Seat No.			Set	t P		
M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023 PHYSICS (MATERIALS SCIENCE) Mathematical Physics (2321101)						
			riday, 05-01-2024 Max. Mark M To 05:30 PM	(s: 60		
Instru	uctio		 All questions are compulsory. Figures to the right indicate full marks. 			
Q.1	A)		The value of $\int_{-\pi}^{\pi} \cos(mx) \sin(nx) dx = $ a) 1 b) $a - 1$	08		
		2)	c) 0 d) π 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 aor singularity of the function.a)Scalar pointb)Singular pointc)Non-singulard)None of these			
		4)	Find the pole of $f(z) = \sin \frac{1}{(z-a)} = \underline{\qquad}$. 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) orthogonalb) oddc) evend) 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 0b) 0 and 1c) 0 and -1d) 0 and 2			
	B)	Fill 1) 2) 3) 4)	in the blanks OR write true/false. Fourier transform is a linear operator. (True/ False) Inverse of unitary matrix is unitary matrix. (True/ False) A square matrix is called orthogonal if $A = A^{-1}$. (True/ False) $x \frac{\partial u}{\partial x} + t \frac{\partial u}{\partial t} = 2u$ is on ordinary differential equation. (True/ False)	04		

1 Seat

Page 2 of 2

Q.2 Answer the following. (Any Six)

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

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

Find the pole of $f(z) = \frac{\sin(z-a)}{(z-a)^4}$ e)

Show that inverse of an orthogonal matrix is orthogonal. f)

g) Solve
$$\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$$

Define singular point, explain in details its types with example. h)

Q.3 Answer the following. (Any Three)

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

Q.4 Answer the following. (Any Two)

Write matrix A gives below as the sum of symmetric & a skew symmetric a) 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
- Evaluate the following integral using residue Theorem. C) $\int_{C} \frac{1+z}{z(2-z)} dz$ 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; $x \frac{dy}{dx} + y \log y = xy e^x$
- Solve the differential equation. C)

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

12

12

12

M.Sc	:. (Se	emester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023 PHYSICS (MATERIALS SCIENCE) Solid State Physics (2321102)
		nday, 07-01-2024 Max. Marks: 60 1 To 05:30 PM
ructio) All questions are compulsory.) The figure to right indicate full marks.
A)	Cho 1)	ose the correct alternative.08Conductivity of metals depends upona) The nature of the materialb) Number of free electronsc) Resistance of the metald) 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

- d) None of the above
- Which of the following is a property of a superconductor?
 a) Perfect diamagnetism
 b) High electrical conductivity
 c) Low electrical conductivity
 d) Non-zero resist 8)
- High electrical resistance Non-zero resistivity

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Q.1

	B)	 Fill in the blanks OR write true / false. 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. 	04
Q.2	Ans a) b) c) d) e) f) g) h)	wer the following. (Any Six). What is Curie Temperature? Define diamagnetic materials. Define specific heat. What is orientational polarization? What is an extrinsic semiconductor? What is penetration depth? State the concept of ferroelectricity. Define Neel temperature.	12
Q.3	Ans a) b) c) d)	wer the following (Any Three) Explain in Brillouin zones in 2-D. Write about the direct and indirect band gap of semiconductors. Explain Meissner's effect. Write a note on the conductivity of solids.	12
Q.4	Ans a) b) c)	wer the following (Any Two) Electronic polarization Explain the Kronig-Penny model. Explain the thermodynamics of superconductors.	12
Q.5	Ans a) b)	wer the following (Any Two) Write the difference between metal, semiconductors and insulators. Write a note on Josephson's tunnelling and its theory.	12

c) Explain the Clausius-Mossotti equation

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	M.S	c. (Se	emester - I) (New) (NEP CBCS) Examination: Oct/ PHYSICS (MATERIALS SCIENCE) Analog and Digital Electronics (231106)	Nov-2023	
			esday, 09-01-2024 To 05:30 PM	Max. Marks	s: 60
Instr	uctio) All Questions are compulsory.) Figure to right indicate full marks.		
Q.1	A)		 bse correct alternative. (MCQ) 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 	<u>-</u> -	08
		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) Currentb) Voltagec) Powerd) Resistance		
		4)	The op-amp comparator circuit usesa) Positive feedbackb) Negative feedbackc) Regenerative feedbackd) 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 mentioner	d	
		6)	 What happen if any positive input signal is applied to open-logal 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 	op configura	ition?
		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 operat a) 2 b) 3 c) 4 d) 5	es	
	B)	1) 2) 3)	n the blanks OR Write True /False. The data in stack is called Circuit is used as signal source in all sort of applicatio bit program counter is available in 8085. The voltage gain of a voltage buffer is	n.	04

12

Q.2 Answer the following. (Any Six)
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.
a) What is dynamic shift register.

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

Seat No.

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

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

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
 - 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

Tuning of the refractive index with the density of the films is possible 3) by sputtering.

- a) Magnetron b) DC
- d) RF c) lon beam

The main problem in questionnaire is . 4)

- 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
- Technique that allow several members of a hiring company to 6) 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 d) All of the above
 - c) Ordinal
- 8) By selecting laser operating conditions, control over microstructure is
 - a) possible
- b) impossible
- c) not defined d) both a) and b)

Max. Marks: 60

08

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	B)	 Fill in the blanks OR Write True or False: 1) In E-beam evaporation, only the target is heated and not the crucible. (True/False) 	04
		 2) In thermal evaporation, films in the thickness range of angstroms to microns are obtained. (True/False) 	
		 Applied research is conducted to solve practical problems. (True/False) 	
		 The basic research is also called as fundamental research. (True/False) 	
Q.2	Ans	swer 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	Ans	swer 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	Ans	swer 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	Ans	swer 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.	

Seat No.				Set P
	M.Sc.	(Semester - I) (Old) (CBCS) PHYSICS (MATER Mathematical Phys	IALS	S SCIENCE)
		riday, 05-01-2024 M To 06:00 PM		Max. Marks: 80
Instru	ctions:	 All questions are compulsory. Figures to the right indicate full 		ırks.
Q.1 /	A) Cho 1)	pose correct alternative. The product of a singular matri a) a unit matrix c) an orthogonal matrix	b)	a null matrix
	2)	What is the value of a_0 in the F - $\pi < t < \pi$? a) 0 c) $\pi^2/_8$		er series of t^2 in the interval $\frac{\pi^2}{_3}$ $\frac{\pi^2}{_4}$
	3)	If A and B are orthogonal matri a) symmetric c) orthogonal	b) d)	antisymmetric unitary
	4)	Evaluate the integral $\int_{0}^{2\pi} \frac{s}{5+1}$ a) 2π c) $\frac{\pi}{2}$	b)	
	5)	The value of $\int_{-\pi}^{\pi} \cos(mx) \sin(mx)$ a) 1 c) 0	nx) d b) d)	-1
	6)	If $ z^2 - 1 = z^2 + 1$ then z lies a) the real axis c) a circle		the imaginary axis on ellipse
	7)	Find the pole of $f(z) = \sin \frac{1}{(z-a)}$ a) $z = a$ c) $z = 1$	b)	z = 0 z = 4
	8)	In Cauchy's Residues theorem a) $2\pi i \sum_{j=1}^{n} a_{-1} z_j$ c) $2\pi i \sum_{j=1}^{n} a_{+1} z_j$	b)	$ \begin{aligned} z &dz = \underline{\qquad} \\ 2\pi i \\ 2\pi i \sum_{j=1}^{n} \end{aligned} $

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.

- 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.

- 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 $x \frac{dy}{dx} + y \log y = xye^x$ 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.

b) Determine the poles of the function z, $f(z) = \frac{1}{z^4 + 1}$ **08**

06

Q.5 Answer the following.

Q.6

Q.7

,	a)	swer the following. $dy = a^{(x)}$	08
	,	Solve $\sin x \frac{dy}{dx} + 2y = \tan^3\left(\frac{x}{2}\right)$	
	b)	Verify Cayley - Hamilton Theorem for the following matrix.	80
		$A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix} \text{ and use the theorem to find } A^{-1}$	
;	Ans	swer the following.	
	a)	Find the order of each pole and residue of $\frac{1-2z}{z(z-1)(z-2)}$	80
	ь.)		<u> </u>
	b)	Show that the eigen value of Hermitian matrix are real.	08
,	Ans	swer the following.	
	a)	In square wave expand the function.	08
		$f(x) = 0; \ -\pi \le x \le 0$	
		$f(x) = 4; -0 \le x \le \pi$ Fourier.	
	b)	Explain Laplace transform of Derivatives.	80

Seat No.			Set	Ρ
М	.Sc.	(Semester - I) (Old) (CBCS) Examination: Oct/Nov-2 PHYSICS (MATERIALS SCIENCE) Solid State Physics (MSC03102)	023	
		Inday, 07-01-2024 Ma I To 06:00 PM	x. Marks	: 80
Instructio	2) 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)	Cho 1)	Dose the correct alternative.Effective mass is equal to mass for free electron.a) Meanb) realc) Residuald) zero		10
	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 zonal a) 1^{st} b) 2^{nd} c) $3rd$ d) 0^{th}	one.	
	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 variable \overline{a} T b T^2 c T^3 d $1/T$	ries as	

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

Fill in the blanks OR Write True or False

B)

Seat No.			Set	Ρ
	M.Sc.	(Semester - I) (Old) (CBCS) Examination: Oct/No PHYSICS (MATERIALS SCIENCE) Analog and Digital Electronics (MSC10103)	v-2023	
		lesday, 09-01-2024 1 To 06:00 PM	Max. Marks	: 80
Instructi	2) 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)	Cho 1)	ose correct alternative. (MCQ)The basic SR flip-flop can be constructed by cross coupling which of the gates?a)AND or OR gateb)XOR or XNOR gatec)NOR or NAND gated)AND or NOR gate	by using	10
	2)	In JK flip-flop "no change" condition appear when a) $J = 1, K = 1$ b) $J = 0, K = 0$ c) $J = 1, K = 0$ d) $J = 0, K = 1$		
	3)	Which is the 16-bit register for 8085 microprocessor? a) Stack pointer b) Accumulator c) Register B d) Register C		
	4)	 The feedback path in an op-amp integrator consists of a) A resistor b) A capacitor c) A resistor and capacitor in series d) A resistor and capacitor in parallel 		
	5)	 Multiplexer has a) Many input and one output b) One input many output c) Many input and many out put d) One input and one output 		
	6)	 The op-amp comparator circuit uses a) Positive feedback b) Negative feedback c) Regenerative feedback d) No feedback 		
	7)	Op- amp is a type of amplifier a) Current b) Voltage c) Power d) Resistance		
	8)	An XOR gate can be used fora) Inverter and non-inverterb) Only inverterc) Only non-inverterd) None of the above		

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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

- 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

- 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) b)	Draw and explain architecture of 8085 microprocessor. Explain Multiplexers and Demultiplexers.	10 06
Q.4	Ans	swer 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	Ans a) b)	wer the following. Explain the operation of three op-amp instrumentation amplifier. Define Oscillators? Explain their types.	10 06
Q.6	Ans	swer 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	Ans	swer the following.	
	a)	Explain the instruction set of 8085 microprocessor.	10
	b)	Draw and explain memory read cycle of 8085 microprocessor.	06

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No.				Set	Ρ		
	M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023 PHYSICS (MATERIALS SCIENCE) Classical Mechanics (MSC03108)						
			ay, 11-01-2024 06:00 PM	Max. Marks	s: 80		
Instru	iction	2) Atte	Nos. 1 and. 2 are compulsory. empt any three questions from Q. No. 3 to Q. No. 7 ure to right indicate full marks.				
Q.1	,	1) The	correct alternative. e position of a particle at any time t subjected to resistive $x = k. (1 + e^{-kt})/v_o$ b) $x = kv_o(1 - e^{-kt})$ $x = v_o(1 - e^{-kt})/k$ d) $x = kv_o(1 + e^{-kt})$	e force is	10 		
		2) The a)	e rate of momentum change of an open system is equal T + MU b) $F - MVW - MV$ d) $F + MU$	to			
		́a)	e reduced mass of two bodies into equivalent one body $(m_1 + m_2)/(m_1.m_2)$ b) $(m_1.m_2)/(m_1 - m_2)$ $m_2/(1 + m_2/m_1)$ d) $m_1/(1 + m_2/m_1)$	is			
		́a)	e time derivative of generalized co-ordinate is Generalized force b) Generalized velocity Generalized momentum d) None of these				
	;) a)	$\varepsilon E > 0$ and $\varepsilon > 1$, the nature of the orbit is Circle b) Parabola Ellipse d) Hyperbola				
) a)	e generalized momentum is equal to $\frac{\partial L}{\partial q_j}$ b) $\frac{\partial L}{\partial \dot{p}_j}$ $\frac{\partial L}{\partial \dot{q}_j}$ d) $\frac{\partial L}{\partial p_j}$				
		a)	ich of the following defines a conservative force <i>F</i> ? $dF/dt = 0$ b) $\nabla F = 0$ $\nabla \times F = 0$ d) $\oint F. dr = 0$				
		a)	sson brackets are under canonical transformati Variant b) nullified anti-symmetric d) invariant	on.			
		a) b) c)	neralized coordinated are independent of each other depend on each other are always cartesian coordinates are always spherical polar coordinates				
		a) b) c)	$e_{F_2} = \sum q_k P_k$ transformation defined as generates exchange transformation generates identity transformation is not canonical transformation None of the above				

	B)	 Fill in the blanks or write true /false. 1) Scleronomic constraint do not explicitly depends on time. (True/False) 2) q_j's which are absent in <i>L</i> 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] = 	06
Q.2	An a) b) c) d)	 swer the following questions. Which conditions are used to verify that the transformation is canonical? Prove any one condition. Prove that forces acting on a particle are conservative then the total energy <i>E</i> of a particle is conserved. Distinguish between the configuration space and phase space. Define Hamiltonian. Give its physical significance. 	16
Q.3	An a) b)	 swer the following. Derive the equation of motion of a particle and deduce the acceleration of Atwood machine under constant force. Obtain the equation of motion of 1) a particle subjected to a resistive force 2) a projectile (no resistance) 	10 06
Q.4	An a) b)	swer the following. Derive the formula for Rutherford scattering cross-section. Derive an equivalent equation for reduction to one body problem from two body problem.	10 06
Q.5	a)	swer the following. State the Kepler's laws of planetary motion and prove the Kepler's third law. Deduce the Lagrange's equation of motion from Hamilton's principle and using derive the generalized momentum.	10 06
Q.6		swer the following. Derive canonical equations of Hamilton. Also write the procedure for constructing Hamiltonian. Obtain Hamilton's equation for one dimensional harmonic oscillator.	10 06
Q.7	a)	swer the following. State and prove Poisson's theorem. Prove the Jacobi identity $[V, [V, W]] + [V, [W, U]] + [W, [U, V]] = 0$	10 06

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

Q

Q

b) Prove the Jacobi identity [V, [V, W]] + [V, [W, U]] + [W, [U, V]] = 006

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Set

Seat	
No.	

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

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

Instructions: 1) Q. Nos. 1 and. 2 are compulsory.

3) Figure to right indicate full marks.

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

- If Ψ_a and Ψ_b are said to be orthogonal to each other, then which of 1) the following is true.
 - a) $\langle \Psi_a | \Psi_b \rangle = 1$ b) $\langle \Psi_a | \Psi_h \rangle = \infty$
 - d) $\langle \Psi_a | \Psi_h \rangle = 0$ c) $\langle \Psi_a | \Psi_h \rangle = \sqrt{1/2}$
- 2) If two operators do not commute with each other, then which of following statement is true.
 - They do not share common eigenfunction. a)
 - They do share common eigenfunction. b)
 - Their eigenvalues are same. c)
 - d) They must anti-commute.

The minimum energy of particle confined to one dimensional rigid box 3) is obtained by substituting *n* equal to

- a) one b) zero
- c) half d) two

4) The total energy operator or Hamiltonian operator is given by $H^{\wedge} = \dots$.

a) $\hat{p}^2/2m$ b) V(x) $(\hat{p}^2/2m) + V(x)$ $(\hat{p}^2/2m) - V(x)$ c) d) 5) Energy of harmonic oscillator is, E = $(1/2)\hbar\omega$ nħω a) b) $(n + 1/2)\hbar\omega$ d) $(n - 1/2) \hbar \omega$ C) The eigen value of L^2 is _____. 6) $l(l+1)\hbar^{2}$ b) $l(l-1)\hbar$ a) $l(l^2 + 1)\hbar^2$ $l(l+1)\hbar$ c) d) Which of the following is lowering operator _____. 7) $L_{r} + iL_{v}$ b) $L_x - L_v$ a) $L_x - iL_y$ c) d) 0 8) The commutation relation between $[x, P_x]$ and $(\partial/\partial x, x]$ is a) *i*ħ, 0 b) 0,*i*ħ $-i\hbar$, 1 d) *i*ħ, 1 c)

9) Which of the following equation is correct? a)

- $[\hat{y}, \hat{p}z] = i\hbar$ $[\hat{x}, \hat{p}y] = i\hbar$ b)
- $[\hat{z}, \hat{p}x] = i\hbar$ $[\hat{z}, \hat{p}z] = i\hbar$ c) d)

Max. Marks: 80

²⁾ Attempt any three questions from Q. No. 3 to Q. No. 7

- 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) $L^2 = L_x^2 + L_y^2 + L_z^2$
 - i and ii only a) i, ii and iv are correct c)

iii and iv only are correct b) All are correct d)

- B) Fill in the blanks or Write True /False.
 - Diffraction and interference are the evidence of wave nature of 1) 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 mis
 - The linear momentum operator is given by . 6)

Q.2 Answer the following.

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

where α is a positive constant.

- Prove that eigen function of Hermitian operator with different eigen values b) are orthogonal to each other.
- Explain unitary transformation. C)
- Define the different postulate of Quantum mechanics. d)

Q.3 Answer the following.

- Derive the time independent Schrödinger equation in 3D. a) 10 06
- Deduce the continuity equation. b)

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.	06

Q.5 Answer the following.

- What is momentum eigen function in the co-ordinate representation? 10 a) Elaborate. 06
- Write down the co-ordinate and momentum representation. b)

Q.6 Answer the following.

- What is the Clebich Gordon coefficient? Explain the construction procedure. 10 a) With simple examples. 06
- Describe the Pauli spin matrices. b)

Q.7 Answer the following.

- Define square well potential in one dimension. Discuss motion of a particle 10 a) of mass m when energy of the particle is less than potential $(E < V_0)$. 06
- Obtain eigen values of operators L^2 and Lz. b)

06

Electrodynamics (MSC03202)							
Time	Day & Date: Tuesday, 19-12-2023 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. Max. Marks: 80						
Q.1	A)						
		2)	Which one of the fundamental form the basis of electromagnea) Faraday lawc) Gauss law of electrostatic	b) Ampere law			
		3)	Lorentz electric force has direc a) Similar to electric field c) Scalar quantity	ction b) Opposite to electric field d) None			
 4) The Poynting vector P is equal to a) E.H b) E × 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 b) Wave length 		b) E × H					
		J?					
		6)	In the skin definition of skin of amplitude reduces to a) Nearly one fifth c) One half	depth, it is distance over which field b) 1/e d) One fourth			
		7)	In Maxwell equation $\nabla \times H = J$ a) Electric flux density				

M.Sc. (Semester - II) (New) (CBCS) Examination: Oct/Nov-2023 **PHYSICS (MATERIALS SCIENCE)** Electrodynamics (MSC03202)

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- c) Surface current density
- d) No physical quantity

		8)		w which governs the inte arge matter	raction of	th	e electromagnetic field with	
				Ğauss law	b)		Faradays law	
			c)	Amperes law	d)		Lorentz force law	
		9)		agnetic vector potential d	ue to magi	ne	etic dipole is proportional	
			a)	 r	b)		1/r	
			c)	1/r ²			1/r ³	
		10)		ectric Potential (Φ) of a q is as	uadrupole	÷ ۱	varies with distance ' r ' on its	
			a)	$\Phi: r^{-1}$	b)		$\Phi: r^{-2}$	
				$\Phi: r^{-3}$, d)		$\Phi: r^{-2}$ $\Phi: r^{3/2}$	
	B)	Fill i	in th	ne blanks OR Write Ture				06
		1)		e charge density of elect				
		2)		dipole, the gauss theorer				
		3)		e Ampere law is based o				
		4)		iform at every point.	aussian si	JĽ	face remains continuous and	
		5)			anetic inte	en	sity is product of the current.	
		6)		e direction of a propagati				
Q.2	Δns	wert	the	following.				16
Q.2	a)			Maxwell's displacement	current?			10
				note on Skin effect and s		?		
				the concept of Thomson			on?	
	d)	State	e th	e boundary condition for	an electro	s	tatic field \overline{E} .	
Q.3	Ans			following.				
	a)			the "Reflection and refra incidence.	ction" of e	ele	ectromagnetic waves at	10
	b)		•	te the concept of displace	ement curi	re	nt.	06
~ 4	A			fallouing				
Q.4	Ans a)			following. in details of boundary co	ndition bet	tw	een conductor and free	10
	u)	spac						10
	b)	•	aine	d the expression for the r	resistance	f	or uniform field &non-uniform	06
Q.5	Ans	wer 1	the	following.				
	a) b)	Deri	ve a			ele	ectric and magnetic field.	10 06

Q.6	Ans a) b)	swer the following. Derive the general expression for electromagnetic energy. Discuss Electromagnetic plane waves in stationary medium?	10 06
Q.7	Ans a) b)	swer the following. Explain the concept of radiation from a half wave antenna. What is Gauss law? Explain differential form of its.	10 06

Statistical Physics (MSC03206) **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. Which law of thermodynamics is the law of conservation of energy? 1) a) First b) Second c) Zero d) Third 2) The phase space is _____ dimensional space. a) 3N b) 6N d) c) N 2N The statistics followed by half spin particles is _____. 3) a) Maxwell-Boltzmann Statistics b) Fermi-Dirac Statistics c) Bose-Einstein Statistics d) None of the above Maxwell-Boltzmann statistics cannot be applied to _____. 4) a) Atoms b) Molecules c) Photons d) Lattice The equation of state for an ideal gas is represented as 5) a) PV = R/Tb) PV = nRTd) PV = RTc) P/V = R/T6) The entropy of an ideal gas at absolute zero is . a) ∞ b) 0 d) Cannot be calculated c) NkB

For which gas mutual interaction between the molecules is zero. 7) Fermi

- a) real b) c) Ideal d) Bose
- Total heat of the substance is also known as _____. 8)
 - a) Internal energy b) Entropy Enthalpy

c) Thermal Capacity d)

Pressure at the critical point is 9)

a) 3b b) 8/27R d) c) 3b/27Rb8a/27Rb

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

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

Max. Marks: 80

SLR-EN-13

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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.

- 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

06

- 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.

Q.10	/	ine renering.	
	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	Ans	wer the following.	
	a)	Write a note on Critical Indices	10
	b)	Write about Liouville's theorem in a classical presentation.	06
Q.5	Ans	wer the following.	
	a)	Write about Second order phase transition.	08
	b)	Write a note on microcanonical, canonical and grand canonical ensembles.	08
Q.6	Ans	wer 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	Ans	wer 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 (MATERIALS SCIENCE)						
	Semiconductor Physics (MSC03301)						
	Day & Date: Friday, 05-01-2024Max. Marks: 80Time: 11:00 AM To 02:00 PM						
Instr	uctio	2) Q. (1) and (2) are compulsory.) Attempt any three from Q. No. 3 to Q. I) Figure to right indicate full marks.	No. 7			
 Q.1 A) Choose the correct alternative. 1) In a semiconductor, the energy gap between the valence band and conduction band is about 							
			a) 5 eV b) c) 15 eV d)				
		2)	Electron-hole pairs are produced bya) Recombinationb)c) Ionizationd)	6,			
	 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 			perature erature nperature			
 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 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 fir 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		1					
		ng medium? $\sigma = 1/JE$					
		10 ¹² EHP/cm ³					
		8)	The atoms of solid are held together bya)Van der Waals forcesb)c)Ionic bondsd)	Hydrogen bonds			
		9)	What is the role of seed crystal in crysta)Nucleation centerb)c)Solventd)	Catalyst			

Seat No.

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Set P

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

		10)	Chai a) b) c) d)	ge carriers can mo Diffusion mechanis Floating mechanis Drift mechanism Both drift and diffus	sm m			
	В)	1) 2) 3) 4) 5) 6)	The LED Nucl Mob (True Deb	blanks OR Write t mean lifetime of ele is an example of _ nuclei often redis eation poses large ility cannot be deter e/False) /e temperature is as tion. (True/False)	ectron-hole pair (luminescer solve. energy barrier. (mined from Hay	nce. True/False) mes-Shockley exp	eriment.	06 ds.
Q.2	Ans a) b) c) d)	Explai Write a	a no n fer a sho	lowing te on optical absorp mi level pinning. ort note on group ve short direct bandga	elocity of electro			16
Q.3	Ans a) b)		rate	lowing n detail about the o short about Nucleat				10 06
Q.4	Ans a) b)	•	n the	lowing e concept of vibratic ef about inverse eff	•		pression.	10 06
Q.5	Ans a) b)	Melting.						10 06
Q.6	Ans a) b)	•	n the	lowing e concept of steady ef about vapour ph	•	neration.		10 06
Q.7	a)	diagra	n in ms.	detail about rectifyir	•	the necessary bar	nd	10
	b)	Explai	n the	e bonding forces in a	solids.			06

Set

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Seat	
No.	

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

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

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.

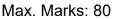
- 1) In computing the splitting of spectral lines in a weak magnetic field the lande g-factor arises because of _____.
 - a) Pauli Exclusion Principle b) spin-orbit coupling
 - c) larmor precession d) relativistic correction
- 2) Laser cooling of atoms is produced due to _____.
 - a) Absorption of photons by atoms
 - b) scattering of photons by atoms
 - c) Transfer of momentum from photon to atoms
 - d) transfer of energy from photons to atoms.
- 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*10⁻³⁴Js C=3*10⁸m)
 - 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) ⁴ F _{3/2}	b)	⁴ F9/2
c) ⁴ 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) 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



Page 2 of 2

- Which of the following molecule will not show the microwave spectra. 9)
 - a) CH_2CI_2 b) SF₆ c) H_2O d) CH₃CI
- 10) The lowest vibrational energy is given by .
 - a) $\frac{1}{2}\omega$ b) ω
 - ω^2 c) $\frac{1}{2} \omega^2$ d)

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

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

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 12 gerlach experiment.
- b) The spin orbit coupling constant for the upper state of Na atom which emits 04 D lines for weak numbers 16959cm-1 and 1697.4cm-1 is?

Answer the following. Q.4

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

Q.5 Answer the following.

- a) Write the consequences for bond elasticity for diatomic molecule as a non-12 rigid 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 04
- **b)** The land's g factor for the ${}^{3}P_{1}$ level of an atom is? {91}.

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 J, mj is? {55}

06

Set

Seat No.

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

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

Instructions: 1) Question no. 1 and 2 are compulsory.

- 2) Attempt any three guestions from Q. No. 3 to Q. No. 7.
- 3) Figure to right indicate full marks.

Q.1 A) Multiple choice questions.

- DC sputtering cannot be used for deposition of 1)
 - a) Metal b) Allov
 - c) Oxide d) All above
- 2) The sticking coefficient depends on
 - a) Substrate temperature Substrate area b)
 - c) Substrate shape d) None of the above

3) The atmospheric pressure is equal to

- a) 760 Torr
- b) 1 Torr
- c) 7.6 Torr
- d) 76 Torr
- 4) In physisorption due to adsorption of the adsorbate molecules the electronic structure of the surface atoms
 - a) Changes irrespective of the adsorbate concentration
 - b) Does not change irrespective of the adsorbate concentration
 - c) Changes with respect to the adsorbate concentration
 - d) None of the above
- The capillary nucleation theory considers the 5)
 - a) Interface energy of the film and substrate
 - b) Roughness of the Substrate
 - c) Melting point of the Substrate
 - d) All of the above
- In resistive evaporation the filaments are usually made of 6) refractory metals such as Tungsten or Tantalum mainly because of their
 - a) Melting point
- Conductivity b)
- d) Hardness c) Ductility
- Mechanically _____ Microstructure results in rough morphology. 7) a) strong
 - b) weak
 - c) forced d) strained

Ρ

08

Max. Marks: 80

		8)	a)	gas cooli Continuous	ng is required	for t b)		e Roots pump. nfinite	
			c)	No		d)	C	Dxygen	
	B)	State		ue or False.					08
		1) 2)	MB		VD we may ge ition technique			oon impurity. rowing epitaxial film in ambient	
		3)		v nucleation	rate results int	o de	ерс	osition of thin film of large grain	
		4)		ctrodepositio strates.	n can be used	d to d	de	posit only conducting	
		5)		Leod gauge o cuum.	can be used fo	or co	ont	tinuous measurement of	
		6) 7)	In c	chemisorptior	VD we may ge n, a strong che or molecule a	emic	cal	bond is formed between the	
		8)	lon	pump is nois	se free				
Q.2	Writ a) b) c) d)	Titan Spra Ion p	ium y py latir	nswers. sublimation rolysis ng coefficient	pump				16
Q.3	Ans a) b)	Desc	ribe		rent types of s generated in	•		•	10 06
Q.4	Ans a) b)	Expla para	ain l met	ers affect the	film growth?		-	oosition and deposition ages of CVD over PVD?	10 06
Q.5	Ans a) b)	Desc	ribe	following. e in brief diffe mportance o	rent types of C f ALD.	CVD).		10 06
Q.6	Ans a) b)	Desc	ribe		les of rotary, d ent vacuum ga			on and turbo molecular pump. ?	10 06
Q.7	Ans a) b)	Desc	ribe				•	cal properties of thin films. ss measurement.	10 06

-			Γο 02:00 PM	3.00		
Instr	uctio	2	Q. Nos. 1 and. 2 are compulsory. Attempt any three questions from Q. No. 3 to Q. No. 7 Figure to right indicate full marks.			
Q.1	A)	Cho 1)	se the correct alternative.The error caused by poor calibration of the instrument is calleda) Random errorb) Systematic errorc) Gross errord) Precision error	10		
		2)	What is the average velocity of the molecules of an ideal gas? a) Infinity b) Constant c) Unstable d) Zero			
		3)	 X-ray diffractometers provide information about the compounds present in a solid sample. a) Quantitative b) Qualitative c) Quantitative and qualitative d) Either quantitative or qualitative 			
		4)	In the Hall Effect, the electric field is in X direction and the velocity is in Y direction. What is the direction of the magnetic field? a) X b) Y c) Z d) XY Plane			
		5)	 In which of the following ways, absorption is related to transmittance? a) Absorption is the logarithm of transmittance b) Absorption is the reciprocal of transmittance c) Absorption is the negative logarithm of transmittance d) Absorption is a multiple of transmittance 			
		6)				
		7)	 The temperature of gas is held constant, while its volume is decreased The pressure exerted by the gas on the wall of the container increases because its molecules a) Strike the walls with higher velocities b) Strike the walls with large force c) Strike the walls more frequently d) Are in contact with the walls for a shorter time 			
		8)	Which mathematical method is used in X-ray crystallography?			

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

Seat

Day & Date: Tuesday, 09-01-2024

No.

SLR-EN-20

Set

Max. Marks: 80

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- b) Laplace Transform
 - Fourier Transform a) Partial differentiation c)
- d) Geiger method

		9)		voltage is zero when the Extrinsic P type	semicondu b) d)		
		10)	repr	e representation of Beer La resents absorption, 'b'repr centration, what does 'a' r Intensity Absorptivity	esents dis	w is given as A = abc. If 'A' tance and 'c' represents Transmittance Admittance	
	B)	Writ 1) 2) 3) 4) 5) 6)	A sy The Cera Zero In Ha mag	Je/ False. stem will be error free if w degree of freedom of a tria amics are employed to pro error is an indication of in	e remove a atomic gas tect the inf astrumenta	all systematic error. s is 6. frastructure from heat.	06
Q.2	Ans a) b) c) d)	State State Wha	e the e and t are	Ilowing. postulates of kinetic theory derive Beer Lambert law. the different X-ray camera e refractive index of thin fil	as and whe	ere are they used?	16
Q.3	a)	, , , , , , , , , , , , , , , , , , , ,					
	b)	•		• •			80
Q.4		deter swer t Expla	rmina he fo ain th	• •	onductors.		08 08 08
	Ans a) b)	deter swer t Expla Wha swer t Expla Desc	rmina he fo ain th t is a he fo ain th cribe t	ntion of band gap of semice bllowing. The functioning of a vacuum	onductors. pump. working a ump.	nd applications.	08
	Ans a) b) Ans a) b)	deter swer t Expla Wha swer t Expla Desc Phot swer t Expla Using	rmina he fo ain th t is a he fo ain th cribe to olumi he fo ain th g the	ntion of band gap of semication of band gap of semication le functioning of a vacuum spectrometer? Explain its blowing. he working of a rotary oil put the technique of measurer	onductors. pump. working a ump. ment of ba	nd applications. nd gap in solids using y measurement. pression for the relation	08 08 08

Seat No.				Set P					
M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS (MATERIALS SCIENCE) Semiconductor Devices (MSC03401)									
Day & Date: Monday, 18-12-2023 Max. Marks: 80 Time: 03:00 PM To 06:00 PM Max. Marks: 80									
Instructi	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)	Chc 1)	A CCD involves actions. a) charge storage and transfer b) only charge transfer c) only storage d) charge storage and loss		10					
	2)	Two valley model of TEDs base a) BCS c) RWH	b)	GaAs is proposed by BBS NWH					
	3)	LEDs fabricated with GaAs emit a) far ultra violet c) visible		wavelength. ultraviolet infrared					
	4)	An overlapping gate structure is performance. a) CCD c) LASER		d for improving LED SCR					
	5)	Photodetector optical sign a) reflects c) modulate	b)	detects amplify					
	6)	The M - S structure forms a) schottky c) ohmic	b)	rier. read non – ohmic					
	7)	$(\alpha_1 + \alpha_2)$ approaches where the set of the se		he SCR devices are at forward 1000 1					
	8)	A Triacs is used where the trans a) Power c) electron transfer	b)	of large is involved. voltage transfer 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 i 1) 2) 3) 4) 5) 6)	n gaps/State True or False Refreshing circuit is incorporated in CCD memory as it provides Pulsed laser can deliver very power. The M-S structure forms barrier. The CCD devices are static. The forward characteristic of a Shockley diode is useful for switching. PUT requires 2 V if gate is biased at 0.8 V.	06
Q.2	Ans a) b) c) d)	Prog Enha Dyna	t he following. gramable UJT. ancement type MOSFET. amic effect in CCD. ative and non-radiative transitions.	16
Q.3	a)	confi	cribe the operating principle of photodiode based on PN junctions, pin iguration and multilayer hetrojunction with. band diagrams and IV acteristics.	10
	b)		v block diagram, doping profile, electric field distribution in p-i-n diode.	06
Q.4	a)		an account of DIAC and TRIAC with suitable diagrams and IV acteristics.	10
	b)		ain di/dt protection.	06
Q.5	a) b)		cribe MS structure with band diagram. rge trapping in MOSFET.	10 06
Q.6	a)	i) ii) iii)	cribe GaAs Gun Oscillator modes in terms of Space charge accumulation Quenched domain mode Delayed domain mode	10
	b)	Expl	ain current flow mechanism in MS junction.	06
Q.7	a)		cribe IV characteristics of solar cell. Derive an expression for ntum efficiency of solar cell.	10
	b)		performance of CCD is improved.	06

Sea No.	t			Set	Ρ				
	M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS (MATERIALS SCIENCE) Nuclear and Particle Physics (MSC03402)								
	Day & Date: Tuesday, 19-12-2023 Max. Marks: 80 Time: 03:00 PM To 06:00 PM Max. Marks: 80								
Instructions: 1) Q. Nos. 1 and. 2 are compulsory. 2) Attempt any three questions from Q. No. 3 to Q. No. 7 3) Figure to right indicate full marks.									
Q.1	A)	Cho 1)	ose the correct alternative.The binding energy of deuteron isa)13.6 eVb)36 MeVc)2.225 MeVd)13.6MeV		10				
		2)	The range of energy eV is called as epithermal reacta)1eVb)0.025eVc)1KeVd)0.1-1MeV	ion.					
		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 insidenucleus isa) 31.2MeVb) 31.2KeVc) 31.2GeVd) 31.2eV	de the					
		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 ofa) 10 ⁻⁸ Secb) 10 ⁻¹¹ Secc) 10 ⁻¹⁴ Secd) 10 ⁻²¹ Sec						
		7)	Unit of cross section isa) Fermib) barnc) MeVd) nucleon per cm3						
		8)	Semi empirical mass formula for the binding energy of nucle contains a surface correction term this term depends on the number A of the nucleus $1/2$						
			a) $A^{-1/3}$ b) $A^{2/3}$ c) $A^{1/3}$ d) A						
		9)	The electric quadruple moment is negative, shape of the nua)Oblateb)Prolatec)Sphericald)All of these	clei is					
		10)	The Can explain magic number.a) Liquid drop modelb) Fermi gas modelc) shell modeld) All of these						

	B)	 Fill in the blanks / True or False. Nuclear binding energy usually expressed in units of The exchange particle which holds the quarks together is called In direct reaction incident particle completely have more than Energy per nucleon Cross sectional area of n-p scattering is 4πa²(T/F) In a deuteron, the force between neutron and proton is short range and repulsive (T/F) Nucleons are bosons (T/F) 	
Q.2	Ans ^y a) b) c) d)	er in brief. Discuss shape and size, mass and relative abundances of nucleus. Discuss superconductivity model. Vrite a note on conservation laws. Vrite a note on cosmic ray.	
Q.3	Ansv a) b)	er the following.verive an expression for scattering cross section of two nucleon system and vrite a note on scattering length.viscuss properties of nuclear forces.06	
Q.4	Ans ^r a) b)	er the following.10Describe liquid drop model of nucleus point out its usefulness and10mitations in understanding the nuclear phenomenon.10xplain the energy levels of shell model. How this helps to explain the06ccurrence of magic numbers? Draw the diagram.06	
Q.5	Ans ^r a) b)	er the following10xplain the nuclear reaction kinematics Obtain an expression for Q value10iscuss the general solution of the Q equation.06comment on compound nuclear disintegration.06	
Q.6	a)	 er the following Bive the Gell-Mann-Nisijima relation and calculate the charge of baryon 10 amily using this relation find out strangeness' and hypercharge of the aryon octet plot the schematic diagram and table. 	
	b)	viscuss quark hypothesis and quantum chromodynamics. 06	
Q.7	Ans [.] a)	er the following Vhat should be the minimum KE of the electrons to probe the size of ₂₀ Ca ⁴⁰ 10 ucleus.	
	b)	n ₈ O ¹⁶ nucleus is spherical and has charge radius R and volume according 06 b empirical observation of the charge radii, the volume of the ₅₄ Xe ¹²⁸ ucleus assume to be spherical what is the ratio of volume of Xe to the olume of Oxygen.	

Set

- the tubes together
- 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
- The extensively used nano particles as catalyst is . 4)
 - 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
- The magnified image of the specimen in SEM is obtained 6)
 - a) CRT Phosphorescent screen b) c) Anode
 - d) Scanning generator
- 7) are used in LEDs.
 - a) Quantum wells
 - c) Quantum rings d) Quantum dots
- The electron microscope which is used to study the internal structure 8) of the plant and animal cells is

b)

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

Quantum wires

Page 1 of 2

Max. Marks: 80

10

- 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

2) Attempt any three guestions from Q. No. 3 to Q. No. 7.

Physics of Nano Materials (MSC03403)

- 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
 - 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
- For emission of the electrons from the metal surface the minimum 3)
- operating between adjacent tubes

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

Instructions: 1) Question no. 1 and 2 are compulsory.

Multiple choice questions.

3) Figure to right indicate full marks.

The basic principle of AFM is

Day & Date: Wednesday, 20-12-2023

Time: 03:00 PM To 06:00 PM

1)

Seat

Q.1 A)

No.

		9)	pict	ich among the following he ure of the specimen? TEM	elps in b)	obtaining a three-dimensional	
			c)	Compound Microscope	d)	Simple Microscope	
		10)	a) c)	is a requirement for th Absorption Transmission	e fluore b) d)	escence process. Radiation All of the above	
	B)	1) 1 2) 1 3) _ 4) 1 5) 1 6) 1	The s n SE The l n AF	EM the morphology of the _ is used for measuring the ball milling technique is a FM, the sample is mounted	io of a sample ne surfa bottom d on a p		06
Q.2	a) b)	 Dielectric quantum confinement Electrodeposition 					
Q.3	a)	Descri nanom	be ti natei	rials.		chnique for the preparation of	10
	b)	vvriy is	spa	atial resolution of STM bet	ler mar		06
Q.4		 Answer the following. Describe principle and operation of STM Give an account of field-enhanced thermionic emission and field-assisted thermionic emission. 					
Q.5	 a) Describe the effect of increasing temperature on the conductivity of an intrinsic semiconductor. 						10 06
Q.6	Ans a) b)	Descri	be t	Ilowing. he density of states at low e hopping conduction med			10 06
Q.7	Ans a) b)	Descri transfe	be tl er in	Ilowing. he basic working principle terms of LDOS. brief the basic process of		AFM and explain the charge chnique.	10 06

					SLR-EN-24				
Sea No.	t				Set P				
	M.Sc. (Semester - IV) (New) (CBCS) Examination: Oct/Nov-2023 PHYSICS (MATERIALS SCIENCE) Advanced Techniques of Materials Characterization (MSC03406)								
	Day & Date: Thursday, 21-12-2023 Max. Marks: 80 Time: 03:00 PM To 06:00 PM Max. Marks: 80								
Instr	uctio	2) Q. Nos. 1 and. 2 are compulsory.) Attempt any three questions from Q.) Figure to right indicate full marks.	No.	3 to Q. No. 7				
Q.1	A)	Mult	tiple Choice questions.		10				
		1)	,	-					
		2)	, .	b) d)	Aluminum Nickel				
		3)		ntion b) d)	· · · · · · · · · · · · · · · · · · ·				
		4)		b) d)	Visible light X ray				
		5)			•				
		6)	, .	b) d)	Rayleigh's scattering none of the above				
		7)	 H₂O and CO₂ molecules both are Ra a) Symmetric stretching (H₂O) and b) Asymmetric stretching (H₂O) are c) Bending (H₂O) and Bending (Co d) Symmetric stretching (H₂O) and 	d Sy nd A O2)	mmetric stretching (CO ₂) symmetric stretching (CO ₂)				
		8)		osco b) d)	opy. TEM Both a) and b)				
		9)		elate b) d)	ed to UV -vis Spectroscopy NMR				
		10)		ansit b) d)	ion take place. Vibrational All of the above				

	В)	 Fill in the blanks OR State true/false 1) types of waves has the shortest wavelength. 2) XPS works on the principle of 3) UV -Vis Spectroscopy is based on principal of 4) BET technique is used to determination of surface area. (True/False) 5) Raman spectroscopy is based on Inelastic scattering. (True/False) 6) Transmission Electron Microscope provides a three-dimensional picture of the specimen. (True/False) 	06
Q.2	Ans a) b) c) d)	wer the following Rayleigh criterion EDAX Secondary and backscattered electrons Magic Angle Spinning (MAS)	16
Q.3	Ans a) b)	line width.	10 06
Q.4	Ans a) b)	schematic Diagram.	10 06
Q.5	Ans a) b)	example.	10 06
Q.6	a)		10 06
Q.7	Ans a) b)	example.	10 06