

M.Phil. Science Examination

Paper-1

Physics

April 2019

Time : 2-30 Hours]

[Max. Marks : 70

Instructions:

- (1) Attempt All Questions.
- (2) All questions carry equal marks.
- (3) Symbols and terminology have their usual meanings.
- (4) Scientific calculator may be permitted

Q-1 (ai) Discuss in detail about citation in scientific publication (what are the sources that need to be cited? What are the advantages of citation indices? What are the major citation indexing services, What are the major criticisms on citation data bases?) 7

(aii) Describe impact factor of journals (How is it calculated? what are the major criticisms, mention different editorial policies that affect impact factor etc.) 7

OR

Q-1 (ai) Describe in detail about Google Scholar 7

(aii) Discuss in detail about various applications of internet with special reference to education 7

Q-1 (b) Attempt any FOUR. 04

Attempt **any four** from the following?

- i). Impact factor of the Journal Nature is between
 - a). <10
 - b). $10 - <20$
 - c). $20 < 30$
 - d). >30
- ii). If h-index of a scientist is 10, what does it mean?
- iii). Mention the two most important protocols used in internet
- iv). Expand the following DSL
- v). Expand the following JCR
- vi). Expand the following URL

Q-2 (ai) What is a research problem? What are the criteria of good research problem? 7

(aii) What are objectives of research? What are the problems encountered by researchers in India? 7

OR

Q-2 (ai) What are characteristics of good hypothesis? Explain Null Hypothesis with 7

examples.

- (aii) What are procedures employed for testing hypothesis? Explain in detail. 7
- Q-2 (b) Attempt any FOUR. 04
- 1 Define hypothesis.
 - 2 What is alternate hypothesis?
 - 3 Name two methods used to test hypothesis.
 - 4 Name different types of research.
 - 5 What is experimental group?
 - 6 What do you mean by Control Group?
- Q-3 (ai) Explain in detail about how to write the "Major Research Project proposal". 7
- (aii) Explain various types of writing references in scientific work. 7
- OR
- Q-3 (ai) Prepare a template for presenting a research work as a poster in a conference. 7
- (aii) Write a note on preparing a power point presentation of your research paper. 7
- Q-3 (b) Attempt any THREE. 03
- 1 What are advantages of Poster over Oral Presentation?
 - 2 Distinguish between references and bibliography.
 - 3 What is meant by ISBN?
 - 4 BRNS stands for?
 - 5 GUJCOST full form is -----.
- Q-4 (ai) List the general causes of fire in the laboratory. What are the different types of fire extinguishers commonly used? Discuss any one in detail. 7
- (aii) Define regression and state its significance. Where is it used? Explain with example. 7
- OR
- Q-4 (ai) Discuss the precautions to be taken for the safety against UV and electrical hazards in laboratory. 7
- (aii) What is meant by curve fitting? Discuss the method of least square fitting. 7
- Q-4 (b) Attempt any THREE. 03
- (i) What is meant by toxicity of chemicals?
 - (ii) What is the difference between accuracy and precision?
 - (iii) State the importance of distillation processes.
 - (iv) List the SI base units.

M.Phil. Science Examination

Paper-2

Physics

April 2019

Time : 2-30 Hours]

[Max. Marks : 70

INSTRUCTION:

1. Attempt all questions.
2. All questions have equal marks.
3. Symbols have their usual meaning.

- Q.1(A) i. Discuss structural and Magnetic properties nanoparticles. [07]
 ii Describe working and construction of STM and write advantages. [07]
- OR
- Q.1(A) i. Discuss chemical and electrical and properties of nanomaterials. [07]
 ii Discuss principle and working of STM. List limitation and advantages of STM. [07]
- Q.1(B) **Write Short Answers (Any Four)** [04]
1. Write Hamiltonian for Mott-Wannier excitation for semiconductor nanoparticles.
 2. Write two applications of TEM.
 3. Write two disadvantages of TEM.
 4. List various modes of AFM
 5. Write one application of 'EDAX'
 6. List two limitations of AFM.
- Q.2(A) i. With neat diagrams, explain the working of diffusion vacuum pump. [07]
 ii Name different vacuum gauges. Explain pirani gauge. State its merits and demerits [07]
- OR
- Q.2(A) i. Define transducer. Explain piezoelectric transducer and state its applications. [07]
 ii Explain thermistor as temperature transducer. Compare it with RTD transducer [07]
- Q.2(B) **Write Short Answers (Any Four)** [04]
1. State the range of UHV.
 2. Define sensitivity of a transducer.
 3. State two applications of capacitor transducer.
 4. What is the range of vacuum a penning gauge can measure ?
 5. Draw the output graph of a typical LVDT.
 6. State the difference between Pirani and Penning gauge in terms of vacuum.

P.T. 0

- Q.3(A) i. Define vacuum. Discuss e-beam evaporation method in detail. [07]
 ii Differentiate between thin and thick film and explain thermal evaporation method in detail. [07]

OR

- Q.3(A) i. Explain Chemical Vapour Deposition method in detail. [07]
 ii State types of sputtering and discuss any one of them in detail. [07]

Q.3(B) **Write Short Answers(any Three)** [03]

1. State the different types of PVD method.
2. Write names of thin film growth stages.
3. What do you mean by sputtering yield?
4. State the difference between the DC and RF sputtering.
5. What is the range of very high vacuum?

- Q.4(A) i. State the principle of X-ray diffraction (XRD). Explain grazing incidence XRD. [07]

- ii Discuss X-ray photoelectron spectroscopy (XPS) technique. [07]

OR

- Q.4(A) i. Using schematic diagram explain scanning electron microscope (SEM). [07]

- ii Explain Van der Pauw technique of sheet resistivity measurement. [07]

Q.4(B) **Write Short Answers(any Three)** [03]

1. Give schematic of interaction of electron beam with matter.
2. State the limitation of two probe method of sheet resistivity measurement.
3. State the advantages and disadvantages of EDAX method.
4. Why X-rays are used for crystallographic diffraction?
5. Differentiate between LEED and RHEED techniques.

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M.Phil. Science Examination

Paper 3 : Physics 603

(Condensed Matter Physics)

Time : 2-30 Hours]

April 2019

[Max. Marks : 70

- Instructions :**
- (1) Attempt all questions.
 - (2) All questions carry equal marks.
 - (3) Symbols and terminology have their usual meanings.
 - (4) Scientific calculator may be permitted.
- Q-1(A) (i) How Fermi surface in crystalline solids is constructed by Harrison's method? Discuss briefly. **07**
- (ii) What do you mean by LCAO? Write brief note on VASP by covering its applications, utilities and usefulness. **07**
- OR
- Q-1(A) (i) Explain in brief tight binding method of calculating the electronic energy bands in solid. **07**
- (ii) What is density functional theory? Discuss Quantum Espresso briefly. **07**
- Q-1(B) Write any FOUR out of SIX **04**
- (i) Write applications of Wein 2K.
 - (ii) Define first Brillouin Zone.
 - (iii) $1\text{eV} = \text{_____ Ryd.}$
 - (iv) Give physical interpretation of the Fermi surface.
 - (v) State applications of Gaussian.
 - (vi) What is meant by jellium model?
- Q-2 (A) (i) Write the Schrödinger equation for conduction electron. How wave function ψ_k can be written using orthogonalized plane wave method. Show that OPW_k is orthogonal to core state. Using ψ_k , derive form of the pseudo-wave function $\psi_k = (1 - \hat{P}) \phi_k$. **07**
- (ii) State the peculiarities of pseudopotential and discuss three basic approximations to find out solution of wave equation. **07**
- OR
- Q-2 (A) (i) Find probability of transition per unit time by solving time dependent Schrödinger equation. **07**
- (ii) Write Schrödinger equation with pseudopotential W . Using perturbation method, find the solution. Find first order correction to the energy $E^1(k)$. **07**
- Q-2(B) Write any FOUR out of SIX **04**
- (i) State difference between local and non-local pseudopotential.
 - (ii) Normalized plane wave $|k + q\rangle$.
 - (iii) State cancellation theorem.
 - (iv) What are the limitations of cellular method?
 - (v) Define projector operator.
 - (vi) Which physical quantities are represented by index α in the core state ψ_α ?
- Q-3 (A) (i) State the name of the indenters and explain any one of microhardness indenter. **07**
- (ii) Explain mechanical creep in detail. **07**
- OR
- Q-3 (A) (i) How hardness value changes in annealing with respect to As-cleaved material? Why? Write your comment. **07**

- (ii) State Meyer's law and discuss anisotropy of material in detail with necessary example. 07
- Q-3(B) Write any THREE out of FIVE 03
- (i) Define hardness.
- (ii) What is the load range of microhardness?
- (iii) Define Meyer's index.
- (iv) What do you mean by cold-working of material?
- (v) What type of information received from anisotropy of the material?
- Q-4 (A) (i) Describe solid state reaction method to prepare to prepare materials. 07
- (ii) Describe sol-gel method to prepare materials. Write two advantages of sol-gel method. 07
- OR
- Q-4 (A) (i) What is TGA? Draw schematic thermogram of single step decomposition reaction. Discuss working function of it. 07
- (ii) Draw a block diagram of an FTIR spectrometer. Describe working function. Write advantages and disadvantages. 07
- Q-4(B) Write any THREE out of FIVE 03
- (i) Write two disadvantages of solid state reaction?
- (ii) Write two limitations of co-precipitation technique?
- (iii) List two applications of DTA.
- (iv) What is DSC?
- (v) Write two applications of FTIR.