



**MBS-003-1534001** Seat No. \_\_\_\_\_

**M. Phil. (Physics) (Sem. II) (CBCS) Examination**

**April / May - 2018**

**Advances in Physics : Paper - II**

**Faculty Code : 003**

**Subject Code : 1534001**

Time :  $2\frac{1}{2}$  Hours]

[Total Marks : 100

- Instructions :**
- (1) All the five questions are compulsory.
  - (2) The numbers on the right margin indicate marks.

**1 Attempt any ten : 20**

- (a) Give a list of compounds exhibiting high- $T_c$  superconductivity. Which compound has the highest  $T_c$ ?
- (b) What is the crystal structure of  $YBa_2Cu_3O_{7-\delta}$ ?
- (c) What is meant by "hole filling" and "hole doping" in HTSC ?
- (d) Why do we need vacuum for thin film preparation ?
- (e) Write chemical formula for mineral spinel.
- (f) Calculate X-ray density of NaCl (its cell edge parameter is  $5.64 \text{ \AA}$  and  $MW = 58.5$ )
- (g) In a X-ray diffraction pattern recorded using X-ray wavelength  $\lambda = 1.5406 \text{ \AA}$  for a spinel ferrite having lattice constant  $a = 8.40 \text{ \AA}$ , calculate at what value of  $2\theta$  the (311) bragg reflection will occur ?
- (h) What do you understand by hydrostatic equilibrium ?
- (i) What are the various methods for growing a single crystal ?
- (j) What is mosbauer effect ?
- (k) What is chemical solution deposition technique ? What parameters decides the ultimate thickness of the film ?
- (l) What is "air-glow" phenomenon ?

- 2** Attempt any two :
- (a) Write a note on pulsed laser deposition technique for preparation of thin film. **10**
- (b) Write a detailed note on  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  high-Tc superconductor. **10**
- (c) For La-M-Cu-O superconducting system, explain using its structure, as to how the doping of divalent Ca, Sr or Ba ions at La-site results into creation of mobile holes ? **10**
- 3** (a) Explain spin polarized tunneling (SPT) and spin dependent scattering (SDS) in manganites. **10**
- (b) Explain in detail structure and morphology of CMR manganites. What do you understand by low and high field MR effect ? **10**
- OR**
- 3** (a) Discuss the sources and loss mechanisms of heat in the atmosphere, hence describe the thermal structure of the atmosphere and account for the diurnal temperature variation. **10**
- (b) What is ionosphere in earth upper atmosphere ? Discuss the structure and properties of ionosphere in detail. **10**
- 4** Attempt any two :
- (a) Describe giving a neat diagram the Bridgeman method of crystal growth. What different shapes of container can be used ? What are the reasons for popularity for this method ? In which way this technique is different from stockbarger's technique for crystal growth ? **10**
- (b) Write a detailed note on theory and applications of NLO materials. **10**
- (c) Describe "hydro-thermal" growth in detail stressing upon the type of materials for which this method is beneficial. Why do you need autoclave in this method ? **10**

- (a) Discuss in detail the ceramic technique for the preparation of spinel ferrites. Explain how nano-sized ferrite particles can be obtained ? Give a list of various chemical routes for the synthesis of nano-structured ferrites.
- (b) What are spinel ferrites ? Explain the spinel structure in brief. Why does net magnetic moment of  $\text{NiFe}_2\text{O}_4$  increase with replacement of magnetic ion  $\text{Ni}^{2+}$  by a non-magnetic ion  $\text{Zn}^{2+}$  in  $\text{Zn}_x\text{Ni}_{1-x}\text{Fe}_2\text{O}_4$  up to  $x=0.5$  ? What is Yafet-Kittel spin arrangement ?
- (c) What are the parameters that govern the intensity of X-ray diffraction Bragg line ? Define each parameter in detail.
- (d) Define hyperfine interaction parameters : isomer shift, quadrupole splitting and nuclear magnetic hyperfine field. Draw the block diagram of Mossbauer spectrometer and explain its operation.
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