SLR-EX-1

Seat No.	

Set P

M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Mathematical Physics

Day & Date: Friday, 05-01-2024 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

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

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

1) The value of $\int_{-\pi}^{\pi} \cos(mx)\sin(nx)\,dx =$ _____.
   a) 1 b) $a-1$
   c) 0 d) π

2) 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

3) A point at which a function $f(z)$ is not analytic is known as a _____ or singularity of the function.
   a) Scalar point b) Singular point
   c) Non-singular d) None of these

4) Find the pole of $f(z) = \sin\frac{1}{(z-a)} =$ _____.
   a) $z = a$ b) $z = 0$
   c) $z = 1$ d) $z = 4$

5) Laplace transform of $f(t)$ is defined for _____.
   a) $+ve$ value of t b) $-ve$ value of t
   c) both $+ve$ & $-ve$ value of t d) None of these

6) Legendre polynomial is a set of _____ function.
   a) orthogonal b) odd
   c) even d) real

7) If $f(z) = e^{2z}$ then the imaginary part of $f(z)$ is _____.
   a) $e^y \sin x$ b) $e^x \cos y$
   c) $e^{2x}\cos 2y$ d) $e^{2x}\sin 2y$

8) What are the eigen values of $\begin{pmatrix} 1 & -i \\ i & 1 \end{pmatrix}$?
   a) Both are 0 b) 0 and 1
   c) 0 and -1 d) 0 and 2

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

1) Fourier transform is a linear operator. (True/ False)
2) Inverse of unitary matrix is unitary matrix. (True/ False)
3) A square matrix is called orthogonal if $A = A^{-1}$. (True/ False)
4) $x\frac{\partial u}{\partial x} + t\frac{\partial u}{\partial t} = 2u$ is on ordinary differential equation. (True/ False)

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

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
$f(x) = 0;\ -\pi \le x \le 0$
$f(x) = h; 0 \le x \le \pi$ 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.

$$y\log y\,dx + (x - \log y)dy = 0$$

SLR-EX-2

Seat No.	

Set P

M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Solid State Physics

Day & Date: Sunday, 07-01-2024 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

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 lantern 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

SLR-EX-3

Seat No.		Set	P

M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Analog and Digital Electronics

Day & Date: Tuesday, 09-01-2024 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

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.

SLR-EX-5

Seat No.	

Set P

M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Research Methodology in Physics

Day & Date: Thursday, 11-01-2024 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

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.

SLR-EX-6

Seat No.	

Set P

M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Mathematical Physics (MSC04101)

Day & Date: Friday, 05-01-2024 Max. Marks: 80
Time: 03:00 AM To 06:00 PM

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) 2π b) π
   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) π

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) $2\pi i \sum_{j=1}^{n} a_{-1}\,zj$ b) $2\pi i$
   c) $2\pi i \sum_{j=1}^{n} a_{+1}\,zj$ d) $2\pi i \sum_{j=1}^{n}$

9) _____ is the real part $(\mathrm{Re}\ Z)$ & _____ is the imaginary $(\mathrm{Im}\ Z)$, 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 α, β, 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**

$A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ 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**

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

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

b) Explain Laplace transform of Derivatives. **08**

SLR-EX-7

Seat No.	

Set P

M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Solid State Physics (MSC04102)

Day & Date: Sunday, 07-01-2024 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

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 Tc 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) 1st b) 2nd
   c) 3rd d) 0th

9) Relative permittivity (ε_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^2
   c) T^3 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**

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Q.7 Answer the following

a) Explain the Kronig-Penney model. **10**
b) Give the expression for electronic polarizability. **06**

SLR-EX-8

Seat No.	

Set P

M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Analog and Digital Electronics (MSC04103)

Day & Date: Tuesday, 09-01-2024 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

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) $\mathrm{J}=1,\mathrm{K}=1$ b) $\mathrm{J}=0,\mathrm{K}=0$
   c) $\mathrm{J}=1,\mathrm{K}=0$ d) $\mathrm{J}=0,\mathrm{K}=1$

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 3rd 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. **10**

b) Explain Multiplexers and Demultiplexers. **06**

Q.4 Answer the following.

a) What is multivibrator? Explain the difference between the three types of multivibrators. **10**

b) Draw and explain 8:1 Multiplexers. **06**

Q.5 Answer the following.

a) Explain the operation of three op-amp instrumentation amplifier. **10**

b) Define Oscillators? Explain their types. **06**

Q.6 Answer the following.

a) Explain inverting configuration of Op amp as a summing, scaling and averaging Amplifier. **10**

b) Explain Inverting and Non inverting amplifier. **06**

Q.7 Answer the following.

a) Explain the instruction set of 8085 microprocessor. **10**

b) Draw and explain memory read cycle of 8085 microprocessor. **06**

SLR-EX-9

Seat No.	

Set P

M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Classical Mechanics (MSC04108)

Day & Date: Thursday, 11-01-2024 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

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) $x = k.(1 + e^{-kt})/v_o$ b) $x = kv_o(1 - e^{-kt})$
   c) $x = v_o(1 - e^{-kt})/k$ d) $x = kv_o(1 + e^{-kt})$

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) $\oint \mathrm{F}.dr = 0$

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**

SLR-EX-11

Seat No.	

Set P

M.Sc. (Semester - II) (New) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Quantum Mechanics (MSC04201)

Day & Date: Monday, 18-12-2023 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

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 Ψ_a and Ψ_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 $\hat{H} =$ _____.
   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) $[\hat{z}, \hat{p}z] = i\hbar$

10) Which of the following equations is/are correct?
   i) $K = r \times p$
   ii) $L = iL_x + jL_y + kL_z$
   iii) $L^2 = L.L$
   iv) $L^2 = {L_x}^2 + {L_y}^2 + {L_z}^2$

   a) i and ii only b) iii and iv only are correct
   c) i, ii and iv are correct d) All are correct

B) Fill in the blanks or Write True /False. **06**

1) Diffraction and interference are the evidence of wave nature of matter. (True/False)
2) Eigen values of Hermitian operator are not real. (True/False)
3) Inner product of Bra and Ket in Quantum mechanics is always 1. (True/False)
4) For a free particle the potential energy $V(x) =$ _____.
5) Potential energy of a particle in harmonic oscillator having mass m is _____.
6) The linear momentum operator is given by _____.

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

a) Normalize the following wave- function in one- dimension:
$\psi(x) = Ae^{-ax}$ for $x > 0$
$= Ae^{+ax}$ for $x < 0$
where α is a positive constant.

b) Prove that eigen function of Hermitian operator with different eigen values are orthogonal to each other.

c) Explain unitary transformation.

d) Define the different postulate of Quantum mechanics.

Q.3 Answer the following.

a) Derive the time independent Schrödinger equation in 3D. **10**

b) Deduce the continuity equation. **06**

Q.4 Answer the following.

a) Obtain Schrödinger's wave equation for Hydrogen atom in terms of spherical polar coordinates, express its radial and angular parts. **10**

b) Define angular momentum and explain the commutation relation. **06**

Q.5 Answer the following.

a) What is momentum eigen function in the co-ordinate representation? Elaborate. **10**

b) Write down the co-ordinate and momentum representation. **06**

Q.6 Answer the following.

a) What is the Clebich Gordon coefficient? Explain the construction procedure. With simple examples. **10**

b) Describe the Pauli spin matrices. **06**

Q.7 Answer the following.

a) Define square well potential in one dimension. Discuss motion of a particle of mass m when energy of the particle is less than potential $(E < V_0)$. **10**

b) Obtain eigen values of operators L^2 and Lz. **06**

SLR-EX-12

Seat No.		Set	P

M.Sc. (Semester - II) (New) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Electrodynamics (MSC04202)

Day & Date: Tuesday, 19-12-2023 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

Instructions: 1) Q. No. 1 and 2 are compulsory.
2) Attempt any Three questions from Q.No.3 to Q.No.7.
3) Figures to the right indicate full marks.

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

1) Divergence of the curl of any vector field is always _____.
   a) 0 b) 1
   c) Infinite d) cant possible

2) Which one of the fundamental equation was modified by Maxwell to form the basis of electromagnetic theory?
   a) Faraday law b) Ampere law
   c) Gauss law of electrostatic d) Gauss law of magnetostatic

3) Lorentz electric force has direction _____.
   a) Similar to electric field b) Opposite to electric field
   c) Scalar quantity d) None

4) The Poynting vector P is equal to _____.
   a) $\mathrm{E}.\mathrm{H}$ b) $\mathrm{E}\times\mathrm{H}$
   c) E/H d) H/E

5) Which property of an electromagnetic wave, depends on the medium in which it is travelling?
   a) Velocity b) Frequency
   c) Time period d) Wave length

6) In the skin definition of skin depth, it is distance over which field amplitude reduces to _____.
   a) Nearly one fifth b) 1/e
   c) One half d) One fourth

7) In Maxwell equation $\nabla \times H = J + \partial D/\partial t\,, J$ is _____.
   a) Electric flux density b) magnetic flux density
   c) Surface current density d) No physical quantity

8) Law which governs the interaction of the electromagnetic field with charge matter _____.
   a) Gauss law b) Faradays law
   c) Amperes law d) Lorentz force law

9) Magnetic vector potential due to magnetic dipole is proportional to _____.
   a) r b) 1/r
   c) $1/r^2$ d) $1/r^3$

10) Electric Potential (Φ) of a quadrupole varies with distance 'r' on its axis as _____.
   a) $\Phi: r^{-1}$ b) $\Phi: r^{-2}$
   c) $\Phi: r^{-3}$ d) $\Phi: r^{3/2}$

B) Fill in the blanks OR Write Ture /False **06**

1) The charge density of electrostatic field is given by _____.
2) In dipole, the gauss theorem value will be _____.
3) The Ampere law is based on _____ Theorem
4) The electric field over the gaussian surface remains continuous and uniform at every point.
5) In Biot-Savart's law, the magnetic intensity is product of the current.
6) The direction of a propagation of electromagnetic wave is $\bar{E}.\bar{B}$.

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

a) Explain Maxwell's displacement current?
b) Write a note on Skin effect and skin depth?
c) Explain the concept of Thomson cross section?
d) State the boundary condition for an electrostatic field$\bar{E}$.

Q.3 Answer the following.

a) Discuss the "Reflection and refraction" of electromagnetic waves at oblique incidence. **10**
b) Elaborate the concept of displacement current. **06**

Q.4 Answer the following.

a) Explain in details of boundary condition between conductor and free space. **10**
b) Obtained the expression for the resistance for uniform field &non-uniform fields. **06**

Q.5 Answer the following.

a) Derive an expression for energy stored in electric and magnetic field. **10**
b) Explain the concept of Radiation damping. **06**

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**

SLR-EX-13

Seat No.	

Set P

M.Sc. (Semester - II) (New) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Statistical Physics (MSC04206)

Day & Date: Wednesday, 20-12-2023 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

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) ∞ b) 0
   c) NkB 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 β-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**

SLR-EX-15

Seat No.	

Set P

M.Sc. (Semester - III) (New) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Semiconductor Physics (MSC04301)

Day & Date: Friday, 05-01-2024 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

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 (> OK) is _____.
   a) 0 b) 1
   c) 0.5 d) 1.0

6) If σ 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^3 b) 10^{12} EHP/cm^3
   c) 10^{10} EHP/m^3 d) 10^{12} EHP/m^3

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:
   a) Diffusion mechanism
   b) Floating mechanism
   c) Drift mechanism
   d) Both drift and diffusion mechanism

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

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

Q.2 Answer the following **16**

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

Q.3 Answer the following

a) Elaborate in detail about the ohmic contacts. **10**
b) Explain in short about Nucleation process. **06**

Q.4 Answer the following

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

Q.5 Answer the following

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

Q.6 Answer the following

a) Explain the concept of steady state carrier generation. **10**
b) Write in brief about vapour phase epitaxy. **06**

Q.7 Answer the following

a) Explain in detail about rectifying contacts with the necessary band diagrams. **10**
b) Explain the bonding forces in solids. **06**

SLR-EX-16

Seat No.	

Set P

M.Sc. (Semester - III) (New) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Atomic, Molecular Physics (MSC04302)

Day & Date: Sunday, 07-01-2024 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

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 Cm-1 for CCI4 excited by 632.8nm of HE-Ne laser, will correspond to scattered wavelength at (given $h=6.6*10^{-34}$Js $C=3*10^{8}$m)
   a) 128.5nm b) 621.8nm
   c) 5000.0nm d) 641.6 nm

4) The outermost shell of an atom of an element is 3d3. 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 time larger than that of normal LI

6) Which of the following molecules does not exibit a rotational spectrum.
   a) HCI b) CO
   c) H2 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 a other in a D orbit, in case of II coupling, the atom may be in a _____ state.
   a) SPD b) PDF
   c) DFG d) Only D

9) Which of the following molecule will not show the microwave spectra.
   a) CH_2Cl_2 b) SF_6
   c) H_2O d) CH_3Cl

10) The lowest vibrational energy is given by _____.
   a) ½ ω b) ω
   c) ½ ω^2 d) ω^2

B) Fill in the blanks or True false from give parenthesis **06**

1) _____ Detector is an IR detector (crystal / Pyroelectric)
2) At J=0 i.e ground rotational state, in which the ____ (rotation / no rotation)
3) Intensity rule for the Zeeman effect of the atomic systems containing more than one valance electron is _____ of type of coupling (dependent /Independent)
4) When L is greater than or equal to S, all integral Value of J between L-S and L+S are allowed.
5) Hyperfine structures arises in tungsten due to presence there even isotopes tungsten.
6) The spherical top molecule have dipole moment owing to their symmetry.

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

a) Give selection rule for LS and JJ coupling
b) State and explain the intensity rule for Zeeman Effect.
c) Distinguish between normal and anomalous Zeeman Effect.
d) Find the spectroscopic term for npl,np2,np4,np5.

Q.3 Answer the following.

a) With the schematic diagram, write the construction and working of stern gerlach experiment. **12**
b) The spin orbit coupling constant for the upper state of Na atom which emits D lines for weak numbers 16959cm-1 and 1697.4cm-1 is? **04**

Q.4 Answer the following.

a) What are the assumption made for the deriving an expression for Lande 'g' factor? Obtain the expression for the Lande 'g' factor for LS coupling. **12**
b) In a hydrogen atom the accidental or coulomb degeneracy for the n=4 state is? {111}. **04**

Q.5 Answer the following.

a) Write the consequences for bond elasticity for diatomic molecule as a non-rigid rotator. **12**
b) The number of Zeeman component for 2D3/2 --> 2P3/2 transition in one electron atom will be?{124} **04**

Q.6 Answer the following.

a) Discuss the techniques and instrumentation of microwave spectrometer and its use in chemical analysis **12**
b) The land's g factor for the $^3P_1$ level of an atom is? {91}. **04**

Q.7 Answer the following.

a) Draw the vibrational energy levels and some transition between them for a diatomic molecules undergoing anharmonic oscillations **12**
b) Consider a state in which I=4, s=1/2 the orientation of total angular moment w.r.t Cos 45 the state with largest possible J, mj is? {55} **04**

SLR-EX-17

Seat No.		Set	P

M.Sc. (Semester - III) (New) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Soft Condensed Matter Physics (MSC04306)

Day & Date: Tuesday, 09-01-2024 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

Instructions: 1) Q. Nos. 1 and 2 are compulsory.
2) Attempt any Three questions from Q.No.3 to Q.No.7.
3) Figures to the right indicate full marks.

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

1) Soft condensed matter is a convenient term for materials in states of matter that are _____.
   a) Simple liquids
   b) Crystalline solids
   c) Either simple liquids or crystalline solids
   d) Neither simple liquids nor crystalline solids

2) The coarse-grained models emphasize _____.
   a) Universality b) Crystallinity
   c) Amorphous nature d) Flexibility

3) In a phase transition, the order parameter for the disordered phase is _____.
   a) Zero b) Finite
   c) Infinite d) Negative

4) Consider the following statements _____.
   i) For first order phase transition, the order parameter changes discontinuously.
   ii) For second order phase transition, the order parameter changes continuously.
   a) Only statement (i) is correct
   b) Only statement (ii) is correct
   c) Both statements are correct
   d) Both statements are incorrect

5) For a phase transition, the order parameter for the ordered phase is ____
   a) Zero b) Finite
   c) Infinite d) Negative

6) In most soft matter systems the degree of molecular ordering _____.
   a) is equal to the full positional order of a single crystal
   b) is equal to the complete positional disorder of a liquid or glass
   c) Falls somewhere between the full positional orders of a single crystal and the complete positional disorder of a liquid or glass
   d) None of these

7) Consider the following statements?
   i) Colloidal particles are typically less than a micrometer in size
   ii) Polymer chains have overall dimensions in the tens of nanometers
   a) Only statement (i) is correct
   b) Only statement (ii) is correct
   c) Both statements are correct
   d) Both statements are incorrect

8) In which of the following crystallinity the molecules are arranged with a degree of order intermediate between the complete disorder of liquid and the long-ranged, three dimensional order of crystal?
   a) Liquid crystallinity
   b) Partial crystallinity
   c) Solid crystallinity
   d) None of these

9) In which of the following liquid crystalline phase the director is parallel the layer normal?
   a) Nematic A
   b) Smectic A
   c) Nematic C
   d) Smectic C

10) Which of the following are the synthetic or natural molecules with the ability to self-assemble into a wide variety of structures?
   a) Amphiphilic molecules
   b) Ambiphilic molecules
   c) Gas molecules
   d) Water molecules

B) Fill in the blank / state true and false **06**

1) The basic aim of condensed matter physics is to understand the collective properties of large assemblies of atoms and molecules in terms of the interactions between their component parts. (True/False)
2) When amphiphiles have the property that part of the molecule has an affinity to water and another part of the molecule is repelled from water. (True/False)
3) Soft matter has often very rich and complicated morphology. (True/False)
4) An ordered arrangement of domains of the two polymer types on mesoscopic length scales is called _____
5) The self-assembled phases are found in soap and other materials that are formed by mixing water with a class of molecules known As _____.
6) A critical volume fraction, above which isolated solute molecules coexist with an infinite aggregate is known as _____

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

a) Write a note on mechanism of phase separation in liquid-liquid unmixing.
b) Explain, why oil and water do not mix.
c) Explain the boundary effects in liquid crystals.
d) Write a note on non-classical exponents in percolation model.

Q.3 Answer the following.

a) Obtain the expression for volume fraction X_M for spherical micelles. **10**
b) Write a note on non-classical exponents in percolation model. **06**

Q.4 Answer the following.

a) Discuss the driven lattice gas model in two-dimensional non-equilibrium systems. **10**
b) Write a note on thermodynamics of solutions. **06**

Q.5 Answer the following.

a) Explain the interfaces between the phases and interfacial tension. **10**
b) Explain the generalized rigidity and the elastic constants of a Nematic liquid crystal **06**

Q.6 Answer the following.

a) Discuss the elasticity and fluctuations of membranes in Supramolecular self-assembly in soft-condensed matter. **10**
b) What is the most spectacular property of soft matter? Write a note on Supramolecular self-assembly in soft-condensed matter. **06**

Q.7 Answer the following.

a) Discuss the types of aggregates encountered in Amphiphilic molecules? **10**

b) Write a note on nucleation by thermal fluctuation in liquid-liquid unmixing. **06**

SLR-EX-19

Seat No.	

Set P

M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Semiconductor Devices (MSC04401)

Day & Date: Monday, 18-12-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

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) ∞ 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

9) In a CCD operation the thermal relaxation time is _____ than the charge storage time.
   a) longer b) much longer
   c) shorter d) much shorter

10) Light emission is not possible in Si due to its _____.
   a) direct band gap b) high mobility
   c) indirect band gap d) doping

B) Fill in gaps/State True or False **06**

1) Refreshing circuit is incorporated in CCD memory as it provides ____.
2) Pulsed laser can deliver very _____ power.
3) The M-S structure forms _____ barrier.
4) The CCD devices are static.
5) The forward characteristic of a Shockley diode is useful for switching.
6) PUT requires 2 V if gate is biased at 0.8 V.

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

a) Programable UJT.
b) Enhancement type MOSFET.
c) Dynamic effect in CCD.
d) Radiative and non-radiative transitions.

Q.3 a) Describe the operating principle of photodiode based on PN junctions, pin configuration and multilayer hetrojunction with. band diagrams and IV characteristics. **10**

b) Draw block diagram, doping profile, electric field distribution in p-i-n diode. **06**

Q.4 a) Give an account of DIAC and TRIAC with suitable diagrams and IV characteristics. **10**

b) Explain di/dt protection. **06**

Q.5 a) Describe MS structure with band diagram. **10**

b) Charge trapping in MOSFET. **06**

Q.6 a) Describe GaAs Gun Oscillator modes in terms of **10**
   i) Space charge accumulation
   ii) Quenched domain mode
   iii) Delayed domain mode

b) Explain current flow mechanism in MS junction. **06**

Q.7 a) Describe IV characteristics of solar cell. Derive an expression for quantum efficiency of solar cell. **10**

b) How performance of CCD is improved. **06**

SLR-EX-20

Seat No.	

Set P

M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Nuclear and Particle Physics (MSC04402)

Day & Date: Tuesday, 19-12-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

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 cm3

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.

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.

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

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

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

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

SLR-EX-21

Seat No.	

Set P

M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Physics of Nano Materials (MSC04403)

Day & Date: Wednesday, 20-12-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

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

9) Which among the following helps in obtaining a three-dimensional picture of the specimen?
   a) TEM b) SEM
   c) Compound Microscope d) Simple Microscope

10) _____ is a requirement for the fluorescence process.
   a) Absorption b) Radiation
   c) Transmission d) All of the above

B) Fill in the blanks / State True or False. **06**

1) The surface area to volume ratio of a sphere with radius 30 nm is _____.
2) In SEM the morphology of the sample is achieved with the help of _____.
3) _____ is used for measuring the surface area of the nanoparticles.
4) The ball milling technique is a bottom up method.
5) In AFM, the sample is mounted on a piezoelectric tube.
6) The electron mobility in semiconductors can be greatly decreased by the formation of polarons.

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

a) BN Nanotubes
b) Dielectric quantum confinement
c) Electrodeposition
d) Metallic SET

Q.3 Answer the following.

a) Describe the chemical vapour deposition technique for the preparation of nanomaterials. **10**
b) Why is spatial resolution of STM better than AFM? **06**

Q.4 Answer the following.

a) Describe principle and operation of STM **10**
b) Give an account of field-enhanced thermionic emission and field-assisted thermionic emission. **06**

Q.5 Answer the following.

a) Describe the effect of increasing temperature on the conductivity of an intrinsic semiconductor. **10**
b) Explain the basic difference between a PVD and CVD process. **06**

Q.6 Answer the following.

a) Describe the density of states at low-dimensional nanostructures. **10**
b) Deduce the hopping conduction mechanism in semiconductors. **06**

Q.7 Answer the following.

a) Describe the basic working principle of an AFM and explain the charge transfer in terms of LDOS. **10**
b) Explain in brief the basic process of VLS technique. **06**

SLR-EX-23

Seat No.	

Set P

M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023
PHYSICS (CONDENSED MATTER PHYSICS)
Experimental Techniques in Physics (MSC04407)

Day & Date: Thursday, 21-12-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

Instructions: 1) Q. Nos. 1 and 2 are compulsory.
2) Attempt any Three questions from Q.No.3 to Q.No.7.
3) Figures to the right indicate full marks.

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

1) In an optical receiver the pin diode has a _____ intrinsic semiconductor layer separating P and N region, and the diode is ____ biased which is helps draw the current carriers away from the intrinsic region.
   a) Short, reverse b) Wide, reverse
   c) Wide, forward d) Short, Forward

2) The device that convert optical radiation into electrical energy is _____.
   a) LED b) Photo- detector
   c) Solar cell d) PIN diode

3) The photoconductive cell is used for _____.
   a) High frequency application
   b) Medium frequency application
   c) Low frequency application
   d) All of these

4) The purpose of secondary filter in fluorescence spectroscopy is _____.
   a) Allows only excitation radiation
   b) Allows only emotion radiation
   c) Allows both excitation and emission radiation
   d) Allows transmitted radiation

5) The kinetic energy of the photoelectron energies is dependent on _____ of the atom, which makes XPS useful to identify the oxide state.
   a) Mass b) Charge
   c) Chemical environment d) Volume

6) Raman Effect is scattering of _____.
   a) Atoms b) Molecules
   c) Proton d) Photons

7) Which transducer is known as self-generating transducer?
   a) Active transducer b) Passive transducer
   c) Secondary transducer d) Analogy transducer

8) Only pyro electric transducer or pyro electric crystals are used as detectors in FTIR spectrophotometer what is mean reason for other types of thermal detectors are not being used in FTIR spectrophotometer.
   a) Less accuracy b) Slower response
   c) Less precision d) Less sensitivity

9) Diffusion pump is a _____.
   a) Oil filter equipment b) Oil Heater
   c) Oil Cooler d) Oil collector

10) Which among the following is used as receiver in fibre optic communication?
   a) LDR b) LED
   c) Photo transistor d) LASER Diode

B) Fill in the blank / state true and false **06**

1) Helium-Neon laser is a _____ level laser.
2) The process of converting energy from one form to another is known as _____.
3) LVDT is a type of _____Transducer.
4) Full form of HR-TEM is _____.
5) In transmission electron microscopy (TEM) _____ is used to magnify the object.
6) _____ is used for the data transmission.

Q.2 Answer the brief. **16**

a) What is TGA?
b) Write a note on Oil diffusion pump?
c) What is optical fibre what are the application of it?
d) What is the oscilloscope, give there basics and fundamental.

Q.3 Answer the following.

a) Explain in detail digital and analoge measuring instruments and there types. **10**
b) Explain in detail LVDT. **06**

Q.4 Answer the following.

a) What is laser, write a note on Spatial, temporal and Einstein coefficient. **10**
b) Discuss construction and working of LCD with schematic diagram. **06**

Q.5 Answer the following.

a) Explain principle construction and working of X-ray diffractometer. **10**
b) Write a note on Oil diffusion pump. **06**

Q.6 Answer the following.

a) Explain principle construction and working of scanning electron microscope. **10**
b) What is TGA? **06**

Q.7 Answer the following.

a) Discuss AFM? **10**
b) Explain XPS. **06**