



**DJJ-003-020403**

Seat No. \_\_\_\_\_

**M. Sc. (Sem. IV) (CBCS) Examination**

**May / June – 2015**

**Physics : ET - 03**

*(Functional Materials)*

**Faculty Code : 003**

**Subject Code : 020403**

Time : 3 Hours]

[Total Marks : 70

- Instructions:**
- (1) Attempt **all** questions.
  - (2) All questions carry **equal** marks.
  - (3) Mathematical symbols have equal meanings.

1. Answer in brief any **seven**: **14**
  - (a) Define functional materials. Give examples. 02
  - (b) Define SPINTRONICS and DMS. 02
  - (c) Define positive and negative MR. 02
  - (d) What is phase diagram? 02
  - (e) Draw a well labeled structure of  $\text{LaMnO}_3$  manganite. 02
  - (f) What is multiferroicity? 02
  - (g) Give examples of few multiferroics. 02
  - (h) What is meant by high  $T_c$  superconductors? 02
  - (i) List the applications of HTSC. 02
  - (j) What are ferrites? Give examples. 02
2. Answer any **two** of following questions: **14**
  - (a) Discuss the fundamental concepts of functional materials. 07
  - (b) Write a short note on DMS materials. 07
  - (c) Discuss in detail about bound magnetic polaron theory. 07
3.
  - (a) Explain four types of MR. 05
  - (b) Discuss the transition temperatures and their dependence on tolerance factor, carrier density and size variance in manganites. 05

- (c) How the Mn-O-Mn bond angles and Mn-O bond lengths affect the transport of manganites? 04

**OR**

- (a) Draw a well labeled phase diagram of  $\text{La}_{1-x}\text{Ca}_x\text{MnO}_3$  manganites. 05
- (b) Calculate the  $\langle r_A \rangle$ ,  $t$  and  $\sigma_A^2$  for  $\text{La}_{0.7}\text{Ca}_{0.1}\text{Sr}_{0.2}\text{MnO}_3$  (Ionic radius:  $\text{La}^{3+} = 1.216\text{\AA}$ ,  $\text{Ca}^{2+} = 1.18\text{\AA}$ ,  $\text{Sr}^{2+} = 1.32\text{\AA}$ ,  $\text{Mn}^{3+} = 0.645\text{\AA}$  and  $\text{O}^{2-} = 1.42\text{\AA}$ ) 05
- (c) Calculate the  $\langle r_A \rangle$ ,  $t$  and  $\sigma_A^2$  for  $\text{La}_{0.7}\text{Ca}_{0.3}\text{MnO}_3$  (Ionic radius:  $\text{La}^{3+} = 1.216\text{\AA}$ ,  $\text{Ca}^{2+} = 1.18\text{\AA}$ ,  $\text{Mn}^{3+} = 0.645\text{\AA}$  and  $\text{O}^{2-} = 1.42\text{\AA}$ ) 04
4. Answer any **two** of following questions: 14
- (a) Why there are so few multiferroics. Discuss the types of multiferroics. 07
- (b) Discuss magnetoelectric effect in multiferroics and multiferroicity in  $\text{YMnO}_3$ . 07
- (c) Explain in detail multiferroicity in  $\text{BiFeO}_3$ . 07
5. Answer any **two** of following questions: 14
- (a) Discuss the synthesis of YBCO and its structure - property correlations. 07
- (b) Explain the role of copper and oxygen in superconductivity in YBCO. 07
- (c) Discuss the structure, properties and applications of ferrites. 07
- (d) Discuss the zener double exchange mechanism and Jahn-Teller effect in manganites. 07
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