Birla Institute of Technology and Science, Pilani, Rajasthan
First Semester 2023-2024
Comprehensive Examination (Closed Book)

Course Title: **Thin Film Technology** Course No. **PHY F379**
Time: 130 mins 08-12-2023 Total marks: **28**

I. Answer all questions of this part on the first page of the answer book. [7]

i. Change of magnetic property of a material under mechanical deformation is called _____
ii. Reynolds number characterizing the flow of a fluid moving through a tube of fixed diameter is directly proportional to _____ and inversely proportional to _____
iii. Sauerbrey equation used in QCM technique is_____.
iv. The materials that exhibit mesophases on (a) varying temperatures are called _____ LC (b) varying concentration of solute in solvent are called _____ LC.
v. The free energy barrier against nucleation in an evaporation process is inversely proportional to _____ and _____ (Choose the two correct parameters from this list: Surface tension, Temperature, particle density, Supersaturation of metal vapor in gas phase)
vi. The _____nm UV line decomposes oxygen molecules and synthesizes _____ molecule.
vii. The fill factor of a solar cell is directly proportional to _____ and inversely proportional to _____.

II. **Answer any 6 questions out of these 7 questions. Each question carries 1.5 marks**. **[9]**
i)How is the optical band gap of semiconductors estimated using absorption spectroscopy? Explain with the help of relevant plot and formula.
ii) In the Raman spectroscopy of a laser of 785 nm was used the source and a stokes shift of 1000 cm^{-1} was observed. Calculate the wavelength of that stokes line.
iii) What is Magneto-optic Kerr effect? Name any two types of Magneto-optic Kerr effect.
iv) What is the principle of Brewster angle Microscopy? For which characterization this technique will be useful?
v) What is sputtering? When this process will be preferred over other processes of thin film deposition?
vi) Sketch the nucleation density as a function of incubation time in a CVD process. Label the different regimes.
vii) What is XPS? With the help of the relevant formula explain the process.

2. What is the role of a reactor in CVD process? With the help of proper schematic diagrams compare their mechanism and advantage/disadvantages between any two types of reactors used in CVD. **[3M]**
3. Explain with proper schematic diagrams the modes of the scanning probe microscopy that are useful for (i) conducting samples and (ii) magnetic samples. **[4M]**
4. What is the principle on which QCM technique works? Where this technique is employed? Explain in detail. [**3M]**
5. How is nematic LC different than conventional fluids? What are the key physical parameters on which a LCD works? **[2M]**

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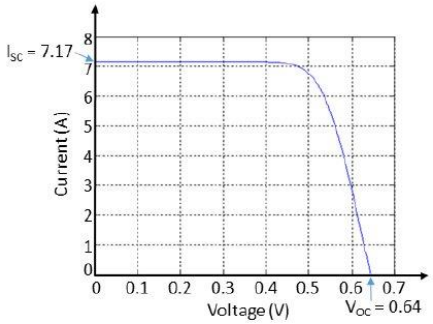
Time: 50 mins 08-12-2023 Total marks: **7**

1. Using the given plot for a solar cell estimate the fill factor when (i) two such solar cells are connected in series (ii) two such solar cells which are connected in series are connected in parallel with two solar cells that are connected in series. **[3M]**



2. The thickness and empty capacitance of fabricated LC cell is measured to be 8 micron and 90 pF respectively. The values of capacitance and resistance of the filled LC cell measured at 5kHz are found to be 849 pF and 122kOhm respectively. Find the complex dielectric permittivity and hence the loss factor. **[3M]**

3. A SPR setup was used to obtain the SPR condition for a metal and dielectric material pair whose relative dielectric permittivity were 8.2 and 1.65 respectively for a wavelength of source of 630 nm. The light is incident onto this metal-dielectric pair through a glass prism at an angle of 42° to achieve SPR condition. Find out the refractive index of the prism. **[1]**

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