

**Birla Institute of Technology & Science, Pilani – K. K. Birla
Goa Campus
Second Semester, 2022 – 2023**

**CHEM F 326
Solid State Chemistry**

**COMPREHENSIVE EXAM (Closed Book)
Date: 18/05/2023**

**Max. Marks: 80
Time: 10AM-1PM**

Instructions: There are two printed pages. Answer all the questions. Full Marks can be awarded only for completely correct answers. Illustrations should be done with pen only. Assume suitable parameter(s)/ data if necessary. Use of scientific calculator is allowed. Answer all parts of a question together.

1. Answer the followings briefly.
 - (a) Describe the symmetry operation involved in $\bar{4}$.
 - (b) How will you distinguish crystalline and amorphous materials by using powder XRD?
 - (c) How SEM can be used to identify the characteristics elements present in a solid material.
 - (d) Plot a schematic diagram showing TG plot for CaCO_3 solid sample.
 - (e) Define Vegards's law.
 - (f) Define and explain phase rule.
 - (g) Explain, why $(\text{Al}_{2-x}\text{Cr}_x)\text{O}_3$ and PdH_x materials are regarded as substitutional and Interstitial solid solutions, respectively.
 - (h) Why TiO shows metallic conductivity?
 - (i) Explain why the Doping Ag^+ ion in ZnS crystal structure imparts blue color to it.
 - (j) How will you prepare coarse pearlite texture from carbon steel?

[10 x 2]

- 2 (a) Write down and explain the resulting solid solution product formulae in the followings:
 - (i) NaCl dissolve in CaCl_2 .
 - (ii) MgO dissolve in Al_2O_3
 - (iii) ZrO_2 dissolve in CaO
- (b) Explain the solid state reaction involving NiO and Al_2O_3 to form NiAl_2O_4 product at 1200°C using Wagner mechanism.

[9+6]

- 3 (a) With the help of a suitable diagram explain the origin of ferroelectric, antiferroelectric and ferrielectric behavior of the materials.
- (b) (i) Define piezoelectric behavior. (ii) Explain piezoelectric behavior observed in quartz.
- (c) How will you confirm paramagnetic to antiferromagnetic ordering of KFeS_2 by using Mossbauer spectroscopy?

[6+4+6]

- 4 (a) Draw a diagram showing coupling of neighboring Ni^{2+} spins antiferromagnetically via superexchange mechanism in NiO crystal. Also, explain it.
- (b) Plot and label a typical magnetization vs. temperature plot of $\text{Dy}_3\text{Fe}_5\text{O}_{12}$. Locate and explain the origin of compensation temperature and Curie temperature in the above plot.

[8 + 6]

- 5 (a) Draw and label the susceptibility vs. temperature plots of ferromagnetic, paramagnetic and antiferromagnetic materials. Indicate any magnetic transition associated with the plots.
- (b) With the help of a diagram explain the design of Ruby laser. With the help of energy level diagram, explain the observed emission by laser action in ruby laser.

[6 + 9]

END