## Seat

No.

# M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) <br> Mathematical Physics (2306101) 

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.

1) The value of $\int_{-\pi}^{\pi} \cos (m x) \sin (n x) d x=$ $\qquad$ .
a) 1
b) $a-1$
c) 0
d) $\pi$
2) If $\left|z^{2}-1\right|=\left|z^{2}\right|+1$ then $z$ lies on $\qquad$ .
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 $\qquad$ or singularity of the function.
a) Scalar point
b) Singular point
c) Non-singular
d) None of these
4) Find the pole of $f(z)=\sin \frac{1}{(z-a)}=$ $\qquad$ -
a) $z=a$
b) $z=0$
c) $z=1$
d) $z=4$
5) Laplace transform of $f(t)$ is defined for $\qquad$ .
a) $+v e$ value of $t$
b) -ve value of $t$
c) both + ve \& $-v e$ value of $t$
d) None of these
6) Legendre polynomial is a set of $\qquad$ function.
a) orthogonal
b) odd
c) even
d) real
7) If $f(z)=e^{2 z}$ then the imaginary part of $f(z)$ is $\qquad$ .
a) $e^{y} \sin x$
b) $e^{x} \cos y$
c) $e^{2 x} \cos 2 y$
d) $e^{2 x} \sin 2 y$
8) What are the eigen values of $\left(\begin{array}{cc}1 & -i \\ i & 1\end{array}\right)$ ?
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.
9) Fourier transform is a linear operator. (True/ False)
10) Inverse of unitary matrix is unitary matrix. (True/ False)
11) A square matrix is called orthogonal if $A=A^{-1}$. (True/ False)
12) $x \frac{\partial u}{\partial x}+t \frac{\partial u}{\partial t}=2 u$ is on ordinary differential equation. (True/ False)
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 $\frac{d^{2} y}{d x^{2}}-6 \frac{d y}{d x}=9 y=0$
d) Find the Laplace transform of the function

$$
f(t)=t e^{-t} \sin 2 t
$$

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 $\frac{d^{2} y}{d x^{2}}-5 \frac{d y}{d x}+6 y=0$
h) Define singular point, explain in details its types with example.
Q. 3 Answer the following. (Any Three)
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 $e^{-a x^{2}}$ where $a>0$
Q. 4 Answer the following. (Any Two)
a) Write matrix $A$ gives below as the sum of symmetric \& a skew symmetric matrix.

$$
A=\left(\begin{array}{rrr}
1 & 2 & 4 \\
-2 & 5 & 3 \\
-1 & 6 & 3
\end{array}\right)
$$

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.
$\int_{c} \frac{1+z}{z(2-z)} d z$ where $c$ is circle $|z|=1$
Q. 5 Answer the following. (Any Two)
a) Evaluate $\int_{0}^{\infty} \frac{\cos 3 \theta}{5+4 \cos \theta} d \theta$
b) Solve; $x \frac{d y}{d x}+y \log \mathrm{y}=x y e^{x}$
c) Solve the differential equation.

$$
y \log y d x+(x-\log y) d y=0
$$

# M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) <br> Solid State Physics (2306102) 

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.

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 $\qquad$ .
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.
9) The SI unit of magnetic field intensity is $\qquad$ .
10) The magnetization ' M ' of a superconductor in a field is $\qquad$ .
11) When a paramagnetic material is heated above Curie temperature it becomes non-magnetic.
12) The temperature above which an antiferromagnetic material becomes paramagnetic is called the melting temperature.
Q. 2 Answer the following. (Any Six). ..... 12a) 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) ..... 12a) 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) ..... 12a) 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

# M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) <br> Analog and Digital Electronics (2306106) 

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)

1) The feedback path in an op-amp integrator consists of $\qquad$ .
a) A resistor
b) A capacitor
c) A resistor and capacitor in series
d) A resistor and capacitor in parallel
2) Multiplexer has $\qquad$ .
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 $\qquad$ type of amplifier.
a) Current
b) Voltage
c) Power
d) Resistance
4) The op-amp comparator circuit uses $\qquad$ .
a) Positive feedback
b) Negative feedback
c) Regenerative feedback
d) No feedback
5) Find the output of inverting amplifier?
a) $V_{0}=A V_{\text {in }}$
b) $\mathrm{V}_{0}=-\mathrm{A} \mathrm{V}_{\text {in }}$
c) $V_{0}=-A\left(V_{\text {in } 1}-V_{\text {in } 2}\right)$
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 $\qquad$ .
a) Two
b) Three
c) Four
d) Five
8) In how many different modes a universal shift register operates $\qquad$ .
a) 2
b) 3
c) 4
d) 5
B) Fill in the blanks OR Write True /False.
9) The data in stack is called $\qquad$ .
10) Circuit is used as signal source in all sort of application.
11) $\qquad$ bit program counter is available in 8085.
12) The voltage gain of a voltage buffer is $\qquad$ .
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 $\mathrm{IO} / \mathrm{M}$ 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 (NANOPHYSICS)
Research Methodology in Physics (2306105)
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.

1) A researcher is generally expected to $\qquad$ .
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 $\qquad$ 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) $R F$
4) The main problem in questionnaire is $\qquad$ .
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 $\qquad$ 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 $\qquad$ .
a) Panel Interview
b) Self-administered interview
c) Mail Interview
d) Electronic Interview
7) The most common scales used in research are $\qquad$ .
a) Nominal
b) Ratio
c) Ordinal
d) All of the above
8) By selecting laser operating conditions, control over microstructure is $\qquad$ .
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)
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)
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)
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)
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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## M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) Mathematical Physics (MSC09101)

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.

1) The product of a singular matrix with its adjoint is $\qquad$ .
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 $A B$ is $\qquad$ .
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 $\int_{-\pi}^{\pi} \cos (m x) \sin (n x) d x=$
a) 1
b) -1
c) 0
d) $\pi$
6) If $\left|z^{2}-1\right|=\left|z^{2}\right|+1$ then $z$ lies on $\qquad$ .
a) the real axis
b) the imaginary axis
c) a circle
d) on ellipse
7) Find the pole of $f(z)=\sin \frac{1}{(z-a)}=$ $\qquad$ .
a) $z=a$
b) $z=0$
c) $z=1$
d) $z=4$
8) In Cauchy's Residues theorem $\oint_{\Gamma} f(z) d z=$ $\qquad$ .
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) $2 \pi i \sum_{j=1}^{n}$

## SLR-EV-6

9) $\qquad$ is the real part $(\operatorname{Re} \mathrm{Z})$ \& $\qquad$ is the imaginary ( $\operatorname{Im} \mathrm{Z}$ ), of the given $z=(1+i) /(2-3 i)$.
a) $-\frac{1}{13} \& \frac{5}{13}$
b) $\quad-\frac{1}{11} \& \frac{4}{13}$
c) $\frac{1}{3} \&-\frac{5}{13}$
d) $\frac{1}{09} \& \frac{5}{13}$
10) Legendre polynomial is a set of $\qquad$ function.
a) orthogonal
b) odd
c) even
d) real
B) Fill in the blanks OR write true/false.
a) A necessary and sufficient condition that solution $y_{1}$ and $y_{2}$ of $y^{\prime \prime}+p(x) y^{\prime}+q(x) y=0$ 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.

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

## Q. 3 Answer the following.

a) Solve $x \frac{d y}{d x}+y \log y=x y e^{x}$
b)

Find the eigen value of a matrix $\left[\begin{array}{lll}2 & 1 & 1 \\ 1 & 2 & 1 \\ 0 & 0 & 1\end{array}\right]$

## Q. 4 Answer the following.

a)

Determine the value of $\alpha, \beta, r$ when $\left[\begin{array}{ccc}0 & 2 \beta & r \\ \alpha & \beta & -r \\ \alpha & -\beta & r\end{array}\right]$ is orthogonal.
b) Determine the poles of the function $z, \quad f(z)=\frac{1}{z^{4}+1}$

## Q. 5 Answer the following.

a) Solve $\sin x \frac{d y}{d x}+2 y=\tan ^{3}\left(\frac{x}{2}\right)$
b) Verify Cayley - Hamilton Theorem for the following matrix. 08
$A=\left[\begin{array}{ccc}2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2\end{array}\right]$ and use the theorem to find $A^{-1}$

## Q. 6 Answer the following.

$\begin{array}{lll}\text { a) Find the order of each pole and residue of } \frac{1-2 z}{z(z-1)(z-2)} & 08 \\ \text { b) Show that the eigen value of Hermitian matrix are real. } & 08\end{array}$
Q. 7 Answer the following.
a) In square wave expand the function.

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

b) Explain Laplace transform of Derivatives. 08

# M.Sc. (Semester - I) (OId) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) Solid State Physics (MSC09102) 

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.

1) Effective mass is equal to $\qquad$ mass for free electron.
a) Mean
b) real
c) Residual
d) zero
2) Elemental solid dielectric has only $\qquad$ polarization.
a) Electronic
b) ionic
c) orientational
d) all
3) In the case of p-type semiconductors, the Fermi level lies at $\qquad$ .
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 $\qquad$ .
a) Zero
b) Finite
c) Infinite
d) None of the above
5) 

a) Metal
b) Semiconductor
c) Insulator
d) Dielectric
6) The coordination number of HCP is $\qquad$ .
a) Two
b) Four
c) Six
d) Twelve
7) Plane cut to negative $x$-axis have the miller indices $\qquad$ .
a) (011)
b) (001)
c) (110)
d) $(-100)$
8) The zone lies in between $+\pi / 2$ to $-\pi / 2$ is the $\qquad$ Brillion zone.
a) $1^{\text {st }}$
b) $2^{\text {nd }}$
c) 3 rd
d) $0^{\text {th }}$
9) Relative permittivity $\left(\varepsilon_{r}\right)$ of the air is $\qquad$ .
a) 2
b) 0.5
c) 1
d) 0
10) Intrinsic concentration of charge carriers in a semiconductor varies as
a) $\quad \mathrm{T}$
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 $\qquad$ 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) ..... 16a) Write about orientational polarization.b) Explain Meissner's effect.c) Derive the rectifier equationd) Show that in the case of an intrinsic semiconductor $E_{f}=\left(E_{c}+E_{v}\right) / 2$
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 ..... 10the crystal.
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) (OId) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) <br> Analog and Digital Electronics (MSC09103)

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)

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 $\qquad$
a) $J=1, K=1$
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 $\qquad$ .
a) A resistor
b) A capacitor
c) A resistor and capacitor in series
d) A resistor and capacitor in parallel
5) Multiplexer has $\qquad$ -
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 $\qquad$
a) Positive feedback
b) Negative feedback
c) Regenerative feedback
d) No feedback
7) Op- amp is a type of amplifier $\qquad$
a) Current
b) Voltage
c) Power
d) Resistance
8) An XOR gate can be used for $\qquad$
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 $3^{\text {rd }}$ highest priority
c) It uses level-triggered signal
d) Its vectored address is 003 CH
B) Fill in the blanks
11) In an instrumentation amplifier, the output voltage is based on the
$\qquad$ times a scale factor.
12) The output voltage of a voltage buffer is $\qquad$ with the input voltage.
13) The voltage gain of a voltage buffer is $\qquad$ .
14) The data in stack is called $\qquad$ _.
15) The sequential circuit is also called $\qquad$ .
16) There are $\qquad$ 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.

## 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.

## 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 10 averaging Amplifier.
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

# M.Sc. (Semester - I) (OId) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) Classical Mechanics (MSC09108) 

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.

1) The position of a particle at any time $t$ subjected to resistive force is $\qquad$ .
a) $x=k \cdot\left(1+e^{-k t}\right) / v_{o}$
b) $x=k v_{o}\left(1-e^{-k t}\right)$
c) $x=v_{o}\left(1-e^{-k t}\right) / k$
d) $x=k v_{o}\left(1+e^{-k t}\right)$
2) The rate of momentum change of an open system is equal to $\qquad$ .
a) $T+M U$
b) $F-M V$
c) $W-M V$
d) $F+M U$
3) The reduced mass of two bodies into equivalent one body is $\qquad$ .
a) $\left(m_{1}+m_{2}\right) /\left(m_{1} \cdot m_{2}\right)$
b) $\left(m_{1} \cdot m_{2}\right) /\left(m_{1}-m_{2}\right)$
c) $m_{2} /\left(1+m_{2} / m_{1}\right)$
d) $m_{1} /\left(1+m_{2} / m_{1}\right)$
4) The time derivative of generalized co-ordinate is $\qquad$ .
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 $\qquad$ .
a) Circle
b) Parabola
c) Ellipse
d) Hyperbola
6) The generalized momentum is equal to $\qquad$ .
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) $d F / d t=0$
b) $\nabla . F=0$
c) $\nabla \times F=0$
d) $\oint$ F. $d r=0$
8) Poisson brackets are $\qquad$ under canonical transformation.
a) Variant
b) nullified
c) anti-symmetric
d) invariant
9) Generalized coordinated $\qquad$ .
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 $\qquad$ .
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.
11) Scleronomic constraint do not explicitly depends on time. (True/False)
12) $q_{j}$ 's which are absent in $L$ are cyclic coordinates. (True/False)
13) Rutherford's differentia scattering cross section has dimensions of solid angle. (True/False)
14) The Euler-Lagrangian differential equations is $\qquad$ .
15) Lagrangian is equal to $\qquad$ .
16) $\left[L_{x}, L_{y}\right]=$ $\qquad$ .
Q. 2 Answer the following questions.
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.
b) Obtain the equation of motion of

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.
b) Derive an equivalent equation for reduction to one body problem from two 06 body problem.
Q. 5 Answer the following.
a) State the Kepler's laws of planetary motion and prove the Kepler's third law.
b) Deduce the Lagrange's equation of motion from Hamilton's principle and 06 using derive the generalized momentum.
Q. 6 Answer the following.
a) Derive canonical equations of Hamilton. Also write the procedure for
constructing Hamiltonian.
b) Obtain Hamilton's equation for one dimensional harmonic oscillator.
Q. 7 Answer the following.
a) State and prove Poisson's theorem. 10
b) Prove the Jacobi identity $[V,[V, W]]+[V,[W, U]]+[W,[U, V]]=0 \quad 06$

# M.Sc. (Semester - III) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) Atomic, Molecular Physics (MSC09302) 

Day \& Date: Sunday, 07-01-2024<br>Time: 11:00 AM To 02:00 PM<br>Instructions: 1) Question no. 1 and 2 are compulsory.<br>2) Attempt any three questions from Q. No. 3 to Q. No. 7.<br>3) Figure to right indicate full marks.

Max. Marks: 80
Q. 1 A) Multiple choice questions.

1) In computing the splitting of spectral lines in a weak magnetic field the lande g-factor arises because of $\qquad$ .
a) Pauli Exclusion Principle
b) spin-orbit coupling
c) larmor precession
d) relativistic correction
2) Laser cooling of atoms is produced due to $\qquad$ .
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 $218 \mathrm{Cm}-1$ for CCl 4 excited by 632.8 nm of HE-Ne laser, will correspond to scattered wavelength at (given $\mathrm{h}=6.6^{*} 10^{-34} \mathrm{Js} \mathrm{C}=3^{*} 10^{8} \mathrm{~m}$ )
a) 128.5 nm
b) 621.8 nm
c) 5000.0 nm
d) 641.6 nm
4) The outermost shell of an atom of an element is 3d3. The spectral symbol for the ground state
a) ${ }^{4} F_{3 / 2}$
b) ${ }^{4} \mathrm{~F}_{9 / 2}$
c) ${ }^{4} \mathrm{D}_{7 / 2}$
d) ${ }^{4} D_{1 / 2}$
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) HCl
b) CO
c) H 2
d) HBr
7) JJ coupling is the $\qquad$ 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 $\qquad$ state.
a) SPD
b) PDF
c) DFG
d) Only D
9) Which of the following molecule will not show the microwave spectra.
a) $\mathrm{CH}_{2} \mathrm{Cl}_{2}$
b) $\mathrm{SF}_{6}$
c) $\mathrm{H}_{2} \mathrm{O}$
d) $\mathrm{CH}_{3} \mathrm{Cl}$
10) The lowest vibrational energy is given by $\qquad$ .
a) $1 / 2 \omega$
b) $\omega$
c) $1 / 2 \omega^{2}$
d) $\omega^{2}$
B) Fill in the blanks or True false from give parenthesis
11) _Detector is an IR detector (crystal / Pyroelectric)
12) At $J=0$ i.e ground rotational state, in which the $\qquad$ (rotation / no rotation)
13) Intensity rule for the Zeeman effect of the atomic systems containing more than one valance electron is $\qquad$ of type of coupling (dependent /Independent)
14) When $L$ is greater than or equal to $S$, all integral Value of $J$ between $L-S$ and $L+S$ are allowed.
15) Hyperfine structures arises in tungsten due to presence there even isotopes tungsten.
16) The spherical top molecule have dipole moment owing to their symmetry.

## Q. 2 Answer the following.

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.
b) The spin orbit coupling constant for the upper state of Na atom which emits D lines for weak numbers $16959 \mathrm{~cm}-1$ and $1697.4 \mathrm{~cm}-1$ is?
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.
b) In a hydrogen atom the accidental or coulomb degeneracy for the $\mathrm{n}=4$ state is? $\{111\}$.

## Q. 5 Answer the following.

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

## Q. 6 Answer the following.

a) Discuss the techniques and instrumentation of microwave spectrometer and 12
its use in chemical analysis
b) The land's $g$ factor for the ${ }^{3} P_{1}$ 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 12 diatomic molecules undergoing anharmonic oscillations
b) Consider a state in which $I=4, s=1 / 2$ the orientation of total angular moment 04
w.r.t Cos 45 the state with largest possible $\mathrm{J}, \mathrm{mj}$ is? $\{55\}$

## M.Sc. (Semester - III) (New) (CBCS) Examination: Oct/Nov-2023

## PHYSICS (NANOPHYSICS)

Functional Nanomaterials (MSC09306)
Day \& Date: Tuesday, 09-01-2024
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) Choose the correct alternative.

1) Laser ablation method is developed by $\qquad$ .
a) Kelvin
b) Richard Smalley
c) Watson and crick
d) Neils bohr

Max. Marks: 80
2) The fibre rein forced plastics has $\qquad$ cost of production.
a) Low
b) High
c) Moderate
d) very high
3) The crystallinity in polyhydroxy alkonoates is lie in the range of $\qquad$ .
a) $70 \%$
b) $60 \%$
c) $50 \%$
d) $40 \%$
4) TEFLON has $\qquad$ -
a) low melting point
b) high melting point
c) low density
d) good conduction of electricity
5) Polymer has outstanding property of being $\qquad$ .
a) heavy weight
b) light weight
c) corrosive
d) brittle
6) Which of the following is stabilizing element in $\beta$-phase of Ti alloys.
a) Al
b) N
c) O
d) Mo
7) The curing process of thermoset is completely $\qquad$ .
a) reversible
b) irreversible
c) adiabatic
d) isothermal
8) The $\qquad$ of $\mathrm{TiO}_{2}$ layer plays a crucial role in the TNT formation.
a) physical dissolution
b) physical association
c) chemical dissolution
d) chemical association
9) The diameter of the nanowire is about $\qquad$ .
a) $10^{-6} \mathrm{~m}$
b) $10^{-3} \mathrm{~m}$
c) $10^{-8} \mathrm{~m}$
d) $10^{-9} \mathrm{~m}$
10) The relation of crystal growth rate is $\qquad$ .
a) $\frac{d r}{d t}=\frac{D\left(C_{h}-C_{i}\right)}{r d_{m}}$
b) $\frac{d r}{d t}=\frac{D\left(C_{h}-C_{i}\right)}{r}$
c) $\frac{d r}{d t}=\frac{D\left(C_{h}-C_{i}\right)}{d_{m}}$
d) $\frac{d r}{d t}=\frac{r\left(C_{h}-C_{i}\right)}{D}$
B) Fill in the blanks OR Write true or false.

1) The layer-by layer assembly of oppositely charged polyelectrolytes originated in the early.
2) Quantum dots have two dimensions. (True/False)
3) Carbon atom can form four covalent bonds. (True/False)
4) Bucky ball is an example of $\qquad$ _.
5) The electrospinning process can be adjusted to control fibre diameter by varying electric filed strength and polymer solution concentration. (True/False)
6) The range of identical Temperature for synthesis of MOF is $500^{\circ} \mathrm{C}$ to $600^{\circ} \mathrm{C}$. (True/False)
Q. 2 Answer the following. ..... 16
a) Discuss basic material used for Polymer Nanocomposites.
b) Explain the applications of quantum dots in Biomedicine.
c) Write the short on the structural properties of $\mathrm{TiO}_{2}$ Nanotube arrays.
d) What are properties of polymer Nanocomposites.

## Q. 3 Answer the following

a) Discuss the fabrication process of $\mathrm{TiO}_{2}$ nanotube arrays by electrochemical anodization with First synthesis generation.
b) What are structural applications nanocomposite fibre?

## Q. 4 Answer the following

a) Write in detail Electrospinning Process for Nanofibres.
b) Explain the synthesis method of semiconductor Nanocrystal in organic solvent.

## Q. 5 Answer the following

a) Define Metal Oxide Frameworks. Write down its advantages and disadvantages.
b) Explain in detail. Arc discharge and Arc melting synthesis method of Boron Nitride Nanotube.

## Q. 6 Answer the following

a) What is polymerisation? Explain Emulsion polymerisation. 08
b) Describe Layer-by-Layer (LBL) assembly with semiconductor Nanoparticles 08
and nanowires.

## Q. 7 Answer the following

a) What arc the key processing parameters of Electrospinning process of 10 Nanofibre and explain any four key parameters in detail.
b) Write the short on the fabrication techniques of Polymer Nanocomposites. 06
M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS)

## Semiconductor Devices (MSC09401)

Day \& Date: Monday, 18-12-2023
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) Select the correct alternative.

1) In Schottky diode, the junction is in between $\qquad$ .
a) N-type \& P-semiconductor
b) N -type semiconductor and metal
c) no junction
d) P-type semiconductor and metal
2) D-MOSFET works in $\qquad$ .
a) enhancement mode only
b) depletion mode only
c) both enhancement and depletion mode
d) none of these
3) The voltage above which E-MOSFET works is known as $\qquad$ voltage.
a) threshold
b) knee
c) firing
d) breakdown
4) 

a) IGBT
b) GTO
c) DIAC
d) LASCR
5) Which of the following power semiconductor device is unipolar?
a) SCR
b) TRIAC
c) IGBT
d) Power MOSFET
6) The minimum current required to keep SCR in on state is known as $\qquad$
as
a) hold in current
b) saturation current
c) leakage current
d) hold in current
7) Which of the following device works in negative resistance region?
a) Zener diode
b) Light Emitting Diode
c) Varator diode
d) Gunn diode
8) In MIS capacitor, the inversion layer is formed in $\qquad$ .
a) metal
b) insulator
c) semiconductor
d) silicon dioxide layer
9) The formula for the frequency in GHz in Gunn diode is given by $\qquad$ . (Where L is in micrometer)
a) $100 / \mathrm{L}$
b) $10 / \mathrm{L}$
c) $100 * \mathrm{~L}$
d) $10 * \mathrm{~L}$
10) The LASER light is $\qquad$ .
a) parallel beam
b) monochromatic
c) coherent
d) all of these
11) If the energy of incident radiation is greater than band gap energy then $\qquad$ -
a) only electrons are created
b) only holes are created
c) both electrons and holes are created
d) none of these
12)
$\qquad$ produces maximum current for incident photon of light.
a) photo cell
b) LDR
c) avalanche photo detector
d) photo diode
B) State True or False

1) MIS structure in MOSFET works as inductor.
a) True
b) False
2) Gunn diode contains no PN junction.
a) True
b) False
3) TRIAC conducts in both direction.
a) True
b) False
4) GaP is used in light emitting diode.
a) True
b) False
Q. 2 Answer the following. 16
a) Write a note on MIS capacitor.
b) With neat diagram explain the construction of DIAC.
c) Explain the working of light activated SCR.
d) Explain the working of PN junction photodetector.

## Q. 3 Answer the following.

a) Explain the I-V characteristics of D-MOSFET and hence define parameters of D-MOSFET.
b) Explain the of Schottky barrier between the metal and semiconductor. Why it is working as rectifying contact?
Q. 4 Answer the following.
a) Explain with neat diagram the construction and working of SCR. 10 Define their ratings.
b) Explain with necessary graph the I-V characteristic of DIAC. 06

## Q. 5 Answer the following.

a) Explain the mechanism of charge transfer in three phase CCD. 10
b) Write a note on TT and LSA operating mode of Gunn diode.
Q. 6 Answer the following.
$\begin{array}{ll}\text { a) Explain the construction and working of heterojunction LASER. } & 08 \\ \text { b) Explain quantum efficiency, response speed, noise and optical absorption } & 08 \\ \text { coefficient of photodetector. } & \end{array}$

## Q. 7 Answer the following.

a) Explain the Gunn effect on the basis of two valley model. 08
b) Explain the construction and working of gate turn off (GTO) SCR. 08

## M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) Nuclear and Particle Physics (MSC09402)

Day \& Date: Tuesday, 19-12-2023
Max. Marks: 80
Time: 03:00 PM To 06:00 PM
Instructions: 1) Question 1and 2 are compulsory.
2) Attempt any three questions from Q. Nos. 3 to Q. Nos. 7.
3) Figure to right indicate full marks.
Q. 1 A) Choose correct alternative.

1) Nuclear force is $\qquad$ .
a) Spin dependent
b) charge dependent
c) both charge and spin independent
d) spin dependent but charge independent
2) The asymmetry term in semi empirical mass formula is due to $\qquad$ .
a) Non spherical shape of the nucleus
b) Non zero spin of the nucleus
c) Unequal number of protons and neutrons
d) equal number of protons and neutrons
3) A nucleus with 235 splits into two nuclei whose mass numbers are in ratio 2:1, then radii of the two new nuclei is (given $\mathrm{R}_{0}=1.4 \mathrm{fm}$ )
a) $5.89 \mathrm{fm}, 6.55 \mathrm{fm}$
b) $5.99 \mathrm{fm}, 7.55 \mathrm{fm}$
c) $6.89 \mathrm{fm}, 7.66 \mathrm{fm}$
d) $1.23 \mathrm{fm}, 3.12 \mathrm{fm}$
4) Which of the following has high penetrating power?
a) Alpha particles
b) protons
c) gamma rays
d) beta particles
5) The mass difference between the nucleus and its constituents nucleons is called the $\qquad$ .
a) Packing fraction
b) binding energy
c) mass conservation
d) mass defect
6) In the distribution of comic ray, the latitude effect is maximum at $\qquad$ .
a) Equator of Earth
b) pole of earth
c) $45^{\circ}$ latitude
d) $-15^{\circ}$ latitude
7) Cyclotron is used to accelerate
a) Neutral particles
b) negative ions
c) positive ions
d) both b and c
8) GM counter cannot detect the $\qquad$ .
a) Protons
b) neutrons
c) beta particles
d) alpha particles
9) Which of the following is not correct statement
a) A deuteron can be disintegrated by irradiating it with gamma rays of energy 4 MeV .
b) A deuteron has no excited states.
c) A deuteron has no electric quadrupole moment.
d) The ${ }^{1} S_{0}$ state of deuteron cannot be formed.
10) The electromagnetic reactions are $\qquad$ .
a) C-conserving
b) C - non conserving
c) CP Non conserving but CPT conserving
d) CPT Non conserving
B) Write True or false.
11) According shell model set of magic numbers is $2,8,20,28,50,82,126$.
12) Isospin and third component of Isospin of proton is $1 / 2,1 / 2$ respectively.
13) Proton is made up of the two down and on up quarks.
14) Baryon number of $e^{+}$and $e^{-}$are 0,0 respectively.
15) Beta decays is the process of transition between two isobars.
16) Eigen values of the parity operator are +1 and -1 .

## Q. 2 Answer the following.

a) What is radioactivity? Explain the decays scheme in nuclides in brief.
b) Explain the basic properties (mass, size, shape, spin, binding energy etc.) of the nucleus.
c) What are the types of nuclear reactions. Comment on the conservations laws of nuclear reactions.
d) Describe the scintillation counter.

## Q. 3 Answer the following.

a) Derive the semi empirical mass formula. Discuss the advantages and 08 disadvantages of liquid drop model.
b) classify the elementary particles. Write short notes of conservation laws in elementary particles.

## Q. 4 Answer the following.

$\begin{array}{ll}\text { a) What are the comic rays. Explain the latitude effect and east- west } & 08 \\ \text { asymmetry. }\end{array}$
b) Explain the nuclear shell model in details. Hence derive the expression for 08
Q. 5 Answer the following.
a) What are the particle accelerator? Explain the principle and working of 08 cyclotron.
b) Deduce the expression for $Q$ value in nuclear reactions. Give its physical 08
significance.

## Q. 6 Answer the following.

$\begin{array}{lll}\text { a) } \begin{array}{l}\text { Derive the expression for the atomic number of stable isobar using the liquid } \\ \text { drop model. Hence solve the following problem find the stable isobar nuclide }\end{array} & \mathbf{0 8} \\ A=125 \text { (given } a c=0.7 \mathrm{MeV} \text { and } \text { asym }=22.5 \mathrm{MeV} \text { ). }\end{array}$

## Q. 7 Answer the following.

A) What are the particle detectors. Write short notes on 08
a) Scintillation detector
b) Semiconductor detector
B) Explain the following each type of nuclear reactions with example 08
a) Direct reactions
b) Nuclear transformation reaction
c) Nuclear fission
d) Nuclear fusion

# M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANO PHYSICS) Characterization of Nano Materials (MSC09403) 

Day \& Date: Wednesday, 20-12-2023
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 correct alternative.
1)
with energy dispersive X-ray analysis (EDAX) is a very useful tool for qualitative \& semi quantitative analysis of elements.
a) Scattering electron Microscopy
b) Scattering ion Microscopy
c) Scanning electron Microscopy
d) Scanning ion Microscopy
2) The energy dispersive $X$-ray spectroscopy (EDX or EDS) is technique used in analytical electron microscopy to determine $\qquad$ of the material.
a) Elemental composition
b) Morphology
c) Particle size
d) Particle shape
3) Which of the following are true for electron microscopy?
a) Specimen should be thin and dry
b) Image is obtained on phosphorescent screen
c) Electron beam must pass through evacuated chamber
d) all of the above
4) Raman shift depends upon $\qquad$ .
a) Incident intensity
b) Incident wavelength
c) Resolving power of spectrograph used
d) molecule energy level of scatterer
5) Young's modulus of perfectly rigid body is $\qquad$ .
a) Unity
b) Negative
c) Infinity
d) Zero
6) What is the wavelength range for UV spectrum of light?
a) $400 \mathrm{~nm}-700 \mathrm{~nm}$
b) $700 \mathrm{~nm}-10 \mathrm{~mm}$
c) $0.01 \mathrm{~nm}-10 \mathrm{~nm}$
d) $10 \mathrm{~nm}-400 \mathrm{~nm}$
7) What are the two the main technique for thermal analysis?
a) FTG \& DGG
b) TGA \& DTA
c) MSP and FCT
d) TSA and DGF
8) Raman effect is scattering of $\qquad$ .
a) Elastic scattering of photon
b) Elastic scattering of electron
c) Inelastic scattering of photon by molecule
d) Inelastic scattering of proton
9) A Microscope in which an image is formed by passing an electron beam through a specimen and focusing electrons by magnetic lens is called as $\qquad$ .
a) TEM
b) Optical
c) SEM
d) FESEM
10) X - rays are $\qquad$ .
a) deflected by an electric field but not by a magnetic field
b) deflected by a magnetic field but not by an electric field
c) not deflected by an electric field or a magnetic field
d) deflected by both magnetic both a magnetic field and an electric field
Q. 1 B) Write True / False 06

1) In Raman spectroscopy the radiation lies in the visible region.
2) Secondary electrons are useful for showing morphology and Topography of samples.
3) VIbrational transistion of molecule is related to UV-vis spectroscopy.
4) Young's modulus is the mechanical property of the material.
5) The resolution of SEM is greater TEM.
6) In STM the sample should be conducting.
Q. 2 Answer the following 16
a) Explain with neat diagram the construction of SEM.
b) A beam of $x$-rays is constructively scattered in second order from the surface of the crystal at an angle of $30^{\circ}$ and spacing between layers of atoms in NaCl crystal is $4.5 \times 10^{\wedge-10} \mathrm{~m}$. Determine the wavelength of X -ray.
c) Differentiate between SEM and TEM.
d) Write a note on electron gun.

## Q. 3 Answer the following.

a) Explain with neat diagram the construction and working of STM. 10
b) Write a note on defects in nanomaterials.

## Q. 4 Answer the following

a) What is the UV-Vis spectroscopy? Explain its working and sample Analysis 10 techniques.
b) Write a note on DPI. 06

## Q. 5 Answer the following

a) Explain in detail the principle, instrumentation and working of XRD. 10
b) Explain the limitations of XRD. 06
Q. 6 Answer the following
a) Explain with neat diagram the construction and working of EDAX/EDS. 08
b) Write a note Young's modulus and surface tension. 08

## Q. 7 Answer the following

a) Explain the photoluminence and excitation wavelength. 08
b) Write a note on TGA and quantum yield. 08
M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANO PHYSICS)
Nano Material Fabrication Techniques (MSC09408)
Day \& Date: Thursday, 21-12-2023
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) Select correct alternative from following.

1) Microscope that uses light rays to produce a dark image against a bright background is known as a $\qquad$ .
a) brightfield microscope
b) Darkfield microscope
c) electron microscope
d) Phase contrast microscope
2) The characterization of Auger spectroscopy can be achieved up to which of the following depths?
a) 2 nm
b) 1 nm
c) 4 nm
d) 8 nm
3) Electromagnetic energy is kept constant in.
a) Continuous wave NMR
b) Fourier Transform NMR
b) Both $a \& b$
d) discontinues wave NMR
4) types of waves has the shortest frequency?
a) X-ray
b) Radio waves
c) Microwave
d) UV
5) Which of the following wave has the shortest wavelength?
a) Radio waves
b) Visible
c) X -Ray
d) Infrared
6) Resolving Power of microscope is depends on wavelength as $\qquad$ .
a) $\lambda$
b) $1 / \lambda$
c) $1 / \lambda^{2}$
d) $\lambda^{2}$
7) Bending of light around a edge of obstacle and enters in shadow region is called $\qquad$ .
a) Diffraction
b) Interference
c) Polarization
d) Reflection
8) Basic principle of STM is $\qquad$ tunneling
a) Classical
b) Semi- classical
c) quantum
d) Both a and c
9) Which among the following microscopes uses light as the source of illumination?
a) Stereomicroscope
b) electron microscope
c) SEM
d) TEM
10) NMR is the study of absorption of $\qquad$ by nuclei in a magnetic field.
a) Radioactive Radiation
b) IR Radiation
c) Radio frequency Radiation
d) Microwaves
B) Answer Truel False. 06
11) In optical microscopy electromagnetic lenses are used.
12) Auger electron spectrum is plot of intensity versus kinetic energy.
13) A microscope of objective focal length 1 cm and an eyepiece of focal length 2.0 cm has a tube length of 20 cm . then magnification of the microscope is 250 .
14) AES is limited when it comes to very high resolution studies.
15) Signal splitting in NMR arises from spin- spin decoupling.
16) Electron spectroscopy is based on the ionization phenomenon.
Q. 2 Answer the following.
a) Write the notes on Electron microscopy
b) Explain the necessity of Ultra high vacuum in X- ray photoelectron spectroscopy.
c) Write down the application of AUGER Electron spectroscopy.
d) Discuss the NMR spectra
Q. 3 Answer the following. 16
a) What is airy disk and explain how the Rayleigh criteria used for limit of resolution.
b) Sketch and briefly describe the operating principles of the atomic force microscopy.
Q. 4 Answer the following.
a) State the limitation of optical microscopy. Write the advantages of electron microscopy over optical microscopy.
b) Explain the principle, operation, working of XPS

Q. 5 Answer the following.
a) Write note on contact and non contact modes of STM.
b) What are type of resonance spectroscopy? Write properties of nuclear spins.
Q. 6 Answer the following. ..... 16

a) Draw neat labeled diagram of Auger Electron Spectroscopy regarding
following points
i) electron energy analyzer
ii) electron detector
iii) electron optical column
b) Explain in detail principle, construction and working of AFM.
Q. 7 Answer the following.
a) Explain in detail principle, construction and working of STM.
b) Write down applications of STM in detail.

## SLR-EV-19

## Seat <br> No.

# M.Sc. (Semester - II) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) Quantum Mechanics (MSC09201) 

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.<br>2) Attempt any three questions from Q. No. 3 to Q. No. 7<br>3) Figure to right indicate full marks.

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

1) If $\Psi_{a}$ and $\Psi_{b}$ are said to be orthogonal to each other, then which of the following is true.
a) $\left\langle\Psi_{a} \mid \Psi_{b}\right\rangle=1$
b) $\left\langle\Psi_{a} \mid \Psi_{b}\right\rangle=\infty$
c) $\left\langle\Psi_{a} \mid \Psi_{b}\right\rangle=\sqrt{1 / 2}$
d) $\left\langle\Psi_{a} \mid \Psi_{b}\right\rangle=0$
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 $\qquad$ .
a) one
b) zero
c) half
d) two
4) The total energy operator or Hamiltonian operator is given by $H^{\wedge}=$ $\qquad$ .
a) $\quad \hat{p}^{2} / 2 m$
b) $\quad V(x)$
c) $\quad\left(\hat{p}^{2} / 2 m\right)+V(x)$
d) $\left(\hat{p}^{2} / 2 m\right)-V(x)$
5) Energy of harmonic oscillator is, $E=$ $\qquad$ .
a) $n \hbar \omega$
b) $(1 / 2) \hbar \omega$
c) $\quad(n+1 / 2) \hbar \omega$
d) $(n-1 / 2) \hbar \omega$
6) The eigen value of $L^{2}$ is $\qquad$ .
a) $l(l+1) \hbar^{2}$
b) $l(l-1) \hbar$
c) $l\left(l^{2}+1\right) \hbar^{2}$
d) $l(l+1) \hbar$
7) Which of the following is lowering operator $\qquad$ .
a) $L_{x}+i L_{y}$
b) $L_{x}-L_{y}$
c) $L_{x}-i L_{y}$
d) 0
8) The commutation relation between $\left[x, P_{x}\right]$ and ( $\left.\partial / \partial x, x\right]$ is $\qquad$ .
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) $[\hat{z}, \hat{p} z]=i \hbar$

## SLR-EV-19

10) Which of the following equations is/are correct?
i) $K=r \times p$
ii) $L=i L_{x}+j L_{y}+k L_{z}$
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.
11) Diffraction and interference are the evidence of wave nature of matter. (True/False)
12) Eigen values of Hermitian operator are not real. (True/False)
13) Inner product of Bra and Ket in Quantum mechanics is always 1. (True/False)
14) For a free particle the potential energy $V(x)=$ $\qquad$ .
15) Potential energy of a particle in harmonic oscillator having mass $m$ is $\qquad$ .
16) The linear momentum operator is given by $\qquad$ .
Q. 2 Answer the following.
a) Normalize the following wave- function in one- dimension:
$\psi(x)=A e^{-a x}$ for $x>0$
$=A e^{+a x}$ for $x<0$
where $\alpha$ 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.
Q. 4 Answer the following.
a) Obtain Schrödinger's wave equation for Hydrogen atom in terms of 10 spherical polar coordinates, express its radial and angular parts.
b) Define angular momentum and explain the commutation relation.
Q. 5 Answer the following.
a) What is momentum eigen function in the co-ordinate representation? 10 Elaborate.
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.
b) Describe the Pauli spin matrices.

## Q. 7 Answer the following.

a) Define square well potential in one dimension. Discuss motion of a particle10 of mass $m$ when energy of the particle is less than potential $\left(E<V_{0}\right)$.
b) Obtain eigen values of operators $L^{2}$ and $L z$.

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M.Sc. (Semester - II) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) Electrodynamics (MSC09202)

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.

1) Divergence of the curl of any vector field is always $\qquad$ .
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 $\qquad$ .
a) Similar to electric field
b) Opposite to electric field
c) Scalar quantity
d) None
4) The Poynting vector $P$ is equal to $\qquad$ .
a) E.H
b) $\mathrm{E} \times \mathrm{H}$
c) $\mathrm{E} / \mathrm{H}$
d) $\mathrm{H} / \mathrm{E}$
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 $\qquad$ .
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 $\qquad$ .
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 $\qquad$ .
a) Gauss law
b) Faradays law
c) Amperes law
d) Lorentz force law
9) Magnetic vector potential due to magnetic dipole is proportional to $\qquad$ .
a) $r$
b) $1 / r$
c) $1 / r^{2}$
d) $1 / r^{3}$
10) Electric Potential ( $\Phi$ ) of a quadrupole varies with distance ' $r$ ' on its axis as $\qquad$ .
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
11) The charge density of electrostatic field is given by $\qquad$ .
12) In dipole, the gauss theorem value will be $\qquad$ .
13) The Ampere law is based on $\qquad$ Theorem
14) The electric field over the gaussian surface remains continuous and uniform at every point.
15) In Biot-Savart's law, the magnetic intensity is product of the current.
16) The direction of a propagation of electromagnetic wave is $\bar{E} . \bar{B}$.

## Q. 2 Answer the following.

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 10
oblique incidence.
b) Elaborate the concept of displacement current. 06
Q. 4 Answer the following.
a) Explain in details of boundary condition between conductor and free 10 space.
b) Obtained the expression for the resistance for uniform field \&non-uniform fields.

## Q. 5 Answer the following.

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

## 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 (NANOPHYSICS) <br> Statistical Physics (MSC09206) 

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 $\qquad$ dimensional space.
a) 3 N
b) 6 N
c) N
d) 2 N
3) The statistics followed by half spin particles is $\qquad$ .
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 $\qquad$ .
a) Atoms
b) Molecules
c) Photons
d) Lattice
5) The equation of state for an ideal gas is represented as $\qquad$ .
a) $P V=R / T$
b) $P V=n R T$
c) $P / V=R / T$
d) $P V=R T$
6) The entropy of an ideal gas at absolute zero is $\qquad$ .
a) $\infty$
b) 0
c) $N k B$
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 $\qquad$ .
a) Internal energy
b) Entropy
c) Thermal Capacity
d) Enthalpy
9) Pressure at the critical point is $\qquad$ .
a) $3 b$
b) $8 / 27 R$
c) $3 b / 27 R b$
d) $8 a / 27 R b$
10) In microcanonical ensembles following parameters remain constant.
a) $T V N$
b) $E V N$
c) $E V T$
d) $E V \mu$
B) Fill in the blanks OR write true/ false.
11) The ratio of the universal gas constant and Avogadro's number is called the velocity constant.
12) The transition in $\beta$-brass is an example of a second-order phase transition.
13) Photon, Phonon, etc. obeys the Fermi Dirac distribution function.
14) Entropy in thermodynamics is a measure of the disorder of the system.
15) The value of the universal gas constant is 8.3143
16) A phase space is a six-dimensional space.
Q. 2 Answer the following.
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.

$\begin{array}{ll}\text { a) Show that Gibb's function is continuous during the first-order phase } & 10 \\ \text { transition, but the first derivative of Gibb's function changes } \\ \text { discontinuously. }\end{array}$
b) What is a triple point? Explain it with the help of a phase diagram.
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 08 ensembles.

## Q. 6 Answer the following.

a) Show that the average energy of a single particle of ideal fermi gas is 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 10
Fermi gas.
b) Write about black body radiation. 06

# M.Sc. (Semester - III) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS ( NANOPHYSICS) <br> Semiconductor Physics (MSC09301) 

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.

1) In a semiconductor, the energy gap between the valence band and conduction band is about $\qquad$ _.
a) 5 eV
b) 10 eV
c) 15 eV
d) 1 eV
2) Electron-hole pairs are produced by $\qquad$ .
a) Recombination
b) Thermal energy
c) Ionization
d) Doping
3) The drift velocity of the conductor $\qquad$ .
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 $\qquad$ .
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 ( $>\mathrm{OK} \mathrm{)} \mathrm{is}$ $\qquad$ -.
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) $\quad \sigma=1 / J E$
c) $\sigma=E / J$
d) $\sigma=E J$
7) The equilibrium number of EHP in pure Si at room temperature is about $\qquad$ .
a) $10^{10} \mathrm{EHP} / \mathrm{cm}^{3}$
b) $10^{12} \mathrm{EHP} / \mathrm{cm}^{3}$
c) $10^{10} \mathrm{EHP} / \mathrm{m}^{3}$
d) $10^{12} \mathrm{EHP} / \mathrm{m}^{3}$
8) The atoms of solid are held together by $\qquad$ .
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 $\qquad$ seconds.
2) LED is an example of $\qquad$ luminescence.
3) $\qquad$ nuclei often redissolve.
4) $\overline{\text { Nucleation poses large energy barrier. (True/False) }}$
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.
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 10 Melting.
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 band10diagrams.
b) Explain the bonding forces in solids. 06

