TM254550E

Reg. No :.....

Name :.....

MASTER'S DEGREE (C.S.S) EXAMINATION, MARCH 2025

2020, 2021, 2022 ADMISSIONS SUPPLEMENTARY

PHYSICS SEMESTER IV - ELECTIVE COURSE

PH4E03TM20 - Nanostructures and Materials Characterisation

Time : 3 Hours **Maximum Weight : 30**

Part A

I. Answer any Eight questions. Each question carries 1 weight **(8x1=8)**

1. In terms of their peculiarity in energy levels, justify the term 'super atoms' commonly used to refer nanoparticles.
2. Draw the first two energy levels along with their wave functions, representing electrons and holes confined in a quantum dot.
3. Mention the advantages of sputtering process over evaporation.
4. Discuss the effects seen in MEMS devices compared to macro-sized devices and hence explain MEMS as sensors.
5. Discuss the relevance of biomimetics in nanotechnology.
6. Express Beer Lambert's law.
7. Give an account of the theory of chemiluminescence. List out the factors that affect the rate of reaction.
8. Describe any two particle ionizations methods widely used in material characterization.
9. State and explain Moseley's law.
10. Sketch and label an x-ray tube.

Part B

II. Answer any Six questions. Each question carries 2 weight **(6x2=12)**

11. Highlight the importance of quantum dots and quantum wires in electronics.
12. Write a short note on Scanning Probe Microscope and Atomic Force Microscope based nanolithography.
13. Discuss the structure of graphene and explain any one method for its synthesis.
14. Explain the relevance of ferrofluids in polarisation and as diffraction gratings.
15. Explain the relevance of fourier transform spectroscopy.
16. Define fluorescence quenching and hence explain static and dynamic quenching.
17. Elaborate on various components of an x-ray production and detection system.
18. Describe the possible errors that we have to be cautious about while interpreting the results obtained from microthermal analysis.

Part C

III. Answer any Two questions. Each question carries 5 weight **(2x5=10)**

19. Outline the key features of the two major approaches used in nano particle synthesis. Explain any three from each category.
20. Explain NEMS and the relevance of molecules as NEMS devices.
21. Explain the relevance of source, monochromator, sample cells and detector in a spectrophotometer.
22. Describe any three thermal methods used in nano particle research.