Annexure – III

Revised Course Structure for M.Sc. Physics and M.Sc. Space Physics

(With effect from 2012-13 admitted batch)

*First year is common for both M.Sc. Physics & M.Sc. Space Physics

M.Sc. Physics & M.Sc. Space Physics – I Semester

Theory Code	Title	L	T	P	Tot Hrs	Exam Marks	Mid sem Marks	Total Marks	Credits
P-101	Classical Mechanics	4	1		5	85	15	100	4
P-102	Introductory Quantum Mechanics	4	1		5	85	15	100	4
P-103	Mathematical Methods of Physics	4	1		5	85	15	100	4
P-104	Electronic Devices & Circuits	4	1		5	85	15	100	4
P-105	Electronics/ Modern Physics Lab Record Comprehensive Viva			12	12	100 50 50			8
	Total	16	4	12	32	540	60	600	24

L: Lecture hours, T- Tutorial hours, P- Practical hours

M.Sc. Physics & M.Sc. Space Physics – II Semester

Theory Code	Title	L	T	P	Tot Hrs	Exam Marks	Mid sem Marks	Total Marks	Credits
P-201	Electrodynamics	4	1		5	85	15	100	4
P-202	Statistical Mechanics	4	1		5	85	15	100	4
P-203	Atomic & Molecualr Physics	4	1		5	85	15	100	4
P-204	Nuclear & particle Physics	4	1		5	85	15	100	4
P-205	Modern Physics/ Electronics Lab Record Comprehensive Viva			12	12	100 50 50			8
	Total	16	4	12	32	540	60	600	24

L: Lecture hours, T- Tutorial hours, P- Practical hours

Choice based paper for other departments in the University campus only

Introductory Atmospheric & Space Physics

M.Sc. Physics – III Semester

Theory Code	Title	L	T	P	Tot Hrs	Exam Marks	Mid sem Marks	Total Marks	Credits
P-301	Solid State Physics	4	1		5	85	15	100	4
P-302	Lasers & Fiber Optics	4	1		5	85	15	100	4
P-303	Digital Electronics & Microprocessors	4	1		5	85	15	100	4
P-304	Communication Electronics	4	1		5	85	15	100	4
P-305	Digital (Including Microprocessor) & Communication Electronics Lab / Solid state Physics Lab Record Comprehensive Viva			12	12	100 50 50			8
	Total	16	4	12	32	540	60	600	24

L: Lecture hours, T- Tutorial hours, P- Practical hours

Choice based paper for other departments in the University campus only

Analytical Techniques

M.Sc. Physics IV Semester

Theory Code	Title	L	T	P	Tot Hrs	Exam Marks	Mid sem Marks	Total Marks	Credits
P-401	Advanced Quantum Mechanics	4	1		5	85	15	100	4
P-402	Properties & Characterization of Materials	4	1		5	85	15	100	4
P-403	Radar & Satellite Communication	4	1		5	85	15	100	4
P-404	Antenna Theory & Radio wave Propagation	4	1		5	85	15	100	4
P-405	Solid state Physics Lab/Digital (Including Microprocessor) & Communication Electronics Lab Record Comprehensive Viva			12	12	100 50 50			8
	Total	16	4	12	32	540	60	600	24

L: Lecture hours, T- Tutorial hours, P- Practical hours

M.Sc. Space Physics – III Semester

Theory Code	Title	L	T	P	Tot Hrs	Exam Marks	Mid sem Marks	Total Marks	Credits
SP-301	Aeronomy	4	1		5	85	15	100	4
SP-302	Principles of Plasma Physics & Space Plasmas	4	1		5	85	15	100	4
SP-303	Digital Electronics & Microprocessors (Common with M.Sc. Physics P-303)	4	1		5	85	15	100	4
SP-304	Communication Electronics (Common with M.Sc. Physics P-304)	4	1		5	85	15	100	4
SP-305	Digital & Communication Electronics & Space Physics Lab Record Comprehensive Viva			12	12	100 50 50			8
	Total	16	4	12	32	540	60	600	24

L: Lecture hours, T- Tutorial hours, P- Practical hours

Analytical Techniques

M.Sc. Space Physics- IV Semester

Theory Code	Title	L	T	P	Tot Hrs	Exam Marks	Mid sem Marks	Total Marks	Credits
SP-401	Ionospheric Radio wave propagation and sounding techniques	4	1		5	85	15	100	4
SP-402	Ionospheric Plasma Dynamics	4	1		5	85	15	100	4
SP-403	Radar & Satellite Communication	4	1		5	85	15	100	4
SP-404	Antenna Theory & Radio wave Propagation	4	1		5	85	15	100	4
SP-405	Project work Project Presentation Project Viva			12	12	100 50 50			8
	Total	16	4	12	32	540	60	600	24

L: Lecture hours, T- Tutorial hours, P- Practical hours

DEPARTMENT OF PHYSICS, ANDHRA UNIVERSITY

I Semester

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

(w.e.f 2012-13 batch)

P101, SP101: CLASSICAL MECHANICS.

UNIT-I: Mechanics of a particle. Mechanics of a system of particles, constraints, D'Alembert's principle and Lagrange's equations, Velocity Dependent potentials and the Dissipation function Simple applications of the Lagrangian Formulation

5 Hrs.

Chapter : 1. Section : 1, 2, 3, 4,5 & 6 .

Hamilton's principle, some techniques of the calculus of variations. .Derivation of Lagrange's equations from Hamilton's principle. Conservation theorems and symmetryproperties,Energy function and the conservation of Energy **6 Hrs.**

Chapter : 2. Section : 1, 2, 3, 5, 6

UNIT-II: Reduction to the equivalent one body problem. The equation of motion and first Integrals, The equivalent One – Dimensional problem and classification of orbits, The differential equation for the orbit, and Integrable power –law potentials, Conditions for closed orbits (Bertrand's theorem), The Kepler problem inverse square law of force , The motion in time in the Kepler problem, Scattering in a central force field..

Chapter : 3. Section. 1, 2, 3, 5, 6, 7, 8 **7 Hrs**

Legendre transformations and Hamilton's equations of motion. Cyclic Coordinates and conservation theorems, Derivation of Hamilton's equation of motion from variational principle, Principle of Least Action.

6 Hrs

Chapter : 7 Section: 1, 2,3,4 5 .

UNIT-III: Equations of canonical transformation, Examples of Canonical transformations, The harmonic Oscillator, 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.

5Hrs

Chapter : 8. Section : 1 , 2 ,4, 5, 6 & 7.

Hamilton – Jacobi equation of Hamilton's principal function, The Harmonic oscillator problem as an example of the Hamilton – Jacobi Method, Hamilton –Jacobi equation for Hamilton's characteristic function. Action – angle variables in systems of one degree of freedom.

8 **Hrs.**

Chapter : 9. Section : 1, 2, 3, & 5.

UNIT-IV: Independent coordinates of rigid body. , The Euler angles, Euler's theorem on theMotion of a rigid body, Infinitesimal rotations, Rate of change of a vector, The Coriolis Effect.

Chapter : 4. Section : 1, 4, 6, 8, 9 .

The Inertia tensor and the moment of inertia, The Eigenvalues of the inertia tensor and the principal axis transformation, Solving rigid body problems and Euler equations of motion, Torque – free motion of a rigid body

6 Hrs

Chapter 5 Section: 3, 4, 5 & 6.

The Eigenvalue equation and the principal axis transformation, Frequencies of free vibration, and normal coordinates, Free vibrations of a linear triatomic molecule

Chapter 10 Section: 2, 3 & 4 . **6 Hrs**

TEXT BOOKS : Classical Mechanics H.Goldstein (Addison-Wleley, 1st & 2nd ed)

REFERENCE BOOKS: Classical Dynamics of Particles and Systems J.B.Marion.

DEPARTMENT OF PHYSICS
ANDHRA UNIVERSITY
Common for
M.Sc. Physics and M.Sc. Space Physics
I Semester (w.e.f 20012-13 batch)

P102, SP102 : INTRODUCTORY QUANTUM MECHANICS

UNIT-I: The Conceptual aspect :Wave particle duality,Uncetainty principle, Principle of superposition - Wave packets – phase velocity and group velocity- Schrodinger Wave Equation - , wave function interpretation and admissibility conditions, probability current density, expectation value, Erhenfest theorem, stationary states. 8hrs

UNIT-II: Bracket notation, orthonormal functions, linear operators and their properties, - Hermitian operator, Schmidt orthogonalisation, Postulates of quantum mechanics, simultaneous measurability of observables, commutator algebra, equation of motion of an operator (Schrodinger representation), Momentum representation- - Dirac delta function and properties. 12 hrs.

UNIT-III: One dimensional problems - Particle in a potential well with (i) infinite walls, (ii) finite walls. Potential step, Potential Barrier. Linear Harmonic Oscillator (Schrodinger method). Free particle. Particle moving in a spherically symmetric potential, spherical harmonics, radial equation,. Eigen values and eigen functions of rigid rotator, hydrogen atom, hydrogenic orbitals, angular momentum operators, commutation relations, eigen values and eigen functions of L^2 , Lz, L+ and L- spin angular momentum, general angular momentum..
15 hrs.

UNIT-IV: Time- independent perturbation theory for **(i)** non degenerate systems and application to ground state of helium atom., effect of electric field on the ground state of hydrogen, spin orbit coupling ii) degenerate systems, application to linear stark effect in hydrogen.. Variation method and its application to helium atom., exchange energy and low lying excited states of helium atom. WKB method, barrier penetration. 15hrs.

Text Book :

Quantum Mechanics R.D. RATNA RAJU

Reference Books :

1. Quantum Mechanics Aruldhas
2. Quantum Mechanics G. S. Chaddha
3. Quantum Mechanics B.H.Bransden and C.J.Joachain
4. Quantum Mechanics E. Merzbacher
5. Quantum Mechanics Richard Liboff

DEPARTMENT OF PHYSICS, ANDHRA UNIVERSITY

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

I Semester

(w.e.f 2012-13 batch)

P103,SP103: **Mathematical Methods of Physics**

Unit I : Complex Variables **15 Hrs**

Function of complex number- definition-properties, analytic function-Cauchy –Riemann conditions-polar form-problems, Complex differentiation, complex integration –Cauchy's integral theorem- Cauchy's integral formulae-multiply connected region- problems, Infinite series-Taylor's theorem- Laurrent's theorem-Problems, Cauchy's Residue theorem- evaluation of definite integrals-problems.

Text Book:1. Mathematical Methods of Physics-G.Arfken,Academic Press

2.Mathematical Physics-Satya Prakash, Sultan Chand & co,New Delhi

3.Complex Variables (Schaum's out line series) MurrayR.Spiegel

Ref Book: Mathematical Methods B.D.Gupta

Unit II : Beta , Gamma functions &Special functions **10 Hrs**

Beta & Gamma functions -definition, relation between them- properties-evaluation of some integrals

Special Functions- Legendre Polynomial, Hermite Polynomial, Laguerre Polynomial-Generating finction-recurrence relations-Rodrigue's formula-orthonormal property-associated Legendre polynomial-simple recurrence relation-orthonormal property-spherical harmonics

Text Book: **1.**Mathematical Methods of Physics-G.Arfken,Academic Press

2.Mathematical Physics-Satya Prakash, Sultan Chand & co,New Delhi

3. Mathematical Physics B S Rajput

Ref book : Special Finctions .M.D.Raisinghania

Unit III : Laplace Transforms & Fourier series, Fourier Transforms **15 Hrs**

Laplace Transforms – definition- properties – Laplace transform of elementary functions-Inverse Laplace transforms-properties- evaluation of Inverse Laplace Transforms-elementary function method-Partial fraction method-Heavyside expansion method-Convolution method-complex inversion formula method-application to differential equations Fourier series-evaluation of Fourier coefficients- Fourier integral theorem-problems-square wave-rectangular wave-triangular wave

Fourier Transforms- infinite Fourier Transforms-Finite Fourier Transforms-Properties-problems-application to Boundary value problem

Text Book: **1.**Mathematical Methods of Physics-G.Arfken,Academic Press

2.Mathematical Physics-Satya Prakash, Sultan Chand & co,New Delhi

3. Laplace n Fourier Transforms Goyal & Gupta,

Ref books: Integral Transforms M.D.Raisinghanna

Integral Transforms Goyal & Gupta

Mathematical Physics B S Rajput

Unit IV: Numerical Analysis **10 Hrs**

Solutions of algebraic and Transcendental equations-Bisection method-method of successive approximations-method of false positionIteration method-Newton Rapson method Simultaneous linear algebraic equations-Gauss elimination method-Gauss Jordan method-Matrix inversion method-jacobi method – Gauss-Siedel method

Interpolation with equal intervals-Finite differences-Newton Forward & Backward Interpolation formule Interpolation with unequal internals-Newtons divided difference formula-Lagrange interpolation formula Numerical Integration-General Quadrature formula-Trapezoidal rule -Simpson'1/3 rule & 3/8 rule

Text Books: Introductory methods of Numerical analysis S.S.Sastry

Numerical Methods V.N.Vedamurthy &.N.Ch.S.N.Iyengar

DEPARTMENT OF PHYSICS, ANDHRA UNIVERSITY

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

I Semester

(w.e.f 2012-2013 admitted batch of students)

P104,SP104: ELECTRONIC DEVICES AND CIRCUITS

UNIT-I

SEMICONDUCTOR DEVICES: 10 Hrs.

Tunnel diode, photo diode, solar cell, LED, Silicon controlled Rectifier, Uni Junction Transistor, Field Effect Transistor, (JFET & MOSFET), CMOS

UNIT-II

MICROWAVE DEVICES: 15 Hrs.

Varactor diode, Parametric Amplifier, Thyristors, Klystron, Reflex Klystron, Gunn Diode, Magnetron,CFA,TWT, BWO, IMPATT, TRAPATT, APD, PIN Diode, Schottky Barrier Diode.

UNIT-III

OPERATIONAL AMPLIFIERS : 10 Hrs.

The ideal Op Amp – Practical inverting and Non inverting Op Amp stages. Op Amp Architecture – differential stage, gain stage, DC level shifting, output stage, offset voltages and currents .

Operational Amplifier parameters- input offset voltage, input bias current , Common Mode Rejection Ratio, Slew Rate

UNIT-IV 15 Hrs.

OP- AMP APPLICATIONS:

Summing amplifier, Integrator, Differentiator,

Voltage to Current converter, Current to Voltage converter

Oscillators – Phase shift oscillator, Wien-Bridge Oscillator, Voltage Controlled Oscillator, Schmitt Trigger

Special applications – Monostable and Astable multivibrators using 555, Phase locked Loop, Voltage regulators.

TEXT BOOKS:

1. Integrated Electronics - Jacob Millman & C.C. Halkies (TMH)
2. Op.Amps and Linear Integrated Circuits – Ramakant A.Gayakwad (PHI)
3. Electronic Communication Systems – George Kennedy(PHI)

REFERENCE BOOKS:

1. Microelectronics - Jacob Millman & Arvin Grabel (McGraw Hill)
2. Electronic Devices and Circuits – G.K. Mithal (Khanna)
3. Op-amps and Linear Integrated Circuits – D. Mahesh Kumar (MacMillan).

DEPARTMENT OF PHYSICS, ANDHRA UNIVERSITY

Common for M.Sc. Physics and M.Sc. Space Physics
I Semester
(w.e.f 2012-13 batch)

P105 / SP105 : MODERN PHYSICS LAB
(Any twelve of the following experiments)

1.Atomic Spectrum of Zinc.
   a) Verification of Lande's interval rule
   b) Study of relative intensities

2.Grating spectrometer
   a)Wavelengths of Hg spectrum,
   b) wavelength of Balmer series, Rydberg constant

3. Reciprocal dispersion curve
4. Application of Point Groups.
   a)Identification of symmetry operations in H_2O, BH_3 , NH_3 and H_2CO
   b)Reducible representations and Vibrational modes of H_2O.
5. Determination of Planck's constant, work function and threshold frequency
6. Band gap of a semiconductor.(Two Probe Method)
7. Thermo emf
8. The Franck-Hertz experiment
9. Band spectrum of CN in the violet
   a)conversion of given wavelengths to wavenumbers and assignment of (v', v'')
   b)Deslandres' table and Vibrational constants.

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

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
Common for M.Sc. Physics and M.Sc. Space Physics
I Semester
(w.e.f 2012-13 batch)

P105/SP105: ELECTRONICS LAB

LIST OF EXPERIMENTS

(Any twelve of the following experiments)

1. FET amplifier (BFW 10/11)
2. Negative feedback amplifier (BC 147)
3. Colpitts Oscillator (BF 194)
4. Phase shift Oscillator (BC 147)
5. Astable Multivibrator (BF 194)
6. Op.Amp.Characteristics (IC 741)
7. Power Supply
8. UJT Characteristics (2 N 2646)
9. R.F.Amplifier (BF 194)
10. Boot-strap time base generator (2N 2222)
11. Active Low pass and High Pass filters (IC 741)
12. Twin -T filter (IC 741)
13. Logarithmic Amplifier (IC 741)
14. Wein Bridge Oscillator (IC 741)
15. Monostable multivibrator (IC 555)
16. Voltage Regulator (IC 723)
17. Phase Shift Oscillator (IC 741)
18. Astable multivibrator (IC 555)
19. Active band pass filter (IC 741)
20. Voltage controlled oscillator ((IC 741, IC 555)

DEPARTMENT OF PHYSICS
ANDHRA UNIVERSITY
II Semester
Common for M.Sc. Physics and M.Sc. (Space Physics)
(w.e.f 2012-13 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
ANDHRA UNIVERSITY
Common for M.Sc. Physics and M.Sc. Space Physics
IISemester
(w.e.f 2012-13 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

ANDHRA UNIVERSITY

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

II Semester (w.e.f 2012-13 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.

DEPARTMENT OF PHYSICS ANDHRA UNIVERSITY

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

IISemester

(w.e.f 2012-13 batch)

P204,SP204: NUCLEAR AND PARTICLE 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, mirror nuclei.

NUCLEAR FORCES : Simple theory of the deuteron, scattering cross-sections, qualitative discussion of neutron- proton and proton- proton scattering, exchange forces, Yukawa's Potential, Characteristics of Nuclear Forces. 10 hrs

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..

NUCLEAR DECAY : Fermi's Theory of β - decay, 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. 15 hrs

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, 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, Quark model. 10 hrs.

UNIT - IV

DETECTING NUCLEAR RADIATION: Interaction of radiation with matter. Gas filled counters, scintillation detectors, semiconductor detectors, energy measurements, buble chamber, magnetic spectrometers.

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

APPLICATIONS OF NUCLEAR PHYSICS: Trace Element Analysis, Rutherford Back-scattering, 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 2012-2013 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.

DEPARTMENT OF PHYSICS
ANDHRA UNIVERSITY
M.Sc. Physics
III Semester
(w.e.f 2012-13 batch)
P301: SOLID SATE PHYSICS.

UNIT-I: CRYSTAL STRUCTURE: 12 Hrs

Periodic array of atoms—Lattice translation vectors and lattices, symmetry operations, The Basis and the Crystal Structure, Primitive Lattice cell, Fundamental types of lattices—Two Dimensional lattice types, three Dimensional lattice types, Index system for crystal planes, simple crystal structures-- sodium chloride, cesium chloride and diamond structures.

UNIT-II: CRYSTAL DIFFRACTION AND RECIPROCAL LATTICE: 12 Hrs

Bragg's law, Experimental diffraction methods-- Laue method and powder method, Derivation of scattered wave amplitude, indexing pattern of cubic crystals and non-cubic crystals (analytical methods). Geometrical StructureFactor, Determination of number of atoms in a cell and position of atoms. Reciprocal lattice, Brillouin Zone, Reciprocal lattice to bcc and fcc Lattices.

UNIT-III: PHONONS AND LATTICE VIBRATIONS: 6 Hrs

Vibrations of monoatomic lattices, First Brillouin Zone, Group velocity, Long wave length, Lattice with two atoms per primitive cell, Quantization of Lattice Vibrations-Phonon momentum.

FREE ELECTRON FERMI GAS: 6 Hrs

Energy levels and density of orbitals in one dimension, Free electron gas in 3 dimensions, Heat capacity of the electron gas, Experimental heat capacity of metals, Motion in Magnetic Fields-Hall effect, Ratio of thermal to electrical conductivity.

UNIT-IV: THE BAND THEORY OF SOLIDS: 8 Hrs

. Nearly free electron model, Origin of the energy gap, The Block Theorem, Kronig-Penny Model, wave equation of electron in a periodic potential, Crystal momentum of an electron-Approximate solution near a zone boundary, Number of orbitals in a band--metals and isolators. The distinction between metals, insulators and semiconductors

TEXT BOOKS:

1.Introdcution to Solid State Physics, C.Kittel, 5^{th} edition,
2.Solid State Physics, A.J.DEKKER.

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS
III Semester
(w.e.f 2012-13 batch)

P302: Lasers and Fiber optics

UNIT-I

LASER SYSTEMS : Light Amplification and relation between Einstein A and B Coefficients. Rate equations for three level and four level systems. Laser systems: Ruby laser, Nd-YAG laser, CO_2 Laser, Dye laser, Excimer laser, Semiconductor laser.

UNIT – II:

LASER CAVITY MODES: **Line shape function and Full Width at half maximum (FWHM) for Natural broadening, Collision broadening, Doppler broadening, Saturation behavior of broadened transitions, Longitudinal and Transverse modes. ABCD matrices and cavity Stability criteria for confocal resonators. Quality factor, Q-Switching, Mode Locking in lasers. Expression for Intensity for modes oscillating at random and modes locked in phase. Methods of Q-Switching and Mode locking.**

UNIT-III

OPTICAL FIBER WAVEGUIDES : **Basic optical laws and Self focusing. Optical fiber modes and configurations Fiber types, Rays and Modes, Step-index fiber structure. Ray optics representation, wave representation. Mode theory of circular step-index wave guides. Wave equation for step-index fibers, modes in step-index fibers and power flow in step-index fibers. Graded – index fiber structure, Graded-index numerical aperture, modes in Graded-index fibers.**

UNIT-IV

FIBER CHARACTERISTICS : Signal Degradation In Fibers - Attenuation, Absorption, Scattering and Bending losses in fibers, radiative losses, Core and Cladding losses. Signal distortion in optical wave guides: Group delay, material dispersion, waveguide dispersion and intermodal dispersion. Pulse broadening in optical fibers. Power launching in Optical fibers, Source-output pattern, Lensing schemes. Fiber-to-fiber joints: Mechanical misalignment, fiber related losses, Fiber and face preparation. fiber splicing techniques, fiber connectors.

TEXT BOOKS:

1. **Lasers -Theory and Applications – K.Thyagarajan and A.K. Ghatak. (MacMillan)**
2. Optical fiber Communications – Gerd Keiser (Mc Graw-Hill)

REFERENCE BOOKS:

1. Laser fundamentals – William T. Silfvast (Cambridge)
2. Introduction to fiber optics – Ajoy Ghatak and K. Thyagarajan (Cambridge)
3. Optical Electronics – Ajoy Ghatak and K.Thyagarajan (Cambridge)
4. Opto- electronics – J. Wilson and J.F.B. Hawkes (Printice Hall)

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS, SPACE PHYSICS
III Semester
(w.e.f 2012-13 batch)
P303, SP303: Digital Electronics & Microprocessors
(Common for M.Sc.Space Physics and M.Sc.Physics)

UNIT - I

Digital Circuits (i) Number Systems and Codes: Binary, Octal, Hexadecimal number systems, Gray code, BCD code, ASCII code.(ii) Logic Gates and Boolean Algebra: OR, AND, NOT, NOR, NAND gates, Boolean theorems, DeMorgan law**s.**

II) Combinational Logic Circuits: (i) Simplification of Boolean Expressions: Algebraic method, Karnaugh Map method, EX-OR, EX-NOR gates, ENCODER, DECODER, Multiplexer, Demultiplexers.

(ii) Digital Arithmetic Operations and Circuits: Binary addition, Design of Adders and Subtractors, Parallel binary adder, IC parallel adder.(iii) Applications of Boolean Algebra: Magnitude Comparator, Parity generator, Checker, Code converter, Seven-segment decoder/ Driver display.

UNIT - II

Sequential Logic Circuits:(i) Flip-Flops and Related Devices: NAND latch, NOR latch, Clocked flip-flops, Clocked S-C flip-flop, J-K flip-flop, D flip-flop, D latch, Asynchronous inputs, Timing problem in flip-flops.(ii) Counters: Asynchronous counters (Ripple), Counters with MOD number $< 2^N$, Asynchronous down counter, Synchronous counters, Up-down counter, Presettable counter.

(iii) Registers: Shift Register, Integrated Circuit registers, Parallel In Parallel Out (PIPO), SISO, SIPO, PISO

(iv) Applications of Counters: Frequency Counter and Digital clock.

A/D and D/A Converter Circuits: D/A Converter, Linear weighted and ladder type, An integrated circuit DAC; Analog-to-Digital Conversion, Digital Ramp ADC, Successive Approximation Method, Sample and Hold Circuit, Digital Voltmeter.

UNIT - III

Intel 8085 Microprocessor:

Architecture, Functional diagram, Pin description, Timing Diagram of Read Cycle, Timing diagram of write Cycle.

Programming the 8085 Microprocessor:

(i) Addressing Methods, Instruction set, Assembly language programming.

(ii) Examples of Assembly Language Programming: Simple Arithmetic - Addition/Subtraction of two 8-bit/16-bit numbers, Addition of two decimal numbers, Masking of digits, word disassembly.

(iii) Programming using Loops: Sum of series of 8-bit numbers, Largest element in the array, Multiple byte addition, Delay sub-routine.

UNIT - IV

Data Transfer Technique:

Serial transfer, Parallel transfer, Synchronous, Asynchronous, DMA transfer, Interrupt driven Data transfer.

8085 Interfacing:

I/O Interfacing: Programmable Peripheral Interfacing, 8255, Programmable Peripheral Interval Timer 8253, Programmable Communication Interface 8251, DAC 0800 and ADC 0800 interfacing.

TEXT & REFERENCE BOOKS:

1. "Digital Systems – Principles and applications" –Ronald.J.Tocci,
2. "Fundamentals of Microprocessors & Microcomputers" - B. RAM.
3. " Introduction to Microprocessors for Engineers and Scientists" - P.K.Ghosh and P.R.Sridhar
4. "Microprocessor Architecture, Programming and Applications with the 8085 /8080A" – Ramesh. S. Gaonkar.

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc PHYSICS, and SPACE PHYSICS
IV SEMESTER
(w.e.f 2012-2013 batch)
P 304 , SP 304 COMMUNICATION ELECTRONICS
(Common for M.Sc. Space Physics and M.Sc Physics)

UNIT 1. **CW Modulation**:

Amplitude Modulation (AM): 8 periods

Introduction, Amplitude modulation, modulation index, Frequency spectrum, Average power

for sinusoidal AM, Amplitude modulator and demodulator circuits, Double side band suppressed carrier (DSBSC) Modulation, Super heterodyne receiver.

Single Side Band Modulation (SSB): 4 periods

SSB principles, Balanced Modulator, SSB generation

Angle Modulation: 8 periods

Frequency modulation (FM), sinusoidal FM, Frequency spectrum for sinusoidal FM

frequency deviation, modulation index, Average power in sinusoidal FM, FM generation

Phase Modulation: Equivalence between PM and FM, FM detectors: Slope detector, Balanced slope detector, Foster – Seley discriminator, Ratio detector, Amplitude limiter, FM receiver.

UNIT 2. **Pulse Modulation:**

Digital Line Codes: Symbols, Functional notation for pulses, Line codes and wave forms: RZ, NRZ, Polar, Unipolar, AMI , HDBn and Manchester codes, M-ary encoding, Differential encoding 8 periods

Sampling theorem, Principles of pulse Amplitude Modulation (PAM) and Pulse Time Modulation(PTM) ,Pulse code modulation (PCM), quantization, Nonlinear quantization, companding, differential pulse code modulation (DPCM), Delta Modulation(DM) .

Digital Carrier Systems: 8 periods

ASK, PSK, FSK and DPSK

UNIT 3. **Special Communication Circuits** : 6 periods

Tuned amplifiers :Single tuned amplifier-Hybrid π – equivalent for the BJT, Short circuit current gain for the BJT in CE and CB amplifiers, CE and CB tuned amplifiers, Cascode amplifier.

Mixer Circuits : Diode mixer, IC balanced mixer.

Filters : Active filters, Ceramic, Mechanical and crystal filters.

Oscillators: Crystal oscillator, Voltage controlled oscillator, phase locked loop(PLL).

UNIT 4. **Noise in Communication Systems:** 8 periods

Thermal Noise, Shot Noise, Partition noise, Signal - to – Noise ratio, Noise factor, Amplifier input noise in terms of F, Noise factor of amplifiers in cascade (Friss formula), Noise temperature, Noise in AM, Noise in FM systems. Noise in pulse modulation systems: Intersymbol interference (ISI) , eye diagrams.

Text Books:

1. Electronic Communications D. Roody and John Coolin

2. Electronic Communications Systems G. Kennedy
3. Modern Analog & Digital Communications B.P. Lathi.

Department of Physics, A.U
ANALYTICAL TECHNIQUES
(Choice Based Paper to be offered in the Dept., of Physics during 3rd Semester for other Dept., students in AU Campus only)
(W.e.f. 2012 – 2013 admitted batch)

Unit I
Concepts of interaction of electromagnetic radiation with matter, wave and particle properties of electromagnetic radiation, electromagnetic spectrum, absorption laws, electronic transitions, optical and molecular spectra, molecular energies, Raman spectra, Dispersion of radiation, photoelectric effect, photoelectric cells, X-ray scattering, Compton effect, radiation sources, detectors, lasers, photometric analytical methods.

References :
1)Instrumental methods of analysis, Willard, Merritt, Dean, Settle (CBS Pub.)
2)Instrumental methods of chemical analysis, H. Kaur (Pragati Prakasan Pub.)

Unit II : Ultrasonic techniques
Introduction, Physical acoustics, low frequency bulk acoustic wave (BAW) , surface acoustic wave (SAW) , piezoelectric materials, high power ultrasonics, medical ultrasonics, acousto-optics, under-water acoustics, and seismology, non-destructive evaluation of materials , medical applications, acoustic microscopy (biological samples)
References:
1)Fundamentals and Applications of Ultra-sonic Waves, John David Cheeke , (CRC Press), 2002
2)Ultrasonics, Fundamentals, Technology and Applications, Dale Ensminger, (CRC Press) 1988.
3)Fundamentals of Ultrasonics , Jack Blitz

Unit III : Magnetic Resonance Techniques
1)Electron Spin Resonance: Basic Concepts, g-factor and nuclear hyperfine interaction, line shapes and widths, sensitivity of detection and quantification, essential features of an ESR spectrometer, Applications of ESR: in Physical Sciences and biological systems, study of free radicals and their significance.

2)Nuclear Magnetic Resonance: Basic principles, continuous wave and pulsed NMR, time domain , frequency domain and the Fourier Transform, measurement of spin -lattice and spin-spin relaxation times, proton and C-13 NMR, basic pulsed Fourier Transform NMR spectrometer,2D NMR, , Magic angle and cross polarization technique applied to solids, applications of NMR in physical and biological sciences, basic features of MRI.

3)Nuclear quadrupole resonance: Basic principle and applications

Unit IV : Structural characterization techniques

X-ray diffraction, indexing pattern of cubic crystals and non-cubic crystals (analytical methods), crystal structure identification and determination of lattice parameters.

Fundamentals of Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM), Principle of image formation and image magnification, major components in SEM and TEM, study of crystal structure using TEM, study of microstructure using SEM.

References :

1)Elements of X-ray Diffraction, B.D. Cullity, Addison-Wesley Publishing Co. Inc., USA (1977).
2)Physical Methods of Materials Characterization (Second Edition), PEJ Flewitt and RK Wild, Institute of Physics Publishing, Bristol, UK.
3)Electron Paramagnetic Resonance : Elementary Theory and ractical Applications, J.A.Weil, J.R.Bolton and J.E.Wertz (Wiley) N.Y, 1994
4) Principles of Nuclear Magnetic Resonance in One and Two Dimensions, R.R.Ernst, G.Bodenhausen and A.Wokun,(Oxford)1987
(5)Basics of NMR, Joseph. P. Hornack, Free Online Text
(6)Nuclear Quadrupole Coupling Constants, E.A.C. Lucken (A.P) 1969

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS AND M.Sc. SPACE PHYSICS
III/IV Semesters
(w.e.f 2012-13 batch)

P 305 : Digital (including Microprocessors) and Communication Electronics Lab

(Any four from Digital Electronics, four from Microprocessors and another four from Communication Electronics -Total of 12 Experiments)

Digital electronics

1. Encoder and Decoder , Multiplexer and De multiplexer
2. Adders: Half adder, Full Adder, Paraller Adder
3. Flip Flops (7400,7402,7408,7446)
4. Decade Counter (IC 7490) and Seven segment Decoder/ Driver (7490,7447)
5 .UP/DOWN Counter IC 74193
5. Digital Comparator (7485)

Micrprocessor Lab

1. Addition/ subtraction of 8 bit numbers and Sum of series of 8 – bit numbers
2. Word Disassembly and Largest number in an array
3. Addition of two 16 – bit numbers and sum of series of 16-bit numbers
4. Interfacing of 8255 PPI: generation of square wave and rectangular waves
5. Interfacing of 8253 programmble timer: Mode 1, Mode2, Mode3, Mode 4, Mode5
6. 0800 DAC interfacing : generation of square, triangular and stair case wave forms

COMMUNICATION LAB

1. AMPLITUDE MODULATION and MIXER
2. BUTTERWORTH FIRST ORDER LOWPASS, HIGHPASS FILTERS and CHEBYSHEV SECOND ORDER LOWPASS FILTER
3. PHASE LOCKED LOOP (PLL) and SAMPLE AND HOLD CIRCUIT
4. FREQUENCY MODULATION
5..DETERMINATION OF FREQUENCY AND WAVELENGTH IN A RECTANGULAR WAVEGUIDE IN $TE_{1,0}$
6. MEASUREMENT OF GAIN ,FRONT TO BACK RATIO,BEAM WIDTH OF RADIATION PATTERN OF a)HALF WAVE DIPOLE
c) FIVE ELEMENT YAGI UDA ANTENNA
c) HELICAL ANTENNA
d) CUT –PARABOIDAL REFLECTOR ANTENNA

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS
III/IV Semesters (w.e.f 2012-13 batch)

P 306 : PRACTICALS

Solid state Physics Lab- List of Experiments

1. Hall Effect: Determination of Hall co-efficient and estimation of charge carrier concentration and mobility.
2. ESR Studies – DPPH - Determination of 'g' value of an electron.
3. X-ray diffraction studies : Determination of lattice constant and number of atoms per unit cell
4. Lattice Dynamics: Study of Phonon Dispersion characteristics.
5. Study of Magnetic Hysteresis loops of ferromagnetic materials (B-H Curve)
6. Measurement of Magnetoresistance of Semiconductors (Four probe arrangement).
7. Coupled Oscillators : Study of the normal modes of vibrations of coupled pendulum, strength of the coupling constant and exchange energy.
8. Determination of Dielectric constant – Determination of wavelength of the microwaves in the guide of an x-band test bench and determination of dielectric constant.
9. Measurement of magnetic susceptibility of Paramagnetic solution by Quink's Method.
10. Measurement of magnetic susceptibility of Paramagnetic solids by Gouy's Method.
11. Thermo e.m.f : Calculations of thermo electric power, Fermi energy and carrier concentration of a given sample.
12. Ultrasonic Diffraction study in Liquids.

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS.
IV SEMESTER
(w.e.f 2012-2013 admitted batch)

P401: ADVANCED QUANTUM MECHANICS .

UNIT - I

Linear Vector Spaces in Quantum Mechanics:

Vectors and operators, change of basis, Dirac's bra and ket notations. Eigen value problem for operators. The continuous spectrum. Application to wave mechanics in one dimension.

(Merzbacher Sec. 14.1, 14.2, 14.3, 14.4, 14.5, 14.6, 14.7)

UNIT - II

Quantum Dynamics :

The equation of motion, Quantization postulates, canonical quantization, Constants of motion and invariance properties. Heisenberg picture. Harmonic Oscillator.

(Merzbacher . Sec. 15.1, 15.2, 15.3, 15.4, 15.6, 15.7)

UNIT - III

Development of time-dependent perturbation theory. The golden rule for constant transistion rates.

(Merzbacher. Chapter. 18 relevent parts)

Addition of two angular momenta. Tensor operators.

Wigner-Eckart theorem. Matrix elements of vector operators. Parity and time reversal symmetries.

(Merzbacher . Section. 16.6, 16.8, 16.10, 16.11)

UNIT - IV

Scattering:

Concept of differential cross-section. Scattering of a wave packet. Born approximation. Partial waves and phase shift analysis.

(Merzbacher. Section. 11.1, 11.2, 11.4, 11.5)

. Relativistic Quantum Mechanics

Klein – Gordon equation, Dirac equation for a free particle, Equation of continuity, Spin of a Dirac particle, Solutions of free particle Dirac equation, Negative energy states and hole theory

TEXT BOOKS:

1. " Quantum Mechanics" by R.D. Ratna Raju
2. "Quantum Mechanics " by E. Merzbacher

Reference Books:

1." Quantum Mechanics" by Thankappan
2. "Quantum Mechanics" by Biswas

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS
IV SEMESTER
(w.e.f 2009-2010 batch)

P.402 : PROPERTIES AND CHARACTERIZATION OF MATERIALS

UNIT - I

THERMAL PROPERTIES:

Anharmonic crystal interactions-thermal expansion, thermal conductivity, lattice thermal resistivity, umklapp processes, and imperfections.

OPTICAL PROPERTIES :

Lattice Vacancies, Diffusion, Color Centers—F Centers, other centers in alkali halides, Alloys, Order-disorder transformations, Elementary theory of Order.

UNIT - II

MICROSCOPIC EXAMINATION:

Fundamentals of Transmission electron microscopy and scanning electron microscopy, study of crystal structure using TEM, study of microstructure using SEM.

UNIT - III

RESONANCE METHODS:

Spin and an applied field—the nature of spinning particles, interaction between spin and a magnetic field, population of energy levels, the Larmor precession, relaxation times—spin- spin relation, spin-lattice relaxation,

Electron Spin Resonance: Introduction, g-factor, experimental methods.

Nuclear Magnetic Resonance—equations of motion, line width, motional narrowing, hyperfine splitting,

Nuclear Gamma Ray Resonance: Principles of Mossbauer Spectroscopy, Line Width, Resonance absorption, Mossbauer Spectrometer, Isomer Shift, Quadrupole Splitting, magnetic field effects, Applications.

UNIT - IV

5ELECTRICAL AND MAGENTIC CHARACTERIZATION TECHNIQUES:

DC & AC Conductivity, Curie temperature, Saturation Magnetization and Susceptibility

OPTICAL SPECTROSCOPY:

Fundamentals of Infra-red Spectroscopy and Applications.

TEXT BOOKS:

Solid State Physics, 5th edition, C.Kittel
Fundamentals of Molecular Spectroscopy CN Banwell
Mossbauer Effect and its Applications VG Bhide

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ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc PHYSICS, and SPACE PHYSICS
IV SEMESTER
(w.e.f 2009-2010 batch)
P 403 , SP 403 Radar and Ssatellite Communication
(Common for M.Sc. Space Physics and M.Sc Physics)

UNIT - I

Radar Systems:

Fundamental – A simple RADAR – overview of frequencies – Antenna gain Radar Equation – Accuracy and Resolution – Integration time and the Doppler shift (Ch 1 of Text Book 1)

Designing a surveillance radar – Radar and surveillance – Antenna beam – width consideration – pulse repetition frequency – unambiguous range and velocity – pulse length and sampling – radar cross section – clutter noise (Ch 2 of Text Book 1)

Tracking Radar – Sequential lobbing – conial scanning – Mono Pulse Radar – Tracking accuracy and Process – Frequency Agility – Radar guidance (Ch3 of Text Book 1)

UNIT - II

Signal and Data Processing – Properties of clutter – Moving Target Indicator Processing Thresholding – Plot extraction – Tract Association, Initiation and Tracking (Ch 5 of Text Book 1)

Radar Antenna – Antenna parameters – Antenna Radiation Pattern and aperture efficiency – Parabolic reflector – cosecant squared antenna pattern – effect of errors on radiation pattern – Stabilization of antennas (Ch7 of Text Book 2).

UNIT - III

Satellite Communication

Satellite System – Historical development of satellites – communication satellite systems – communication satellites – orbiting satellites – satellite frequency bands – satellite multiple access formats (Ch1 of Text Book 3).

Satellite orbits and inclination – Look angles, orbital perturbations, space craft and its subsystems – attitude and orbit control system – Telemetry, Tracking and Command – Power system – Transponder – Reliability and space qualification – launch vehicles

(Ch2 & 3 of Text Book 4)

UNIT - IV

Multiple Access Techniques – Time division multiple access – Frequency division multiple access – Code division multiple access – Space domain multiple access

(Ch 7 of Text Book 4).

Earth Station technology – Subsystem of an earth station – Transmitter – Receiver Tracking and pointing – Small earth station – different types of earth stations – Frequency coordination – Basic principles of special communication satellites – INMARSAT VSAT, GPS, RADARSAT, INTELST

(Ch 10 & 11 of Text Book 4).

Text Books:

1. Understanding Radar Systems – Simon Kingsley and Shaun Quegan.
2. Introduction to Radar Systems – MI Skolnik
3. Satellite Communication – Robert M. Gagliardi
4. Satellite Communication – Manojit Mitra

ANDHRA UNIVERSITY

DEPARTMENT OF PHYSICS

M.Sc. PHYSICS and M.Sc. SPACE PHYSICS,

IV SEMESTER

(w.e.f. 2009-2010 admitted batch)

P404, SP404 : ANTENNA THEORY AND RADIOWAVE PROPAGATION

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

UNIT - I

Radiation

Potential functions of electro magnetic fields. Potential function for sinusoidal oscillations. Fields radiated by an alternating current element. Power radiated by a current element and radiation resistance. Radiation from a quarter wave monopole or a half wave dipole. EM field close to an antenna and far field approximation.

(Chapter 10 in Jordan and Balmain) *6 Hrs.*

Antenna Fundamentals

Definition of an antenna. Antenna properties – radiation pattern, gain, directive gain and directivity. Effective area. Antenna beam width and band width. Directional properties of dipole antennas.

(Chapter 11 in Jordan and Balmain and Chapter 2 in Kraus)
8Hrs.

UNIT - II

Antenna Arrays

Two element array. Linear arrays. Multiplication of patterns and binomial array. Effect of Earth on vertical patterns. Mathematical theory of linear arrays. Antenna synthesis – Tchebycheff polynomial method. Wave polarization.

(Chapter 11 and 12 in Jordan and Balmain and Chapter 4 in Kraus)
10 Hrs.

Impedance

Antenna terminal impedance. Mutual impedance between two antennas. Computation of mutual impedance. Radiation resistance by induced emf method. Reactance of an antenna. Biconcal antenna and its impedance.

(Chapter 14 in Jordan and Balmain and Chapters 8.1 –8.5 in Kraus)
6 Hrs.

UNIT - III

Frequency Independent (FI) Antennas

Frequency Independence concept. Equiangular spiral. Log Periodic (LP) antennas. Array theory of LP and FI structures.

(Chapter 15 in Jordan and Balmain and Chapter 15 in Kraus)
6Hrs.

Methods of excitation and Practical Antennas

Methods of excitation and stub matching and baluns. Folded dipole, loop antennas. Parasitic elements and Yagi-Uda arrays and Helical antenna.

(Chapter11.15 in Jordan and Balmain)
6Hrs.

UNIT - IV

Radio Wave Propagation

Elements of Ground wave and Space wave propagation. Tropospheric propagation and Troposcatter. Fundamentals of Ionosphere. Sky wave propagation – critical frequency, MUF and skip distance.

(Chapter 16 and 17 in Jordan and Balmain) *8Hrs.*

BOOKS

1."Electromagnetic waves and Radiating Systems" by E.C.Jordan and K.G.Balmain

2."Antennas" by J.D.Kraus. (Second Edition)

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. SPACE PHYSICS
III SEMESTER
(w.e.f. 2012-2013 admitted batch)
SP 301 AERONOMY

UNIT – I : NEUTRAL ATMOSPHERE
Structure and Composition
(Chapters 1 in Rishbeth & Garriott and 4.1 in Hargreaves).
Nomenclature-Thermal structure of the atmosphere. Hydrostatic equation of the atmospheric structure. Scale height and geopotential height. Exosphere. *4 Hrs.*
Atmospheric composition. Dissociation and diffusive separation and thermospheric composition. Heat balance and temperature profile of thermosphere. *6 Hrs.*
UNIT – II: Chemical concepts in Atmosphere
(Chapters 2.1, 2.2, 2.3 and 3.4 in Brasseur & Solomon)
Thermodynamic considerations – Enthalpy . Elementary chemical kinetics- Reaction rate constants and chemical life time of species. Unimolecular, bimolecular and termolecular reactions. *8 Hrs.*
Effect of dynamics on chemical species. *2 Hrs.*

UNIT – III: IONIZED ATMOSPHERE
(*Chapters 3, 5 and 6 in Rishbeth & Garriott and 4.2, 4.3 and 10 in Hargreaves)*
Photochemical processes in the ionosphere
Introduction to ionosphere – discovery. Continuity equation and photochemical equilibrium. Theory of photo-ionization and Chapman production function. Chemical recombination and electron density. *5 Hrs.*
Solar radiation and production of ionospheric layers. *3 Hrs.*
Loss reactions
Different types of recombination processes. Chemistry of E and F1 regions. D region balance equations. D region chemistry – formation of water cluster ions. Electron attachment and negative ions. Positive and negative ion schemes of D region. *6Hrs.*
Linear and square law loss formulae and splitting of F layer. Vertical transport, ambipolar diffusion and F2 peak. Diffusion between ionosphere and protonosphere. *4 Hrs.*
Airglow. *4 Hrs.*
UNIT – IV: Morphology
Geographical and temporal structure of the ionosphere – Diurnal, seasonal and solar cycle variations of D, E and F regions and F region anomalies. *6 Hrs.*
Solar flare effects
Sudden Ionospheric Disturbances (SIDs) *2 Hrs.*

BOOKS
1."Introduction to Ionospheric Physics" by H.Rishbeth & O.K.Garriott
2."Aeronomy of the Middle Atmosphere" by Guy Brasseur & S.Solomon.
3."Upper Atmosphere and Solar Terrestrial Relations" by J.K.Hargreaves

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. SPACE PHYSICS
III SEMESTER
(w.e.f. 2012-2013 admitted batch)

SP 302 PRINCIPLES OF PLASMA PHYSICS AND SPACE PLASMAS

UNIT – I: PRINCIPLES OF PLASMA PHYSICS

Plasma and its characteristics

(Chapter 1 in Boyd and Sanderson)

Definition of a plasma. Plasma characteristics: Quasi neutrality, Plasma oscillations, Debye shielding, Debye length and Debye potential. *2 Hrs.*

Particle orbit theory

(Chapters 2.1 to 2.8 in Boyd and Sanderson)

Motion of charged particles in constant and uniform electric and magnetic fields. Particle motion in magnetic field with gradient and curvature : Particle motion in converging magnetic fields. Invariance of magnetic moment of a charged particle in slowly varying magnetic field. Magnetic mirror. Adiabatic mirror trap. *8 Hrs.*

UNIT – II: Hydromagnetics

(Chapter 4 in Boyd and Sanderson)

Frozen fields and Force free fields. Magneto-hydrostatics – magnetic stress tensor. Pinching in plasmas. Linear pinch – Bennett's relation, Theta pinch and Dynamic pinch. Hydro-magnetic stability. Kink and Sausage instabilities. R.T.instability. Alfven waves. *8 Hrs.*

Cold plasmas

(Chapters 7.1 to 7.3 in Boyd and Sanderson)

Definition of cold plasma. General wave concepts: wave polarization,group velocity. Waves in cold plasma: waves with **k** parallel to **B:** Shear Alfven waves and Ion Cyclotron waves; waves with **k** perpendicular to **B:** Compressional Alfven waves
8 Hrs.

UNIT – III: SPACE PLASMAS

Geomagnetism

(Chapter 7 in Rishbeth and Garriott)

Origins of geomagnetic field. Representation of Earth's magnetic field and magnetic field components. Geomagnetic field variations. *4 Hrs.*

Solar Wind and Interplanetary Magnetic Field (IMF)

(Chapters 7.1, 7.2 and 7.3 in Hargreaves)

Sun Spots and solar cycle. Solar flares. Theory of solar wind. Observed properties of the solar wind. IMF and sector structure. *4 Hrs.*

UNIT – IV: Magnetosphere and Plasma in magnetosphere

(Chapter 7.4 and 7.5, 7.6 in Hargreaves and Chapter 4 in Ratcliffe)

The geomagnetic cavity – Formation of the cavity. Magnetopause and definition of Magnetosphere. The polar clefts. The shock and sheath. Magnetotail. Plasmasphere and low

energy plasma and the plasma sheet. Radiation Belts - Observation of Van Allen particles and their production and loss mechanisms. *8 Hrs.*

Dynamical Magnetosphere and Space Weather

(Chapters 8.1.1, 8.1.2; 8.2, 8.3 and 11 and 12 in Hargreaves and Chapter 4 in Ratcliffe)

The Axford and Hines model. Reconnection with the IMF. Geomagnetic storms, substorms and auroral phenomena and their influence on Earth's space environment and systems. ***8 Hrs.***

BOOKS: ***1."Plasma Dynamics" by T.J.M.Boyd and J.J.Sanderson***

2. "The Upper Atmosphere and Solar Terrestrial Relations" by J.K.Hargreaves

3. "Introduction to Ionosphere and Magnetosphere" by J.A.Ratcliffe.

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS, SPACE PHYSICS
III SEMESTER
(w.e.f. 2012-2013 admitted batch)

P303, SP303: Digital Electronics & Microprocessors
(Common for M.Sc. Space Physics and M.Sc. Physics)

UNIT - I

Digital Circuits (i) Number Systems and Codes: Binary, Octal, Hexadecimal number systems, Gray code, BCD code, ASCII code.(ii) Logic Gates and Boolean Algebra: OR, AND, NOT, NOR, NAND gates, Boolean theorems, DeMorgan law**s.**

II) Combinational Logic Circuits: (i) Simplification of Boolean Expressions: Algebraic method, Karnaugh Map method, EX-OR, EX-NOR gates, ENCODER, DECODER, Multiplexer, Demultiplexers.

(ii) Digital Arithmetic Operations and Circuits: Binary addition, Design of Adders and Subtractors, Parallel binary adder, IC parallel adder.(iii) Applications of Boolean Algebra: Magnitude Comparator, Parity generator, Checker, Code converter, Seven-segment decoder/ Driver display.

UNIT - II

Sequential Logic Circuits:(i) Flip-Flops and Related Devices: NAND latch, NOR latch, Clocked flip-flops, Clocked S-C flip-flop, J-K flip-flop, D flip-flop, D latch, Asynchronous inputs, Timing problem in flip-flops.(ii) Counters: Asynchronous counters (Ripple), Counters with MOD number $< 2^N$, Asynchronous down counter, Synchronous counters, Up-down counter, Presettable counter.

(iii) Registers: Shift Register, Integrated Circuit registers, Parallel In Parallel Out (PIPO), SISO, SIPO, PISO

(iv) Applications of Counters: Frequency Counter and Digital clock.

A/D and D/A Converter Circuits: D/A Converter, Linear weighted and ladder type, An integrated circuit DAC; Analog-to-Digital Conversion, Digital Ramp ADC, Successive Approximation Method, Sample and Hold Circuit, Digital Voltmeter.

UNIT - III

Intel 8085 Microprocessor:

Architecture, Functional diagram, Pin description, Timing Diagram of Read Cycle, Timing diagram of write Cycle.

Programming the 8085 Microprocessor:

(i) Addressing Methods, Instruction set, Assembly language programming.

(ii) Examples of Assembly Language Programming: Simple Arithmetic - Addition/Subtraction of two 8-bit/16-bit numbers, Addition of two decimal numbers, Masking of digits, word disassembly.

(iii) Programming using Loops: Sum of series of 8-bit numbers, Largest element in the array, Multiple byte addition, Delay sub-routine.

UNIT - IV

Data Transfer Technique:

Serial transfer, Parallel transfer, Synchronous, Asynchronous, DMA transfer, Interrupt driven Data transfer.

8085 Interfacing:

I/O Interfacing: Programmable Peripheral Interfacing, 8255, Programmable Peripheral Interval Timer 8253, Programmable Communication Interface 8251, DAC 0800 and ADC 0800 interfacing.

TEXT & REFERENCE BOOKS:

6. "Digital Systems – Principles and applications" –Ronald.J.Tocci,
7. "Fundamentals of Microprocessors & Microcomputers" - B. RAM.
8. " Introduction to Microprocessors for Engineers and Scientists" - P.K.Ghosh and P.R.Sridhar
9. "Microprocessor Architecture, Programming and Applications with the 8085 /8080A" – Ramesh. S. Gaonkar.

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS, SPACE PHYSICS
III SEMESTER
(w.e.f. 2012-2013 admitted batch)

P 304 , SP 304: COMMUNICATION ELECTRONICS

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

UNIT 1. **CW Modulation**:

Amplitude Modulation (AM): 8 periods

Introduction, Amplitude modulation, modulation index, Frequency spectrum, Average power for sinusoidal AM, Amplitude modulator and demodulator circuits, Double side band suppressed carrier (DSBSC) Modulation, Super hetorodyne receiver.

Single Side Band Modulation (SSB): 4 periods

SSB principles, Balanced Modulator, SSB generation

Angle Modulation: 8 periods

Frequency modulation (FM), sinusoidal FM, Frequency spectrum for sinusoidal FM

frequency deviation, modulation index, Average power in sinusoidal FM, FM generation.

Phase Modulation: Equivalence between PM and FM, FM detectors: Slope detector, Balanced slope detector, Foster – Seley discriminator, Ratio detector, Amplitude limiter, FM receiver.

UNIT 2. **Pulse Modulation:**

Digital Line Codes: Symbols, Functional notation for pulses, Line codes and wave forms: RZ, NRZ, Polar, Unipolar, AMI , HDBn and Manchester codes, M-ary encoding, Differential encoding 8 periods

Sampling theorem, Principles of pulse Amplitude Modulation (PAM) and Pulse Time Modulation(PTM) ,Pulse code modulation (PCM), quantization, Nonlinear quantization, companding, differential pulse code modulation (DPCM), Delta Modulation(DM) .

Digital Carrier Systems: 8 periods

ASK, PSK, FSK and DPSK

UNIT 3. Special Communication Circuits : 6 periods

Tuned amplifiers :Single tuned amplifier-Hybrid π – equivalent for the BJT, Short circuit current gain

for the BJT in CE and CB amplifiers, CE and CB tuned amplifiers, Cascode amplifier.

Mixer Circuits : Diode mixer, IC balanced mixer.

Filters : Active filters, Ceramic, Mechanical and crystal filters.

Oscillators: Crystal oscillator, Voltage controlled oscillator, phase locked loop(PLL).

UNIT 4. **Noise in Communication Systems:** 8 periods

Thermal Noise, Shot Noise, Partition noise, Signal - to – Noise ratio, Noise factor, Amplifier input noise in terms of F, Noise factor of amplifiers in cascade (Friss formula), Noise temperature,

Noise in AM, Noise in FM systems. Noise in pulse modulation systems: Intersymbol interference (ISI) ,

eye diagrams.

Text Books:

1. Electronic Communications D. Roody and John Coolin
2. Electronic Communications Systems G. Kennedy
3. Modern Analog & Digital Communications B.P. Lathi.

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. SPACE PHYSICS
III SEMESTER
(w.e.f. 2012-2013 admitted batch)
SP 305**,:** Communication and Space Physics LAB
(Any six from communication lab and another six from Space Physics Lab)

Communications Lab

1. AMPLITUDE MODULATION
2. FREQUENCY MODULATION AND DETECTION
3. MIXER
4. BUTTERWORTH FIRST ORDER LOWPASS AND HIGHPASS FILTERS
5. CHEBYSHEV SECOND ORDER LOWPASS FILTER
6. PHASE LOCKED LOOP (PLL)
7. PULSE MODULATION-PAM-AND SAMPLING
8. STUDY OF PRE- EMPHASIS AND DE- EMPHASIS CIRCUITS
9. GENERATION OF PWAM, AND PPM USINGPLL AND 555 TIMER
10. STUDY OF FSK TRANSMISSION AND RECEPTION
11. OPTICAL FIBRE –BENDING LOSSES AND NUMERICAL APERTURE
12. MEASUREMENT OF BIT ERROR RATE (BER)
13. MEASUREMENT OF SPEED OF LIGHT IN OPTICAL FIBRE
14. DETERMINATION OF FREQUENCY AND WAVELENGTH IN A RECTANGULAR WAVEGUIDE IN $TE_{1,0}$
15. DETERMINMATION OF STANDING WAVE RATIO AT REFLECTION COEFFICIENT
16. STUDY OF ISOLATOR /CIRCULATOR
17. MEASUREMENT OF GAIN ,FRONT TO BACK RATIO,BEAM WIDTH OF RADIATION PATTERN IN
18. HALF WAVE DIPOLE
19. 18.FIVE ELEMENT YAGI UDA ANTENNA
20. 19.HELICAL ANTENNA
21. 20.CUT –PARABOIDAL REFLECTOR ANTENNA

SPACE PHYSICS LAB

1.Ionogram scaling- Ionospheric parameters.
2. TEC Measurement using Faraday Rotation Technique
3.Ionospheric Scintillation Characteristics.
4.Modelling Experiment –I Neutral Species.
5.Modelling Experiment –II Electron Density
6. Measurement of Aerosol Optical Depth using Solar Radiometer
7.Measurement of Near Surface Aerosol Mass size distribution
8.Measurement of Aerosol Scattering coefficient (Demonstration)

9. Verification of Gates: AND,OR,NOT,NAND,NOR, EX –OR,EX – NOR gates
10. Adders: Half adder, Full Adder, Parallel Adder
11. Flip Flops
12. Decade Counter IC 7490
13. Seven segment Decoder/ Driver
14..UP/DOWN Counter
15. Digital Comparator
16. Addition/Subtraction of 8 – bit Numbers
17. Decimal addition of 8 – bit numbers
18. Addition of two 16 – bit numbers
19 .Sum of Series of 8- bit numbers
20 .Largest number in an array
21. Interfacing of 8255 PPI: generation of square wave and rectangular waves

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. SPACE PHYSICS
IV SEMESTER
(w.e.f. 2012-2013 admitted batch)

SP 401 IONOSPHERIC RADIO WAVE PROPAGATION AND SOUNDING TECHNIQUES

UNIT – I :IONOSPHERIC RADIO WAVE PROPAGATION
Theory of wave propagation ***(Chs. 2.5 – 2.10 in Davies)***
Properties of plane waves in isotropic and anisotropic media. Group propagation. Ray and group velocities. Phase and group paths. *2 Hrs.*
Radio waves in ionized media *(Ch.4 in Davies)*
Propagation in isotropic plasma and refractive index. Concepts of critical frequency and virtual height. Magnetoionic theory – constitutive relations of magnetoplasma and the Appleton-Hartree (A-H) formula for refractive index. Ordinary and extraordinary waves. Reflection conditions. Quasi Longitudinal (QL) and Quasi Transverse (QT) approximations to AH formula, Dispersion curves *8 Hrs.*
UNIT-II
Absorption *(Chs.5 and 6 in Davies)*
Deviative and non-deviative absorption. *6 Hrs.*
Oblique incidence propagation *(Chs.12.1, 12.2 and 12.3 in Davies)*
Equivalence theorems – Secant law, Breit and Tuve's theorem and Martin's equivalence theorem. Transmission curves for flat ionosphere. *4 Hrs.*
Ray paths in ionosphere (Chs.7.1 and 7.2 in Davies)
Need for ray tracing. Methods of ray tracing – Bremmers rules for ray tracing and Booker's Quartic. *4 Hrs.*
UNIT-III : IONOSPHERIC SOUNDING TECHNIQUES
Ground based techniques *(Ch.2 in Rishbeth & Garriott and Appendix A in Kelly & Heelis)*
Pulse sounding and ionosonde. Reduction of ionograms to N-h profiles. Ionospheric absorption measurement by A1 and A2 techniques. Faraday rotation and Total Electron Content (TEC). Scattering of radio waves in the ionosphere – incoherent scatter radar and coherent scatter (MST) radar. *14 Hrs.*
UNIT-IV
Rocket& Satellite techniques *(Chs.1&2 in Rishbeth & Garriott & Appendix A in Kelly&Heelis)*
Satellite drag experiment for atmospheric density. Langmuir Probe (LP) and Retardation Potential Analyzer (RPA). Ion mass spectrometers. Fluxgate magnetometer. Double probe electric field detectors. Barium ion cloud measurements. ***12 Hrs.***

BOOKS: ***1. "Ionospheric radio propagation" by K.Davies***
2. "Introduction to ionospheric physics" by H.Rishbeth & O.K.Garriott.
3. "The earth's ionosphere (Plasma physics & dynamics) by M.C.Kelly & R.A.Heelis.

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. SPACE PHYSICS
IV SEMESTER
(w.e.f. 2012-2013 admitted batch)

SP 402 IONOSPHERIC PLASMA DYNAMICS

UNIT – I: FUNDAMENTALS OF IONOSPHERIC PLASMA DYNAMICS
(Chs.1.4 in Holton, 1 & 4 in Rishbeth and Garriott, 2 in Kelly and Heelis)
Fundamental forces – Pressure gradient force and Viscosity force. Apparent forces – Centrifugal force and Coriolis force. Equation of motion of the neutral air. Geostrophic approximation and thermal wind equation. *4 Hrs.*
Elements of atmospheric tides, planetary waves and internal gravity waves. *6 Hrs.*
Steady state ionospheric plasma motions due to applied forces. Electrical conductivity of the ionosphere. Generation of electric fields and electric field mapping. *6 Hrs.*

UNIT – II: EQUATORIAL ELECTRODYNAMICS
(Chs. 3 and 4 in Kelly & Heelis)
Motions in the equatorial ionosphere
F region – Motions of equatorial F region. Equatorial F region dynamo. E region – E region dynamo and Equatorial Electro Jet (EEJ). Feedback between electrodynamics and thermospheric winds. *10 Hrs.*

UNIT – III: Equatorial plasma instabilities
F region plasma instabilities – Development of instabilities. Development and initiation of equatorial spread F. Linear theory of GRT instability. *6 Hrs.*
E region plasma instabilities and linear theory of EEJ instabilities. *4 Hrs.*

UNIT – IV: ELECTRODYNAMICS AND MID-LATITUDE IONOSPHERE
(Ch. 5 in Kelly and Heelis)
Competing influences on tropical and mid latitude ionospheres. Equatorial anomaly. Electrodynamics of tropical and mid latitude zone. Night time tropical ionosphere. E region in mid latitude zone. *8 Hrs.*
Irregularities in mid latitude ionosphere. Mid latitude plasma instabilities and F region plasma instabilities in the equatorial anomaly region. Midlatitude E region instabilities. *6 Hrs.*

BOOKS: 1. "Introduction to dynamic meteorology" by J.R.Holton.
2. "Introduction to ionospheric physics" by H.Rishbeth and O.K.Garriott.
3. "The earth's ionosphere (plasma physics and electro dynamics)" by M.C.Kelly and R.A.Heelis.

ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc PHYSICS, and SPACE PHYSICS
IV SEMESTER
(w.e.f. 2012-2013 admitted batch)
SP 403 Radar and Satellite Communication
(Common for M.Sc. Space Physics and M.Sc Physics)

UNIT - I

Radar Systems:

Fundamental – A simple RADAR – overview of frequencies – Antenna gain Radar Equation – Accuracy and Resolution – Integration time and the Doppler shift (Ch 1 of Text Book 1)

Designing a surveillance radar – Rader and surveillance – Antenna beam – width consideration – pulse repetition frequency – unambiguous range and velocity – pulse length and sampling – radar cross section – clutter noise (Ch 2 of Text Book 1)

Tracking Radar – Sequential lobbing – conial scanning – Monopoles Radar – Tracking accuracy and Process – Frequency Agility – Radar guidance (Ch3 of Text Book 1)

UNIT - II

Signal and Data Processing – Properties of clutter – Moving Target Indicator Processing Shareholding – Plot extraction – Tract Association, Initiation and Tracking (Ch 5 of Text Book 1)

Radar Antenna – Antenna parameters – Antenna Radiation Pattern and aperture distribution – Parabolic reflector – cosecant squared antenna pattern – effect of errors on radiation pattern – Stabilization of antennas (Ch7 of Text Book 2).

UNIT - III

Satellite Communication

Satellite System – Historical development of satellites – communication satellite systems – communication satellites – orbiting satellites – satellite frequency bands – satellite multiple access formats (Ch1 of Text Book 3).

Satellite orbits and inclination – Look angles, orbital perturbations, space craft and its subsystems – attitude and orbit control system – Telemetry, Tracking and Command – Power system – Transponder – Reliability and space qualification – launch vehicles

(Ch2 & 3 of Text Book 4)

UNIT - IV

Multiple Access Techniques – Time division multiple access – Frequency division multiple access – Code division multiple access – Space domain multiple access

(Ch 7 of Text Book 4).

Earth Station technology – Subsystem of an earth station – Transmitter – Receiver Tracking and pointing – Small earth station – different types of earth stations – Frequency coordination – Basic principles of special communication satellites – INMARSAT VSAT, GPS, RADARSAT, INTELST

(Ch 10 & 11 of Text Book 4).

Text Books:

1. Understanding Radar Systems – Simon Kingsley and Shaun Quegan.
2. Introduction to Radar Systems – MI Skolnik
3. Satellite Communication – Robert M. Gagliardi
4. Satellite Communication – Manojit Mitra

ANDHRA UNIVERSITY

DEPARTMENT OF PHYSICS

M.Sc. PHYSICS and M.Sc. SPACE PHYSICS,

IV SEMESTER

(w.e.f. 2012-2013 admitted batch)

P404, SP404 : ANTENNA THEORY AND RADIOWAVE PROPAGATION

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

UNIT - I

Radiation

Potential functions of electro magnetic fields. Potential function for sinusoidal oscillations. Fields radiated by an alternating current element. Power radiated by a current element and radiation resistance. Radiation from a quarter wave monopole or a half wave dipole. EM field close to an antenna and far field approximation.

(Chapter 10 in Jordan and Balmain) *6 Hrs.*

Antenna Fundamentals

Definition of an antenna. Antenna properties – radiation pattern, gain, directive gain and directivity. Effective area. Antenna beam width and band width. Directional properties of dipole antennas.

(Chapter 11 in Jordan and Balmain and Chapter 2 in Kraus)
8Hrs.

UNIT - II

Antenna Arrays

Two element array. Linear arrays. Multiplication of patterns and binomial array. Effect of Earth on vertical patterns. Mathematical theory of linear arrays. Antenna synthesis – Tchebycheff polynomial method. Wave polarization.

(Chapter 11 and 12 in Jordan and Balmain and Chapter 4 in Kraus)
10 Hrs.

Impedance

Antenna terminal impedance. Mutual impedance between two antennas. Computation of mutual impedance. Radiation resistance by induced emf method. Reactance of an antenna. Biconcal antenna and its impedance.

(Chapter 14 in Jordan and Balmain and Chapters 8.1 –8.5 in Kraus)
6 Hrs.

UNIT - III

Frequency Independent (FI) Antennas

Frequency Independence concept. Equiangular spiral. Log Periodic (LP) antennas. Array theory of LP and FI structures.

(Chapter 15 in Jordan and Balmain and Chapter 15 in Kraus)
6Hrs.

Methods of excitation and Practical Antennas

Methods of excitation and stub matching and baluns. Folded dipole, loop antennas. Parasitic elements and Yagi-Uda arrays and Helical antenna.

(Chapter11.15 in Jordan and Balmain)
6Hrs.

UNIT - IV

Radio Wave Propagation

Elements of Ground wave and Space wave propagation. Tropospheric propagation and Troposcatter. Fundamentals of Ionosphere. Sky wave propagation – critical frequency, MUF and skip distance.

(Chapter 16 and 17 in Jordan and Balmain) *8Hrs.*

BOOKS

1."Electromagnetic waves and Radiating Systems" by E.C.Jordan and K.G.Balmain

2."Antennas" by J.D.Kraus. (Second Edition)