Exam Code: 508603 Paper Code: 3201

Programme: Master of Science (Physics) (FYIP)

Semester – III

Course Title: Statistics

Course Code: FPHL-3173

Time Allowed: 3 Hours Maximum Marks: 70

Note: Attempt five questions in all, selecting at least one question from each Section. Fifth question may be attempted from any section. Each question carries 14 marks. Non-scientific calculators are permitted. Graph paper and logarithmic tables will be provided.

SECTION-A

1. (a) Define an ideal measure of central tendency and discuss the properties it should possess. Compare the Arithmetic Mean, Median, and Mode based on these properties. **(7 marks)**

   (b) The marks obtained by 50 students in an examination are given. Construct a continuous frequency distribution and represent the data using a suitable diagrammatic representation (e.g., a Frequency Polygon). **(7 marks)**

   Example Data: 25, 30, 42, 55, 61, 70, 75, 48, 52, 65, 33, 39, 58, 62, 71, 78, 80, 50, 45, 60, 28, 35, 44, 57, 68, 72, 77, 82, 85, 41, 46, 59, 63, 73, 76, 81, 84, 88, 90, 31, 37, 49, 53, 66, 69, 74, 79, 83, 86, 89.

2. (a) Explain the purpose and method of constructing a Histogram and a Less than Ogive (Cumulative Frequency Curve). Illustrate how the values of the Mode and the Median can be determined graphically from these diagrams. **(7 marks)**

   (b) Find the Geometric Mean (G.M.) for the following discrete frequency distribution: **(7 marks)**

Variable (x)	5	15	25	35	45
Frequency (f)	2	4	6	3	5

SECTION-B

3. (a) Explain the concept of Dispersion in statistics. Define Standard Deviation and state its advantages as a measure of dispersion over the Mean Deviation and Quartile Deviation. **(7 marks)**

   (b) Calculate the Coefficient of Variation (C.V.) for the following distribution and use it to comment on the consistency of the data.

Class Interval:	0-10	10-20	20-30	30-40	40-50
Frequency:	5	8	15	16	6

(7 marks)

4. (a) Show that the Standard Deviation is independent of the change of origin but not of the change of scale. **(7 marks)**

(b) The following results were calculated for scores in two tests, P and Q:

Test P: Mean = 60, Standard Deviation = 12

Test Q: Mean = 80, Standard Deviation = 10

If the number of students who appeared for both tests was the same, compare the relative measures of dispersion for the two tests. **(7 marks)**

SECTION-C

5. (a) Define a Moment in statistics. Differentiate between a Central Moment and a Raw Moment (Moment about an arbitrary origin, A). Establish the relationship for the first central moment (m_1) in terms of raw moments and interpret the result. **(7 marks)**

(b) Calculate Bowley's Coefficient of Skewness for the following distribution and comment on the nature of the skewness. **(7 marks)**

Weekly Wages (₹)	100-120	120-140	140-160	160-180	180-200
No. of Workers (f)	10	15	30	18	7

6. (a) State and explain Sheppard's correction for moments. Under what conditions is this correction applied? **(7 marks)**

(b) For a frequency distribution, the moments about the value 5 are $m_1' = 2$, $m_2' = 20$, $m_3' = 40$, and $m_4' = 150$. Calculate the first four central moments (m_1 , m_2 , m_3 , m_4) and comment on the Skewness and Kurtosis of the distribution. **(7 marks)**

SECTION-D

7. (a) Define mutually exclusive events and exhaustive events with suitable examples. State and prove the additive law of probability for two events A and B. **(7 marks)**

(b) In a factory, machines A, B, and C manufacture 30%, 30%, and 40% of the total production, respectively. Past experience shows that 2%, 3%, and 4% of the products manufactured by machines A, B, and C, respectively, are defective. If a product is randomly selected and found to be defective, what is the probability that it was manufactured by machine B? **(7 marks)**

8. (a) State and explain the various definitions of probability. Define an axiomatic probability function and list its key properties. **(7 marks)**

(b) If A and B are independent events, show that: **(7 marks)**

(i) $\bar{A}$ and B are independent. (ii) $\bar{A}$ and $\bar{B}$ are independent.

Exam Code: 508603 Paper Code: 3199

Programme: Master of Science (Physics) (FYIP) Semester III

Course Title: Electromagnetic Theory

Course Code: FPHL-3391

Time Allowed: 3 Hours Max. Marks: 70

Note: Attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 14 marks. Students can use Non-Scientific calculators or logarithmic tables.

Section A

1. (a) Discuss the phenomenon of mutual induction and find the expression for mutual inductance of two coils and hence prove the reciprocity theorem? (8)

(b) Calculate the coefficient of self induction of an iron cored solenoid having area of cross-section 5 cm^2, length 2 m and number of turns 5000? $\mu_r = 100$. (6)

2. State Maxwell's four equations for electrodynamics and derive their diffrential form. (14)

Section B

3. (a) Drive the wave equation in terms of electric field for EM waves in conductors and dielectrics? Give the solution of wave equation for a plane polarized wave in both the cases? (8)

(b) Discuss the response of a conducting medium to EM waves at low and high frequencies. (6)

4. (a) Derive the Poynting theorem from Maxwell's equations. Interpret the Poynting vector physically and discuss how it quantifies instantaneous and average power flow. (8)

(b) A linearly polarized plane electromagnetic wave in vacuum is propagating in the +z direction. The electric and magnetic fields are: $E(z, t) = E_0 \cos(kz - \omega t)\, \hat{x}$

$B(z, t) = B_0 \cos(kz - \omega t)\, \hat{y}$, Given: $E_0 = 200$ V/m, $c = 3.0 \times 10^8$ m/s, $\mu_0 = 4\pi \times 10^{-7}$ H/m

$\eta_0 \approx 377\ \Omega$

(i) Find the instantaneous Poynting vector S(z, t).

(ii) Find the time-average Poynting vector $\langle S \rangle$. (6)

Section C

5. Discuss the reflection and refraction of plane waves at a boundary separating two dielectric media. Explain how boundary conditions on **E** and **H** lead to the emergence of the classical laws of reflection and refraction. (14)

6. (a) Explain with suitable mathematical arguments why electromagnetic waves are transverse in nature. Discuss how boundary conditions support this conclusion. (8)

(b) What is TIR of electromagnetic waves? Drive the expression for critical angle? (6)

Section D

7. What is circular polarization? Derive the general equation describing the trajectory of the electric field vector for an circularly polarized wave. Under what limiting circumstances does it degenerate into linear or circular polarization? (14)

8. (a) Discuss in detail the operating principle of a Half-Wave Plate. Derive the retardation condition and explain how the device induces rotation of the plane of polarization. (8)

(b) What is double refraction (birefringence)? Explain the fundamental reason behind its occurrence in anisotropic media. Using suitable arguments, explain the emergence of ordinary and extraordinary rays. (6)

Exam Code: 508603 **Paper Code: 3200**

Programme: Master of Science (Physics) (FYIP) Semester III

Course Title: Optics

Course Code: FPHL-3392

Time Allowed: 3 Hours **Max. Marks: 70**

Note: Attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 14 marks. Students can use Non-Scientific calculators or logarithmic tables.

Section A

1. a) Explain Haidinger and Fizeau fringes. Discuss the formation of Fizeau fringes with Newton ring apparatus. Explain the formation of Newton's ring by reflected light. Describe the method to measure refractive index of material using Newton rings. (12)

b) Calculate the fringe width of the interference pattern produced in a young's double slit experiment with two slits 10^{-3} m apart on a screen 1 m away. The wavelength of light is 589.3nm. (2)

2. a) Describe the Fresnel's biprism method of finding the wavelength of light. Give theory of the method. Explain what happens when white light is used to illuminate the slit. How Fresnel biprism interference differs with that of Lloyd single mirror. (10)

b) Can interference occur with longitudinal waves? Explain. (2)

c) Can two independent point sources, say two electric lamps operating under similar conditions, produce sustained interference patterns? Why? (2)

Section B

3. a) Describe Fraunhoffer diffraction of double slit and discuss central as well as secondary maxima.(9)

b) On moving a movable mirror in Michelson Interferometer through 2.3×10^{-4} m, 790 fringes are observed to cross the field of view. Calculate λ. (3)

c) In a single slit diffraction pattern, the width of slit is made double than original width. How does it affect the size and intensity of central diffraction band? (2)

4. a) Explain the principle of Fabry Perot interferometer. Obtain an expression for the intensity of transmitted light with the help of this instrument. Also explain the visibility and sharpness of the fringes obtained in it. (9)

b) What is the function of additional glass plate in the Michelson's interferometer? (3)

c) Light streaks are seen when we look at a strong source of light with half shut eyes. Explain Why? (2)

Section C

5. a) Describe Fraunhoffer diffraction of N slits and discuss the missing orders. (9)

b) Why do we call Fresnel's zone as half period zone? (3)

c) How zone plate differs from convex lens? (2)

6. a) Distinguish between resolving power and dispersive power of a grating . State and explain Rayleigh's criterion for limit of resolution. Derive an expression for resolving power of diffraction grating. (10)

b) Light of wavelength 6000A passes through a narrow circular aperture of radius 0.09 cm. At what distance along the axis will the first maximum intensity be observed? (4)

Section D

7. a) Explain the principle of holography. Describe in detail the process of recording and reconstruction of a hologram with the help of a neat diagram.How does holography differ from ordinary photography? (12)

b) If the angle between a polariser and analyser is 30° what will be the intensity of light transmitted, having original intensity I_0 incident on the polariser. (2)

8. a) What is fibre optics? What is the principle of light propagation in optical fibres? Define numerical aperture and acceptance angle of an optical fibre. (7)

b) Discuss with suitable diagram, the principle, construction and working of Ruby laser. (7)

Exam Code: 508603 Paper Code: 3203

Programme: Master of Science (Physics) (FYIP) Semester III

Course Title: Python Programming

Course Code: FPHM-3125

Time Allowed: 3 Hours Max. Marks: 40

Note: Attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 8 marks.

SECTION-A

1. Write Technical Strengths of Python. What is meant by "Interactive Shell" in Python? How is it different from running a script in Python? (8)
2. Explain Data Types in Python with examples. Write Python Code to
   (a) Create a Dictionary
   (b) Modify Dictionary
   (c) Iteration over a Dictionary (8)

SECTION-B

3. What is a String in Python? Write Python Codes to (a) Concatenate Strings (b) Slice String (c) Compare Strings (d) Convert String from uppercase to lowercase. (8)
4. Explain For Loop in Python using suitable examples. How is it different from While Loop? Write a Python Code to arrange a List in Descending Order using Bubble Sort. (8)

SECTION-C

5. (a) What is difference between Formal and Actual Arguments?
   (b) Explain Recursion using a Python Code. (4, 4)
6. (a) Explain the types of Arguments by giving suitable example of each.
   (b) By writing a Python Code demonstrates the use of "args" and "kwargs". (5, 3)

SECTION-D

7. (a) What is Read Function in Python? Write a code example to demonstrate the use of read() and readline() functions.

(b) How to open and write into Python Files? Explain using Python Program. (4, 4)

8. (a) List Key differences between Os and Sys modules.

(b) Explain the use of seek() method for manipulating the file pointer using suitable Python Code Example. (5, 3)

Exam Code: 508603 Paper Code: 3202

Programme: Master of Science (Physics) (FYIP) Semester III

Course Title: Introduction to Glass Science and Glass Ceramics

Course Code: FPHM-3394

Time Allowed: 3 Hours Max. Marks: 40

Note: Attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 8 marks.

Section A

1. Define vitreous state. Discuss how glasses found in nature differ from man-made glasses. 8
2. How is ionic bonding different from covalent and mixed bonding? Give examples to support your claim. 8

Section B

3. Explain the Volume/Temperature diagram and its significance in glass formation. 8
4. According to Zachariasen's what should be the properties of a metal oxide are required for forming a glass? 8

Section C

5. Discuss the effect of temperature and composition on the heat capacity of glasses. 8
6. Discuss the properties and applications of soda-lime, borosilicate. 8

Section D

7. Discuss the recycling challenges associated with glass materials. 8
8. Analyse the economic and environmental implications of large-scale glass manufacturing. 8