Seat No.				Set	Ρ
Μ	.Sc.	(Se	emester - I) (New) (NEP CBCS) Examination: Oct PHYSICS (NANOPHYSICS) Mathematical Physics (2306101)	/Nov-2023	\$
Day & Time:	k Dat 03:(te: Fr 00 PN	riday, 05-01-2024 M To 05:30 PM	Max. Marks	: 60
Instru	uctio	ons:	 All questions are compulsory. Figures to the right indicate full marks. 		
Q.1	A)	Cho 1) 2)	The value of $\int_{-\pi}^{\pi} \cos(mx) \sin(nx) dx =$ a) 1 b) $a-1$ c) 0 d) π If $ z^2 - 1 = z^2 + 1$ then z lies on a) the real axis b) the imaginary axis		08
		3)	c) a circled) on ellipseA point at which a function $f(z)$ is not analytic is known as or singularity of the function.a) Scalar pointb) Singular point d) None of these	a	
		4)	Find the pole of $f(z) = \sin \frac{1}{(z-a)} = $ a) $z = a$ b) $z = 0$ c) $z = 1$ d) $z = 4$		
		5)	Laplace transform of $f(t)$ is defined for a) +ve value of t b) -ve value of t c) both +ve & -ve value of t d) None of these		
		6)	Legendre polynomial is a set of function. a) orthogonal b) odd c) even d) real		
		7)	If $f(z) = e^{2z}$ then the imaginary part of $f(z)$ is a) $e^{y} \sin x$ b) $e^{x} \cos y$ c) $e^{2x} \cos 2y$ d) $e^{2x} \sin 2y$		
		8)	What are the eigen values of $\begin{pmatrix} 1 & -i \\ i & 1 \end{pmatrix}$?a) Both are 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/	e) False)	04

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)

- Discuss in details Cauchy's Integral Formula. a)
- 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)

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

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М.	Sc. (S	emester - I) (New) (NEP CBC PHYSICS (NANC Solid State Physic	CS) Exa DPHYSI cs (2300	mination: Oct/Nov-202 CS) 6102)	23	
ny & E me: 0	Date: Sเ 3:00 PN	unday, 07-01- /I To 05:30 Pl	-2024 M		Max. Ma	rks: 60)
struc	tions: 1 2	l) All questior 2) The figure	ns are compulsory. to right indicate full ma	arks.			
1 A) Cho 1)	Conductivit Conductivit a) The na c) Resis	rect alternative. ty of metals depends u ature of the material tance of the metal	upon b) d)	 Number of free electrons Number of electrons	30	3
	2)	At what ten a) Meltin c) Neel	nperature does ferrom Ig	nagnetic r b) d)	material become paramagn Curie None of these	etic?	
	3)	Which of th a) Diama c) Antife	ne following is a strong agnetic material rromagnetic material	g magnet b) d)	? Paramagnetic material Ferromagnetic material		
	4)	Electronic (a) molec b) magn c) atomic d) orient	polarization also know cular polarization etic polarization c polarization ation polarization	/n as			
	5)	What is the resistance a) Super c) Resis	e phenomenon where below a certain critica rconductivity tance	a materia Il tempera b) d)	al exhibits zero electrical ature? Conductivity Insulation		
	6)	For which o a) Paran b) Ferror c) Diama d) none	of the following is mag nagnetic Materials onl magnetic Materials on agnetic Materials of the above	netic sus y ly	sceptibility negative?		
	7)	The sprinkl room becau a) Water b) Water c) The te d) None	ing of water reduces s use r is a bad conductor of r has a large lantern h emperature of the wate of the above	slightly th f heat eat of va _l er is less	e temperature of a closed porization than the room		

- Which of the following is a property of a superconductor?
 a) Perfect diamagnetism
 b) High electrical conductivity
 d) Non-zero resist 8)
- High electrical resistance Non-zero resistivity

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	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

Seat No.				Set	Ρ
N	A.So	c. (S	emester - I) (New) (NEP CBCS) Examination: Oct/ PHYSICS (NANOPHYSICS) Analog and Digital Electronics (2306106)	′Nov-2023	
Day & Time:	Dat 03:0	e: Tu 0 PM	uesday, 09-01-2024 // To 05:30 PM	Max. Marks	s: 60
Instru	ictio	ns: 1 2) All Questions are compulsory. 2) Figure to right indicate full marks.		
Q.1	A)	Cho (1)	 ose 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 	_ .	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) Current b) Voltage c) Power d) 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 mentioned	ed	
		6)	 What happen if any positive input signal is applied to open-logal Output reaches saturation level Output voltage swing's peak to peak Output will be a sine waveform Output will be a non-sinusoidal waveform 	oop configura	ation?
		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 opera a) 2 b) 3 c) 4 d) 5	tes	
	B)	Fill i 1) 2) 3) 4)	in 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

	b) c) d) e) f) g) h)	Draw AND gate with truth table. What is the function of IO/M signal in the 8085? What is differential amplifier. 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	Ans 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	Ans 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	Ans 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

Q.2 Answer the following. (Any Six)a) Define Input offset voltage.

Seat No.

M.Sc. (Semester - I) (New) (NEP CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) **Research Methodology in Physics (2306105)**

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

4) The main problem in questionnaire is .

- a) Accessible to Diverse Respondent
- b) Greater Anonymity
- c) Shows an inability of respondent to provide information
- d) None of these
- 5) UV-Vis spectroscopy cannot analyze compounds that with light.
 - a) don't interact b) interact c) merge
 - d) none of the above
- 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
 - c) Ordinal
- 8) By selecting laser operating conditions, control over microstructure is
 - a) possible c) not defined

- b) impossible d) both a) and b)
- d) All of the above

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Max. Marks: 60

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	Ans	swer	the following. (Any Six)	12
	a)	Stat	te the various sampling methods.	
	b)	Wri	te the applications of Pulsed Laser Deposition.	
	C)	What	at are the applications of UV-Vis Spectroscopy?	
	d)	What	at are patents?	
	e)	Det	ine Quantitative research method.	
	1) a)		ine priysical and chemical vapour deposition.	
	9) h)	W/h	at are the applications of FTIR Spectroscopy	
	,	VVII	at are the applications of r fire opecitoscopy.	
Q.3	Ans	swer	the following. (Any three)	12
	a)	Wri	te a note on Descriptive Vs Analytical research methods.	
	b)	Diff	erentiate between SEM and TEM techniques.	
	C)	Wri	te a note on web as source.	
	d)	Wri	te the basic mechanism of sputtering technique.	
Q.4	Ans	swer	the following. (Any two)	12
	a)	Def	ine Research? What are characteristics of Research.	
	b)	Disc	cuss different type of Research.	
	C)	Wri	te a note on Review of Literature.	
Q.5	Ans	swer	the following. (Any two)	12
	a)	Wha	at is Research Design? What are its essentials	
	b)	Writ	te in detail about the concept of Chemical Bath Deposition.	
	C)	Exp	lain in detail about Spray Pyrolysis.	

B) Fill in the blanks OR Write True or False:

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No.							Jei	F
	Μ.	Sc. (Semeste	er - I) (Old)	(CBCS)) Exa	amination: Oct/Nov-2023	
			N.4	PHYSIC	S (NAN)		IYSICS) MSC00404)	
_				athematica	al Phys	ics (M3C09101)	
Day Time	& Da e: 03:0	te: Fr 00 AN	iday, 05-0 /I To 06:00	1-2024) PM			Max. Mark	3: 80
Instr	uctio	ons: 1 2) All ques 2) Figures	tions are com to the right in	ipulsory. dicate ful	ll mar	ks.	
Q.1	A)	Cho	ose corre	ct alternative).			10
		1)	The prod	uct of a singu	lar matrix	with	its adjoint is	
			a) a uni	t matrix thogonal mat	riv	d)	a null matrix Square matrix	
		2)	What is the		in the Er		$\frac{1}{2}$ sorios of t^2 in the interval	
		2)	$-\pi < t <$	$\pi?$	III UIE FU	Juner		
			a) 0			b)	$\pi^{2}/_{3}$	
			c) $\pi^{2}/_{0}$			d)	π^2/Λ	
		3)	If A and F	s are orthogo	nal matric	ses tl	hen the product AB is	
		0)	a) symr	netric		b)	antisymmetric	
			c) ortho	gonal		d)	unitary	
		4)	Evaluate	the integral	$\int_0^{2\pi} \frac{\mathrm{si}}{5+}$	n²θ 4cos	$\frac{1}{\theta}d\theta$	
			a) 2π			b)	π	
			c) $n/2$			d)	n/4	
		5)	The value	e of $\int_{-\pi}^{\pi} \cos(\theta)$	mx) sin(n	ıx) dx	c =	
			a) 1			b)	-1	
			c) 0			d)	π	
		6)	$ f z^2 - 1 $	$= z^2 + 1$ th	en z lies	on		
			a) the re	eai axis de		d)	the imaginary axis	
		7)	Find the r	note of $f(z)$ –	$\sin \frac{1}{2}$	=		
		,	-)		(z-a)	- <u></u>	·	
			a) $z = a$ c) $z = 1$	l		d)	z = 0 z = 4	
		8)	$\frac{1}{2}$, /'s Residues	theorem	~) f f(-	dz - dz - dz	
		5)	a) $2\pi i \Sigma$	$a_{i=1}^{n} a_{-1} zi$		ヵノマ b)	$2\pi i$	
			 c) 2πi Σ 	$\sum_{j=1}^{n} a_{+1} z j$		d)	$2\pi i \sum_{j=1}^{n}$	

c)
$$\frac{1}{3} \& -\frac{5}{13}$$
 d) $\frac{1}{09} \& \frac{5}{13}$

10) Legendre polynomial is a set of _____ function. a) orthogonal b) odd

c) even d) real

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

- 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**

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Q.5 Answer the following.

Q.U	a)	Solve $\sin x \frac{dy}{dx} + 2y = \tan^3 \left(\frac{x}{2}\right)$	08
	b)	Verify Cayley - Hamilton Theorem for the following matrix. $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and use the theorem to find A^{-1}	08
Q.6	Ans a) b)	Swer the following. Find the order of each pole and residue of $\frac{1-2z}{z(z-1)(z-2)}$ Show that the eigen value of Hermitian matrix are real.	08 08
Q.7	Ans a)	swer the following. In square wave expand the function. $f(x) = 0; -\pi \le x \le 0$ $f(x) = 4; -0 \le x \le \pi$ Fourier.	08
	b)	Explain Laplace transform of Derivatives.	08

Seat No.				Set	Ρ
	Μ.	Sc. (Semester - I) (Old) (CBCS) Examination: PHYSICS (NANOPHYSICS)	: Oct/Nov-2023	
			Solid State Physics (MSC09102)	1	
Day & Time: (Date 03:00	e: Sur 0 PM	day, 07-01-2024 To 06:00 PM	Max. Marks	s: 80
Instru	ctior	ו s: 1) 2) 3)	Q. Nos. 1 and. 2 are compulsory. Attempt any three questions from Q. No. 3 to Q. I Figure to right indicate full marks.	No. 7	
Q.1 /	4)	Choo 1)	b se the correct alternative. Effective mass is equal to mass for free e a) Mean b) real c) Residual d) zero	ectron.	10
		2)	Elemental solid dielectric has only polariz a) Electronic b) ionic c) orientational d) all	ation.	
		3)	 In the case of p-type semiconductors, the Fermi I 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 	evel lies at n band	
		4)	In the case of superconductor, at Tc conductance a) Zero b) Finite c) Infinite d) None of	e becomes	
		5)	has a positive temperature coefficient of rea)Metalb)Semicec)Insulatord)Dielect	esistance. onductor tric	
		6)	The coordination number of HCP isa) Twob) Fourc) Sixd) Twelve	e	
		7)	Plane cut to negative x-axis have the miller indicea)(011)b)(001)c)(110)d)(-100)	9S	
		8)	The zone lies in between $+\pi/2$ to $-\pi/2$ is the a) 1 st b) 2 nd c) 3rd d) 0 th	Brillion zone.	
		9)	Relative permittivity (ε_r) of the air isa) 2b) 0.5c) 1d) 0		
		10)	Intrinsic concentration of charge carriers in a sem	iconductor varies as	
			$ \begin{array}{cccc} \hline a) & T & b) & T^2 \\ c) & T^3 & d) & 1/T \end{array} $		

	·	 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)	w er 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)

Q.

Q.

Seat No.						Set	Ρ	
	M.Sc. (Semester - I) (Old) (CBCS) Examination: Oct/Nov-2023 PHYSICS (NANOPHYSICS) Analog and Digital Electronics (MSC09103)							
Day & Da Time: 03	ate: Tue :00 PM	esday, 09-01- To 06:00 PM	-2024 1		Ma	ax. Marks	: 80	
Instructi	ons: 1) 2) 3)	All question Attempt any Figure to rig	s are compulsory. three questions fron ht indicate full marks	ו Q.3	to Q.7.			
Q.1 A)	Choo 1)	The basic S which of the a) AND o c) NOR o	alternative. (MCQ) R flip-flop can be cor gates? r OR gate r NAND gate	nstruc b) d)	ted by cross coupling by XOR or XNOR gate AND or NOR gate	using	10	
	2)	In JK flip-flo a) $J = 1, K$ c) $J = 1, K$	p "no change" condit	ion ap b) d)	pear when J = 0, K = 0 J = 0, K = 1			
	3)	Which is the a) Stack (c) Registe	e 16-bit register for 80 pointer er B)85 m b) d)	icroprocessor? Accumulator Register C			
	4)	The feedbac a) A resis b) A capa c) A resis d) A resis	ck path in an op-amp tor citor tor and capacitor in s tor and capacitor in p	integ series paralle	rator consists of			
	5)	Multiplexer a) Many i b) One in c) Many i d) One in	nas nput and one output put many output nput and many out p put and one output	ut				
	6)	The op-amp a) Positiv b) Negati c) Regen d) No fee	o comparator circuit u e feedback ve feedback erative feedback dback	ses _				
	7)	Op- amp is a) Curren c) Power	a type of amplifier t	b) d)	Voltage Resistance			
	8)	An XOR gat a) Inverte c) Only n	e can be used for r and non-inverter on-inverter	b) d)	Only inverter None of the above			

Seat

06

16

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	wer 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	swer the following.	
	a)	Explain the operation of three op-amp instrumentation amplifier.	10
	b)	Define Oscillators? Explain their types.	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

Sea No.	t			Set	Ρ
	N	I.Sc.	(Semester - I) (Old) (CBCS) Examina PHYSICS (NANOPHYSIC Classical Mechanics (MSC0	ition: Oct/Nov-2023 S) 9108)	
Day a Time	& Da : 03:	te: Th 00 PN	ursday, 11-01-2024 1 To 06:00 PM	Max. Marks	s: 80
Instr	uctio	o ns: 1 2 3) Q. Nos. 1 and. 2 are compulsory. 2) Attempt any three questions from Q. No. 3 t 3) Figure to right indicate full marks.	:o Q. No. 7	
Q.1	A)	Cho 1)	pose correct alternative. The position of a particle at any time t subje a) $x = k.(1 + e^{-kt})/v_o$ b) $x = k$ c) $x = v_o(1 - e^{-kt})/k$ d) $x = k$	cted to resistive force is $v_o(1 - e^{-kt})$ $v_o(1 + e^{-kt})$	10
		2)	The rate of momentum change of an open s a) $T + MU$ b) $F - M$ c) $W - MV$ d) $F + M$	system is equal to <i>IV</i> I <i>U</i>	
		3)	The reduced mass of two bodies into equival a) $(m_1 + m_2)/(m_1 \cdot m_2)$ b) $(m_1 \cdot m_2)$ c) $m_2/(1 + m_2/m_1)$ d) $m_1/(2)$	alent one body is $n_2)/(m_1 - m_2)$ $1 + m_2/m_1)$	
		4)	The time derivative of generalized co-ordina a) Generalized force b) Gene c) Generalized momentum d) None	ite is ralized velocity of these	
		5)	For $E > 0$ and $\varepsilon > 1$, the nature of the orbita) Circleb) Paratec) Ellipsed) Hype	is oola rbola	
		6)	The generalized momentum is equal toa) $\partial L/\partial q_j$ b) $\partial L/\partial q_j$ c) $\partial L/\partial \dot{q}_j$ d) $\partial L/\partial q_j$	 o _j	
		7)	Which of the following defines a conservative a) $dF/dt = 0$ b) $\nabla F =$ c) $\nabla \times F = 0$ d) $\oint F.dt$	r = 0 r = 0	
		8)	Poisson brackets are under canonic a) Variant b) nullifi c) anti-symmetric d) invar	cal transformation. ed iant	
		9)	 Generalized coordinated a) are independent of each other b) depend on each other c) are always cartesian coordinates d) are always spherical polar coordinates 		
		10)	The $F_2 = \sum q_k P_k$ transformation defined as a) generates exchange transformation b) generates identity transformation c) is not canonical transformation		

d) None of the above

Page 1 of 2

	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	Ans a) b) c) d)	wer 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	Ans 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	Ans 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	Ans a) b)	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	Ans a) b)	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	Ans a) b)	swer the following. State and prove Poisson's theorem. Prove the Jacobi identity [<i>V</i> , [<i>V</i> , <i>W</i>]] + [<i>V</i> , [<i>W</i> , <i>U</i>]] + [<i>W</i> , [<i>U</i> , <i>V</i>]] = 0	10 06

Seat No.

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

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 CCl4 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 F _{9/2}
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

Max. Marks: 80

Set

06

16

- 9) Which of the following molecule will not show the microwave spectra.
 - a) CH_2CI_2 b) SF_6
 - c) H₂O d) CH₃CI
- 10) The lowest vibrational energy is given by _____.
 - a) $\frac{1}{2}\omega$ b) ω
 - c) $\frac{1}{2}\omega^2$ d) ω^2

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

- 1) _____ Detector is an IR detector (crystal / Pyroelectric)
- 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 more than one valance electron is _____ of type of coupling (dependent /Independent)
- 4) When L is greater than or equal to S, all integral Value of J between L-S and L+S are allowed.
- 5) Hyperfine structures arises in tungsten due to presence there even isotopes tungsten.
- 6) The spherical top molecule have dipole moment owing to their symmetry.

Q.2 Answer the following.

- 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
 D lines for weak numbers 16959cm-1 and 1697.4cm-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 n=4 state 04 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}.

Q.7 Answer the following.

- a) Draw the vibrational energy levels and some transition between them for a 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}

Saat				7					
Seat No.								Set	Ρ
	M.S	Sc. (S	Semester Fun	- III) (New) PHYSICS ctional Nar	(CBCS) 6 (NANO 10materi	Ex PH ials	amination: Oct/N YSICS) (MSC09306)	ov-2023	
Day & Time:	Date 11:0	e: Tue 0 AM	esday, 09-0 To 02:00 F	1-2024 °M				Max. Marks	: 80
Instru	ictior	1s: 1) 2) 3)	Q. Nos. 1 Attempt ar Figure to r	and 2 are cor ny three ques ight indicate t	npulsory. tions from full marks.	Q. 1	No. 3 to Q. No. 7		
Q.1	A)	Choo 1)	ose the co Laser abla a) Kelvi c) Wats	rrect alterna ation method i n son and crick	t ive. s develop	ed b b) d)	y Richard Smalley Neils bohr		10
		2)	The fibre r a) Low c) Mode	ein forced pla erate	astics has	b) d)	cost of production. High very high		
		3)	The crysta a) 70% c) 50%	illinity in polyf	nydroxy all	konc b) d)	ates is lie in the rang 60% 40%	e of	
		4)	TEFLON f a) low n b) high c) low d d) good	nas nelting point melting point lensity conduction c	of electricit	У			
		5)	Polymer h a) heav c) corro	as outstandin y weight sive	g property	v of b b) d)	being light weight brittle		
		6)	Which of t a) Al c) O	he following i	s stabilizin	g ele b) d)	ement in <i>β-</i> phase of N Mo	Γi alloys.	
		7)	The curing a) rever c) adiat	g process of ti sible patic	nermoset i	s co b) d)	mpletely irreversible isothermal		
		8)	The a) physic c) chem	of TiO ₂ lay ical dissolutio nical dissolutio	er plays a n on	cruc b) d)	ial role in the TNT for physical association chemical associatior	rmation.	
		9)	The diame a) 10 ⁻⁶ n c) 10 ⁻⁸ n	eter of the nar า า	nowire is a	bout b) d)	t 10 ⁻³ m 10 ⁻⁹ m		

06

16

10) The relation of crystal growth rate is _____.

a)
$$\frac{dr}{dt} = \frac{D(C_h - C_i)}{rd_m}$$

b) $dr \quad D(C_h - C_i)$

$$\frac{dt}{dt} = \frac{r}{r}$$

$$\frac{dr}{dt} = \frac{D(C_h - C_i)}{d_m}$$

d)
$$\frac{dr}{dt} = \frac{r(C_h - C_i)}{D}$$

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 ____
- 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°C to 600°C. (True/False)

Q.2 Answer the following.

- a) Discuss basic material used for Polymer Nanocomposites.
- **b**) Explain the applications of quantum dots in Biomedicine.
- \mathbf{c}) Write the short on the structural properties of TiO₂ Nanotube arrays.
- d) What are properties of polymer Nanocomposites.

Q.3 Answer the following

Q.4

a) b)	Discuss the fabrication process of TiO ₂ nanotube arrays by electrochemical anodization with First synthesis generation. What are structural applications nanocomposite fibre?	08 08
Ans a) b)	wer the following Write in detail Electrospinning Process for Nanofibres. Explain the synthesis method of semiconductor Nanocrystal in organic solvent.	08 08

Q.5 Answer the following

- a) Define Metal Oxide Frameworks. Write down its advantages and
 08 disadvantages.
- b) Explain in detail. Arc discharge and Arc melting synthesis method of Boron 08 Nitride Nanotube.

Q.6 Answer the following

- a) What is polymerisation? Explain Emulsion polymerisation.
- **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

Seat No.						S	Set	Ρ
	M.S	Sc. (S	emester Sen	- IV) (New) (CBCS) PHYSICS (NANO niconductor Devic	Exar PHYS es (M	nination: Oct/Nov-202 SICS) SC09401)	23	
Day & Time:	Date 03:0	e: Mor 0 PM	nday, 18-12 To 06:00 Pl	-2023 M		Max. M	1arks	: 80
Instru	ctio	n s: 1) 2) 3)	Q. Nos. 1 a Attempt an Figure to ri	and. 2 are compulsory. by three questions from ight indicate full marks.	Q. No	. 3 to Q. No. 7		
Q.1	A)	Seleo 1)	ct the corre In Schottky a) N-type b) N-type c) no jur d) P-type	ect alternative. / diode, the junction is i e & P-semiconductor e semiconductor and m nction e semiconductor and m	n betw netal netal	/een		12
		2)	D-MOSFE ⁻ a) enhar b) deple c) both e d) none	T works in ncement mode only tion mode only enhancement and deplo of these	etion n	node		
		3)	The voltage voltage. a) thresh c) firing	e above which E-MOSI nold	FET w b) d)	orks is known as knee breakdown		
		4)	a) IGBT c) DIAC	e of SCR fires by incide	nt ligh b) d)	t. GTO LASCR		
		5)	Which of th a) SCR c) IGBT	ne following power sem	iicondu b) d)	uctor device is unipolar? TRIAC Power MOSFET		
		6)	The minimu as a) hold in c) leakag	um current required to n current ge current	keep S b) d)	SCR in on state is known saturation current hold in current		
		7)	Which of th a) Zener c) Varate	ne following device wor r diode or diode	ks in n b) d)	egative resistance region? Light Emitting Diode Gunn diode		
		8)	In MIS cap a) metal c) semic	acitor, the inversion lay	/er is fo b) d)	ormed in insulator silicon dioxide layer		
		9)	The formul (Where L is a) 100/L c) 100*L	a for the frequency in (s in micrometer)	GHz in b) d)	Gunn diode is given by 10/L 10*L	<u> </u>	

		10)	The a) c)	LASER light is parallel beam coherent	b) d)	monochromatic all of these	
		11)	lf the then a) b) c) d)	e energy of incident radiation is only electrons are created only holes are created both electrons and holes are c none of these	grea create	ater than band gap energy ed	
		12)	a) c)	_ produces maximum current t photo cell avalanche photo detector	for in b) d)	icident photon of light. LDR photo diode	
	B)	State 1)	e Tru MIS a)	e or False structure in MOSFET works as True	indu b)	uctor. False	04
		2)	Gun a) TRIA	n diode contains no PN junctior True AC conducts in both direction	п. b)	False	
		4)	a) GaP	True is used in light emitting diode.	b)	False	
~ ~			a)	True	b)	False	4.0
Q.2	Ans a) b) c) d)	wer the Write With Expla Expla	ne fol a no neat o in the in the	l lowing. te on MIS capacitor. diagram explain the constructio e working of light activated SCF e working of PN junction photoc	n of R. letec	DIAC.	16
Q.3	Ans a)	wer th Expla	ne fol ain the	l lowing. e I-V characteristics of D-MOSF	ET a	and hence define parameters	08
	b)	Expla it is w	in the orkin	e of Schottky barrier between th g as rectifying contact?	ne m	etal and semiconductor. Why	08
Q.4	Ans a) b)	wer th Expla Defin Expla	ne fol iin wit e the iin wit	l lowing. th neat diagram the constructio ir ratings. th necessary graph the I-V chai	n an racte	d working of SCR. ristic of DIAC.	10 06
Q.5	Ans a) b)	wer th Expla Write	ne fol iin the a no [:]	l lowing. e mechanism of charge transfei te on TT and LSA operating mo	r in tl ode c	hree phase CCD. of Gunn diode.	10 06
Q.6	Ans a) b)	wer th Expla Expla coeffi	ne fol iin the iin qu cient	l lowing. e construction and working of h antum efficiency, response spe of photodetector.	etero ed, i	ojunction LASER. noise and optical absorption	08 08
Q.7	Ans a)	wer tł Expla	ne fol ain the	l lowing. e Gunn effect on the basis of tw	/o va	lley model.	08

b) Explain the construction and working of gate turn off (GTO) SCR.

Seat	
No.	

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

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

Instructions: 1) Question 1 and 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.

- Nuclear force is 1)
 - 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 .

- 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 $R_0 = 1.4$ fm)

- a) 5.89fm,6.55fm c) 6.89fm, 7.66fm
- b) 5.99fm,7.55fm d) 1.23fm, 3.12fm
- Which of the following has high penetrating power? 4)
 - a) Alpha particles b) protons
 - c) gamma rays d)
- The mass difference between the nucleus and its constituents nucleons 5) is called the
 - a) Packing fraction
- c) mass conservation
- 6) In the distribution of comic ray, the latitude effect is maximum at
 - a) Equator of Earth
- d) -15°latitude
- Cyclotron is used to accelerate 7)

c) 45°latitude

- a) Neutral particles b) negative ions
- c) positive ions d) both b and c
- GM counter cannot detect the _ 8) a) Protons
 - b) neutrons
 - c) beta particles alpha particles d)

Max. Marks: 80

10



Set



- - beta particles

- binding energy b)
- d) mass defect
- - pole of earth b)

- 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 _____.
 - a) C conserving
 - b) C non conserving
 - c) CP Non conserving but CPT conserving
 - d) CPT Non conserving

B) Write True or false.

- 1) According shell model set of magic numbers is 2,8,20,28,50,82,126.
- 2) Isospin and third component of Isospin of proton is 1/2, 1/2 respectively.
- 3) Proton is made up of the two down and on up quarks.
- 4) Baryon number of e^+ and e^- are 0, 0 respectively.
- 5) Beta decays is the process of transition between two isobars.
- 6) 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.
 08

Q.4 Answer the following.

- a) What are the comic rays. Explain the latitude effect and east- west
 08 asymmetry.
- b) Explain the nuclear shell model in details. Hence derive the expression for or correction energy term due to spin-orbit interaction.

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 significance.
 08

Q.6 Answer the following.

- a) Derive the expression for the atomic number of stable isobar using the liquid drop model. Hence solve the following problem find the stable isobar nuclide A= 125 (given $a_c = 0.7$ MeV and $a_{sym} = 22.5$ MeV).
- b) Derive the expression for the Q value in alpha decays. Solve following problem Consider the spontaneous emission of alpha decay from 92U²³²Find the kinetic energy of alpha particle, if the energy Q is released.

06

Q.7	Answer	the	following.	
-----	--------	-----	------------	--

d) Nuclear fusion

A)	Wh	at are the particle detectors. Write short notes on	08
-	a)	Scintillation detector	
	b)	Semiconductor detector	
B)	Exp	plain the following each type of nuclear reactions with example	08
-	a)	Direct reactions	
	b)	Nuclear transformation reaction	
	c)	Nuclear fission	

Set

Seat	
No.	

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

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

Instructions: 1) Q. Nos. 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 Choose correct alternative. A)

- with energy dispersive X-ray analysis (EDAX) is a very useful 1) tool for qualitative & semi quantitative analysis of elements.
 - Scattering electron Microscopy a)
 - b) Scattering ion Microscopy
 - Scanning electron Microscopy c)
 - Scanning ion Microscopy d)

The energy dispersive X-ray spectroscopy (EDX or EDS) is technique used 2) in analytical electron microscopy to determine of the material.

- Elemental composition a) Particle size c)
- Morphology b) d) Particle shape

3) Which of the following are true for electron microscopy?

- Specimen should be thin and dry a)
- Image is obtained on phosphorescent screen b)
- Electron beam must pass through evacuated chamber c)
- all of the above d)
- 4) Raman shift depends upon _____.
 - Incident intensity a)
 - Incident wavelength b)
 - Resolving power of spectrograph used c)
 - molecule energy level of scatterer d)
- 5) Young's modulus of perfectly rigid body is
 - a) Unity b) Negative
 - Infinity Zero c) d)
- What is the wavelength range for UV spectrum of light? 6) a)
 - 400 nm 700 nm 700 nm -10mm b)
 - 0.01 nm -10 nm 10 nm - 400 nm c) d)
- 7) What are the two the main technique for thermal analysis?
 - FTG & DGG TGA & DTA b)
 - MSP and FCT TSA and DGF c) d)
- Raman effect is scattering of _____. 8)

a)

- Elastic scattering of photon a)
- Elastic scattering of electron b)
- Inelastic scattering of photon by molecule c)
- Inelastic scattering of proton d)

Max. Marks: 80

06

16

- 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
 - TEM a)

Optical b)

c) SEM d) FESEM

- 10) X - rays are
 - deflected by an electric field but not by a magnetic field a)
 - deflected by a magnetic field but not by an electric field b)
 - not deflected by an electric field or a magnetic field c)
 - deflected by both magnetic both a magnetic field and an electric field d)

Q.1 B) Write True / False

- In Raman spectroscopy the radiation lies in the visible region. 1)
- Secondary electrons are useful for showing morphology and Topography 2) of samples.
- 3) VIbrational transistion of molecule is related to UV-vis spectroscopy.
- Young's modulus is the mechanical property of the material. 4)
- 5) The resolution of SEM is greater TEM.
- In STM the sample should be conducting. 6)

Q.2 Answer the following

- Explain with neat diagram the construction of SEM. a)
- b) A beam of x-rays is constructively scattered in second order from the surface of the crystal at an angle of 30° and spacing between layers of atoms in NaCl crystal is $4.5 \times 10^{\Lambda-10}$ m. Determine the wavelength of X-ray.
- Differentiate between SEM and TEM. C)
- Write a note on electron gun. d)

Q.3 Answer the following.

- Explain with neat diagram the construction and working of STM. 10 a) 06
- Write a note on defects in nanomaterials. b)

Answer the following Q.4

- What is the UV-Vis spectroscopy? Explain its working and sample Analysis 10 a) techniques. b) Write a note on DPI. 06 Answer the following Explain in detail the principle, instrumentation and working of XRD. 10 a) 06
 - Explain the limitations of XRD. b)

Q.6 Answer the following

Q.5

Explain with neat diagram the construction and working of EDAX/EDS. 08 a) b) Write a note Young's modulus and surface tension. 08

Q.7 Answer the following

Explain the photoluminence and excitation wavelength. 08 a) b) Write a note on TGA and quantum yield. 08

Ν	PHYSICS (N ano Material Fabricati	NO PHYSICS) 1 Techniques (MSC09408)
Day & Date: Thu Time: 03:00 PM	ırsday, 21-12-2023 To 06:00 PM	Max. Ma
Instructions: 1) 2) 3)	Question no. 1 and 2 are of Attempt any three question Figure to right indicate full	าpulsory. from Q. No. 3 to Q. No. 7. arks.
Q.1 A) Selec 1)	ct correct alternative from Microscope that uses light bright background is know a) brightfield microscope	l lowing. ys to produce a dark image against a is a b) Darkfield microscope

Seat

No.

- a dark image against a
 - eld microscope
 - c) electron microscope Phase contrast microscope d)
- The characterization of Auger spectroscopy can be achieved up to 2) which of the following depths?

a)	2 nm	b)	1nm
``		• • •	-

- c) 4 nm d) 8nm
- Electromagnetic energy is kept constant in. 3)
 - a) Continuous wave NMR Fourier Transform NMR b) d) discontinues wave NMR
 - b) Both a& b
- 4) types of waves has the shortest frequency?
 - a) X-ray b) Radio waves
 - c) Microwave UV d)
- Which of the following wave has the shortest wavelength? 5)
 - a) Radio waves Visible b)
 - c) X -Ray d) Infrared

6) Resolving Power of microscope is depends on wavelength as .

- $1/\lambda$ a) λ b) λ^2
- c) $1/\lambda^2$ d)

Bending of light around a edge of obstacle and enters in shadow 7) region is called _____. b) Interference

- a) Diffraction
- c) Polarization Reflection d)
- Basic principle of STM is tunneling 8)
 - Semi- classical a) Classical b)
 - Both a and c C) quantum d)
- Which among the following microscopes uses light as the source of 9) illumination?
 - a) Stereomicroscope c) SEM
- b) electron microscope
- d) TEM

SLR-EV-17

Max. Marks: 80

06

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10) NMR is the study of absorption of _____ by nuclei in a magnetic field.

- a) Radioactive Radiation
- b) IR Radiation
- c) Radio frequency Radiation
- d) Microwaves

B) Answer True/ False.

- 1) In optical microscopy electromagnetic lenses are used.
- 2) Auger electron spectrum is plot of intensity versus kinetic energy.
- 3) 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.
- 4) AES is limited when it comes to very high resolution studies.
- 5) Signal splitting in NMR arises from spin- spin decoupling.
- 6) 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.

- 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.

- 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.

en [<i>x,</i> b) d)	P_x] and $(\partial/\partial x, x]$ is 0, $i\hbar$ $i\hbar$, 1	
s cori b)	rect? $[\hat{x}, \hat{p}y] = i\hbar$	
d)	$[\hat{z},\hat{p}z]=i\hbar$	
		Page 1 of 2

M.Sc. (Semester - II) (New) (CBCS) Examination: Oct/No	v-2023
PHYSICS (NANOPHYSICS)	
Quantum Mechanics (MSC09201)	

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

5)

a)

c)

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No.

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

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

3) Figure to right indicate full marks.

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

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

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

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

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

a) $\hat{p}^2/2m$ b) V(x)c) $(\hat{p}^2/2m) + V(x)$ d) $(\hat{p}^2/2m) - V(x)$ Energy of harmonic oscillator is, E = _____.

a) $n\hbar\omega$ b) $(1/2)\hbar\omega$ c) $(n+1/2)\hbar\omega$ d) $(n-1/2)\hbar\omega$

6) The eigen value of L^2 is _____. a) $l(l \pm 1)b^2$ b) l(l = 1)b

c)
$$l(l^2 + 1)\hbar^2$$
 d) $l(l - 1)\hbar$

7) Which of the following is lowering operator _____.

a)	$L_x + iL_y$	b)	$L_x - L_y$
c)	$L_x - iL_y$	d)	0

8) The commutation relation between $[x, P_x]$ and $(\partial/\partial x, x]$ is _____ a) $i\hbar, 0$ b) $0, i\hbar$

c) $-i\hbar, 1$ d) $i\hbar, 1$

9) Which of the following equation is correct?

 $[\hat{z}, \hat{p}x] = i\hbar$

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

Set

Max. Marks: 80

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

c)

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

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

b) Define angular momentum and explain the commutation relation.

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

					visc	<i>J</i> U <u>J</u> ZUZ)	
Day Time	& Da e: 11:	te: Tu 00 AN	iesd /I Tc	lay, 19-12-2023 0 02:00 PM		Max. Marks	: 80
Insti	ructio	ons: ´	1) Q 2) At 3) Fi	. No. 1 and 2 are compulsory. ttempt any Three questions fro gures to the right indicate full n	m Q. narks	No.3 to Q.No.7. s.	
Q.1	A)	Cho 1)	ose Div a) c)	e the correct alternatives from vergence of the curl of any vect 0 Infinite	n the or fie b) d)	options. eld is always 1 cant possible	10
		2)	Wh for a) c)	nich one of the fundamental eq m the basis of electromagnetic Faraday law Gauss law of electrostatic	uatio theo b) d)	n was modified by Maxwell to ry? Ampere law Gauss law of magnetostatic	
		3)	Loi a) c)	rentz electric force has direction Similar to electric field Scalar quantity	n b) d)	Opposite to electric field None	
		4)	Th a) c)	e Poynting vector P is equal to E . H E/H	b) d)	 E × H H/E	
		5)	Wł me a) c)	nich property of an electromagr edium in which it is travelling? Velocity Time period	b) d)	wave, depends on the Frequency Wave length	
		6)	In am a) c)	the skin definition of skin dep plitude reduces to Nearly one fifth One half	oth, it b) d)	t is distance over which field 1/e One fourth	
		7)	In l a) c)	Maxwell equation $∇ × H = J + δ$ Electric flux density Surface current density	∂ <i>D /∂</i> b) d)	<i>t</i> , <i>J</i> is magnetic flux density No physical quantity	

M.Sc. (Semester - II) (New) (CBCS) Examination: Oct/Nov-2023 **PHYSICS (NANOPHYSICS)** Flectrodynamics (MSC00202)

Seat No.

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			c)́	Amperes law	d)	Lorentz force law	
		9)	Ma	ignetic vector potent	ial due to maç	gn	etic dipole is proportional	
			to a)	 r	b)	1/r	
			c)	1/r ²	d	ý	1/r ³	
		10)	Ele	ectric Potential (Φ) o	f a quadrupol	e	varies with distance ' r ' on its	
			axi	s as	h	3	Φr^{-2}	
			а) с)	$\Phi: r^{-3}$	d b)	$\Phi: r^{3/2}$	
	B)	Fill	in th	ne blanks OR Write	Ture /False	-		06
		1)	Th	e charge density of e	electrostatic fi	ele	d is given by	
		2)	In (Th	dipole, the gauss the e Ampere law is bas	ed on	VIII Tł	be	
		4)	Th	e electric field over t	he gaussian s	sui	rface remains continuous and	
		5)	uni	form at every point.	o mognotio int	tar	noity in product of the ourrent	
		5) 6)	The	e direction of a propa	agation of ele	cti	romagnetic wave is \overline{E} . \overline{B} .	
02	Δns	wer	the f	following				16
Q.2	a)	Exp	lain	Maxwell's displacem	nent current?			
	b)	Writ	ear	note on Skin effect a	ind skin depth	<u>؟</u>		
	d)	⊑xp Stat	e the	e boundary conditior	for an electro	os	static field \overline{E} .	
03	۸ne	WOR	that	following				
Q.J	a)	Disc	CUSS	the "Reflection and	refraction" of	ele	ectromagnetic waves at	10
	ь.)	oblic	que i	incidence.				00
	D)	Elac	orat	te the concept of dis	placement cu	rre	ent.	06
Q.4	Ans	wer	the	following.				4.0
	a)	Exp	iain i ce.	In details of boundar	y condition be	Ξī	ween conductor and free	10
	b)	Obta field	aine Is.	d the expression for	the resistance	e f	for uniform field &non-uniform	06
Q.5	Ans	wer	the	following.				
	a) b)	Deri Exp	ve a lain t	n expression for ene the concept of Radia	ergy stored in ation damping	el I.	lectric and magnetic field.	10 06

- Law which governs the interaction of the electromagnetic field with charge matter _____. a) Gauss law b) Faradays law 8)

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 (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. Choose the correct alternatives from the options. Q.1 A) 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
- 3) The statistics followed by half spin particles is
 - a) Maxwell-Boltzmann Statistics
 - b) Fermi-Dirac Statistics
 - c) Bose-Einstein Statistics
 - d) None of the above

4) Maxwell-Boltzmann statistics cannot be applied to _____.

- a) Atoms b) Molecules
- c) Photons d) Lattice

The equation of state for an ideal gas is represented as 5)

- a) PV = R/Tb) PV = nRT
- c) P/V = R/Td) PV = RT
- 6) The entropy of an ideal gas at absolute zero is
 - a) ∞ b) 0 c) NkB
 - d) Cannot be calculated

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

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

Pressure at the critical point is 9)

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

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

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No.	

SLR-EV-21

10) In microcanonical ensembles following parameters remain constant.

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.

a)

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.0		wer the following.						
	a)	Show that Gibb's function is continuous during the first-order phase transition, but the first derivative of Gibb's function changes discontinuously.	10					
	b)	What is a triple point? Explain it with the help of a phase diagram.	06					
Q.4	Answer the following.							
	a)	Write a note on Critical Indices	10					
	b)	Write about Liouville's theorem in a classical presentation.	06					
Q.5	Answer the following.							
	a)	Write about Second order phase transition.	08					
	b)	Write a note on microcanonical, canonical and grand canonical ensembles.	08					
Q.6	Answer the following.							
	a)	Show that the average energy of a single particle of ideal fermi gas is 3/5 times the fermi energy of the system.	10					
	b)	Explain the law of corresponding states.	06					
Q.7	Answer the following.							
	a)	Derive the expression for Fermi energy at strongly degenerate ideal Fermi gas.	10					
	b)	Write about black body radiation.	06					

	М.9	Sc.	(Sem	ester - III) (New) (PHYSICS (Semiconductor	CBCS) Exa NANOPHY Physics (N	mination: Oct/Nov [.] SICS) ISC09301)	-2023
Day Time	& Dat : 11:0	e: F 0 A	riday, (M To 0	05-01-2024 2:00 PM		, Ma	ax. Marks: 80
Instr	uctio	ns:	1) Q. (2) Atte 3) Figu	1) and (2) are compul mpt any three from Q ure to right indicate ful	sory. . No. 3 to Q. N I marks.	lo. 7	
Q.1	A)	Cł 1)	ioose t In a cone	ween the valence banc	10 and and		
			a) c)	5 eV 15 eV	b) d)	10 eV 1 eV	
		2)	Elec a) c)	ctron-hole pairs are pr Recombination Ionization	oduced by b) d)	 Thermal energy Doping	
		3)	The a) b) c) d)	drift velocity of the co Increase with an inc Decrease with Decrease Increase with Decrease Decrease with the in	onductor rease in tempe ease in tempe ase in the tem acrease in tem	 erature rature perature perature	
		4)	In S a) c)	chottky barrier, barrie Amount of doping m Temperature	r height deper aterial b) d)	nds on Type of doping mate None of the above	rial
		5)	The any a) c)	probability that an electron temperature (> OK) is 0 0.5	ectron in a met s b) d)	tal occupies the fermi le 1 1.0	evel, at
		6)	lf σ and a) c)	is the conductivity, wh the current density J $\sigma = J/E$ $\sigma = E/J$	nat is the relati in a conductin b) d)	on between the electric g medium? $\sigma = 1/JE$ $\sigma = EJ$	tield E
		7)	The abo a) c)	equilibrium number o ut 10 ¹⁰ EHP/cm ³ 10 ¹⁰ EHP/m ³	of EHP in pure b) d)	Si at room temperature 10 ¹² EHP/cm ³ 10 ¹² EHP/m ³	e is
		8)	The a) c)	atoms of solid are he Van der Waals force Ionic bonds	ld together by s b) d)	––––- Hydrogen bonds Hydrophobic forces	
		9)	Wha a) c)	at is the role of seed c Nucleation center Solvent	rystal in crysta b) d)	al growth? Catalyst Solution	

Set P

		 10) Charge carriers can move in semiconductor via: a) Diffusion mechanism b) Floating mechanism c) Drift mechanism d) Both drift and diffusion mechanism 					
	В)	 Fill in the blanks OR Write true/ false. 1) The mean lifetime of electron-hole pair (EHP) is less than seconds. 2) LED is an example of luminescence. 3) nuclei often redissolve. 4) Nucleation poses large energy barrier. (True/False) 5) Mobility cannot be determined from Haynes-Shockley experiment. (True/False) 6) Debye temperature is associated with the highest allowed mode of vibration. (True/False) 	6				
Q.2	Ans a) b) c) d)	swer the following16Write a note on optical absorption.Explain fermi level pinning.Write a short note on group velocity of electrons.Explain in short direct bandgap semiconductors.					
Q.3	Ans a) b)	wer the following Elaborate in detail about the ohmic contacts. Explain in short about Nucleation process.					
Q.4	Ans a) b)	swer the following Explain the concept of vibrational specific heat and derive its expression. Write in brief about inverse effective mass tensor.					
Q.5	Ans a) b)	swer the following Elaborate in detail about the growth of bulk semiconductors by Zone Melting. Explain in brief about surface and interface states.					
Q.6	Ans a) b)	wer the followingExplain the concept of steady state carrier generation.1Write in brief about vapour phase epitaxy.0	0 6				
Q.7	 Answer the following a) Explain in detail about rectifying contacts with the necessary band diagrams. 						
	D)	Explain the bonding forces in solids. 0	6				