UNIVERSITY OF THE PUNJAB

Part-II   A/2016
Examination:- M.A./M.Sc.

Subject: Space Science (New Course)   TIME ALLOWED: 3 hrs.
PAPER: I (Astrophysics and Cosmology)   MAX. MARKS: 100

NOTE: *Attempt any FIVE questions selecting at least TWO questions from each section. All questions carry equal marks.*

Section I

1 a. Write a comprehensive note on Cepheid and RR Lyrae stars.
   b. Explain the H-R Diagram for the classification of stars.

2 a. What are Comets? How they are formed?
   b. Explain the stellar evolution and various stages of a star.

3 a. What are the main sequence stars? Explain open and globular clusters of stars.
   b. Explain structures and characteristics of red giants.

4 a. What are Neutron stars? Explain the formation and detection of Neutron stars.
   b. Explain the difference between Absolute and Apparent Magnitude. Give an Example.

Section II

5 a. State and Explain Hubble's law.
   b. What is CMBR? How it is measure?

6 State and Derive the Fluid equation.

7 Explain the idea of Expansion of Universe through the eyes of Newton, Einstein and Hubble.

8 Explain the following
   a. Equation of State
   b. The Friedmann Equation

9 State and Explain Cosmological Principle, its Justification and Criticism. Write Cosmological Constant with Equation.

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Part-II A/2016

Examination:- M.A./M.Sc.

Subject: Space Science (Common)

PAPER: II Electromagnetic Waves and Space Plasma (Old Course)   **TIME ALLOWED: 3 hrs.**
Electrodynamics and Space Plasma (New Course)   **MAX. MARKS: 100**

NOTE: Attempt any FIVE questions, at least TWO questions from each section. All questions carry equal marks.

SECTION-I

Q.1) a) By using the concept of anti symmetric Tensor obtain the expression for electromagnetic field Tensor.   14

b) In free space $E(z,t) = E_o \sin((\omega t - \beta z) \hat{j}$ v/m calculate displacement density vector, magnetic flux density and magnetic field intensity .   6

Q-2)   Discuss Electromagnetic wave propagation techniques for conducting media , Find the values   of propagation constant phase constant and wavelength .   **20**

Q-3) a) Prove that net inward power flux supplied by the field over the surface S must equal to the time rate of increase of electromagnetic energy inside the volume V plus total ohmic losses with in the volume V.   15

b) In free space $E(z,t) = 1.0 \sin(\omega t - \beta z) \hat{i}$ v/m show that average power over a circular disc of radius 15.5 m in z-direction is one watt.   5

Q.4)   What is the concept of electric potential and vector potential. Obtain the   Electromagnetic Wave equations in terms of potential   20

SECTION-II

Q-5)   What is Debye shielding ? Calculate the Debye length by applying the concept of potential   well. **20**

Q-6)   Find the drift velocity if plasma particles are under the influence of non- uniform electric field and also discuss physical significance.   20

Q-7)   Find the dispersion relation for electrostatic electron wave and explain the term involved in it. **20**

Q.-8)   Prove that the dispersion relation for Ion acoustic wave is

$$\omega^2 = \frac{K T_e + K T_i}{M} \; k^2$$

where **k** is wave number and K is Boltzman constant.   20

Q-9)   Discuss the behavior of charge particle in uniform magnetic field and with gravitational field .Discuss the physical significance for both field separately.   20

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NOTE: *Answer any FIVE questions at least TWO questions from each section. All questions carry equal marks. Draw diagrams where necessary.*

Section-I

Question No. 1:

(20 Marks)

a) Briefly explain analog and digital communication systems   [6]

b) What is bandwidth? How it is calculated and what are half-power points?   [4]

c) What about selectivity and Q factor?   [4]

d) Incorporate types and uses of RF spectrum.   [6]

Question No. 2:

a) Briefly explain with diagrams.   (20 Marks)   [8]

1. Simplex/ Duplex

2. Modulation/ Multiplexing

3. Transducer/ Transceiver

4. Time/ Frequency Domains

b) Describe the figures below   [4]
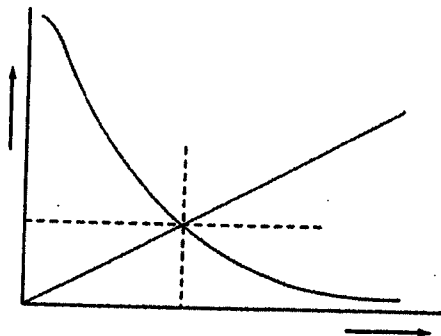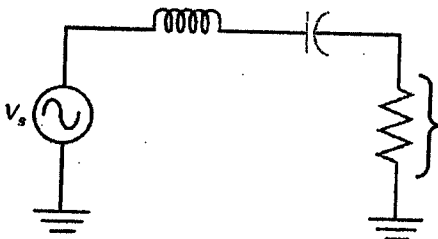
c) An amplifier has an input of 18 mV and an output of 4 V. What is the gain in decibels?   [4]

d) Discuss briefly why it is common to use modulated high-frequency carriers to broadcast radio and TV signals, rather than sending the signals directly.   [4]

Question No. 3:

(20 Marks)

a) What is the resonant frequency of a 2 pF capacitor and a 50 nH inductor?   [3]

b) Carefully sketch and label the waveform of a 1 MHz carrier which has been amplitude modulated by a 100 kHz sine wave, with a modulation index of 1. Show about 20 cycles of the carrier. [6]

c) When a thunderstorm is approaching, a crackling noise (due to "spikes" of impulsive interference) is often heard in AM radio broadcasts, but not in FM radio broadcasts. Briefly explain this observation. [3]

d) Elaborate amplitude modulation techniques and discuss benefits of SSB over DSB. Discuss several possible cons and pros of modulation based on modulation index. [8]
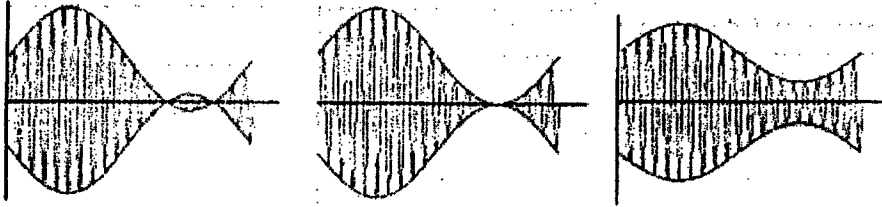
Question No. 4: (20 Marks)

a) Discuss noise-suppression effects of FM. [4]

b) Describe Bessel Functions and relate them with Modulation Index and Sidebands. [6]

c) Describe balanced modulator and differentiate its types. [5]

d) Calculate total attenuation and output voltage. [5]

$V_{in} = 3$ V → Loss stage $A_1 = 0.2$ → Loss circuit $A_2 = 0.9$ → Loss component $A_3 = 0.06$ → V_{out}
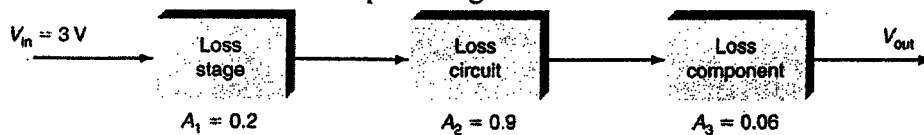
Section-II

Question No. 5: (20 Marks)

a) Describe and categorize orbits based on mission requirement/ altitude/ inclination. [10]

b) Calculate the minimum $\Delta V(s)$ to escape from Earth while a satellite is orbiting in LEO (1000 km) and in HEO (Rp = 6,878 km, Ra = 42,240 km). [6]

c) Prove that $\epsilon = -\mu/2a$. [4]

Question No. 6: (20 Marks)

a) A solar day is 24 hrs while a sidereal day = 23 h, 56 min, 4.1 s. Calculate e, v and mean motion (n) for a satellite which always maintains the same position above the Earth. [6]

b) A satellite is in a circular orbit at an altitude of 250 km. It needs to move from its current inclination of 13° to 47°. What ΔV does this transfer require? [3]

c) A space agency wants to place a communication satellite into GEO from a low-Earth parking orbit of radius 6570 km. What is the total ΔV and time for this transfer? [8]

d) A rocket is launched vertically from the surface of the Earth with an initial velocity of 10 km/s. What maximum height does it reach? [3]

Question No. 7:   **(20 Marks)**

   e) Elaborate i, a, e, and T for Molniya, Tundra and Sun-Synchronous orbits using ground tracks.[6]

   f) Elaborate Satellite Look Angles by diagram(s) and explain how these angles play a role in satellite tracking and satellite visibility.   [3]

   g) Describe satellite sub-systems with diagrams.   [11]

Question No. 8: Compute the unknown parameters.   **(20 Marks)**

Orbit Type	Elliptical	Circular
Eccentricity, e		
Semi-major Axis, a		
Periapsis Distance, R_p		
Semi-latus rectum, p		
Specific Mechanical Energy, ϵ		
Distance from Central Body, r		
Orbital Velocity, v		
Periapsis Velocity, v_p		
Apoapsis Velocity, v_a		
Orbital Period, T		
Mean Motion, n		
Escape Velocity, V_{esc}		

Question No. 9:   **(20 Marks)**

   a) Which type of satellite orbit(s) provides the best performance for a communications network for each of the following criteria: [10]
      i.   Minimum free space path loss
      ii.   Best coverage of high latitude locations
      iii. Full global coverage for a mobile communications network
      iv. Minimum latency (time delay) for voice and data networks
      v.   Ground terminals with little or no antenna tracking required

   b) The FRIIS equation for an RF link is $C = (P_T / 4*\pi*R^2)*G_T*A_{eff}$. Compute EIRP and Free Space Loss (L_{fs}).   [6]

   c) A moderate rate private network VSAT uplink terminal has transmit power of 10 watts, and both the transmit and receive parabolic antennas have a diameter of 3 m. The antenna efficiency is 55% for both antennas. The satellite is in Geostationary orbit at 12 GHz frequency of operation. Calculate the received power.   [4]

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NOTE: *Attempt any FIVE questions. All questions carry equal marks.*

Q-1 (a)	Give an overview of Aerospace System and discuss the role of AEROSPACE MANAGEMENT in aerospace industry?	**10**
(b)	Describe the concept of an OPERATIONAL ORGANIZATION for a Communication satellite?	**10**
Q-2 (a)	Write a complete note on GEOSTATIONARY ORBIT. What is its significance for a communication satellite?	**10**
(b)	Write a brief description of SATELLITE COMPOSITION?	**10**
Q-3 (a)	How the communication of a satellite is affected by SUN'S INTERFERENCE?	**10**
(b)	How a satellite is injected into its FINAL ORBIT?	**10**
Q-4 (a)	Calculate the SATELLITE PERIOD, SATELLITE VELOCITY and SATELLITE POSITION while discussing the Satellite Path in space?	**10**
(b)	What are the different Classical Orbital Elements. Give a brief description of each of them?	**10**

Q-5   What do you understand by ORBITAL PERTURBATION. What are   **20**

the different types of perturbations and what are the Main causes for

orbital perturbations?

Q-6   Explain the full working of GPS calculating the position.   **20**

What are its different segments?

Q-7 (a)   What is a SPACE PROBE. Describe its different modules   **10**

and components?

(b)   What is the scientific principle of SOLID PROPELLANT. Write   **10**
down the advantages of liquid propellant?

Q-8   Write in detail the overall working of Geosynchronous Meteorological   **20**

Satellite (GMS)?

Q-9   **Write notes on any TWO of the following**   **20**

    i.   Multistage rocket
    ii. Atmospheric drag
    iii. Strategic Defense Initiative (SDI)

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Subject: Space Science (Old & New Course)   **TIME ALLOWED: 3 hrs.**
PAPER: V,VI (Geographic Information System)   **MAX. MARKS: 100**

NOTE: Attempt any FIVE questions. All questions carry equal marks.
Draw diagrams where necessary.

1. What is RELATIONAL DATA MODEL? How spatial data is stored in this model. Explain the merits of this model.   (5,5,10)

2. Explain how Data Visualization techniques help in understanding of the data as compared to simple tabular information? Discuss the importance of maps and explain different map components?   (10,10)

3. What is Land Information System? Discuss the role of GIS in cadastral mapping. Explain the cadastral mapping in Pakistan.   (5,5,10)

4. Explain the key concept of GIS network analysis? How transportation networks, stream networks and utility networks of Pakistan can benefit from GIS based Network Analysis?   (5, 15)

5. Write a comprehensive note on TWO of the followings: (10,10)
   (a) Triangulated Irregular Network(TIN)
   (b) Spatial Decision Support System
   (c) Components of GIS and working
   (d) Internet GIS

6. What is the GEO-CODING and GEO-REFERENCING in GIS? How do we encode locational information with example?   (10,10)

7. What are Coordinate Systems? What is the difference between Geographic and Projected Coordinate System? Explain the key concepts of Universal Transverse Mercator (UTM) Projection System?   (5,7,8)

8. What is Urban Planning? Discuss the role of GIS in urban planning. Explain how GIS can play role in urban planning sectors of Pakistan.   (5,5,10)

9. What is the difference between Vertical and Oblique Aerial Photographs? What is Ortho-photography? What is Stereoscopic Parallax? How parallax is measured using two overlapping photographs?   (6,3,3, 8)