

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- MAY-2023

Course Code (Credits): 18B1WBT633 (3)

Max. Marks: 35

Course Name: Nano-Biotechnology

Course Instructors: Dr. Abhishek

Max. Time: 2.0 Hour

Note: All questions are compulsory. Marks are indicated against each question in square brackets.

1. Heavy metal pollution has been considered as a global environmental issue due to various industrial activities, such as electroplating, metallurgy, fertilizer, and so on. Heavy metals are one of the most dangerous pollutants due to their high toxicity and their bioaccumulation effect. The typical heavy metal ions mainly include mercury ions (Hg^{2+}), lead ions (Pb^{2+}), cadmium ions (Cd^{2+}) etc among all Hg^{2+} is one of the most toxic heavy metal ions with bio-accumulative properties and many other harmful effects. Provide an instrument-free nanoparticles-based strategy for the detection of Hg^{2+} which will be simple, easy to use and rapid for onsite detection. [5] [CO-5]
2. What is green synthesis? Detail-out the mechanism of reduction in green synthesis and write down the various steps involved in green synthesis. Also write down why green synthesis is more convenient than physical methods and what are the limitations of these methods. [5] [CO-2]
3. Nanotechnology is currently being utilized for tissue engineering and regenerative medicine. Nanostructures can mimic tissue-specific bio-environments by designing constructs with particular biochemical, mechanical and electrical properties. Give a layout for the development of artificial tissue using the concept of tissue engineering and also detail out the significance of growth factor, nanomaterial and bioreactor in artificial tissue development. [5] [CO-4]
4. Nanomedicine is one of the leading applications of nanotechnology, which is committed to developing nanoscale medicinal tools to provide an effective health care system. This approach allows us to understand human physiology in a better way to fight against several deadly diseases such as cancer and cardiovascular diseases. The significance of nanomedicine is mainly applied for imaging, diagnosis of diseases, and architecting more efficient, cost-effective and safe drug delivery systems to precisely deliver drugs to target sites which can accelerate treatment outcomes via reducing off-target effects and toxicities. How will you design a targeted nanodrug delivery system for cancer treatment using Doxorubicin as a model drug and folic acid as a targeted moiety? Give your strategies with proper justification. [6] [CO-4]

5. Nanomaterial properties and characteristics are greatly dependent on the nanoparticle size and shape. Therefore, it is important to have a tool of determining the nanoparticle size and shape in order to predict its behaviour when using them. There are multiple methods (DLS, AFM, SEM, TEM etc) for nanoparticle size distribution determination. Compare the working principle of Atomic Force Microscopy (AFM) and Dynamic Light Scattering (DLS) and discuss their suitability for characterizing nanoparticle size and shape for samples of different shapes. [5] [CO-3]
6. Nanotechnology is an excellent example of an emerging technology, offering engineered nanomaterials with the great potential for producing products with substantially improved performances. There are various methods (PVD, Chemical reduction, Laser ablation, Biogenic etc.) to develop nanomaterial of different size and shape. Which methods you will prefer to synthesize biocompatible nanoparticles for targeted drug delivery application and why? [5] [CO-2]
7. NPs can be used in a long list of applications due to their unique physical and chemical properties (Mechanical, optical, electrical properties and high surface area to volume ratio etc.) that do not exist in their larger-dimension counterparts of the same materials. Prove with suitable example that nanomaterials have better optical and mechanical properties as compare to bulk counterpart. [4] [CO-1]