



# UNIVERSITY OF THE PUNJAB

Part-I A/2018  
Examination:- M.A./M.Sc.

Roll No. ....

Subject: Space Science  
PAPER: I (Mathematical Techniques & Quantum Mechanics)

TIME ALLOWED: 3 hrs.  
MAX. MARKS: 100

**NOTE:** Attempt any **FIVE** questions by selecting at least **TWO** questions from each section. Try to be focused and give only precise answers of the asked questions.

## SECTION-I

- Question No 1 (20)  
Describe Schrodinger wave equation and transform into time independent wave form?
- Question No 2 (20)  
What is step potential? Calculate the transmission and reflection coefficient?
- Question No 3 (20)  
How we can find the solution for a particle moving in 3 dimensional box?
- Question No 4 (20)  
a. Prove that the sum of two different Hermitian operators is also Hermitian.  
b. Prove that the Eigen values of an Hermitian operator is always real.

## SECTION-II

- Question No 5 (20)  
a) Evaluate the Fourier series of the function  $\frac{x^2}{e^2}$  over the interval  $-\pi \leq x \leq \pi$ .  
b) Prove that the generating function for Legendre's polynomial is given by  
$$G(x, t) = \frac{1}{\sqrt{1-2xt+t^2}} = \sum_{n=0}^{\infty} P_n(x)t^n$$
, where  $P_n(x)$  are Legendre's polynomials.
- Question No 6 (20)  
Use the method of Frobenius to find the series solution of  $2xy'' + y' - y = 0$  in  $x$ .
- Question No 7 (20)  
a) Prove that the function  $u = x^2 - y^2 - 2xy - 2x + 3y$  is harmonic. Find a function  $v$  such that  $f(z) = u + iv$  is analytic and express  $f(z)$  in terms of  $z$   
b) Evaluate  $\oint_c \frac{9z^2 - zi + 4}{z(z^2 + 1)} dz$ , where  $c$  is a circle of radius 2 units with center at origin.
- Question No 8 (20)  
a) Prove that co-ordinates of spherical system are orthogonal to each other.  
b) Using Laplace Transformation solve the IVB.  $y'' - 2y' - 3y = t^2$ ,  $y(0) = -25$ ,  $y'(0) = 0$ .
- Question No 9 (20)  
Find the general solution of the Bessel equation  $x^2y'' + xy' + (x^2 - \frac{1}{9})y = 0$ .

# UNIVERSITY OF THE PUNJAB



Part-I A/2018  
Examination:- M.A./M.Sc.

Roll No. ....

Subject: Space Science  
PAPER: II (Meteorology & Climatology)

TIME ALLOWED: 3 hrs.  
MAX. MARKS: 100

**NOTE: Attempt any FIVE questions in total by choosing at least TWO questions from each section. All questions carry equal marks.**

## SECTION- I

- Q-1 (a) Define Lapse rate of Temperature and Inversion Layer? 10  
(b) Explain Thermal structure of atmosphere? 10
- Q-2 Explain with diagram diurnal variation of: 20  
a) Temperature  
b) Relative Humidity  
c) Atmospheric Pressure
- Q-3 Explain with diagram direction of flow of: 20  
a) Low pressure  
b) High pressure  
c) Trough  
d) Ridge
- Q-4 Define the following: 20  
a) Coriolis force  
b) Pressure gradient  
c) Temperature gradient  
d) Geostrophic wind
- Q-5 Define and derive Clausius Clapeyron Equation? 20

## SECTION- II

- Q-6 Explain the causes of climate change in detail? 20
- Q-7 Discuss climate models and Palynology? 20
- Q-8 Explain climatic classification in detail? 20
- Q-9 Write a note on climatic controlling factors? 20



# UNIVERSITY OF THE PUNJAB

Part-I A/2018  
Examination:- M.A./M.Sc.

Roll No. ....

Subject: Space Science  
PAPER: III (Astronomy)

TIME ALLOWED: 3 hrs.  
MAX. MARKS: 100

**NOTE: Attempt any FIVE questions in all selecting at least ONE question from each section is compulsory. Support your answers with diagrams/charts/figures, where needed. All questions carry equal marks.**

## Section I

Q1. Define the basic postulates of Special Theory of Relativity and derive a relationship for Lorentz transformation. Also discuss the consequences of the Lorentz Transformations. [20]

Q2. (a) Derive and explain

(i) Einstein Mass Energy Relation.

(ii) Energy-Momentum Relation [10]

(b) A nucleus at rest in a laboratory emits a photon and recoils. If its initial mass is  $m_0$  and it loses the rest energy  $\Delta E$  in the emission, show that the energy of the emitted photon is given by

$$hf = \Delta E \left( 1 - \frac{\Delta E}{2m_0 c^2} \right) \quad [10]$$

Q3. (a) State and explain Doppler Effect. Also discuss Longitudinal and Transverse Doppler Effect [10]

(b) By considering the motion of a charged particle in a magnetic field, prove that  $T = 2\pi mc / eH$ . [10]

## Section II

Q4. (a) What is Escape velocity? Derive a relationship for the Escape velocity and orbital velocity of a body. [10]

(b) Calculate the hour angle of a certain star if  $\alpha = 08^h 10^m 34^s$  and local Sidereal time =  $12^h 19^m 22^s$ . [10]

Q5. (a) State and prove Kepler's law of periods. [10]

(b) Discuss horizontal and equatorial system of co-ordinates. [10]

Q6. (a) Find, for latitude  $\phi$ , the zenith distance at upper transit of stars of given declination if latitude  $\phi = 50^{\circ}N$  and declination  $= \delta = 20^{\circ}S$ . [10]

(b) State and explain the equation of time graphically. Also discuss where and why equation of time is zero, maximum and medium. [10]

## Section III

Q7. Write in details the characteristics, surface, atmosphere etc. of Terrestrial planets? [20]

Q8. (a) Name all the Zodiac constellations. Explain Orion and Big Dipper? [10]

(b) What are sun spots? Discuss their formation and Sun spots cycle. [10]

Q9. Write notes on any TWO of the following: [20]

(i) Compton Effect

(ii) Earth Moon System

(iii) Intervals and Light cone



# UNIVERSITY OF THE PUNJAB

Part-I A/2018  
Examination:- M.A./M.Sc.

Roll No. ....

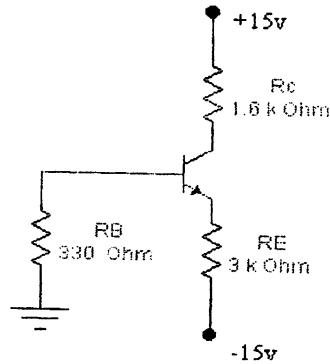
Subject: Space Science  
PAPER: IV (Electronics)

TIME ALLOWED: 3 hrs.  
MAX. MARKS: 100

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

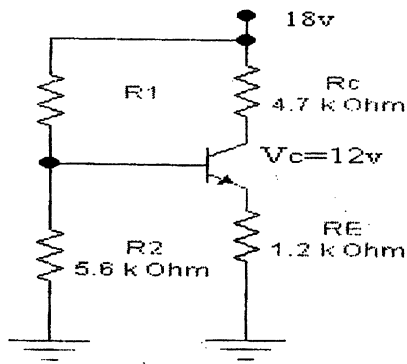
## Section I

1.
  - a) Explain the movement of charge carriers across the PN junction under forward bias and reverse bias conditions. Also draw the I-V curves for diode. (10)
  - b) What are clippers discuss its types with examples. (10)
2.
  - a) What is Zener diode and how it works? Briefly explain  $I_{ZK}$ ,  $I_{ZT}$ , and power derating for Zener diode. (10)
  - b) Determine the minimum and maximum input voltages that can be regulated by the Zener diode where  $R_S=100\Omega$ ,  $V_Z=5.1V$ ,  $I_{ZT}=49mA$ ,  $Z_Z=7\Omega$ ,  $I_{ZK}=1mA$  and  $I_{ZM}=196mA$  (10)
3.
  - a) Derive the relation between  $\alpha$  and  $\beta$  for a transistor (10)
  - b) Calculate the value of  $V_{CE(off)}$  and  $I_{C(sat)}$  for the circuit (10)



4.
  - a) Discuss the approximate analysis for voltage divider bias configuration of a transistor? How this biasing method provides more stability of Q point than others? (10)
  - b) Given the information provided determine  $I_C$ ,  $V_E$ ,  $V_B$  and  $R_1$  for the circuit. (10)

P.T.O.



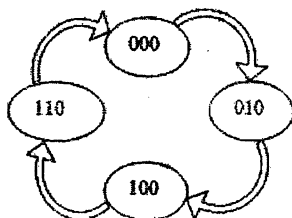
- 5.
- What is an Operational Amplifier? Write its two best applications with diagram. (10)
  - What are clampers? Explain clamping action (10)

**section II**

- 6.
- What is a Gray code? Write the conversion process of Gray code to binary and vice versa. (10)
  - Perform the following: (10)
    - 1001010 (binary to gray code)
    - 00010 (gray code to binary)
    - 7 (Express decimal number in binary as 4-bit sign magnitude number)
    - Express following number in BCD code and perform BCD subtraction 223-157
    - 0010 0010 0011 – 0001 0101 0111 (BCD Subtraction)

- 7.
- Using DE Morgan's law & Boolean algebra prove that (10)
    - $(X + Y)(\bar{X} + \bar{Y})(X + \bar{Y})(\bar{X} + Y) = 0$
    - $\bar{X}(Y+Z)(X+Y+Z) = XZ$
  - Design a combinational circuit with three inputs and one output. The output is 1 when the binary value is less than 3. The output is 0 otherwise. (10)

- 8.
- What is the main difference between a latch and a Flip-Flop? Draw the circuit for S-R flip flop and make its truth table. Also describe its draw back and how this is improved in J-K flip flop? (10)
  - Design synchronous counter for following state diagram. (10)



- 9.
- Construct a bidirectional shift register and also explain its function. (10)
  - What is the difference between shift register and counter? Describe the register's types with respect to data movement. (10)

# UNIVERSITY OF THE PUNJAB



Part-I A/2018  
Examination:- M.A./M.Sc.

Roll No. ....

**Subject: Space Science**  
**PAPER: V (Remote Sensing & Image Processing)**

**TIME ALLOWED: 3 hrs.**  
**MAX. MARKS: 100**

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

1. What are different Resolutions in Remote Sensing? Describe the interdependency of these resolutions on each other and discuss its practical limitations. (4, 10, 6)
2. What are True color composites and False color composite? Describe the use of different FCC for the enhancement and variability for vegetative landcovers, Elaborate your answer with examples. (6, 10, 4)
3. How different sensors in Remote Sensing are categorized? Discuss Push Broom and Whisk Broom scanning systems. Give details of an Optical Mechanical Scanner. (4, 6, 10)
4. What are Additive and Subtractive Primary colors? How these two can be related in a color Triangle? Discuss in detail the cubical color model and describe that how RGB and HHS spaces are expressed in the color cube. (3, 5, 12)
5. What are spectral signatures? Draw and discuss in detail the signature of Vegetation, describing variations in spectral response pattern in different portions of spectrum. Draw the Practical signature of vegetation for Landsat ETM+ sensor. (2, 14, 4)
6. Define systematic geometric distortion in satellite data, and explain the process of spatial interpolation in rectification. (8, 12)
7. Define the process of classification and discuss in stepwise detail of the process of supervised Classification. (8, 12)
8. What are the two major types of Contrast Enhancements? Discuss Standard Deviation stretch and Piece wise Linear Contrast Enhancements in detail. (4, 8, 8)
9. Write note-on any **Two** of the following: (10, 10)
  - i. Visual Interpretation Key
  - ii. ASTER Sensor
  - iii. Applications of Remote Sensing in Forestry