MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SIXTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION
APRIL/MAY 2019
SUBJECT: INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY (ECE - 3290)

TIME: 3 HOURS   **MAX. MARKS: 50**

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A.   Name two crystal structures which are called "close packed structures". Justify your answer.

1B.   Calculate number of atoms in 1.4 nm Pt nano crystal. Consider the Pt to be using bulk density of Pt. Consider the bulk density of Pt to be 21.5 grams/cm^3.

1C.   What is Hamiltonian? Write the law of conservation of energy in terms of Hamiltonian for a paricle moving in a potetial field which is independent of time.

(4+3+3)

2A.   Calculate miller indices for the plane with the intercepts 2a, -3b and 4c along the crystallographic axes. Find angle between the crystal planes [2, 1, 1] and [1, 1, 2].

2B.   Define the energy density for a travelling wave in a continuous medium like string. Consider a travelling wave of the form U(r, t) = B Sin (qr-ωt) and find its energy density.

2C   Define the phase velocity of travelling wave and explain.

(3+4+3)

3A.   Derive the energy density of standing waves.

3B.   Write the quantum equivalent of the following classical quantity :
i) Density of Optical energy   ii) Optical Intensity and   iii) Total optical power

3C.   Explain an experiment to show that the electrons behave like a wave.

(4+3+3)

4A.   Explain two dimensional and one dimensional sub bands when a partcle is confined in two dimensions and in one dimension respectively.

4B.   Explain photolithography for fabrication of nanostructures. What is its limitation? Indicate two techniques to circumvent its limitation.

4C.   Explain what is epitaxial thin films? Explain with two examples of fabrication techniques.

(3+4+3)

5A.   Explain the principle and working of Scanning tunnelling microscopy. How STM can be utilised to occupied and unoccupied density of states of a given sample.

5B.   Explain how the STM tips can be fabricated and characterised. Explain the principle of AFM.

(5+5)