



**Q.2 Answer the following. (Any Six)**

- a) Find the pole  $f(z) = \sin\left(\frac{1}{z-a}\right)$
- b) What are the conditions for a matrix to be orthogonal matrix?
- c) Solve  $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} = 9y = 0$
- d) Find the Laplace transform of the function  

$$f(t) = te^{-t} \sin 2t$$
- e) Find the pole of  $f(z) = \frac{\sin(z-a)}{(z-a)^4}$
- f) Show that inverse of an orthogonal matrix is orthogonal.
- g) Solve  $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$
- h) Define singular point, explain in details its types with example.

**Q.3 Answer the following. (Any Three)**

12

- a) Discuss in details Cauchy's Integral Formula.
- b) State and prove the Parseval's Theorem.
- c) Show that the eigen value of Hermitian matrix are real.
- d) Find the Fourier Transform of  $e^{-ax^2}$  where  $a > 0$

**Q.4 Answer the following. (Any Two)**

12

- a) Write matrix  $A$  gives below as the sum of symmetric & a skew symmetric matrix.

$$A = \begin{pmatrix} 1 & 2 & 4 \\ -2 & 5 & 3 \\ -1 & 6 & 3 \end{pmatrix}$$

- b) In square wave expand the function  
 $f(x) = 0; -\pi \leq x \leq 0$   
 $f(x) = h; 0 \leq x \leq \pi$  fourier
- c) Evaluate the following integral using residue Theorem.  
 $\int_c \frac{1+z}{z(2-z)} dz$  where  $c$  is circle  $|z| = 1$

**Q.5 Answer the following. (Any Two)**

12

- a) Evaluate  $\int_0^\infty \frac{\cos 3\theta}{5+4\cos\theta} d\theta$
- b) Solve;  $x \frac{dy}{dx} + y \log y = xy e^x$
- c) Solve the differential equation.  
 $y \log y dx + (x - \log y) dy = 0$

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**M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Solid State Physics (2321102)**

Day & Date: Sunday, 07-01-2024  
 Time: 03:00 PM To 05:30 PM

Max. Marks: 60

**Instructions:** 1) All questions are compulsory.  
 2) The figure to right indicate full marks.

**Q.1 A) Choose the correct alternative. 08**

- 1) Conductivity of metals depends upon \_\_\_\_\_.
  - a) The nature of the material
  - b) Number of free electrons
  - c) Resistance of the metal
  - d) Number of electrons
- 2) At what temperature does ferromagnetic material become paramagnetic?
  - a) Melting
  - b) Curie
  - c) Neel
  - d) None of these
- 3) Which of the following is a strong magnet?
  - a) Diamagnetic material
  - b) Paramagnetic material
  - c) Antiferromagnetic material
  - d) Ferromagnetic material
- 4) Electronic polarization also known as \_\_\_\_\_.
  - a) molecular polarization
  - b) magnetic polarization
  - c) atomic polarization
  - d) orientation polarization
- 5) What is the phenomenon where a material exhibits zero electrical resistance below a certain critical temperature?
  - a) Superconductivity
  - b) Conductivity
  - c) Resistance
  - d) Insulation
- 6) For which of the following is magnetic susceptibility negative?
  - a) Paramagnetic Materials only
  - b) Ferromagnetic Materials only
  - c) Diamagnetic Materials
  - d) none of the above
- 7) The sprinkling of water reduces slightly the temperature of a closed room because
  - a) Water is a bad conductor of heat
  - b) Water has a large latent heat of vaporization
  - c) The temperature of the water is less than the room
  - d) None of the above
- 8) Which of the following is a property of a superconductor?
  - a) Perfect diamagnetism
  - b) High electrical resistance
  - c) Low electrical conductivity
  - d) Non-zero resistivity

**B) Fill in the blanks OR write true / false. 04**

- 1) The SI unit of magnetic field intensity is \_\_\_\_\_.
- 2) The magnetization 'M' of a superconductor in a field is \_\_\_\_\_.
- 3) When a paramagnetic material is heated above Curie temperature it becomes non-magnetic.
- 4) The temperature above which an antiferromagnetic material becomes paramagnetic is called the melting temperature.

**Q.2 Answer the following. (Any Six). 12**

- a) What is Curie Temperature?
- b) Define diamagnetic materials.
- c) Define specific heat.
- d) What is orientational polarization?
- e) What is an extrinsic semiconductor?
- f) What is penetration depth?
- g) State the concept of ferroelectricity.
- h) Define Neel temperature.

**Q.3 Answer the following (Any Three) 12**

- a) Explain in Brillouin zones in 2-D.
- b) Write about the direct and indirect band gap of semiconductors.
- c) Explain Meissner's effect.
- d) Write a note on the conductivity of solids.

**Q.4 Answer the following (Any Two) 12**

- a) Electronic polarization
- b) Explain the Kronig-Penny model.
- c) Explain the thermodynamics of superconductors.

**Q.5 Answer the following (Any Two) 12**

- a) Write the difference between metal, semiconductors and insulators.
- b) Write a note on Josephson's tunnelling and its theory.
- c) Explain the Clausius-Mossotti equation

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**M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Analog and Digital Electronics (231106)**

Day & Date: Tuesday, 09-01-2024  
 Time: 03:00 PM To 05:30 PM

Max. Marks: 60

**Instructions:** 1) All Questions are compulsory.  
 2) Figure to right indicate full marks.

**Q.1 A) Choose correct alternative. (MCQ)**

**08**

- 1) The feedback path in an op-amp integrator consists of \_\_\_\_\_.
  - a) A resistor
  - b) A capacitor
  - c) A resistor and capacitor in series
  - d) A resistor and capacitor in parallel
- 2) Multiplexer has \_\_\_\_\_.
  - a) Many input and one output
  - b) One input many output
  - c) Many input and many out put
  - d) One input and one output
- 3) Op- amp is a \_\_\_\_\_ type of amplifier.
 

a) Current	b) Voltage
c) Power	d) Resistance
- 4) The op-amp comparator circuit uses \_\_\_\_\_.
 

a) Positive feedback	b) Negative feedback
c) Regenerative feedback	d) No feedback
- 5) Find the output of inverting amplifier?
 

a) $V_o = AV_{in}$	b) $V_o = -AV_{in}$
c) $V_o = -A(V_{in1}-V_{in2})$	d) None of the mentioned
- 6) What happen if any positive input signal is applied to open-loop configuration?
  - a) Output reaches saturation level
  - b) Output voltage swing's peak to peak
  - c) Output will be a sine waveform
  - d) Output will be a non-sinusoidal waveform
- 7) In 8085 microprocessor, how many interrupts are maskable \_\_\_\_\_.
 

a) Two	b) Three
c) Four	d) Five
- 8) In how many different modes a universal shift register operates \_\_\_\_\_.
 

a) 2	b) 3
c) 4	d) 5

**B) Fill in the blanks OR Write True /False.**

**04**

- 1) The data in stack is called \_\_\_\_\_.
- 2) \_\_\_\_\_ Circuit is used as signal source in all sort of application.
- 3) \_\_\_\_\_ bit program counter is available in 8085.
- 4) The voltage gain of a voltage buffer is \_\_\_\_\_.

- Q.2 Answer the following. (Any Six) 12**
- a) Define Input offset voltage.
  - b) Draw AND gate with truth table.
  - c) What is the function of IO/M signal in the 8085?
  - d) What is differential amplifier.
  - e) What is dynamic shift register.
  - f) Why op-amp called direct coupled high differential circuit.
  - g) What is microprocessor? Give the power supply & clock frequency of 8085.
  - h) Define CMRR frequency response.
- Q.3 Answer the following. (Any Three) 12**
- a) Explain the timing diagram of 8085.
  - b) Explain Multiplexers and Demultiplexers.
  - c) Write a note on RS flip flop and JK flip flop.
  - d) Explain Inverting and Non inverting amplifier.
- Q.4 Answer the following. (Any Two) 12**
- a) Define Oscillators? Explain their types.
  - b) Write a note on 8085 instruction set.
  - c) Explain in details of instrumentation amplifier.
- Q.5 Answer the following. (Any Two) 12**
- a) Discuss Synchronous and Asynchronous counter.
  - b) Draw and explain 8:1 Multiplexers.
  - c) What is multivibrator? Explain the difference between the three types of multivibrators.

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**M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Research Methodology in Physics (2321105)**

Day & Date: Thursday, 11-01-2024  
 Time: 03:00 PM To 05:30 PM

Max. Marks: 60

**Instructions:** 1) All questions are compulsory.  
 2) Figure to right indicate full marks.

**Q.1 A) Choose the correct alternatives from the options.**

**08**

- 1) A researcher is generally expected to \_\_\_\_\_.
  - a) Study of existing literature in afield
  - b) Generate new principle and theories
  - c) Synthesis the ideas given by others
  - d) Evaluate the finding of a study
- 2) Oxides and Nitrides can be applied by \_\_\_\_\_ evaporation.
  - a) E-beam
  - b) Thermal
  - c) Magnetron
  - d) DC
- 3) Tuning of the refractive index with the density of the films is possible by sputtering.
  - a) Magnetron
  - b) DC
  - c) Ion beam
  - d) RF
- 4) The main problem in questionnaire is \_\_\_\_\_.
  - a) Accessible to Diverse Respondent
  - b) Greater Anonymity
  - c) Shows an inability of respondent to provide information
  - d) None of these
- 5) UV-Vis spectroscopy cannot analyze compounds that \_\_\_\_\_ with light.
  - a) don't interact
  - b) interact
  - c) merge
  - d) none of the above
- 6) Technique that allow several members of a hiring company to interview a job candidate at the same time is \_\_\_\_\_.
  - a) Panel Interview
  - b) Self-administered interview
  - c) Mail Interview
  - d) Electronic Interview
- 7) The most common scales used in research are \_\_\_\_\_.
  - a) Nominal
  - b) Ratio
  - c) Ordinal
  - d) All of the above
- 8) By selecting laser operating conditions, control over microstructure is \_\_\_\_\_.
  - a) possible
  - b) impossible
  - c) not defined
  - d) both a) and b)

- B) Fill in the blanks OR Write True or False: 04**
- 1) In E-beam evaporation, only the target is heated and not the crucible. (True/False)
  - 2) In thermal evaporation, films in the thickness range of angstroms to microns are obtained. (True/False)
  - 3) Applied research is conducted to solve practical problems. (True/False)
  - 4) The basic research is also called as fundamental research. (True/False)
- Q.2 Answer the following. (Any Six) 12**
- a) State the various sampling methods.
  - b) Write the applications of Pulsed Laser Deposition.
  - c) What are the applications of UV-Vis Spectroscopy?
  - d) What are patents?
  - e) Define Quantitative research method.
  - f) Define physical and chemical vapour deposition.
  - g) Write primary literature review sources.
  - h) What are the applications of FTIR Spectroscopy.
- Q.3 Answer the following. (Any three) 12**
- a) Write a note on Descriptive Vs Analytical research methods.
  - b) Differentiate between SEM and TEM techniques.
  - c) Write a note on web as source.
  - d) Write the basic mechanism of sputtering technique.
- Q.4 Answer the following. (Any two) 12**
- a) Define Research? What are characteristics of Research.
  - b) Discuss different type of Research.
  - c) Write a note on Review of Literature.
- Q.5 Answer the following. (Any two) 12**
- a) What is Research Design? What are its essentials
  - b) Write in detail about the concept of Chemical Bath Deposition.
  - c) Explain in detail about Spray Pyrolysis.



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Set **P**

**M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Mathematical Physics (MSC03101)**

Day & Date: Friday, 05-01-2024  
 Time: 03:00 AM To 06:00 PM

Max. Marks: 80

**Instructions:** 1) All questions are compulsory.  
 2) Figures to the right indicate full marks.

**Q.1 A) Choose correct alternative.****10**

- 1) The product of a singular matrix with its adjoint is \_\_\_\_\_.  
 a) a unit matrix                      b) a null matrix  
 c) an orthogonal matrix              d) Square matrix
- 2) What is the value of  $a_0$  in the Fourier series of  $t^2$  in the interval  $-\pi < t < \pi$ ?  
 a) 0    b)  $\pi^2/3$   
 c)  $\pi^2/8$                                         d)  $\pi^2/4$
- 3) If A and B are orthogonal matrices, then the product AB is \_\_\_\_\_.  
 a) symmetric                                b) antisymmetric  
 c) orthogonal                                d) unitary
- 4) Evaluate the integral  $\int_0^{2\pi} \frac{\sin^2\theta}{5 + 4\cos\theta} d\theta$   
 a)  $2\pi$     b)  $\pi$   
 c)  $\pi/2$     d)  $\pi/4$
- 5) The value of  $\int_{-\pi}^{\pi} \cos(mx) \sin(nx) dx =$   
 a) 1    b) -1  
 c) 0    d)  $\pi$
- 6) If  $|z^2 - 1| = |z^2| + 1$  then  $z$  lies on \_\_\_\_\_.  
 a) the real axis                                b) the imaginary axis  
 c) a circle                                        d) on ellipse
- 7) Find the pole of  $f(z) = \sin \frac{1}{(z-a)}$  = \_\_\_\_\_.  
 a)  $z = a$                                         b)  $z = 0$   
 c)  $z = 1$                                         d)  $z = 4$
- 8) In Cauchy's Residues theorem  $\oint_{\Gamma} f(z) dz =$  \_\_\_\_\_.  
 a)  $2\pi i \sum_{j=1}^n a_{-1} z_j$                       b)  $2\pi i$   
 c)  $2\pi i \sum_{j=1}^n a_{+1} z_j$                       d)  $2\pi i \sum_{j=1}^n z_j$

9) \_\_\_\_\_ is the real part (Re Z) & \_\_\_\_\_ is the imaginary (Im Z), of the given  $z = (1 + i)/(2 - 3i)$ .

a)  $-\frac{1}{13}$  &  $\frac{5}{13}$

b)  $-\frac{1}{11}$  &  $\frac{4}{13}$

c)  $\frac{1}{3}$  &  $-\frac{5}{13}$

d)  $\frac{1}{09}$  &  $\frac{5}{13}$

10) Legendre polynomial is a set of \_\_\_\_\_ function.

a) orthogonal

b) odd

c) even

d) real

**B) Fill in the blanks OR write true/false.**

**06**

- a) A necessary and sufficient condition that solution  $y_1$  and  $y_2$  of  $y'' + p(x)y' + q(x)y = 0$  is linearly independent is that the Wronskian is zero. (True/False)
- b) Fourier series can be used to represent discontinuous where all orders of derivatives need not exist. (True/False)
- c) The Fourier transform operator is unitary.
- d) The first order ODE can never be linear separable and exact at the same time. (True/False)
- e) A Fourier transform is a linear operator. (True/False)
- f) A square matrix is called orthogonal if  $A = A^{-1}$ . (True/False)

**Q.2 Answer the following.**

**16**

- a) If A and B are two orthogonal matrices, show that AB is also orthogonal matrix.
- b) Find the Laplace transform of  $\frac{s^2 - a^2}{(s^2 + a^2)^2}$
- c) Find the residue of  $\frac{1}{(z^2 + 1)^3}$  at  $z = i$
- d) Solve  $y e^y dx = (y^3 + 2xe^y) dy$

**Q.3 Answer the following.**

a) Solve  $x \frac{dy}{dx} + y \log y = xye^x$

**08**

b) Find the eigen value of a matrix  $\begin{bmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 0 & 0 & 1 \end{bmatrix}$

**08**

**Q.4 Answer the following.**

a) Determine the value of  $\alpha, \beta, r$  when  $\begin{bmatrix} 0 & 2\beta & r \\ \alpha & \beta & -r \\ \alpha & -\beta & r \end{bmatrix}$  is orthogonal.

**08**

b) Determine the poles of the function  $z, f(z) = \frac{1}{z^4 + 1}$

**08**

**Q.5 Answer the following.**

a) Solve  $\sin x \frac{dy}{dx} + 2y = \tan^3\left(\frac{x}{2}\right)$  08

b) Verify Cayley - Hamilton Theorem for the following matrix. 08

$$A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix} \text{ and use the theorem to find } A^{-1}$$

**Q.6 Answer the following.**

a) Find the order of each pole and residue of  $\frac{1 - 2z}{z(z - 1)(z - 2)}$  08

b) Show that the eigen value of Hermitian matrix are real. 08

**Q.7 Answer the following.**

a) In square wave expand the function. 08

$$f(x) = 0; -\pi \leq x \leq 0$$

$$f(x) = 4; -0 \leq x \leq \pi \text{ Fourier.}$$

b) Explain Laplace transform of Derivatives. 08

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**M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Solid State Physics (MSC03102)**

Day & Date: Sunday, 07-01-2024  
 Time: 03:00 PM To 06:00 PM

Max. Marks: 80

- Instructions:** 1) Q. Nos. 1 and. 2 are compulsory.  
 2) Attempt any three questions from Q. No. 3 to Q. No. 7  
 3) Figure to right indicate full marks.

**Q.1 A) Choose the correct alternative. 10**

- 1) Effective mass is equal to \_\_\_\_\_ mass for free electron.
  - a) Mean
  - b) real
  - c) Residual
  - d) zero
- 2) Elemental solid dielectric has only \_\_\_\_\_ polarization.
  - a) Electronic
  - b) ionic
  - c) orientational
  - d) all
- 3) In the case of p-type semiconductors, the Fermi level lies at \_\_\_\_\_.
  - a) Below near to conductor band
  - b) Above near to valence band
  - c) Below near to valence band
  - d) At the middle of the valence and conduction band
- 4) In the case of superconductor, at  $T_c$  conductance becomes \_\_\_\_\_.
  - a) Zero
  - b) Finite
  - c) Infinite
  - d) None of the above
- 5) \_\_\_\_\_ has a positive temperature coefficient of resistance.
  - a) Metal
  - b) Semiconductor
  - c) Insulator
  - d) Dielectric
- 6) The coordination number of HCP is \_\_\_\_\_.
  - a) Two
  - b) Four
  - c) Six
  - d) Twelve
- 7) Plane cut to negative x-axis have the miller indices \_\_\_\_\_.
  - a) (011)
  - b) (001)
  - c) (110)
  - d) (-100)
- 8) The zone lies in between  $+\pi/2$  to  $-\pi/2$  is the \_\_\_\_\_ Brillion zone.
  - a) 1<sup>st</sup>
  - b) 2<sup>nd</sup>
  - c) 3<sup>rd</sup>
  - d) 0<sup>th</sup>
- 9) Relative permittivity ( $\epsilon_r$ ) of the air is \_\_\_\_\_.
  - a) 2
  - b) 0.5
  - c) 1
  - d) 0
- 10) Intrinsic concentration of charge carriers in a semiconductor varies as \_\_\_\_\_.
  - a) T
  - b) T<sup>2</sup>
  - c) T<sup>3</sup>
  - d) 1/T

- B) Fill in the blanks OR Write True or False** **06**
- 1) Some conductors are \_\_\_\_\_ below critical temperature.
  - 2) FCC structure contains the contribution of \_\_\_\_\_ atoms.
  - 3) The packing fraction of the BCC structure is 74%. (T/F)
  - 4) NaCl shows orientation polarization. (T/F)
  - 5) Diamond is a conductor. (T/F)
  - 6) The addition of pentavalent impurity creates an n-type semiconductor. (T/F)
- Q.2 Answer the following (any four)** **16**
- a) Write about orientational polarization.
  - b) Explain Meissner's effect.
  - c) Derive the rectifier equation
  - d) Show that in the case of an intrinsic semiconductor  $E_f = (E_c + E_v)/2$
  - e) Write a note on dielectric Breakdown.
- Q.3 Answer the following**
- a) What is meant by imperfections in crystals? Explain the various defects in the crystal. **10**
  - b) Explain BCC and FCC Crystal structures. **06**
- Q.4 Answer the following**
- a) Discuss the BCS theory in detail. **10**
  - b) Write a note on the types of superconductors **06**
- Q.5 Answer the following**
- a) Write about the London equation. **08**
  - b) Write the expression for penetration depth. **08**
- Q.6 Answer the following**
- a) Write about Reciprocal Lattice. **10**
  - b) Explain DC Josephson's effect. **06**
- Q.7 Answer the following**
- a) Explain the Kronig-Penney model. **10**
  - b) Give the expression for electronic polarizability. **06**

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**M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Analog and Digital Electronics (MSC10103)**

Day & Date: Tuesday, 09-01-2024  
 Time: 03:00 PM To 06:00 PM

Max. Marks: 80

- Instructions:** 1) All questions are compulsory.  
 2) Attempt any three questions from Q.3 to Q.7.  
 3) Figure to right indicate full marks.

**Q.1 A) Choose correct alternative. (MCQ)**

**10**

- 1) The basic SR flip-flop can be constructed by cross coupling by using which of the gates?
  - a) AND or OR gate
  - b) XOR or XNOR gate
  - c) NOR or NAND gate
  - d) AND or NOR gate
- 2) In JK flip-flop "no change" condition appear when \_\_\_\_\_
  - a)  $J = 1, K = 1$
  - b)  $J = 0, K = 0$
  - c)  $J = 1, K = 0$
  - d)  $J = 0, K = 1$
- 3) Which is the 16-bit register for 8085 microprocessor?
  - a) Stack pointer
  - b) Accumulator
  - c) Register B
  - d) Register C
- 4) The feedback path in an op-amp integrator consists of \_\_\_\_\_.
  - a) A resistor
  - b) A capacitor
  - c) A resistor and capacitor in series
  - d) A resistor and capacitor in parallel
- 5) Multiplexer has \_\_\_\_\_
  - a) Many input and one output
  - b) One input many output
  - c) Many input and many out put
  - d) One input and one output
- 6) The op-amp comparator circuit uses \_\_\_\_\_
  - a) Positive feedback
  - b) Negative feedback
  - c) Regenerative feedback
  - d) No feedback
- 7) Op- amp is a type of amplifier \_\_\_\_\_
  - a) Current
  - b) Voltage
  - c) Power
  - d) Resistance
- 8) An XOR gate can be used for \_\_\_\_\_
  - a) Inverter and non-inverter
  - b) Only inverter
  - c) Only non-inverter
  - d) None of the above

- 9) Which of the following addressing method does the instruction, MOV AX,[BX] represent?
  - a) register indirect addressing mode
  - b) direct addressing mode
  - c) register addressing mode
  - d) register relative addressing mode
- 10) Which of the following is a property of RST 7.5 interrupt?
  - a) It is a non-maskable interrupt
  - b) It has 3<sup>rd</sup> highest priority
  - c) It uses level-triggered signal
  - d) Its vectored address is 003C H

**B) Fill in the blanks**

**06**

- 1) In an instrumentation amplifier, the output voltage is based on the \_\_\_\_\_ times a scale factor.
- 2) The output voltage of a voltage buffer is \_\_\_\_\_ with the input voltage.
- 3) The voltage gain of a voltage buffer is \_\_\_\_\_.
- 4) The data in stack is called \_\_\_\_\_.
- 5) The sequential circuit is also called \_\_\_\_\_.
- 6) There are \_\_\_\_\_ general purpose registers in 8085 microprocessor.

**Q.2 Answer the following**

**16**

- a) Define
  - i) Input offset voltage
  - ii) Voltage follower
- b) Draw AND gate and NOT gate with truth table.
- c) What is microprocessor? Give the power supply & clock frequency of 8085 and List the allowed register pairs of 8085.
- d) Write a note on Demorgan's Theorem.

**Q.3 Answer the following.**

- a) Draw and explain architecture of 8085 microprocessor.
- b) Explain Multiplexers and Demultiplexers.

**10**

**06**

**Q.4 Answer the following.**

- a) What is multivibrator? Explain the difference between the three types of multivibrators.
- b) Draw and explain 8:1 Multiplexers.

**10**

**06**

**Q.5 Answer the following.**

- a) Explain the operation of three op-amp instrumentation amplifier.
- b) Define Oscillators? Explain their types.

**10**

**06**

**Q.6 Answer the following.**

- a) Explain inverting configuration of Op amp as a summing, scaling and averaging Amplifier.
- b) Explain Inverting and Non inverting amplifier.

**10**

**06**

**Q.7 Answer the following.**

- a) Explain the instruction set of 8085 microprocessor.
- b) Draw and explain memory read cycle of 8085 microprocessor.

**10**

**06**

Seat  
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**M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Classical Mechanics (MSC03108)**

Day & Date: Thursday, 11-01-2024  
 Time: 03:00 PM To 06:00 PM

Max. Marks: 80

- Instructions:** 1) Q. Nos. 1 and. 2 are compulsory.  
 2) Attempt any three questions from Q. No. 3 to Q. No. 7  
 3) Figure to right indicate full marks.

**Q.1 A) Choose correct alternative. 10**

- 1) The position of a particle at any time  $t$  subjected to resistive force is \_\_\_\_\_.
  - a)  $x = k.(1 + e^{-kt})/v_0$
  - b)  $x = kv_0(1 - e^{-kt})$
  - c)  $x = v_0(1 - e^{-kt})/k$
  - d)  $x = kv_0(1 + e^{-kt})$
- 2) The rate of momentum change of an open system is equal to \_\_\_\_\_.
  - a)  $T + MU$
  - b)  $F - MV$
  - c)  $W - MV$
  - d)  $F + MU$
- 3) The reduced mass of two bodies into equivalent one body is \_\_\_\_\_.
  - a)  $(m_1 + m_2)/(m_1.m_2)$
  - b)  $(m_1.m_2)/(m_1 - m_2)$
  - c)  $m_2/(1 + m_2/m_1)$
  - d)  $m_1/(1 + m_2/m_1)$
- 4) The time derivative of generalized co-ordinate is \_\_\_\_\_.
  - a) Generalized force
  - b) Generalized velocity
  - c) Generalized momentum
  - d) None of these
- 5) For  $E > 0$  and  $\varepsilon > 1$ , the nature of the orbit is \_\_\_\_\_.
  - a) Circle
  - b) Parabola
  - c) Ellipse
  - d) Hyperbola
- 6) The generalized momentum is equal to \_\_\_\_\_.
  - a)  $\partial L/\partial q_j$
  - b)  $\partial L/\partial \dot{p}_j$
  - c)  $\partial L/\partial \dot{q}_j$
  - d)  $\partial L/\partial p_j$
- 7) Which of the following defines a conservative force  $F$ ?
  - a)  $dF/dt = 0$
  - b)  $\nabla.F = 0$
  - c)  $\nabla \times F = 0$
  - d)  $\oint F.dr = 0$
- 8) Poisson brackets are \_\_\_\_\_ under canonical transformation.
  - a) Variant
  - b) nullified
  - c) anti-symmetric
  - d) invariant
- 9) Generalized coordinated \_\_\_\_\_.
  - a) are independent of each other
  - b) depend on each other
  - c) are always cartesian coordinates
  - d) are always spherical polar coordinates
- 10) The  $F_2 = \sum q_k P_k$  transformation defined as \_\_\_\_\_.
  - a) generates exchange transformation
  - b) generates identity transformation
  - c) is not canonical transformation
  - d) None of the above



**B) Fill in the blanks or write true /false. 06**

- 1) Scleronomic constraint do not explicitly depends on time. (True/False)
- 2)  $q_j$ 's which are absent in  $L$  are cyclic coordinates. (True/False)
- 3) Rutherford's differentia scattering cross section has dimensions of solid angle. (True/False)
- 4) The Euler-Lagrangian differential equations is \_\_\_\_\_.
- 5) Lagrangian is equal to \_\_\_\_\_.
- 6)  $[L_x, L_y] =$  \_\_\_\_\_.

**Q.2 Answer the following questions. 16**

- a) Which conditions are used to verify that the transformation is canonical? Prove any one condition.
- b) Prove that forces acting on a particle are conservative then the total energy  $E$  of a particle is conserved.
- c) Distinguish between the configuration space and phase space.
- d) Define Hamiltonian. Give its physical significance.

**Q.3 Answer the following.**

- a) Derive the equation of motion of a particle and deduce the acceleration of Atwood machine under constant force. 10
- b) Obtain the equation of motion of 06
  - 1) a particle subjected to a resistive force
  - 2) a projectile (no resistance)

**Q.4 Answer the following.**

- a) Derive the formula for Rutherford scattering cross-section. 10
- b) Derive an equivalent equation for reduction to one body problem from two body problem. 06

**Q.5 Answer the following.**

- a) State the Kepler's laws of planetary motion and prove the Kepler's third law. 10
- b) Deduce the Lagrange's equation of motion from Hamilton's principle and using derive the generalized momentum. 06

**Q.6 Answer the following.**

- a) Derive canonical equations of Hamilton. Also write the procedure for constructing Hamiltonian. 10
- b) Obtain Hamilton's equation for one dimensional harmonic oscillator. 06

**Q.7 Answer the following.**

- a) State and prove Poisson's theorem. 10
- b) Prove the Jacobi identity  $[V, [V, W]] + [V, [W, U]] + [W, [U, V]] = 0$  06

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**M.Sc. (Semester - II) (New) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Quantum Mechanics (MSC03201)**

Day & Date: Monday, 18-12-2023  
 Time: 11:00 AM To 02:00 PM

Max. Marks: 80

- Instructions:** 1) Q. Nos. 1 and. 2 are compulsory.  
 2) Attempt any three questions from Q. No. 3 to Q. No. 7  
 3) Figure to right indicate full marks.

**Q.1 A) Fill in the blanks by choosing correct alternative. 10**

- 1) If  $\Psi_a$  and  $\Psi_b$  are said to be orthogonal to each other, then which of the following is true.
  - a)  $\langle \Psi_a | \Psi_b \rangle = 1$
  - b)  $\langle \Psi_a | \Psi_b \rangle = \infty$
  - c)  $\langle \Psi_a | \Psi_b \rangle = \sqrt{1/2}$
  - d)  $\langle \Psi_a | \Psi_b \rangle = 0$
- 2) If two operators do not commute with each other, then which of following statement is true.
  - a) They do not share common eigenfunction.
  - b) They do share common eigenfunction.
  - c) Their eigenvalues are same.
  - d) They must anti-commute.
- 3) The minimum energy of particle confined to one dimensional rigid box is obtained by substituting  $n$  equal to \_\_\_\_\_.
  - a) one
  - b) zero
  - c) half
  - d) two
- 4) The total energy operator or Hamiltonian operator is given by  $H^\wedge =$  \_\_\_\_\_.
  - a)  $\hat{p}^2/2m$
  - b)  $V(x)$
  - c)  $(\hat{p}^2/2m) + V(x)$
  - d)  $(\hat{p}^2/2m) - V(x)$
- 5) Energy of harmonic oscillator is,  $E =$  \_\_\_\_\_.
  - a)  $n\hbar\omega$
  - b)  $(1/2)\hbar\omega$
  - c)  $(n + 1/2)\hbar\omega$
  - d)  $(n - 1/2)\hbar\omega$
- 6) The eigen value of  $L^2$  is \_\_\_\_\_.
  - a)  $l(l + 1)\hbar^2$
  - b)  $l(l - 1)\hbar$
  - c)  $l(l^2 + 1)\hbar^2$
  - d)  $l(l + 1)\hbar$
- 7) Which of the following is lowering operator \_\_\_\_\_.
  - a)  $L_x + iL_y$
  - b)  $L_x - L_y$
  - c)  $L_x - iL_y$
  - d) 0
- 8) The commutation relation between  $[x, P_x]$  and  $(\partial/\partial x, x)$  is \_\_\_\_\_.
  - a)  $i\hbar, 0$
  - b)  $0, i\hbar$
  - c)  $-i\hbar, 1$
  - d)  $i\hbar, 1$
- 9) Which of the following equation is correct?
  - a)  $[\hat{y}, \hat{p}_z] = i\hbar$
  - b)  $[\hat{x}, \hat{p}_y] = i\hbar$
  - c)  $[\hat{z}, \hat{p}_x] = i\hbar$
  - d)  $[\hat{z}, \hat{p}_z] = i\hbar$







**Q.6 Answer the following.**

- a) Derive the general expression for electromagnetic energy. **10**
- b) Discuss Electromagnetic plane waves in stationary medium? **06**

**Q.7 Answer the following.**

- a) Explain the concept of radiation from a half wave antenna. **10**
- b) What is Gauss law? Explain differential form of its. **06**

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**M.Sc. (Semester - II) (New) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Statistical Physics (MSC03206)**

Day & Date: Wednesday, 20-12-2023  
 Time: 11:00 AM To 02:00 PM

Max. Marks: 80

- Instructions:** 1) Question No.1 and 2 are compulsory.  
 2) Attempt any three questions from Q. No. 3 to Q. No. 7.  
 3) Figure to right indicate full marks.

**Q.1 A) Choose the correct alternatives from the options. 10**

- 1) Which law of thermodynamics is the law of conservation of energy?
  - a) First
  - b) Second
  - c) Zero
  - d) Third
- 2) The phase space is \_\_\_\_\_ dimensional space.
  - a) 3N
  - b) 6N
  - c) N
  - d) 2N
- 3) The statistics followed by half spin particles is \_\_\_\_\_.
  - a) Maxwell-Boltzmann Statistics
  - b) Fermi-Dirac Statistics
  - c) Bose-Einstein Statistics
  - d) None of the above
- 4) Maxwell-Boltzmann statistics cannot be applied to \_\_\_\_\_.
  - a) Atoms
  - b) Molecules
  - c) Photons
  - d) Lattice
- 5) The equation of state for an ideal gas is represented as \_\_\_\_\_.
  - a)  $PV = R/T$
  - b)  $PV = nRT$
  - c)  $P/V = R/T$
  - d)  $PV = RT$
- 6) The entropy of an ideal gas at absolute zero is \_\_\_\_\_.
  - a)  $\infty$
  - b) 0
  - c)  $Nk_B$
  - d) Cannot be calculated
- 7) For which gas mutual interaction between the molecules is zero.
  - a) real
  - b) Fermi
  - c) Ideal
  - d) Bose
- 8) Total heat of the substance is also known as \_\_\_\_\_.
  - a) Internal energy
  - b) Entropy
  - c) Thermal Capacity
  - d) Enthalpy
- 9) Pressure at the critical point is \_\_\_\_\_.
  - a)  $3b$
  - b)  $8/27R$
  - c)  $3b/27Rb$
  - d)  $8a/27Rb$

- 10) In microcanonical ensembles following parameters remain constant.
- |          |            |
|----------|------------|
| a) $TVN$ | b) $EVN$   |
| c) $EVT$ | d) $EV\mu$ |

**B) Fill in the blanks OR write true/ false. 06**

- 1) The ratio of the universal gas constant and Avogadro's number is called the velocity constant.
- 2) The transition in  $\beta$ -brass is an example of a second-order phase transition.
- 3) Photon, Phonon, etc. obeys the Fermi Dirac distribution function.
- 4) Entropy in thermodynamics is a measure of the disorder of the system.
- 5) The value of the universal gas constant is 8.3143
- 6) A phase space is a six-dimensional space.

**Q.2 Answer the following. 16**

- a) State the types of ensembles and point out the difference between canonical and Grand Canonical Ensemble.
- b) Discuss the conditions for phase equilibrium.
- c) Show that during the second order phase transition  $\partial^2 G_1 / \partial T^2 \neq \partial^2 G_2 / \partial T^2$ .
- d) What is a partition function? Derive it for Canonical Ensemble.
- e) Explain the P-T diagram of the phase transaction.

**Q.3 Answer the following.**

- a) Show that Gibb's function is continuous during the first-order phase transition, but the first derivative of Gibb's function changes discontinuously. 10
- b) What is a triple point? Explain it with the help of a phase diagram. 06

**Q.4 Answer the following.**

- a) Write a note on Critical Indices 10
- b) Write about Liouville's theorem in a classical presentation. 06

**Q.5 Answer the following.**

- a) Write about Second order phase transition. 08
- b) Write a note on microcanonical, canonical and grand canonical ensembles. 08

**Q.6 Answer the following.**

- a) Show that the average energy of a single particle of ideal fermi gas is  $3/5$  times the fermi energy of the system. 10
- b) Explain the law of corresponding states. 06

**Q.7 Answer the following.**

- a) Derive the expression for Fermi energy at strongly degenerate ideal Fermi gas. 10
- b) Write about black body radiation. 06



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**M.Sc. (Semester - III) (New) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Semiconductor Physics (MSC03301)**

Day & Date: Friday, 05-01-2024  
 Time: 11:00 AM To 02:00 PM

Max. Marks: 80

- Instructions:** 1) Q. (1) and (2) are compulsory.  
 2) Attempt any three from Q. No. 3 to Q. No. 7  
 3) Figure to right indicate full marks.

**Q.1 A) Choose the correct alternative.****10**

- 1) In a semiconductor, the energy gap between the valence band and conduction band is about \_\_\_\_\_.
  - a) 5 eV
  - b) 10 eV
  - c) 15 eV
  - d) 1 eV
- 2) Electron-hole pairs are produced by \_\_\_\_\_.
  - a) Recombination
  - b) Thermal energy
  - c) Ionization
  - d) Doping
- 3) The drift velocity of the conductor \_\_\_\_\_.
  - a) Increase with an increase in temperature
  - b) Decrease with Decrease in temperature
  - c) Increase with Decrease in the temperature
  - d) Decrease with the increase in temperature
- 4) In Schottky barrier, barrier height depends on \_\_\_\_\_.
  - a) Amount of doping material
  - b) Type of doping material
  - c) Temperature
  - d) None of the above
- 5) The probability that an electron in a metal occupies the fermi level, at any temperature ( $> 0K$ ) is \_\_\_\_\_.
  - a) 0
  - b) 1
  - c) 0.5
  - d) 1.0
- 6) If  $\sigma$  is the conductivity, what is the relation between the electric field  $E$  and the current density  $J$  in a conducting medium?
  - a)  $\sigma = J/E$
  - b)  $\sigma = 1/JE$
  - c)  $\sigma = E/J$
  - d)  $\sigma = EJ$
- 7) The equilibrium number of EHP in pure Si at room temperature is about \_\_\_\_\_.
  - a)  $10^{10}$  EHP/cm<sup>3</sup>
  - b)  $10^{12}$  EHP/cm<sup>3</sup>
  - c)  $10^{10}$  EHP/m<sup>3</sup>
  - d)  $10^{12}$  EHP/m<sup>3</sup>
- 8) The atoms of solid are held together by \_\_\_\_\_.
  - a) Van der Waals forces
  - b) Hydrogen bonds
  - c) Ionic bonds
  - d) Hydrophobic forces
- 9) What is the role of seed crystal in crystal growth?
  - a) Nucleation center
  - b) Catalyst
  - c) Solvent
  - d) Solution

- 10) Charge carriers can move in semiconductor via:
- Diffusion mechanism
  - Floating mechanism
  - Drift mechanism
  - Both drift and diffusion mechanism

**B) Fill in the blanks OR Write true/ false. 06**

- The mean lifetime of electron-hole pair (EHP) is less than \_\_\_\_\_ seconds.
- LED is an example of \_\_\_\_\_ luminescence.
- \_\_\_\_\_ nuclei often redissolve.
- Nucleation poses large energy barrier. (True/False)
- Mobility cannot be determined from Haynes-Shockley experiment. (True/False)
- Debye temperature is associated with the highest allowed mode of vibration. (True/False)

**Q.2 Answer the following 16**

- Write a note on optical absorption.
- Explain fermi level pinning.
- Write a short note on group velocity of electrons.
- Explain in short direct bandgap semiconductors.

**Q.3 Answer the following**

- Elaborate in detail about the ohmic contacts. 10
- Explain in short about Nucleation process. 06

**Q.4 Answer the following**

- Explain the concept of vibrational specific heat and derive its expression. 10
- Write in brief about inverse effective mass tensor. 06

**Q.5 Answer the following**

- Elaborate in detail about the growth of bulk semiconductors by Zone Melting. 10
- Explain in brief about surface and interface states. 06

**Q.6 Answer the following**

- Explain the concept of steady state carrier generation. 10
- Write in brief about vapour phase epitaxy. 06

**Q.7 Answer the following**

- Explain in detail about rectifying contacts with the necessary band diagrams. 10
- Explain the bonding forces in solids. 06

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**M.Sc. (Semester - III) (New) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Atomic, Molecular Physics (MSC03302)**

Day & Date: Sunday, 07-01-2024  
 Time: 11:00 AM To 02:00 PM

Max. Marks: 80

- Instructions:** 1) Question no. 1 and 2 are compulsory.  
 2) Attempt any three questions from Q. No. 3 to Q. No. 7.  
 3) Figure to right indicate full marks.

**Q.1 A) Multiple choice questions.****10**

- 1) In computing the splitting of spectral lines in a weak magnetic field the Lande g-factor arises because of \_\_\_\_\_.
  - a) Pauli Exclusion Principle
  - b) spin-orbit coupling
  - c) Larmor precession
  - d) relativistic correction
- 2) Laser cooling of atoms is produced due to \_\_\_\_\_.
  - a) Absorption of photons by atoms
  - b) scattering of photons by atoms
  - c) Transfer of momentum from photon to atoms
  - d) transfer of energy from photons to atoms.
- 3) First Raman shifted line observed at  $218 \text{ cm}^{-1}$  for  $\text{CCl}_4$  excited by  $632.8 \text{ nm}$  of He-Ne laser, will correspond to scattered wavelength at (given  $h=6.6 \times 10^{-34} \text{ Js}$   $c=3 \times 10^8 \text{ m/s}$ )
  - a)  $128.5 \text{ nm}$
  - b)  $621.8 \text{ nm}$
  - c)  $5000.0 \text{ nm}$
  - d)  $641.6 \text{ nm}$
- 4) The outermost shell of an atom of an element is  $3d^3$ . The spectral symbol for the ground state
  - a)  ${}^4F_{3/2}$
  - b)  ${}^4F_{9/2}$
  - c)  ${}^4D_{7/2}$
  - d)  ${}^4D_{1/2}$
- 5) A negative muon, which has a mass nearly 200 times that of an electron, replaces an electron in a Li atom. The lowest ionization energy for the muonic Li atom is approximately.
  - a) The same as that of He
  - b) The same as that of normal Li
  - c) The same as that of normal Be
  - d) 200 times larger than that of normal Li
- 6) Which of the following molecules does not exhibit a rotational spectrum.
  - a) HCl
  - b) CO
  - c)  $\text{H}_2$
  - d) HBr
- 7) JJ coupling is the \_\_\_\_\_ Coupling.
  - a) Weak
  - b) strong
  - c) less weak
  - d) none of these
- 8) One electron in P orbit and another in a D orbit, in case of LS coupling, the atom may be in a \_\_\_\_\_ state.
  - a) SPD
  - b) PDF
  - c) DFG
  - d) Only D



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**M.Sc. (Semester - III) (New) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Materials Processing (MSC03307)**

Day & Date: Tuesday, 09-01-2024  
 Time: 11:00 AM To 02:00 PM

Max. Marks: 80

- Instructions:** 1) Question no. 1 and 2 are compulsory.  
 2) Attempt any three questions from Q. No. 3 to Q. No. 7.  
 3) Figure to right indicate full marks.

**Q.1 A) Multiple choice questions.**

**08**

- 1) DC sputtering cannot be used for deposition of
  - a) Metal
  - b) Alloy
  - c) Oxide
  - d) All above
- 2) The sticking coefficient depends on
  - a) Substrate temperature
  - b) Substrate area
  - c) Substrate shape
  - d) None of the above
- 3) The atmospheric pressure is equal to
  - a) 760 Torr
  - b) 1 Torr
  - c) 7.6 Torr
  - d) 76 Torr
- 4) In physisorption due to adsorption of the adsorbate molecules the electronic structure of the surface atoms \_\_\_\_\_.
  - a) Changes irrespective of the adsorbate concentration
  - b) Does not change irrespective of the adsorbate concentration
  - c) Changes with respect to the adsorbate concentration
  - d) None of the above
- 5) The capillary nucleation theory considers the
  - a) Interface energy of the film and substrate
  - b) Roughness of the Substrate
  - c) Melting point of the Substrate
  - d) All of the above
- 6) In resistive evaporation the filaments are usually made of refractory metals such as Tungsten or Tantalum mainly because of their \_\_\_\_\_.
  - a) Melting point
  - b) Conductivity
  - c) Ductility
  - d) Hardness
- 7) Mechanically \_\_\_\_\_ Microstructure results in rough morphology.
  - a) strong
  - b) weak
  - c) forced
  - d) strained

- 8) \_\_\_\_\_ gas cooling is required for the Roots pump.
- a) Continuous
  - b) Infinite
  - c) No
  - d) Oxygen

**B) State True or False.****08**

- 1) In case of MOCVD we may get carbon impurity.
- 2) MBE is a deposition technique for growing epitaxial film in ambient condition
- 3) Low nucleation rate results into deposition of thin film of large grain size.
- 4) Electrodeposition can be used to deposit only conducting substrates.
- 5) McLeod gauge can be used for continuous measurement of vacuum.
- 6) In case of MOCVD we may get carbon impurity.
- 7) In chemisorption, a strong chemical bond is formed between the adsorbate atom or molecule and the substrate.
- 8) Ion pump is noise free

**Q.2 Write short answers.****16**

- a) Titanium sublimation pump
- b) Spray pyrolysis
- c) Ion plating
- d) Sticking coefficient

**Q.3 Answer the following.**

- a) Describe in brief different types of sputtering.
- b) Explain How stress is generated in thin films?

**10****06****Q.4 Answer the following.**

- a) Explain how environment for thin film deposition and deposition parameters affect the film growth?
- b) Give different advantages and disadvantages of CVD over PVD?

**10****06****Q.5 Answer the following.**

- a) Describe in brief different types of CVD.
- b) Explain importance of ALD.

**10****06****Q.6 Answer the following.**

- a) Describes the principles of rotary, diffusion and turbo molecular pump.
- b) Give account of different vacuum gauges?

**10****06****Q.7 Answer the following.**

- a) Describes mechanical, electrical and optical properties of thin films.
- b) Explain in brief quartz crystal film thickness measurement.

**10****06**

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**M.Sc. (Semester - III) (New) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Materials Characterization (MSC03308)**

Day & Date: Tuesday, 09-01-2024  
 Time: 11:00 AM To 02:00 PM

Max. Marks: 80

- Instructions:** 1) Q. Nos. 1 and. 2 are compulsory.  
 2) Attempt any three questions from Q. No. 3 to Q. No. 7  
 3) Figure to right indicate full marks.

**Q.1 A) Choose the correct alternative. 10**

- 1) The error caused by poor calibration of the instrument is called \_\_\_\_\_.
  - a) Random error
  - b) Systematic error
  - c) Gross error
  - d) Precision error
- 2) What is the average velocity of the molecules of an ideal gas?
  - a) Infinity
  - b) Constant
  - c) Unstable
  - d) Zero
- 3) X-ray diffractometers provide \_\_\_\_\_ information about the compounds present in a solid sample.
  - a) Quantitative
  - b) Qualitative
  - c) Quantitative and qualitative
  - d) Either quantitative or qualitative
- 4) In the Hall Effect, the electric field is in X direction and the velocity is in Y direction. What is the direction of the magnetic field?
  - a) X
  - b) Y
  - c) Z
  - d) XY Plane
- 5) In which of the following ways, absorption is related to transmittance?
  - a) Absorption is the logarithm of transmittance
  - b) Absorption is the reciprocal of transmittance
  - c) Absorption is the negative logarithm of transmittance
  - d) Absorption is a multiple of transmittance
- 6) ASTM stands for \_\_\_\_\_.
  - a) American Society for Tensile Measurement
  - b) American Society for Testing and Materials
  - c) American Society for Tool Measurement
  - d) American Society for Tensile Material
- 7) The temperature of gas is held constant, while its volume is decreased. The pressure exerted by the gas on the wall of the container increases, because its molecules \_\_\_\_\_.
  - a) Strike the walls with higher velocities
  - b) Strike the walls with large force
  - c) Strike the walls more frequently
  - d) Are in contact with the walls for a shorter time
- 8) Which mathematical method is used in X-ray crystallography?
  - a) Fourier Transform
  - b) Laplace Transform
  - c) Partial differentiation
  - d) Geiger method





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**M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Semiconductor Devices (MSC03401)**

Day & Date: Monday, 18-12-2023  
 Time: 03:00 PM To 06:00 PM

Max. Marks: 80

- Instructions:** 1) Attempt five questions.  
 2) Question No.1 and 2 are compulsory.  
 3) Attempt any three from Q. No. 3 to Q. No. 7.

**Q.1 A) Choose correct alternatives.****10**

- 1) A CCD involves \_\_\_\_ actions.
  - a) charge storage and transfer
  - b) only charge transfer
  - c) only storage
  - d) charge storage and loss
- 2) Two valley model of TEDs based on GaAs is proposed by \_\_\_\_\_.
  - a) BCS
  - b) BBS
  - c) RWH
  - d) NWH
- 3) LEDs fabricated with GaAs emit \_\_\_\_\_ wavelength.
  - a) far ultra violet
  - b) ultraviolet
  - c) visible
  - d) infrared
- 4) An overlapping gate structure is used for improving \_\_\_\_ performance.
  - a) CCD
  - b) LED
  - c) LASER
  - d) SCR
- 5) Photodetector \_\_\_\_\_ optical signal.
  - a) reflects
  - b) detects
  - c) modulate
  - d) amplify
- 6) The M - S structure forms \_\_\_\_\_ barrier.
  - a) schottky
  - b) read
  - c) ohmic
  - d) non – ohmic
- 7)  $(\alpha_1 + \alpha_2)$  approaches \_\_\_\_\_ when the SCR devices are at forward breakdown.
  - a) 100
  - b) 1000
  - c)  $\infty$
  - d) 1
- 8) A Triacs is used where the transfer of large \_\_\_\_\_ is involved.
  - a) Power
  - b) voltage transfer
  - c) electron transfer
  - d) charge transfer



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**M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Nuclear and Particle Physics (MSC03402)**

Day & Date: Tuesday, 19-12-2023  
 Time: 03:00 PM To 06:00 PM

Max. Marks: 80

- Instructions:** 1) Q. Nos. 1 and. 2 are compulsory.  
 2) Attempt any three questions from Q. No. 3 to Q. No. 7  
 3) Figure to right indicate full marks.

**Q.1 A) Choose the correct alternative. 10**

- 1) The binding energy of deuteron is \_\_\_\_\_.
  - a) 13.6 eV
  - b) 36 MeV
  - c) 2.225 MeV
  - d) 13.6MeV
- 2) The range of energy \_\_\_\_\_ eV is called as epithermal reaction.
  - a) 1eV
  - b) 0.025eV
  - c) 1KeV
  - d) 0.1-1MeV
- 3) The simplest two nucleon system exist in nature is of \_\_\_\_\_.
  - a) n-n
  - b) n-p
  - c) p-p
  - d) dose not exist
- 4) the height of potential barrier faced by an alpha particle inside the nucleus is \_\_\_\_\_.
  - a) 31.2MeV
  - b) 31.2KeV
  - c) 31.2GeV
  - d) 31.2eV
- 5) The energy equivalent to 1 a m u is \_\_\_\_\_.
  - a) 931 eV
  - b) 931 KeV
  - c) 931 MeV
  - d) 93 BeV
- 6) The compound nucleus ha life time is of the order of \_\_\_\_\_.
  - a)  $10^{-8}$  Sec
  - b)  $10^{-11}$  Sec
  - c)  $10^{-14}$ Sec
  - d)  $10^{-21}$ Sec
- 7) Unit of cross section is \_\_\_\_\_.
  - a) Fermi
  - b) barn
  - c) MeV
  - d) nucleon per cm<sup>3</sup>
- 8) Semi empirical mass formula for the binding energy of nucleus contains a surface correction term this term depends on the mass number A of the nucleus
  - a)  $A^{-1/3}$
  - b)  $A^{2/3}$
  - c)  $A^{1/3}$
  - d) A
- 9) The electric quadruple moment is negative, shape of the nuclei is \_\_\_\_\_.
  - a) Oblate
  - b) Prolate
  - c) Spherical
  - d) All of these
- 10) The \_\_\_\_\_ Can explain magic number.
  - a) Liquid drop model
  - b) Fermi gas model
  - c) shell model
  - d) All of these

- B) Fill in the blanks / True or False. 06**
- 1) Nuclear binding energy usually expressed in units of \_\_\_\_\_
  - 2) The exchange particle which holds the quarks together is called \_\_\_\_\_.
  - 3) In direct reaction incident particle completely have more than \_\_\_\_\_  
Energy per nucleon
  - 4) Cross sectional area of n-p scattering is  $4\pi a^2$  (T/F)
  - 5) In a deuteron, the force between neutron and proton is short range and repulsive (T/F)
  - 6) Nucleons are bosons (T/F)

- Q.2 Answer in brief. 16**
- a) Discuss shape and size, mass and relative abundances of nucleus.
  - b) Discuss superconductivity model.
  - c) Write a note on conservation laws.
  - d) Write a note on cosmic ray.

- Q.3 Answer the following. 10**
- a) Derive an expression for scattering cross section of two nucleon system and write a note on scattering length. 10
  - b) Discuss properties of nuclear forces. 06

- Q.4 Answer the following. 10**
- a) Describe liquid drop model of nucleus point out its usefulness and limitations in understanding the nuclear phenomenon. 10
  - b) Explain the energy levels of shell model. How this helps to explain the occurrence of magic numbers? Draw the diagram. 06

- Q.5 Answer the following 10**
- a) Explain the nuclear reaction kinematics Obtain an expression for Q value discuss the general solution of the Q equation. 10
  - b) Comment on compound nuclear disintegration. 06

- Q.6 Answer the following 10**
- a) Give the Gell-Mann-Nisijima relation and calculate the charge of baryon family using this relation find out strangeness' and hypercharge of the baryon octet plot the schematic diagram and table. 10
  - b) Discuss quark hypothesis and quantum chromodynamics. 06

- Q.7 Answer the following 10**
- a) What should be the minimum KE of the electrons to probe the size of  ${}_{20}\text{Ca}^{40}$  nucleus. 10
  - b) An  ${}_{8}\text{O}^{16}$  nucleus is spherical and has charge radius R and volume according to empirical observation of the charge radii, the volume of the  ${}_{54}\text{Xe}^{128}$  nucleus assume to be spherical what is the ratio of volume of Xe to the volume of Oxygen. 06

Seat No.	
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**M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023**  
**PHYSICS (MATERIALS SCIENCE)**  
**Physics of Nano Materials (MSC03403)**

Day & Date: Wednesday, 20-12-2023  
 Time: 03:00 PM To 06:00 PM

Max. Marks: 80

- Instructions:** 1) Question no. 1 and 2 are compulsory.  
 2) Attempt any three questions from Q. No. 3 to Q. No. 7.  
 3) Figure to right indicate full marks.

**Q.1 A) Multiple choice questions.**

**10**

- 1) The basic principle of AFM is \_\_\_\_\_.
  - a) change in force due to change in distance
  - b) change in current due to change in distance
  - c) change in shape due to change in distance
  - d) change in size due to change in distance
- 2) Nanotubes usually form in bundles. Which is the best description of such a bundle?
  - a) The tubes are aligned, axes parallel, with van der Waals forces operating between adjacent tubes
  - b) The tubes are connected together by covalent C-C bonds
  - c) The tubes are randomly organized, with the axes of the tubes lying in random directions
  - d) The bundles are of discrete sizes, and dipole-dipole forces hold the tubes together
- 3) For emission of the electrons from the metal surface the minimum required energy is \_\_\_\_\_.
  - a) binding energy of the electron
  - b) work function of the metal
  - c) kinetic energy of the electron
  - d) None of the above
- 4) The extensively used nano particles as catalyst is \_\_\_\_\_.
 

a) Silver	b) Copper
c) Gold	d) Cerium
- 5) \_\_\_\_\_ operate like a single electron transistor.
 

a) Quantum wells	b) Quantum wires
c) Quantum dots	d) Quantum rings
- 6) The magnified image of the specimen in SEM is obtained \_\_\_\_\_.
 

a) CRT	b) Phosphorescent screen
c) Anode	d) Scanning generator
- 7) \_\_\_\_\_ are used in LEDs.
 

a) Quantum wells	b) Quantum wires
c) Quantum rings	d) Quantum dots
- 8) The electron microscope which is used to study the internal structure of the plant and animal cells is \_\_\_\_\_.
 

a) SEM	b) TEM
c) Light microscope	d) Compound microscope





- B) Fill in the blanks OR State true/false** **06**
- 1) \_\_\_\_\_ types of waves has the shortest wavelength.
  - 2) XPS works on the principle of \_\_\_\_\_.
  - 3) UV -Vis Spectroscopy is based on principal of \_\_\_\_\_.
  - 4) BET technique is used to determination of surface area. (True/False)
  - 5) Raman spectroscopy is based on Inelastic scattering. (True/False)
  - 6) Transmission Electron Microscope provides a three-dimensional picture of the specimen. (True/False)
- Q.2 Answer the following** **16**
- a) Rayleigh criterion
  - b) EDAX
  - c) Secondary and backscattered electrons
  - d) Magic Angle Spinning (MAS)
- Q.3 Answer the following**
- a) What is EPR condition? Explain in detail continuous wave EPR and EPR line width. **10**
  - b) Explain fluorescence microscope. **06**
- Q.4 Answer the following**
- a) Describe principle and working of Transmission Electron Microscope with schematic Diagram. **10**
  - b) Write a note on Selected Area Electron Diffraction. **06**
- Q.5 Answer the following**
- a) Describe qualitative and quantitative analysis of Auger electron spectrum with example. **10**
  - b) Explain elastic and inelastic scattering. **06**
- Q.6 Answer the following**
- a) Describe principal and working of AFM with schematic diagram. **10**
  - b) Explain Magic Angle Spinning (MAS). **06**
- Q.7 Answer the following**
- a) Describe Principal and working of Raman Spectroscopy with suitable example. **10**
  - b) Explain Electron energy analyzer of XPS. **06**