Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.Tech. (BME) DEGREE END SEM EXAMINATIONS, NOVEMBER 2017
SUBJECT: INTRODUCTION TO BIOMEDICAL NANOTECHNOLOGY (BME 4012)
(REVISED CREDIT SYSTEM)
Saturday, 25th November 2017, 2 PM-5 PM

TIME: 3 HOURS **MAX. MARKS: 100**

Instructions to Candidates:

1. **Answer ALL questions.**
2. **Draw labeled diagram wherever necessary**

1.	**(a)**	Explain the relation between surface energy and particle size.	**5**
	(b)	Explain the mechanisms for reducing overall surface energy in nanomaterials.	**5**
	(c)	Explain "LaMer's mechanism" of nanoparticle synthesis. Discuss the electrostatic stabilization mechanism associated with nanoparticles.	**10**
2.	**(a)**	You have synthesized 4 samples (A,B,C & D) of ZnO nanoparticles. Explain the principle behind and application of Scanning Electron Microscope (SEM) and X-ray Diffraction (XRD) for the characterization of these nanoparticles.	**10**
	(b)	i) Draw a rough diagram of the UV-Vis absorption spectra associated with each ZnO nanoparticle (spherical shape) samples (exact calculation of absorption wavelength is not required) and explain the differences in the absorption wavelength with "particle in a box" concept. Assume that the following parameters pertaining to the 4 samples: Diameter of Sample A < Diameter of Sample B < Diameter of Sample C < Diameter of Sample D. ii) If the particles you synthesized were gold nanoparticles (spherical or rod shaped), how would the UV-Visible absorption spectra change with size and shape? Explain the reasons.	**10**
3.	**(a)**	Describe physical vapor deposition method (PVD) and chemical vapor deposition method (CVD) for nanomaterial synthesis.	**10**
	(b)	Explain the principle behind and operation modes of Atomic force microscopy (AFM) and Scanning Tunneling Microscope (STM). What is Dip pen lithography?	**10**

4.	**(a)**	Explain "temperature induced" and "ultrasound induced" nano drug delivery systems.	**5**
	(b)	Explain surface-enhanced Raman Scattering (SERS) in the context of biosensing.	**5**
	(c)	Design a pH induced intracellular drug delivery system for doxorubicin delivery, which can also deliver multi modal imaging nanoprobes (MRI+ Optical imaging).	**10**
5.	**(a)**	What is tissue engineering? Explain the 3 major strategies used for tissue engineering. Why are nanomaterials/nanostructures important in tissue engineering?	**5**
	(b)	Explain in detail, the "biological fate" of nanomaterials.	**5**
	(c)	Explain photo thermal therapy, and photodynamic therapy, for cancer treatment.	**10**