No. of Printed Pages : 2

Exam. Seat No.: _____

SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR
Fourth Semester of M. Sc. (Physics) Examination
Day: Wednesday Date: 20-03-2019 Time: 10.00 AM to 1.00 PM
Subject code:PS04CPHY22 Subject: Advanced Experimental & Characterization Techniques

Total Marks: 70

Q.1 **Choose the correct answer from the given choices. Only one choice is allowed.** **(08)**

(1) Which of the following chemical vapour deposition method is better for depositing epitaxial thin films?

(A) LPCVD   (B) LECVD   (C) PECVD   (D) HTVCD

(2) In plasma enhanced CVD, low pressure plasma is used to
(A) provide necessary reaction temperature
(B) decompose gas molecules into reactive molecular fragments
(C) support CVD reaction by sputtering
(D) None of these

(3) A single stage Gifford Mc-Mahon cooler produces cryogenic temperature down to ____K.
(A) 4   (B) 2.5   (C) 15   (D) 77

(4) _____ is a primary thermometer.
(A) Resistance thermometer   (B) ^{3}He melting-curve thermometer
(C) Thermoelectric element   (D) Nuclear spin resonance thermometer

(5) The output (or signal) of a mass spectrometer is quantified in terms of
(A) mass of constituent elements of the sample
(B) mass-to-charge ratio of the constituent elements of the sample
(C) wavelength of the light emitted by the constituent elements of the sample
(D) intensity of the light emitted by the constituent elements of the sample

(6) An advanced analytical method for materials, often known as HPLC in short, is
(A) High Performance Laser Chromatography
(B) Hot Plasma Laser Chromatography
(C) High Performance Liquid Chromatography
(D) Heavy Petroleum Liquid Chromatography

(7) The scattered α-particles has energy proportional to $[(M - M_0)/(M + M_0)]^2 E_0$ at scattering angle $\theta \sim$_____in RBS technique.
(A) 90°   (B) 45°   (C) 0°   (D) 180°

(8) In scanning electron microscope, secondary electrons are emitted from the sample surface depth in the range
(A) 1 – 10 Å   (B) 10 –1000 Å   (C) 50 – 500 Å   (D) 1000 – 2000 Å

Q.2 **Answer any SEVEN of the following questions in brief.** **(14)**

(1) Differentiate between X, Y and Z type of LB films.
(2) To form epitaxial heterojunction which parameters play a significant role so that they can be used efficiently for optoelectronic devices? Explain in short.
(3) Define sputtering and sputtering yield.

[P.T.O]

(4) What is the role of rotary valve in Gifford-McMahon cooler?

(5) Explain the working principle of gas thermometers in brief.

(6) Explain the principle of atomic absorption spectroscopy with necessary diagram.

(7) Define the following terms used in chromatography
(i) mobile phase,   (ii) stationary phase,   (iii) eluent,   (iv) eluate

(8) Explain Ewald sphere construction with necessary diagram.

(9) Write the working principle of electron energy loss spectroscopy (EELS).

Q.3 (a) Explain MBE technique in detail to deposit epitaxial compound semi-conductor thin films.   (6)

(b) For insulating thin films why RF sputtering is preferred over DC sputtering? Explain RF sputtering with suitable figures.   (6)

OR

(b) Discuss LECVD and HTCVD methods used to deposit thin films.   (6)

Q.4 (a) Sketch the diagram of a simple cooling machine and explain its working using Stirling cycle.   (6)

(b) Discuss the design of a Helium bath cryostat and explain its working. Also write its merits and limitations.   (6)

OR

(b) Distinguish between primary thermometers and secondary thermometers and discuss in detail about the use of metals and doped semiconductors for resistance thermometers to measure cryogenic temperatures.   (6)

Q.5 (a) Write the different ionization techniques used in mass spectrometry. Briefly describe any two of these techniques.   (6)

(b) What is chromatography? State different types of chromatographic techniques. Describe the principle and basic set up of a typical gas chromatography instrument.   (6)

OR

(b) Describe the principle and applications of the inductively coupled argon plasma emission spectroscopy. Draw necessary diagram.   (6)

Q.6 (a) Discuss in detail small-angle X-ray scattering (SAXS) and small-angle neutron scattering (SANS). What are the merits and demerits of SANS over SAXS?   (6)

(b) Explain working of angular dependent X-ray photoelectron spectrometer (ADXPS) .What are the limitations of ADXPS with respect to conventional XPS?   (6)

OR

(b) Explain the material characterization technique which is capable to detect very low chemical concentration up to 2×10^{-6} at.% . Discuss the working of this technique with different mass analyzer: Time of flight mass analyzer and magnetic sector mass analyzer   (6)