# B. Sc. / M. Sc. (Applied Physics) (Sem. VII) (CBCS) Examination

## March - 2021

## Advanced Materials & Applications : Paper - IV

### (New Course) (Core)

**Faculty Code : 003**

**Subject Code : 0497007**

Time : $2\frac{1}{2}$ Hours]                                           [Total Marks : **70**

**1**    Attempt short questions : (Two marks each)                    **14**
   (1)   List various families of HTSC compounds.
   (2)   Define Multiferroicity.
   (3)   Give examples of type I and type II multiferroics.
   (4)   List various applications of ferrites.
   (5)   What is meant by positive and negative MR ?
   (6)   Define magnetoresistance (MR). Write an equation of MR.
   (7)   Draw a Schematic diagram of $MnO_6$ Octahedra.

**2**    Attempt short questions : (two marks each)                    **14**
   (1)   Why is (i) Magnetoelectric (ME) effect and (ii) Ferrites.
   (2)   Why there are few Multiferroic materials ?
   (3)   Draw a well-labeled crystal structure of Y-123 Superconductor (orthorhombic)
   (4)   Describe classification of Composites based on Reinforced material.
   (5)   What are composites ?
   (6)   What are the soft and hard ferrites ? Give examples of each.
   (7)   What are different names given to High-$T_C$ superconductor ?

**3**    Write the detailed answers of following questions :           **14**
   (1)   Describe various applications of high - $T_C$ superconductors.
   (2)   Describe in detail the synthesis of $YBa_2Cu_3O_7$ superconductor using solid-state reaction method. Write down the Cu-valencies in $YBa_2Cu_3O_6$ and $YBa_2Cu_3O_7$.

4   Write the detailed answers of following questions :   **14**
    (1) Explain the role of Copper and Oxygen in $Y_{123}$ superconductor.
    (2) What are types of high-$T_C$ superconductor ? Describe using examples.

5   Write the detailed answers of following questions :   **14**
    (1) Write a note on $BiFeO_3$ multiferroic and its properties.
    (2) Draw a well-labeled diagram of $BiFeO_3$ crystal structure and discuss about its phase stability.

6   Write the detailed answers of following questions :   **14**
    (1) Draw a well-labeled diagram of Zener double exchange and Jahn-Teller effect in mixed valent manganites. Explain in detail.
    (2) Explain various applications of CMR materials.

7   Write the detailed answers of following questions :   **14**
    (1) Calculate A-site, B-site average ionic radius of (a) $La_{0.7}Sr_{0.3}MnO_3$ (b)$La_{0.7}Sr_{0.1}Ba_{0.2}MnO_3$ and hence calculate its tolerange factor and $\sigma A^{21}$. (Ionic radii of $La^{3+}$ - 1.216, $Sr^{2+}$ - 1.31, $Ba^{2+}$ = 1.47 $\mathring{A}$ , $Mn^{3+}$ - 0.645, $Mn^{4+}$ - 0.53 and $O^{2-}$ = 1.42 $\mathring{A}$ ).
    (2) Define Strain in manganite films. What are the different types of strain ?

8   Write the detailed answers of following questions :   **14**
    (1) Write down the salient features of $BiFeO_3$ Multiferroic and give its applications.
    (2) What is polymer matrtix composite ? Give two examples of each.

9   Write the detailed answers of following questions :   **14**
    (1) Discuss the dependence of transition temperature on tolerance factor, a carrier density and size variance in manganites.
    (2) What are ferrites ? Give their types and properties.

10  Write the detailed answers of following questions :   **14**
    (1) Explain Ceramic Matrix Composites.
    (2) Describe the classification of composite. Discuss Metal-matrix composites material and its applications.