### ANDHRA UNIVERSITY
DEPARTMENT OF PHYSICS
M.Sc. SPACE PHYSICS
III SEMESTER.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP301</td>
<td>AERONOMY (85 +15)</td>
<td>100</td>
</tr>
<tr>
<td>SP302</td>
<td>PRINCIPLES OF PLASMA PHYSICS AND SPACE PLASMAS (85 +15)</td>
<td>100</td>
</tr>
<tr>
<td>SP303</td>
<td>DIGITAL ELECTRONICS &amp; MICROPROCESSORS (85+15)</td>
<td>100</td>
</tr>
<tr>
<td>SP304</td>
<td>RADAR SYSTEMS &amp; SATELLITE COMMUNICATION (85+15)</td>
<td>100</td>
</tr>
<tr>
<td>SP305</td>
<td>COMMUNICATION LAB (75+ 25)</td>
<td>100</td>
</tr>
<tr>
<td>SP306</td>
<td>SPACE PHYSICS LAB (75+25)</td>
<td>100</td>
</tr>
</tbody>
</table>

Total Marks 600

**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
ANDHRA UNIVERSITY  
DEPARTMENT OF PHYSICS  
M.Sc. SPACE PHYSICS  
III SEMESTER  
(w.e.f. 2009-2010 admitted batch)  
SP 301 AERONOMY

UNIT – I : NEUTRAL ATMOSPHERE  
Structure and Composition  
(Chapters 1 in Rishbeth & Garriott and 4.1 in Hargreaves).  
6 Hrs.

UNIT – II: Chemical concepts in Atmosphere  
(Chapters 2.1, 2.2, 2.3 and 3.4 in Brasseur & Solomon)  
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  
5 Hrs.  
Solar radiation and production of ionospheric layers.  
3 Hrs.  
Loss reactions  
6 Hrs.  
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  
6 Hrs.  
Solar flare effects  
Sudden Ionospheric Disturbances (SIDs)  
2 Hrs.

BOOKS  
1. "Introduction to Ionospheric Physics” by H.Rishbeth & O.K.Garriott  
UNIT – I: PRINCIPLES OF PLASMA PHYSICS
Plasma and its characteristics
(Chapter 1 in Boyd and Sanderson)
Definition of a plasma. Quasi neutrality, Plasma oscillations, 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 uniform electric and magnetic fields. Particle motion in magnetic field with gradient and curvature and 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)

Cold plasmas
(Chapters 7.1 to 7.3 and 7.5 to 7.7 in Boyd and Sanderson)
Definition of cold plasma. Waves in cold plasma for k parallel to B and k perpendicular to B. Cut offs and resonances 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)
(Chapter 7.1, 7.2 and 7.3 in Hargreaves)

UNIT – IV: Magnetosphere and Plasma in magnetosphere
(Chapter 7.4 and 7.5, 7.6 in Hargreaves and Chapter 4 in Ratcliffe)

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
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 laws.

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

UNIT - II
(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:**

**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 subroutine.

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:**
2. “Fundamentals of Microprocessors & Microcomputers” - B. RAM.  
3. “ Introduction to Microprocessors for Engineers and Scientists” - P.K.Ghosh and P.R.Sridhar  
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)

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).

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:
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. SPACE PHYSICS
III SEMESTER
(w.e.f. 2009-2010 admitted batch)

SP 305: COMMUNICATION 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 USING PLL 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. DETERMINATION 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 HALF WAVE DIPOLE
18. FIVE ELEMENT YAGI UDA ANTENNA
19. HELICAL ANTENNA
20. CUT–PARABOIDAL REFLECTOR ANTENNA
1. Ionogram scaling - Ionospheric parameters.
2. TEC Measurement using Faraday Rotation Technique
3. Ionospheric Scintillation Characteristics.
5. Modelling Experiment – II Electron Density
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.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 401.</td>
<td>IONOSPHERIC RADIO WAVE PROPAGATION AND SOUNING TECHNIQUES</td>
<td>100</td>
</tr>
<tr>
<td>SP 402.</td>
<td>IONOSPHERIC PLASMA DYNAMICS</td>
<td>100</td>
</tr>
<tr>
<td>SP 403.</td>
<td>COMMUNICATION ELECTRONICS</td>
<td>100</td>
</tr>
<tr>
<td>SP 404.</td>
<td>ANTENNA THEORY AND RADIOWAVE PROPAGATION</td>
<td>100</td>
</tr>
<tr>
<td>SP 405.</td>
<td>PROJECT</td>
<td>150</td>
</tr>
</tbody>
</table>

**PROJECT VIVA – VOCE.** 50

Total Marks 600

**SCHEME OF EXAMINATION**
- Theory pass minimum: 40%
- Practical pass minimum: 50%
- Viva Examination: 40%
- Aggregate: 50%

**SCHEME OF INSTRUCTION**:
- Teaching Hours: 4 Periods per week
- Tutorial: 1 Period per week
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)

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)

UNIT-IV

Rocket & Satellite techniques (Chs. 1 & 2 in Rishbeth & Garriott & Appendix A in Kelly & Heelis)

BOOKS:
1. “Ionospheric radio propagation” by K. Davies
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)
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

UNIT – III: Equatorial plasma instabilities
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:
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.


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:

Tuned amplifiers: Single tuned amplifier-Hybrid $\pi$ – 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


**Text Books:**

1. Electronic Communications D. Roody and John Coolin
2. Electronic Communications Systems G. Kennedy
UNIT - I
Radiation

Antenna Fundamentals

UNIT - II
Antenna Arrays

Impedance

UNIT - III
Frequency Independent (FI) Antennas

Methods of excitation and Practical Antennas

UNIT - IV
Radio Wave Propagation

BOOKS
2. “Antennas” by J.D.Kraus. (Second Edition)