**MPHE-027** 

**ASSIGNMENT BOOKLET** 

M.Sc. (Physics) Programme (MSCPH)

NANOSCIENCE

Valid from 1<sup>st</sup> January, 2025 to 31<sup>th</sup> December, 2025



School of Sciences Indira Gandhi National Open University Maidan Garhi, New Delhi-110068 (2025) Dear Student,

Please read the section on assignments in the Programme Guide for M.Sc. (Physics). A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet. The total marks for this assignment is 100, of which 40 marks are needed to pass it.

#### Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ENROLMENT NO.:					
	NAME:				
	ADDRESS:				
COURSE CODE:					
COURSE TITLE:					
ASSIGNMENT CODE:					
STUDY CENTRE:	DATE:				

## PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

- 2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.
- 3) Leave 4 cm margin on the left, top and bottom of your answer sheet.
- 4) Your answers should be precise.
- 5) Submit the complete assignment answer sheets containing Part A and Part B, within the due date.
- 6) The assignment answer sheets are to be submitted to your Study Centre as per the schedule. Answer sheets received after the due date shall not be accepted. We strongly suggest that you retain a copy of your answer sheets.
- 7) This assignment is valid from 1<sup>st</sup> January 2025 to 31<sup>st</sup> December 2025. If you have failed in this assignment or fail to submit till its validity, then you need to get the assignment for the next year and submit it as per the instructions given in the Programme Guide.
- 8) For any queries, please contact: <u>sgokhale@ignou.ac.in</u> or <u>slamba@ignou.ac.in</u>. Please note that we do not provide answers to the questions asked in this Assignment.

We wish you a good luck.

# Tutor Marked Assignment

Course Code: MPHE-027 Assignment Code: MPHE-027/TMA/2025

Max. Marks: 100

#### Note: Attempt all questions. The marks for each question are indicated against it.

### PART A

1.	a)	Explain the use of nanotechnology in the Prehistoric and Ancient Era.	(5)
	b)	Outline the role of developments in quantum mechanics and microscopy techniques in understanding the nanostructures.	(5)
2.	a)	Calculate the surface energy for a copper crystal for (110) plane. Copper has FCC structure with atomic radius 1.28 Å. The heat of vaporization is 341 kJ mol <sup>-1</sup> .	(5)
	b)	Describe the phenomenon of Ostwald Ripening based on the solute concentration g by Thompson-Freundlich relation.	iven (5)
3.	a)	Explain the principle used in sonochemical method of synthesizing nanoparticles.	(5)
	b)	Which chemical components in the plant extracts make them active for metal nanoparticle synthesis? What is the difference between the static and dynamic self assemblies?	(1+4)
4.	a)	Draw a labeled schematic diagram of the system used to synthesize Fullerenes. How was the presence of cage molecules of carbon first discovered?	(3+2)
	b)	Given for a single wall carbon nanotube that rolls on, chiral vector is $\mathbf{r} = n\mathbf{a_1} + m\mathbf{a_2}$ , Find out the chiral angle and diameter of CNT with $(n, m) = (5,5)$ .	(5)
5.	a)	Describe the features of Type II semiconductor@semiconductor core-shell particles with the help of band diagram. How can longer wavelength optical tuning be achieved in Type II particles?	(4+1)
	b)	Explain the origin of two absorption peaks in the absorption spectra in the visible range for nanorod structures of metals like gold.	(5)

#### PART B

6.	a)	Derive the expression for the quantum conductance of a nanowire connected to	
		two reservoirs of electrons with chemical potentials $\mu_1$ and $\mu_2$ with $\mu_1 > \mu_2$ .	(5)
	b)	Describe the variation of Hall resistance $\rho_{\textit{xy}}$ and longitudinal resistance $\rho_{\textit{xx}}$ with	
		magnetic field in integer quantum Hall effect and fractional quantum Hall effect.	
		Can these phenomena be explained using free electron theory?	(5)

7. a) Explain Neel relaxation time and blocking temperature for a superparamagnetic particle. How does the blocking temperature change with the size of the particle? (4)

	b)	Draw a typical hysteresis loop for a superparamagnetic material and state its characteristics.	(4)
	c)	How does the structure of a multilayer system exhibiting GMR differ from that exhibiting TMR?	(2)
8.	a)	How can the blue colour of a morpho butterfly be explained using the concept of a photonic crystal?	(3)
	b)	What is a photonic band gap? How is it different from an electronic band gap?	(3)
	c)	What is a topological insulator? Explain how a thin film of $Bi_2Se(Te)_3$ is transformed into a topological insulator.	(4)
9.	a)	What are nanocomposites? Describe the applications of nanoparticle reinforced ceramic nanocomposites.	(1+4)
	b)	Describe the use of nanotechnology in improving the masks used by health workers	(5)
10.	. a)	Explain the use of nanotechnology in targeted drug delivery. What are its advantages?	(5)
	b)	Describe the mechanism of photocatalytic degradation of toxic pollutants like	
		Volatile Organic Compounds (VOCs) using nanomaterials like fullerenes and CNTs.	(5)

\*\*\*\*\*\*