	St. Philomena's College (Autonomous), Mysore **Question Bank**	
	Programme: M.Sc. Physics **IV Semester**	
	Course Title: Condensed Matter Physics - 3 ; QP Code:58306 **Course Type: Soft Core**	
1	Explain what is complex dielectric constant.	2
2	Explain what is ionic polarizability.	4
3	What are polar and non-polar dielectrics? Explain with examples.	4
4	Define the terms (i) Electric dipole and (ii) Electric polarizaation.	4
5	Explain what are dielectrics and list any three important applications of dielectric solids.	4
6	Differentiate between optical and electron microscopy.	4
7	Define the terms (i) electric flux density and (ii) electric susceptibility χ_e. Show that the electric susceptibity is related to the dielectric constant ϵ_r in the form $\chi_e = (\epsilon_r - 1)$.	6
8	Explain what is dielectric constant. Show that the dielectric constant ϵ_r is related to electronic polarizability in the form: $\varepsilon_r = 1 + \frac{N\alpha}{\varepsilon_0}$.	6
9	Briefly describe ionic and orientational polarizations in a dielectric subjected to an electric field.	6
10	For a dielectric medium possessing cubic symmetry, show that: $\frac{\varepsilon_r - 1}{\varepsilon_r + 2} = \frac{N\alpha}{3\varepsilon_0}$.	6
11	Explain the terms (i) the complex dielectric constant and (ii) the phase factor.	6
12	Explain what is meant by (i) complex dielectric constant and (ii) relaxation time.	6
13	Explain the terms (i) relaxation time and (ii) dielectric loss.	6
14	Explain the classification of ferroelectric crystals with examples.	6
15	Describe the basic properties of $BaTiO_3$.	6
16	What are the objections against the dipole theory of ferroelectrics? Explain	6
17	Write a note on ferroelectric domains.	6
18	Describe any six general properties of ferroelectric materials.	6
19	Discuss the dipole theory of ferroelectricity.	6
20	Explain the significance of nanoscaled materials?	6
21	Discuss the electrical and optical properties of nanomaterials.	6
22	Describe the general principle involved in Physical Vapour deposition method.	6
23	Discuss the physical properties of nanostructured materials which are size dependent?	6
24	Describe the preparation of nanomaterials using laser ablation method.	6
25	Discuss the basic principle involved in sputtering method and also mention the parameters affecting the yield of the target material.	6
26	Outline the synthesis of nanomaterial using plant extract.	6
27	Discuss the importance of microscopic, spectroscopic and diffraction techniques in characterizing the prepared nanostructured materials.	6
28	With a neat labelled diagram explain Fourier Transform Infrared Spectroscopy.	6
29	Explain Physical Vapour Deposition and discuss its general principle in the preparation of thin films.	6
30	Discuss resistive heating method of preparing thin films.	6
31	Explain how thin films are prepared using magnetron sputtering technique.	6
32	Derive an expression for electronic polarization and explain its temperature dependence.	8
33	Explain the types of polarization of a dielectric solid when subjected to an electric field.	8
34	Discuss the theory of electronic polarization.	8
35	Explain a method of determining the dipole moment of gaseous molecules in the laboratory.	8
36	Obtain Clausius-Mosotti relation and hence Lorenz-Lorentz relation for a medium possessing cubic symmetry.	8
37	Obtain Clausius-Mosotti relation relating macroscopic dielectric constant (ϵ_r) with microscopic polarizability (α_e).	8
38	Discuss with necessary theory the effect of temperature on the static dielectric constant of gases.	8
39	Explain the mechanism of domain growth in ferroelectrics.	8
40	Describe the basic properties of Rochelle salt.	8
41	Describe how lithography can be achieved using electron and ion-beams	8
42	Discuss the hydrothermal method of preparing nanomaterials.	8

43	Discuss how nanomaterials are prepared employing sol-gel method.	8
44	Discuss the process of preparing thin films using electron bombardment heating	8
45	Explain Chemical Vapour Deposition and describe PECVD method of preparing thin films.	8
46	Describe the electrolytic deposition and electroless deposition methods of preparing thin films.	8
47	Describe the Langmuir-Hinshelwood and Elay-Riedal mechanism of growth in chemical vapourdeposition method.	9
48	Discuss in detail how an atomic force microsope can be used for the purpose of lithography.	9
49	What is ferritin ? Discuss the procedure to convert ferritin into apoferritin and how it can be used to synthesize CdS nanoparticles.	9
50	Explain the role of X-ray diffraction in characterizing nanomaterials.	9
51	With a neat labelled diagram describe the working of Scanning Electron Microscope.	9
52	Discuss the principle and working of Scanning Tunnelling Microscope.	9
53	Describe the principle and working of optical microscope with a neat labelled diagram.	9
54	Discuss the principle and working of Atomic Force Microscope.	9
55	Outline the preparations of CdS nanoparticles when $[Cd(NO_3)_2]$ salt is treated with yeast?	9
56	How is spectroscopy helpful in characterizing nanomaterials? Discuss the working of photoluminescence spectroscopy.	9
57	Explain the principle and working of UV-visible-IR absorption spectroscopy.	9
58	Explain what is sputtering and describe how thin films are prepared employing RF sputtering.	9
59	Elucidate the method of preparing thin films employing thermal evaporation using laser beam.	9
60	Describe the types of Chemical Vapour Deposition methods used in preparation of thin films	9
61	Discuss how thin films are prepared employing spray pyrolysis method.	9
62	Discuss the process of determining thickness of thin films employing electrical methods.	9
63	Describe the method of determining thickness of thin films by optical absorption.	9
64	Outline the method of characterizing thickness of thin films by optical interference	9
65	Discuss in detail how thickness of thin film is measured using quartz crystal monitor?	9
66	Explain what is EDAX and describe how it is useful in understanding property of thin.	9
67	Write a note on different chemical analysis techniques used to characterize thin films.	9
68	Discuss how X-ray diffraction technique is useful in characterizing thin films.	9
69	What is XPS? How is it used to characterize thin film? Discuss.	9
70	Discuss the classical theory of electronic polarization in dielectrics.	10
71	Discuss in detail, the different polarization mechanisms that exist in dielectrics and explain their temperature dependence.	10
72	Derive Langevin-Debye equation for the total polarizability in a dielectric.	10
73	Explain a method of determining the dipole moment of gaseous molecules in the laboratory.	10
74	Derive an expression for the orientational polarization as a function of temperature in a polar dielectric material.	10
75	Explain what is meant by local field in a dielectric. Obtain expression for it in a dielectric medium possessing cubic symmetry.	10
76	Show that in the presence of the applied field of strength $\vec{E}_0$, the local field ($\vec{E}_{Loc}$) seen at any lattice site in a dielectric solid is given as $\vec{E}_{Loc} = \vec{E}_0 + \frac{\vec{P}}{3\varepsilon_0}$	10
77	Explain with necessary theory the temperature dependence of spontaneous polarization in ferroelectric materials.	10
78	Discuss with relevant theory the Curie-Weiss law for ferroelectrics.	10
79	Discuss the preparation of nanomaterials by employing (i) precipitation method and (ii) solvothermal method	10
80	In detail describe the preparation of nanomaterials by chemical vapour deposition method.	10
81	Explain what is nanolithography and describe in detail the X-ray based Lithography.	10
82	Explain the following techniques used in characterizing nanomaterials: i) EXAFS and ii) Neutron diffraction	10
83	Explain what is sputtering and discuss how thin films are prepared employing DC sputtering technique.	10
84	List various thin film deposition techniques and compare their characteristics.	10
85	What is Chemical Vapour Deposition? Discuss MOCVD and LPCVD methods of preparing thin films.	10
86	Obtain expression for the average energy dissipated per second per unit volume in a dielectric subjected to an ac field of frequency ω.	12
87	Obtain expressions for $\epsilon'(\omega)$ and $\epsilon''(\omega)$ in terms of frequency ω and relaxation time $\boldsymbol{\tau}$ and show that $\epsilon''(\omega)$ is a measure of the dielectric loss.	12
88	With relevant theory show that the energy absorbed by a dielectric in the presence of an applied field of frequency $\boldsymbol{\omega}$varies proportional to $\boldsymbol{\epsilon''(\omega)}$.	12

89	Discuss with relevant theory and suitable figures the frequency dependence of the real and imaginary parts of the complex dielectric constant of a dielectric solid.	12
90	Describe the classification and properties of representative ferroelectrics.	12