and applications.

Reference Books:

1. An Introduction to Dynamic Meteorology by James R Holton, Academic Press Inc.
2. Climatology, An atmospheric Science by John E. Oliver and John J. Hindore, Pearson Education
3. Electronic Communication systems by George Kennedy and Bernard Davis, Tata McGraw Hill publishing Co., Ltd.
4. Introduction to Ionospheric Physics by Henry Rishbeth and Owen K. Garriot, Academic press
5. Understanding GPS principles and applications by Elliot D. Kaplan and Christopher J. Hegarty, Artech House, Boston.

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
LIST OF EXPERIMENTS FOR
COMMON FOR M.SC.PHYSICS AND M.SC. (SPACE PHYSICS)
IISemester
(w.e.f 2009-10 batch)
P205,SP205: MODERN PHYSICS LAB -II

1. **Atomic Spectrum of Sodium.**
   a)identification of sharp and diffuse doublets
   b) doublet separation
   c) assignment of principal quantum numbers
2. **Raman Spectrum of Carbon Tetrachloride**
   a)Raman shifts
   b) Fermi resonance
3. **Vibrational analysis of AlO Green system.**
   a)identification of sequences, assignment of vibrational quantum numbers,
   b) Deslandre's table and Vibrational constants.
4. **Determination of Specific Charge of an electron by Thomson's Method.**
5. **Experments with He- Ne laser .**
   a)Polarization of laser light
   b)Divergence of laser beam and monochromaticity.
6. **Band gap of a semiconductor(Four probe method).**
7. **Dielectric constant as a function of temperature and determination of Curie**
   Temperature
8. **Susceptibility of a substance Gouy's method**
9. **Dissociation energy of Iodine molecule from the given data.**

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
LIST OF EXPERIMENTS FOR
COMMON FOR M.SC.PHYSICS AND M.Sc. SPACE PHYSICS
IISemester
(w.e.f 2009-10 batch)
P206,SP206: ELECTRONICS LAB -II

List of Experiments (Any SIX of the following)

1. Active Low pass and High Pass filters (IC 741)

2.Twin -T filter (IC 741)

3. Logarithmic Amplifier (IC 741)

4. Wein Bridge Oscillator (IC 741)

5. Monostable multivibrator (IC 555)

6. Voltage Regulator (IC 723)

7. Phase Shift Oscillator (IC 741)

8. Astable multivibrator (IC 555)

9.Active band pass filter (IC 741)

10. Voltage controlled oscillator ((IC 741, IC 555)