



UNIVERSITY OF THE PUNJAB
M.A./M.Sc. Part – I Annual Examination – 2020

Roll No.
 Time: 3 Hrs. Marks: 100

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

NOTE: Attempt any FIVE questions by attempting atleast TWO questions from each Section. All questions carry equal marks.

SECTION – I

Question No: 1 State and explain Schrodinger time independent equation and discuss any one application of time independent equation. [20]

Question No: 2

- a) What is the importance of operators in quantum mechanics; explain null-operator, unity operator, and commutation relation of two operators, Eigen operators and Eigen functions and expectation value of physical observation. [10]
- b) Prove that Eigen function corresponding of an Eigen-operator to different Eigen values is orthogonal to each other. [10]

Question No: 3 Discuss time independent perturbation theory for non-generate energy system. [20]

Question No: 4 Explain angular momentum operator in quantum mechanics also prove that

$$[L_x, L_y] = i \hbar L_z \quad [20]$$

SECTION-II

Question No: 5

- a) Find a Fourier sine series for the function e^x on the interval $(0, \pi)$. [10]
- 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. [10]

Question No: 6

Find general solution of $x^2y'' + xy' + x^2y = 0$ near $x = 0$. [20]

Question No: 7

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 . [10]

b) Evaluate $\oint_c \frac{9z^2 - z + 4}{z(z^2 + 1)^2} dz$, where c is a circle of radius 2 units with center at origin [10]

Question No: 8

a) Prove that co-ordinates of spherical system are orthogonal to each other. [10]

b) Using Laplace Transformation solve the IVB: $y''' - 3y'' + 3y' - y = t^2 e^t$, $y(0) = 1$, $y'(0) = 2$, $y''(0) = 3$. [10]

Question No: 9

Find the general solution of the Bessel equation $x^2y'' + xy' + (x^2 - p^2)y = 0$ of order p . [20]



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Subject: Space Science

Paper: II (Meteorology & Climatology)

Roll No.

Time: 3 Hrs. Marks: 100

NOTE: Attempt any FIVE questions in all by selecting atleast TWO questions from each Section. All questions carry equal marks.

SECTION-I

- Q-1** What is the difference between tropical and extra tropical storm? Write a brief note on a tropical storms. (20)
- Q-2** What do you know about thunderstorm, discuss its development stages and its types in details? (20)
- Q-3 (a)** Explain the formation of Jet Streams. (10)
- (b)** Derive an equation that describe the potential temperature. (10)
- Q-4** Derive the Hydrostatic Equation and explain its applications. (20)
- Q-5** Write a comprehensive note on any two of the followings. (20)
- (a)** Stages of Tornado, **(b)** Weather analysis and forecasting, **(c)** Air Mass, **(d)** Fronts

SECTION-II

- Q-6** Discuss in detail the climate change in geologic history of earth. (20)
- Q-7** Write a complete note on the enhanced Greenhouse effect. (20)
- Q-8** Write a comprehensive note on any two of the following. (20)
- (a)** Climate Model, **(b)** Causes of Climate Change, **(c)** Climate Controlling Factors.
- Q-9** Enlist the climate classification types and discuss any one of them in detail. (20)



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Subject: Space Science

Paper: III (Astronomy)

Roll No.

Time: 3 Hrs. Marks: 100

NOTE: Attempt any FIVE questions by selecting at least ONE question from each section.

SECTION – I

- Q.1. a) Explain Galilean transformation, Inertial and non-inertial frame of references.
b) By considering the motion of a charged particle in a magnetic field. Prove that $T = 2\pi mc/eH$.

- Q.2. a) State and explain Compton's effect and prove that Compton wavelength can be calculated through

$$\lambda - \lambda_0 = \frac{h}{m_0c(1 - \cos \theta)}$$

- b) What is Aberration of light? State, explain and derive a relationship for the Aberration of light?
- Q.3. a) State and explain Einstein Mass Energy Relation.
b) State types of intervals, if $ds^2 > 0$, $ds^2 < 0$ and $ds^2 = 0$. Explain geometrical representation among these intervals for two events. Describe the corresponding spatial and temporal intervals?

SECTION – II

- Q.4. a) Differentiate between the co-ordinates of the Earth and co-ordinates of the Celestial Sphere. Support your answer with suitable diagrams.
b) In a spherical triangle ABC if $b = 32 \text{ deg } 12 \text{ min}$, $c = 56 \text{ deg } 49 \text{ min}$ and $A = 40 \text{ deg } 33 \text{ min}$. Find a , B and C .
- Q.5. a) Find, for latitude ϕ and the declination δ of star Dubhe if the altitudes of star at upper and lower transits at the north of zenith are $79 \text{ deg } 25 \text{ min}$ and $23 \text{ deg } 35 \text{ min}$.
b) State and prove Kepler's 1st law?
- Q.6. a) Discuss seasons, causes and reasons of four seasons.
b) State and explain the orbital elements.

SECTION – III

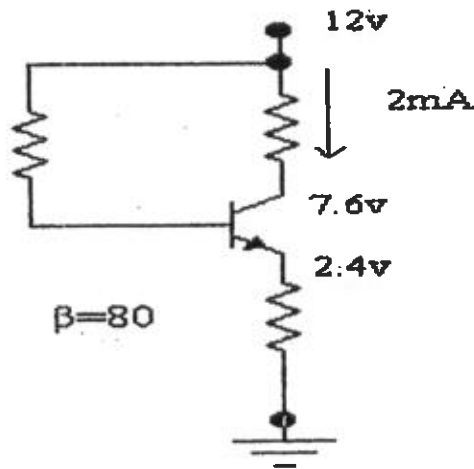
- Q.7. a) Discuss minor planets in our solar System.
b) What are constellations? Draw constellation and label alpha stars of winter triangle constellations.
- Q.8. Why or why not you can observe dark spots on the sun. Discuss in detail.
- Q.9. Write a note on (i) Lunar and Solar Eclipses, (ii) Tachyons.



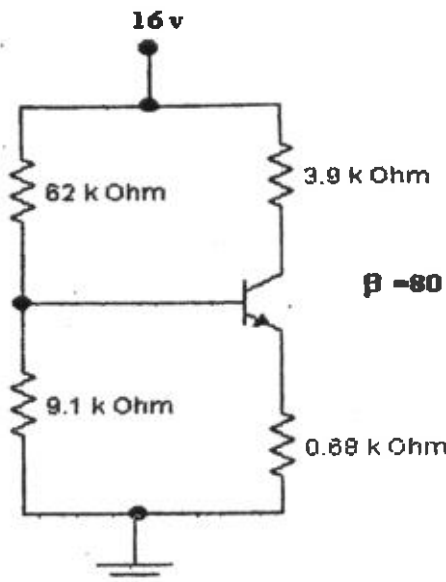
NOTE: Attempt any FIVE questions selecting at least TWO questions from each section. All questions carry equal marks.

Section I

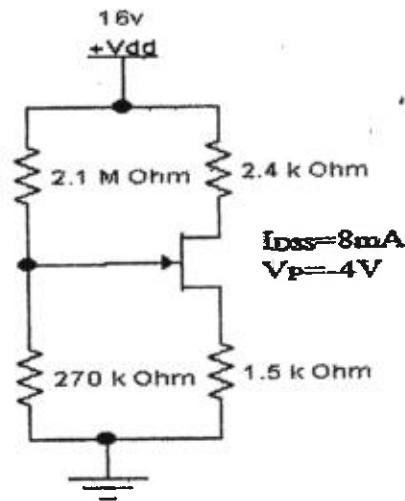
- Q.1. a) Explain potential barrier across the diode's PN junction? Also draw the I-V curves for Ge diode. (10)
 b) Draw a circuit for bridge rectifier write down the applications for bridge rectifier circuit? (10)
- Q.2. a) What is the difference between ordinary diode and a Zener diode? (10)
 b) How voltages are regulated using the Zener diode please explain? (10)
- Q.3. a) Define and draw the CE input and output curves (10)
 b) Given the information provided calculate determine R_C , R_E and R_B (10)



- Q.4. a) Name at least three biasing methods for transistor? Discuss in detail the emitter bias configuration with its advantages and disadvantages. (10)
 b) Given the information provided determine I_B , I_C , V_{CE} , V_C , V_E and V_B for the circuit. (10)



- Q.5 a) Discuss the voltage divider bias configuration for JFET. How can we draw bias line for this configuration? (10)
 b) Determine V_{GSQ} , V_b , V_s , V_{DS} for the following network shown in figure with $I_{DQ} = 2.4\text{mA}$. (10)



section II

- Q.6. a) How a binary code can be converted into gray code and vice versa? Explain with examples. (10)
 b) Perform the following: (10)
 i) Add following BCD numbers 0110 0111 + 0101 0011
 ii) Subtraction of signed numbers in 2's complement format 01100101 - 11101000
- Q.7. a) Use the mapping method to minimize the following standard SOP expression (10)
 $\bar{A} B \bar{C} \bar{D} + A B \bar{C} \bar{D} + \bar{A} \bar{B} C \bar{D} + A B C D + A B C \bar{D} + A \bar{B} \bar{C} D + \bar{A} B \bar{C} D$
 $+ A B \bar{C} D + \bar{A} B C D + ABCD$
 b) How half adder can be converted into full adder? Design a logic circuit for full adder. (10)
- Q.8. a) What is difference between decoder and encoder? (10)
 b) Design a 4-input priority encoder, with inputs D_0 , D_1 , D_2 and D_3 , such that giving D_0 highest priority and D_3 lowest priority. (10)
- Q.9. a) Explain parallel-in and serial-out shift registers? (10)
 b) What is the basic principle of ring counter and Johnson counter? (10)



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Paper: V (Remote Sensing & Image Processing)

Time: 3 Hrs. Marks: 100

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

- Q No.1** What are the major Atmospheric Interactions? Discuss in detail Selective Scattering and explain the blue-sky manifestation. (4,10,6)
- Q No.2** What are the spectral signatures? Draw and discuss in detail the signature of Vegetation, describing dips in signature pattern in the context of atmospheric windows in different portions of spectrum (3,14,3)
- Q No.3** What are different Resolutions in Remote Sensing? Describe the interdependency of Spatial and Spectral Resolutions on each other, describing your answer with examples of Landsat and IKONOS satellites (4,6,10)
- Q No.4** What are True color composites (TCC) and False color composites (FCC)? Describe the use of FCC for the enhancement and variability for vegetation soil and Snow landcovers, elaborate using Landsat data (5,15)
- Q No.5** How different sensors in Remote Sensing are categorized based on source of illumination? Discuss in detail the working of an Optical Mechanical Scanner (6,14)
- Q No.6** Define geometric anomalies, and explain the process of rectification for the correction of geometric errors (5,15)
- Q No.7** Define the process of classification and discuss in detail the process of ISODATA Classification (4,16)
- Q No.8** What are two main types of Contrast Enhancements? Discuss in detail the process of Linear Contrast Enhancement using Percentage Linear Contrast enhancements (6,14)
- Q No.9** Write Note on any two of the following
1) Visual Interpretation Key
2) OLI sensor
3) Cubical Color Model (10,10)