

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

M.A./M.Sc. THIRD SEMESTER EXAMINATION, DECEMBER 2018

SECOND YEAR [BATCH 2017-20]

APPLIED CHEMISTRY

Date : 24/12/2018

Time : 11 am – 1 pm

Paper : XVI

Full Marks : 50

[Elective: Characterization of Materials & Elements of Advanced Topic]

Answer any five questions:

[5×10]

1. What is resolution in context to microscopy and how electron microscope provides a better magnification than optical microscope? What is empty magnification? For optical microscopes, glass lenses are used, what lenses are used in electron microscopes? Name the most commonly used modes of SEM for studying (i) surface feature and (ii) Z (atomic number) contrast. If the voltage of an electron microscope is enhanced by a factor of four, how the wavelength of electron will change? (4+1+1+2+2)
2. What is ferroelectricity? Mention two differences between ferroelectric and paraelectric material. Name a ferroelectric material used in ceramic capacitors. What are domains and why domains are formed in ferroelectric materials? Briefly state what characterization should be done to distinguish a ferroelectric from a normal dielectric. (2+2+1+3+2)
3. What is anelasticity? Given that bone is a viscoelastic material, show schematically how bone will fracture when (i) the load is applied slowly and (ii) the application of load is very fast. For aircraft turbine blades, what material is used and why? What are auxetic materials? Give an example. For mechanical characterization of ceramic materials, why statistical approach is very important? (2+2+2+2+2)
4. It is believed that our inner ears help us to sense external sound apparently mimicking the principle of Fourier transform – what is meant by this statement? Briefly state the principle of FT-IR spectroscopy. It is well-known that UV radiation entering through the holes in ozone layer of upper atmosphere is responsible for a surge in skin cancer - keeping this in mind suggest a spectroscopic technique to detect ozone in ambient air. What is tunneling and how scanning tunneling microscope works? (2+3+1+4)

5. Outline some key advantages of hydrothermal synthesis technique. What is critical point (thermodynamic) and what are subcritical and supercritical hydrothermal synthesis? What is acoustic cavitation and how does it help to synthesize nanoparticles at around room temperature? How crystallite size can be determined from X-ray diffraction? (3+3+2+2)
6. Define and outline some important applications of quantum dots with examples. What is blue shift in context to (say CdSe) quantum dots and which spectroscopic technique is used to characterize such blue shifts? Briefly state how particle size of quantum dots can be approximated from BET studies. (4+3+3)
7. What is the type of hybridization in CNT and fullerenes? Which characterization tool can be used to measure the thickness of single-layer and multi-layer graphenes? What is the nature of CNT in context to electrical conductivity? What is the most widely used spectroscopic technique to characterize and differentiate fullerene, CNT, graphene and graphite and why? Is graphene a perfectly flat 2D material, if not why? Are graphene and fullerene aromatic? (2+1+2+2+1+2)
8. How DSC is different from DTA and for quantitative detection of heat change during phase transformation, which one is better and why? What are actuators? What type of thermally responsive actuator can be used for coupling of oil pipes? How sensor is defined by engineers? (5+2+1+2)

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