Notice

Date: Monday, 14/11/2022

It is hereby informed to the students of M.Sc. – I and II, that First Term Internal Evaluation Examination is scheduled between 28th to 29th November 2022 in the Department of Physics.

Instructions:

1) Nature of question paper for M.Sc. – I: 05 MCQ's (05 Marks), 01 Short Answer Questions (05 Marks), 01 Long Answer Questions (10 Marks)
2) Nature of question paper for M.Sc. – II: 05 MCQ's (05 Marks), 01 Short Answer Questions (05 Marks), 01 Long Answer Questions (10 Marks)
3) Students should present before 15 minutes of the examination.
4) Answer sheets will be provided by the Department.
5) Strictly mention the Full Name and Roll number on Answer Sheet correctly.
6) All students should remain present for the Internal Examination as the examination will not be conducted afterwords in any case.

Sr. No.	Date	Class	Name of the Paper	Time
01	28/11/2022	M. Sc. – I	(01) Mathematical Physics	12 – 01 PM
			(02) Classical Mechanics	02 – 03 PM
02	28/11/2022	M. Sc. – II	(01) Nuclear and Particle Physics	12 – 01 PM
			(02) Thin Film Deposition and other Techniques	02 – 03 PM
03	29/11/2022	M. Sc. – I	(01) Quantum Mechanics I	12 – 01 PM
			(02) Condensed matter Physics	02 – 03 PM
04	29/11/202	M. Sc. – II	(01) Solid State Physics – 01	12 – 01 PM
			(02) Solid State Physics – 02	02 – 03 PM

Coordinator

HOD, Physics
Head of the
Department of Physics
Vivekanand College, Kolhapur

VIVEKANAND COLLEGE ESTD JUNE 1964 KOLHAPUR - 416003

"Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe
Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Vivekanand College, Kolhapur (Autonomous)
Department of Physics

M.Sc. Part-I SEM I Internal Examination (2022-23)
Mathematical Physics

Total Marks:20 Time :-3.00 pm to 4.00 pm

Instructions:-

1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of log table and calculator is allowed.

Q.1) Choose the correct alternative and rewrite **5 marks**

1) The product of eigen values of matrix is equal to it's …..
a) Trace b) Determinant c) Eigen vector d) Characteristics equation

2) Every matrix satisfies it's ……..
a) Characteristic equation b) Eigen values
c) Eigen vector d) All of above

3) If the determinant of matrix is zero then the matrix is called as ……
a) Singular matrix b) Identity matrix
c) Equal matrix d) Periodic matrix

4) Multiplication of matrices is ……
a) commutative b) not commutative c) not associative d) determinant

5) If every i^{th} element of matrix A is equal to conjugate complex j^{th} element of matrix A , then matrix A is called as ……..
a) Hermition matrix b) Idempotent Matrix c) Orthogonal matrix d) Conjugate matrix

Q.2. Attempt the following (Any One) **10 marks**

1) Verify the Cayley-Hamilton theorem for the matrix $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$

2) Find the matrix P which transform the matrix $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$ to a diagonal form.

Q.3. Attempt the following **5 marks**

i) State and Prove the Cayley-Hamiltonian Theorem.
ii) State and prove Cauchy-Riemann Condition

"Dissemination of Education for Knowledge Science and Culture"
Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College (Autonomous) Kolhapur

Department of Physics

M.Sc. I Internal Examination, May-2022

Attendance Sheet

Date: Mathematical Physics

Time: 12.00-1.00 p.m.

Roll. No.	Name of Candidate	Sign
1331	Ahiwale Snehal Nitin	
1332	Biradar Anand Nagappa	
1333	Jarkoli Smith Kallappa	
1334	Kavatagi Shivraj C.	
1335	Mithari Shweta Sardar	
1336	Randive Rajshree Mahesh	
1337	Sagar Shivani Dattatryay	
1338	Chuhan Aditi S.	
1339	Shirke Pranali Pradip	
1340	Shirodkar Shubham R.	
1341	Todkar Dnyaneshwari Pandit	

VIVEKANAND COLLEGE KOLHAPUR (Autonomous) ESTD JUNE 1964

20/20

08331

Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या — या विषयाच्या प्रयोग परीक्षा

Practical Examination in Mathematical Physics.

at the M.Sc-I Internal Examination 2024-25 Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) 1615

विभाग (Section)

ESTD JUNE 1964 VIVEKANAND COLLEGE KOLHAPUR (Autonomous)

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.

२. उपकरणांच्या वापराबाबत तुम्हांला काही माहीत नसेल तर परीक्षक किंवा प्रयोगशाळा सहाय्यक यांना तुम्हाला मदत करण्याविषयी विनंती करा.

३. कोणताही विद्युतप्रयोग करण्यापूर्वी, प्रत्यक्ष पुरविलेली सर्व उपकरणे आणि सर्व 'कनेक्शन' नीट लावून घेऊन संबंधित कामाची नीटनेटकी कार्ययोजना करण्याची नितांत आवश्यकता आहे आणि ह्या नंतर, पुढे काम चालू करण्याविषयी परीक्षकांची परवानगी मिळविणे आवश्यक आहे.

४. सर्व निरीक्षणे कोष्टकवजा तक्त्यात भरावी. मधल्या सर्व गणना आणि निर्णय हे शक्य तितक्या सुवाच्यपणे आणि स्पष्टपणे नोंदविलेले असणे हे हितावह आहे.

५. प्रारंभिक किंवा अंतिम निरीक्षणात संख्यावाचक आकडे एकावर एक लिहू नयेत. जर लिहिलेला कोणताही आकडा नको असेल तर त्यावर एक रेघ ओढून पाहिजे असलेला आकडा त्याच्याजवळ लिहा.

६. प्रयोगशाळेतून बाहेर पडण्यापूर्वी आपले टेबल चांगल्या स्थितीत आहे याची खात्री करा.

INSTRUCTIONS TO CANDIDATES

1. Read the question carefully and perform the experiment as required.
2. If there be anything the apparatus that you do not know, ask the examiner or the laboratory assistant to help you,
3. Before doing any electrical experiment, it is obsolutely essential that you make a neat working sketch of all apparatus actually provided and of the necessary connection, and obtain the examiner's permission to proceed.
4. Express all observations in a tabular form.
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(येथून लेखनास सुरवात करा.) (Begin writing here.)

Q1

1) Eigen vector

2) Characteristics equation

3) Singular Matrix

Section	Q. No.												
	Marks												

प्र. क्र. Q. No.

4) Commutative

5) Hermitian matrix.

5

Q2. Cayley - Hamiltonian Theorem:-

Statement:- Every square matrix satisfies its own characteristic equation.

If $|A-\lambda I| = (-1)^n (\lambda^n + a_1\lambda^{n-1} + a_2\lambda^{n-2} \dots + a_n)$

be the characteristic polynomial of $n\times n$ matrix $A = (a_{ij})$ then the matrix equation

$$X^n + a_1 X^{n-1} + a_2 X^{n-2} + \dots + a_n I = 0$$

$$A^n + a_1 A^{n-1} + a_2 A^{n-2} + \dots + a_n I = 0.$$

Proof:- Since the elements of $A-\lambda I$ are at most of the first degree in λ, the elements of adj $(A-\lambda I)$ are at most degree $(n-1)$ in λ.

$$\text{Adj}(A-\lambda I) = B_0\lambda^{n-1} + B_1\lambda^{n-2} \dots + B_{n-1}$$

Where, $B_0, B_1, \dots B_{n-1}$ are $n\times n$ matrices, their elements being polynomial in λ.

$$(A-\lambda I)\,\text{Adj}(A-\lambda I) = |A-\lambda I|\, I$$

$$(A-\lambda I)(B_0\lambda^{n-1} + B_1\lambda^{n-2} + \dots + B_{n-1}) = (-1)^n(\lambda^n + a_1\lambda^{n-1} + \dots + a_n] I$$

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

Equating coefficients of like powers of λ on both sides,

$$-IB_0 = (-1)^n I$$

$$AB_0 - IB_1 = (-1)^n I a_1$$

$$AB_1 - IB_2 = (-1)^n a_2 I$$

$$\vdots$$

$$AB_{n-1} = (-1)^n a_2 I$$

Thus, $A^n + a_1 A^{n-1} + \dots + a_n I = 0$.

Thus if A is square matrix and if

$$\lambda^3 - 2\lambda^2 + 3\lambda - 4 = 0 \quad \text{--- (1)}$$

be its characteristics equation, then according to Cayley Hamilton Theorem eqn (1) is satisfied by A.

$$A^3 - 2A^2 + 3A - 4 = 0.$$

~~we find its A^{-1}~~

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No. 2

1) $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$

$|A - \lambda I| = 0$

$$\begin{vmatrix} 2-\lambda & 1 & 1 \\ 0 & 1-\lambda & 0 \\ 1 & 1 & 2-\lambda \end{vmatrix} = 0$$

$= (2-\lambda)[(1-\lambda)(2-\lambda) - 0] - 1[0] + 1[0 - (1-\lambda)]$

$= (2-\lambda)[2 - \lambda - 2\lambda + \lambda^2] + (1-\lambda)$

$(2-\lambda)[2 - 3\lambda + \lambda^2] - (1-\lambda)$

$4 - 6\lambda + 2\lambda^2 - 3\lambda + 3\lambda^2 - \lambda^3 - (1-\lambda)$

$-\lambda^3 + 5\lambda^2 - 7\lambda + 3 = 0$

$\lambda^3 - 5\lambda^2 + 7\lambda - 3 = 0.$

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Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या _____ या विषयाच्या प्रयोग परीक्षा

Practical Examination in _____

at the _____ Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) 1615 विभाग (Section) _____

VIVEKANAND COLLEGE KOLHAPUR ESTD JUNE 1964

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.

२. उपकरणांच्या वापराबाबत तुम्हांला काही माहीत नसेल तर परीक्षक किंवा प्रयोगशाळा सहाय्यक यांना तुम्हाला मदत करण्याविषयी विनंती करा.

३. कोणताही विद्युतप्रयोग करण्यापूर्वी, प्रत्यक्ष पुरविलेली सर्व उपकरणे आणि सर्व 'कनेक्शन' नीट पाहून घेऊन संबंधित काम्रची नीटनेटकी कार्ययोजना करण्याची नितांत आवश्यकता आहे आणि ह्या नंतर, पुढे काम चालू करण्याविषयी परीक्षकांची परवानगी मिळविणे आवश्यक आहे.

४. सर्व निरीक्षणे कोष्टकवजा तक्त्यात भरावी. मधल्या सर्व गणना आणि निर्णय हे शक्य तितक्या सुवाच्चपणे आणि स्पष्टपणे नोंदविलेले असणे हे हितावह आहे.

५. प्रारंभिक किंवा अंतिम निरीक्षणात संख्यावाचक आकडे एकावर एक लिहू नयेत. जर लिहिलेला कोणताही आकडा नको असेल तर त्यावर एक रेघ ओढून पाहिजे असलेला आकडा त्याच्याजवळ लिहा.

६. प्रयोगशाळेतून बाहेर पडण्यापूर्वी आपले टेबल चांगल्या स्थितीत आहे याची खात्री करा.

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(येथून लेखनास सुरवात करा.) (Begin writing here.)

$$\lambda^3 - 5\lambda^2 + 7\lambda + 3I = 0$$

$$A^3 - 5A^2 + 7A + 3I = 0$$

$$A^2 = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix} \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$$

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

$$A^2 = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix} \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 4+0+1 & 2+1+1 & 2+0+2 \\ 0+0+0 & 0+1+0 & 0+0+0 \\ 2+0+2 & 1+1+2 & 1+0+4 \end{bmatrix}$$

$$A^2 = \begin{bmatrix} 5 & 4 & 4 \\ 0 & 1 & 0 \\ 4 & 4 & 5 \end{bmatrix}$$

$$A^3 = \begin{bmatrix} 5 & 4 & 4 \\ 0 & 1 & 0 \\ 4 & 4 & 5 \end{bmatrix} \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 10+0+4 & 5+4+4 & 5+0+8 \\ 0+0+0 & 0+1+0 & 0+0+0 \\ 8+0+5 & 4+4+5 & 4+0+10 \end{bmatrix}$$

$$A^3 = \begin{bmatrix} 14 & 13 & 13 \\ 0 & 1 & 0 \\ 13 & 13 & 14 \end{bmatrix}$$

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

$$A^3 - 5A^2 + 7A + 3 = 0$$

$$\begin{bmatrix} 14 & 13 & 13 \\ 0 & 1 & 0 \\ 13 & 13 & 14 \end{bmatrix} - 5 \begin{bmatrix} 5 & 4 & 4 \\ 0 & 1 & 0 \\ 4 & 4 & 5 \end{bmatrix} + 7 \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix} + 3 \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = 0$$

$$\begin{bmatrix} 14 & 13 & 13 \\ 0 & 1 & 0 \\ 13 & 13 & 14 \end{bmatrix} - \begin{bmatrix} 25 & 20 & 20 \\ 0 & 5 & 0 \\ 20 & 20 & 25 \end{bmatrix} + \begin{bmatrix} 14 & 7 & 7 \\ 0 & 7 & 0 \\ 7 & 7 & 14 \end{bmatrix} + \begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix} = 0$$

$$\begin{bmatrix} -11 & -7 & -7 \\ 0 & -4 & 0 \\ -7 & -7 & -11 \end{bmatrix} + \begin{bmatrix} 17 & 7 & 7 \\ 0 & 10 & 0 \\ 7 & 7 & 17 \end{bmatrix} = 0$$

$$\begin{bmatrix} 6 & 0 & 0 \\ 0 & 6 & 0 \\ 0 & 0 & 6 \end{bmatrix} = 0$$

10

Section	Q. No.												
	Marks												

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Q. No	

20/20

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Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या — या विषयाच्या प्रयोग परीक्षा

Practical Examination in Mathematical Physics

at the M.Sc-I Internal Examination 2022-23 Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) 1604

विभाग (Section)

VIVEKANAND COLLEGE KOLHAPUR (Autonomous) ESTD JUNE 1964

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.

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(येथून लेखनास सुरवात करा.) (Begin writing here.)

Q1.

i) Eigen vector

ii) characteristic equation

iii) Singular matrix

Section	Q. No.												
	Marks												

प्र. क्र. Q. No.

4) commutative

5) Hermitian.

~~Q3~~

Q2

1) $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$

$$|A - \lambda I| = 0$$

$$\begin{vmatrix} 2-\lambda & 1 & 1 \\ 0 & 1-\lambda & 0 \\ 1 & 1 & 2-\lambda \end{vmatrix} = 0$$

$$(2-\lambda)[(1-\lambda)(2-\lambda) - 0] - 1[0-0] +$$

$$1[0 - (1-\lambda)] = 0$$

$$(2-\lambda)[2 - \lambda - 2\lambda + \lambda^2] - (1-\lambda) = 0$$

$$4 - 6\lambda + 2\lambda^2 - 2\lambda + 3\lambda^2 - \lambda^3 - 1 + \lambda = 0$$

$$-\lambda^3 + 5\lambda^2 - 7\lambda + 3 = 0$$

$$\lambda^3 - 5\lambda^2 + 7\lambda - 3 = 0$$

(continued in supplement).

Section	Q. No.												
	Marks												

Q. No. 3

Cayley - Hamilton Theorem :-

Every square matrix satisfies its own characteristic equation.

If $|A-\lambda I| = (-1)^n (\lambda^n + a_1\lambda^{n-1} + a_2\lambda^{n-2} + \dots + a_n)$

be the characteristics polynomial of $n \times n$ matrix $A = (a_{ij})$ then the matrix equation

$$X^n + a_1 X^{n-1} + a_2 X^{n-2} + \dots + a_n I = 0$$

$$A^n + a_1 A^{n-1} + a_2 A^{n-2} + \dots + a_n I = 0$$

Since the elements of $A-\lambda I$ are at most of the first degree in λ, the elements of $adj(A-\lambda I)$ are at most degree $(n-1)$ in λ.

$$Adj(A-\lambda I) = B_0\lambda^{n-1} + B_1\lambda^{n-2} + \dots + B_{n-1}$$

where $B_0, B_1, \dots B_{n-1}$ are $n \times n$ matrices, their elements being polynomial in λ.

$$(A-\lambda I)\, adj(A-\lambda I) = |A-\lambda I|\, I$$

$$(A-\lambda I)(B_0\lambda^{n-1} + B_1\lambda^{n-2} + \dots + B_{n-1}) = (-1)^n(\lambda^n + a_1\lambda^{n-1} + \dots a_n)I$$

Equating coefficients of the power λ on both sides we have,

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

$-IB_0 = (-1)^n I$

$AB_0 - IB_1 = (-1)^n I a_1$

$AB_1 - IB_2 = (-1)^n a_2 I$

$\vdots$

$AB_{n-1} = (-1)^n a_2 I$

Thus,

$A^n + a_1 A^{n-1} + \dots + a_n I = 0$

If A is square matrix then

$A^3 - 2A^2 + 3A - 4 = 0$ be its characteristic equation.

08394

Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या _____ या विषयाच्या प्रयोग परीक्षा

Practical Examination in _____

at the _____ Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) 1604 विभाग (Section) _____

VIVEKANAND COLLEGE KOLHAPUR ESTD JUNE 1964 (Autonomous)

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.

२. उपकरणांच्या वापराबाबत तुम्हांला काही माहीत नसेल तर परीक्षक किंवा प्रयोगशाळा सहाय्यक यांना तुम्हाला मदत करण्याविषयी विनंती करा.

३. कोणताही विद्युतप्रयोग करण्यापूर्वी, प्रत्यक्ष पुरविलेली सर्व उपकरणे आणि सर्व 'कनेक्शन' नीट पाहून घेऊन संबंधित कामाची नीटनेटकी कार्ययोजना करण्याची नितांत आवश्यकता आहे आणि ह्या नंतर, पुढे काम चालू करण्याविषयी परीक्षकांची परवानगी मिळविणे आवश्यक आहे.

४. सर्व निरीक्षणे कोष्टकवजा तक्त्यात भरावी. मधल्या सर्व गणना आणि निर्णय हे शक्य तितक्या सुवाच्चपणे आणि स्पष्टपणे नोंदविलेले असणे हे हितावह आहे.

५. प्रारंभिक किंवा अंतिम निरीक्षणात संख्यावाचक आकडे एकावर एक लिहू नयेत. जर लिहिलेला कोणताही आकडा नको असेल तर त्यावर एक रेघ ओढून पाहिजे असलेला आकडा त्याच्याजवळ लिहा.

६. प्रयोगशाळेतून बाहेर पडण्यापूर्वी आपले टेबल चांगल्या स्थितीत आहे याची खात्री करा.

INSTRUCTIONS TO CANDIDATES

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(येथून लेखनास सुरवात करा.) (Begin writing here.)

Q 2 $A^3 - 3A^2 + 7A - 3 = 0$

1)

$$A^2 = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix} \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 4+0+1 & 2+1+1 & 2+0+2 \\ 0+0+0 & 0+1+0 & 0+0+0 \\ 2+0+2 & 1+1+2 & 1+0+4 \end{bmatrix}$$

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

$$A^2 = \begin{bmatrix} 5 & 4 & 4 \\ 0 & 1 & 0 \\ 4 & 4 & 5 \end{bmatrix}$$

$$A^3 = \begin{bmatrix} 5 & 4 & 4 \\ 0 & 1 & 0 \\ 4 & 4 & 5 \end{bmatrix} \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 10+0+4 & 5+4+4 & 5+0+8 \\ 0+0+0 & 0+1+0 & 0+0+0 \\ 8+0+5 & 4+4+5 & 4+0+10 \end{bmatrix}$$

$$A^3 = \begin{bmatrix} 14 & 13 & 13 \\ 0 & 1 & 0 \\ 13 & 13 & 14 \end{bmatrix}$$

$$A^3 - 3A^2 + 7A - 3I = 0$$

$$\begin{bmatrix} 14 & 13 & 13 \\ 0 & 1 & 0 \\ 13 & 13 & 14 \end{bmatrix} - 3 \begin{bmatrix} 5 & 4 & 4 \\ 0 & 1 & 0 \\ 4 & 4 & 5 \end{bmatrix} + 7 \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix} - 3 \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} =$$

Section	Q. No.												
	Marks												

प्र. क्र.

Q. No.

$$\begin{bmatrix} 14 & 13 & 13 \\ 0 & 1 & 0 \\ 13 & 13 & 14 \end{bmatrix} - \begin{bmatrix} 15 & 12 & 12 \\ 0 & 3 & 0 \\ 12 & 12 & 15 \end{bmatrix} + \begin{bmatrix} 14 & 7 & 7 \\ 0 & 7 & 0 \\ 7 & 7 & 14 \end{bmatrix} - \begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

$$\begin{bmatrix} -1 & 1 & 1 \\ 0 & -2 & 0 \\ 1 & 1 & -1 \end{bmatrix} + \begin{bmatrix} 11 & 7 & 7 \\ 0 & -4 & 0 \\ 7 & 7 & 11 \end{bmatrix} = 0.$$

$$\begin{bmatrix} 10 & 8 & 8 \\ 0 & -6 & 0 \\ 8 & 8 & 10 \end{bmatrix} = 0$$

10

Section	Q. No.												
	Marks												

प्र. क्र.	
Q. No.	

15/20

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Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या या विषयाच्या प्रयोग परीक्षा

Practical Examination in Mathematical Physics -

at the M.Sc - I Internal Examination 2022-23 Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.)

विभाग (Section)

VIVEKANAND COLLEGE ESTD JUNE 1964 KOLHAPUR (Autonomous)

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.

२. उपकरणांच्या वापराबाबत तुम्हांला काही माहीत नसेल तर परीक्षक किंवा प्रयोगशाळा सहाय्यक यांना तुम्हाला मदत करण्याविषयी विनंती करा.

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(येथून लेखनास सुरवात करा.) (Begin writing here.)

Q1

1) Determinant

2) characteristic equation

3) not commutative

Section	Q. No.												
	Marks												

प्र. क्र. Q. No. 5) Hermitian matrix.

Q2 $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$

$|A - \lambda I| = 0$

$$\begin{vmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{vmatrix} - \begin{vmatrix} \lambda & 0 & 0 \\ 0 & \lambda & 0 \\ 0 & 0 & \lambda \end{vmatrix} = 0$$

$$\begin{vmatrix} 2-\lambda & 1 & 1 \\ 0 & 1-\lambda & 0 \\ 1 & 1 & 2-\lambda \end{vmatrix} = 0$$

$(2-\lambda)[(1-\lambda)(2-\lambda)] - 1[0] + 1[-(1-\lambda)] = 0$

$(2-\lambda)[2 - \cancel{\lambda} - 2\lambda + \lambda^2] - 1 + \lambda] = 0.$

$4 - 6\lambda + 2\lambda^2 - 2\lambda + 3\lambda^2 - \lambda^3 - 1 + \lambda = 0$

$-\lambda^3 + 5\lambda^2 - 7\lambda + 3 = 0$

$\lambda^3 - 5\lambda^2 + 7\lambda - 3 = 0$

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

$$\lambda^2 - 2\lambda + 1 = 0$$

$$(\lambda - 1)(\lambda - 1)$$

$$\lambda = 1, 1$$

Q3

ii) Cauchy Riemann condition:-

complex function $f(z) = u + iv$

$$f'(z) = \lim_{t \to 0} \frac{f(z+t) - f(z)}{t}$$

$$= \lim_{t \to 0} \frac{f(z+it) - f(z)}{it}$$

$$\lim_{t \to 0} \frac{f(z+t) - f(z)}{t} = \lim_{t \to 0} \frac{u(x+t, y) + iv(x+t, y) - u(x, y) - v(x, y)}{t}$$

$$= \frac{\partial u}{\partial x} + i \frac{\partial v}{\partial x}$$

Taking derivative we have,

$$-i \frac{\partial u}{\partial y} + \frac{\partial v}{\partial y}$$

equating real and imaginary parts

If $f(z) = u + iv$ is a complex differentiable

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

then its real and imaginary part satisfy the Cauch - Riemann equation

$$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$$

$$\frac{\partial v}{\partial x} = -\frac{\partial u}{\partial y}$$

$$\boxed{f'(z) = \frac{\partial u}{\partial x} + i\frac{\partial v}{\partial x} = \frac{\partial v}{\partial y} - i\frac{\partial u}{\partial y}}$$

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Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या _____ या विषयाच्या प्रयोग परीक्षा

Practical Examination in Mathematical physics -

at the M.Sc - I Internal Examination 2022-23 Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) _____ विभाग (Section) _____

VIVEKANAND COLLEGE KOLHAPUR (Autonomous) ESTD JUNE 1964

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.

२. उपकरणांच्या वापराबाबत तुम्हांला काही माहीत नसेल तर परीक्षक किंवा प्रयोगशाळा सहाय्यक यांना तुम्हाला मदत करण्याविषयी विनंती करा.

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(येथून लेखनास सुरवात करा.) (Begin writing here.)

Q1	
1	Determinant
2	characteristic equation.
3	not commutative

Section	Q. No											
	Marks											

Q. No 2

Characteristic matrix.

Q 2. $A \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$

$|A - \lambda I| = 0$

$$\begin{vmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{vmatrix} - \begin{vmatrix} \lambda & 0 & 0 \\ 0 & \lambda & 0 \\ 0 & 0 & \lambda \end{vmatrix} = 0.$$

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6

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$\lambda^3 - 5\lambda^2 + 7\lambda - 3 = 0.$

Section	Q. No.											
	Marks											

प्र. क्र.
Q. No

$\lambda^2 - 2\lambda + 1 = 0$

$(\lambda - 1)(\lambda - 1)$

$\lambda = 1, 1$

Q 3.
ii) cauchy Riemann condition.
complex function $f(z) = u + iv$.

$$f'(z) = \lim_{t \to 0} \frac{f(z+t) - f(z)}{t}$$

$$= \lim_{t \to 0} \frac{f(z+it) - f(z)}{it}$$

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$$\frac{du}{dx} = i\frac{dv}{dx}$$

taking derivative we have

$$-i\frac{du}{dy} + \frac{dv}{dy}$$

equation real & imaginary part
z/s $f(z) = u + iv$ is a complex
differentiable.

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

then its real & imaginary part satisfy the Cauchy - Riemann equation.

$$\frac{du}{dx} = \frac{dv}{dy}$$

$$\frac{dv}{dx} = -\frac{du}{dy}$$

$$\boxed{f'(z) = \frac{du}{dx} + i\frac{dv}{dx} = \frac{du}{dy} - i\frac{dv}{dy}}$$

15/20

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Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या _____ या विषयाच्या प्रयोग परीक्षा

Practical Examination in Mathematical physics

at the M.Sc - I Internal Examination 2023 Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) _____ विभाग (Section) _____

VIVEKANAND COLLEGE KOLHAPUR (Autonomous) ESTD JUNE 1964

उमेदवारांना सूचना

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(येथून लेखनास सुरवात करा.)(Begin writing here.)

Q1.

1. Determinant

2. characteristic equation

3. not commutative

Section	Q. No.												
	Marks												

Q. No. 5 Diagonalization matrix.

Q. No.

$$A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$$

$$|A - \lambda I| = 0.$$

$$\begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix} - \begin{bmatrix} \lambda & 0 & 0 \\ 0 & \lambda & 0 \\ 0 & 0 & \lambda \end{bmatrix} = 0$$

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$$\lambda^3 - 5\lambda^2 + 7\lambda - 3 = 0$$

$$\lambda^2 - 2\lambda + 1 = 0$$

$$(\lambda - 1)(\lambda - 1)$$

$$\lambda = 1, 1$$

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

Q 3.
ii)

Cauchy Riemann condition
complex function $f(z) = u + iv$

$$f'(z) = \lim_{t \to 0} \frac{f(z+t) - f(z)}{t}$$

$$= \lim_{t \to 0} \frac{f(z+it) - f(z)}{it}$$

$$\lim_{t \to 0} \frac{f(z+t) - f(z)}{t} = \lim \frac{u(x+t, y) + iv(x+t, y) - u(x, y) - u(x, y)}{t}$$

$$\frac{du}{dx} + i\frac{dv}{dx}.$$

Taking derivative we have

$$\frac{-i\,du}{dy} + \frac{dv}{dy}.$$

equation real & imaginary parts.
z is $f(z) = u + iv$ is a complex differentiable.

then its real & imaginary part satisfy the cauchy Reman equation.

$$\frac{du}{dx} = \frac{dv}{dy}$$

"Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. BapujiSalunkhe

Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Vivekanand College, Kolhapur (Autonomous)

Department of Physics

M.Sc. Part-I SEM I Internal Examination (2022-23)

Classical Mechanics

Time :- 11.00 am-12.00 noon Total Marks: 20

Q. 1 Select most correct alternative **(05)**

i) Special Theory of Relativity consist of ……..

a) Electron b) Neutron c) Proton d) Mesons

ii) Lorentz Transformation was discovered by …….

a) Carl D. Anderson b) J. J. Thomson

c) Ernest Rutherford d) James Chadwick

iii) Deuteron is combination of proton and ……

a) Electron b) Neutron c) α – particle d) Mesons

iv) Which of the following is not fundamental particle …….

a) Electron b) Neutron c) Proton d) α – particle

v) Cosmic rays are produced in ……

a) near moon b) near sun c) in volcanoes d) in outer space

Q.2) Attempt any One **(10)**

i) Discuss principal of special theory of relativity. Hence obtain the Lorentz transformation equation

ii) Define Hamiltonian. Obtain the Hamiltonian equation motion; also write Hamiltonian equation of motion in Cartesian coordinate system.

Q.3) Attempt any One **(5)**

i) Derive the relativistic law of addition of velocities. Hence

a) Show that C is ultimate speed.

b) Show that when velocity of light is added to the velocity of light, we get velocity of light

ii) What is Poisson's Bracket? Write the equation of motion in Poisson's Bracket form.

"Dissemination of Education for Knowledge Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College (Autonomous) Kolhapur

Department of Physics

M.Sc. I Internal Examination, May-2022

Attendance Sheet

Date: Classical Mechanics

Time: 2.00-3.00 p.m.

Roll. No.	Name of Candidate	Sign
1331	Ahiwale Snehal Nitin	
1332	Biradar Anand Nagappa	
1333	Jarkoli Smith Kallappa	
1334	Kavatagi Shivraj C.	
1335	Mithari Shweta Sardar	
1336	Randive Rajshree Mahesh	
1337	Sagar Shivani Dattatryay	
1338	Chuhan Aditi S.	
1339	Shirke Pranali Pradip	
1340	Shirodkar Shubham R.	
1341	Todkar Dnyaneshwari Pandit	

VIVEKANAND COLLEGE KOLHAPUR (Autonomous) ESTD JUNE 1964

09933

Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या ——— या विषयाच्या प्रयोग परीक्षा

Internal ~~Practical~~ Examination in Classical Mechanics

at the M.Sc.-I Internal Examination -2022 Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) 1609

विभाग (Section) 14/20

VIVEKANAND COLLEGE KOLHAPUR (Autonomous) ESTD JUNE 1964

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.

२. उपकरणांच्या वापराबाबत तुम्हांला काही माहीत नसेल तर परीक्षक किंवा प्रयोगशाळा सहाय्यक यांना तुम्हाला मदत करण्याविषयी विनंती करा.

३. कोणताही विद्युतप्रयोग करण्यापूर्वी, प्रत्यक्ष पुरविलेली सर्व उपकरणे आणि सर्व 'कनेक्शन' नीट पाहून घेऊन संबंधित कामाची नीटनेटकी कार्ययोजना करण्याची नितांत आवश्यकता आहे आणि ह्या नंतर, पुढे काम चालू करण्याविषयी परीक्षकांची परवानगी मिळविणे आवश्यक आहे.

४. सर्व निरीक्षणे कोष्टकवजा तक्त्यात भरावी. मधल्या सर्व गणना आणि निर्णय हे शक्य तितक्या सुवाच्चपणे आणि स्पष्टपणे नोंदविलेले असणे हे हितावह आहे.

५. प्रारंभिक किंवा अंतिम निरीक्षणात संख्यावाचक आकडे एकावर एक लिहू नयेत. जर लिहिलेला कोणताही आकडा नको असेल तर त्यावर एक रेघ ओढून पाहिजे असलेला आकडा त्याच्याजवळ लिहा.

६. प्रयोगशाळेतून बाहेर पडण्यापूर्वी आपले टेबल चांगल्या स्थितीत आहे याची खात्री करा.

INSTRUCTIONS TO CANDIDATES

1. Read the question carefully and perform the experiment as required.
2. If there be anything the apparatus that you do not know, ask the examiner or the laboratory assistant to help you,
3. Before doing any electrical experiment, it is obsolutely essential that you make a neat working sketch of all apparatus actually provided and of the necessary connection, and obtain the examiner's permission to proceed.
4. Express all observations in a tabular form.
   It is also desirable that all intermediate calculations and results should be entered as neatly and clearly as possible
5. No numerical figures should be written over either in the preliminary or final observations. If any figure is shought to be discarded it should be run through and the desired figure written near to it.
6. Please see that your table is in good order before you leave the laboratory.

(येथून लेखनास सुरवात करा.) (Begin writing here.)

Q1

i) Proton

ii) J. J. Thomson

iii) Outer space

Section	Q. No.											
	Marks											

प्र. क्र. Q. No.

iv) Proton

v) α - particle.

04

Q2. ii) Hamiltonian (H) is defined in terms of generalized co-ordinates (q) and conjugate momenta (p).

$$H(q_i, p_i, t) = \sum_i \dot{q}_i p_i - L$$

L - Lagrangian of the system.

$\dot{q}$ - Time derivative of generalized co-ordinate q and time t.

The Hamilton's eq'n of motion are a set of first order differential eq'n that describe the time evolution of generalized co-ordinate (q_i) and their conjugate momenta (p_i)

The equation are as follows,

$$\frac{dq}{dt} = \frac{\partial H}{\partial p}$$

$$\frac{dp}{dt} = -\frac{\partial H}{\partial q}$$

(i) $$\frac{dq}{dt} = \frac{\partial}{\partial t}\left(\sum_i \dot{q} p - L\right)$$

$$= \dot{q} - \frac{\partial L}{\partial \dot{q}} \frac{\partial \dot{q}}{\partial p}$$

Section	Q. No.												
	Marks												

प्र. सं.
Q. No.

$$\frac{dq}{dt} = \frac{\partial H}{\partial p}$$

(2) $$\frac{dp}{dt} = -\frac{\partial}{\partial q}\left(\sum p\dot{q} - L\right)$$

$$= -\frac{\partial L}{\partial q} - \frac{\partial L}{\partial \dot{q}}\frac{\partial \dot{q}}{\partial q}$$

$$= -\frac{\partial H}{\partial q}$$

These are the Hamilton's eq^n of motion.

05

Section	Q. No.												
	Marks												

प्र. क्र. 3

Q. No. ii) The Poissons bracket is a mathematical operation used in classical mechanics to describe dynamics of a system.

The Poisson bracket $\{f, g\}$ is defined as,

$$\{f, g\} = \frac{\partial f}{\partial q}\frac{\partial g}{\partial p} - \frac{\partial f}{\partial p}\frac{\partial g}{\partial q}$$

where, q and p are the generalised co-ordinates and conjugate momenta.

It represents a measure of the rate of change of one quantity w.r.t another.

The Hamiltonian eq'n of motion is expressed as,

$$\frac{dq}{dt} = \{q, H\}$$

$$\frac{dp}{dt} = \{p, H\}$$

$\{q, H\}$, $\{p, H\}$ are the Poisson bracket between generalized co-ordinates and conjugate momenta.

$$\frac{dq}{dt} = \frac{\partial H}{\partial p}$$

$$\frac{dp}{dt} = -\frac{\partial H}{\partial q}$$

• 09931

Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या या विषयाच्या प्रयोग परीक्षा

~~Practical~~ Internal Examination in Classical Mechanics

at the M.Sc. - I Internal examination - 2022 Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) 1618

विभाग (Section)

11/20

ESTD JUNE 1964 (Autonomous)

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.

२. उपकरणांच्या वापराबाबत तुम्हांला काही माहीत नसेल तर परीक्षक किंवा प्रयोगशाळा सहाय्यक यांना तुम्हाला मदत करण्याविषयी विनंती करा.

३. कोणताही विद्युतप्रयोग करण्यापूर्वी, प्रत्यक्ष पुरवितेली सर्व उपकरणे आणि सर्व 'कनेक्शन' नीट पाहून घेऊन संबंधित कामाची नीटनेटकी कार्ययोजना करण्याची नितांत आवश्यकता आहे आणि ह्या नंतर, पुढे काम चालू करण्याविषयी परीक्षकांची परवानगी मिळविणे आवश्यक आहे.

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५. प्रारंभिक किंवा अंतिम निरीक्षणात संख्यावाचक आकडे एकावर एक लिहू नयेत. जर लिहिलेला कोणताही आकडा नको असेल तर त्यावर एक रेघ ओढून पाहिजे असलेला आकडा त्याच्याजवळ लिहा.

६. प्रयोगशाळेतून बाहेर पडण्यापूर्वी आपले टेबल चांगल्या स्थितीत आहे याची खात्री करा.

INSTRUCTIONS TO CANDIDATES

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6. Please see that your table is in good order before you leave the laboratory.

(येथून लेखनास सुरवात करा.) (Begin writing here.)

Q1)

v) in outer space

ii) J. J. Thomson

i) Proton

Section	Q. No.												
	Marks												

प्र. क्र. Q. No.

iii) electron

iv) α - particle

05

Q.2.

ii) Hamiltonian is a function (H) is defined in terms of the systems generalized co-ordinates (q) and their conjugate momenta (p).

$$H(q, p, t) = \sum \dot{q} p - L$$

L - Lagrangian of the system.

$\dot{q}$ - time derivative of the generalised co-ordinate q and time 't'.

The Hamilton's eq^n of motion are first order differential eq^n that describe the time evolution of the generalized co-ordinates 'q' and conjugate momenta 'p'.

The equations are as follows,

(1) $$\frac{\partial q}{dt} = \frac{\partial H}{\partial p}$$

(2) $$\frac{dp}{dt} = -\frac{\partial H}{\partial q}$$

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

(1) $$\frac{dq}{dt} = \frac{\partial}{\partial p}\left(\sum \dot{q}p - L\right)$$

$$= \dot{q} - \frac{\partial L}{\partial \dot{q}}\frac{\partial \dot{q}}{\partial p}$$

$$\frac{dq}{dt} = \frac{\partial H}{\partial p}$$

(2) $$\frac{dp}{dt} = -\frac{\partial}{\partial q}\left(\sum p\dot{q} - L\right)$$

$$= -\frac{\partial L}{\partial q} - \frac{\partial L}{\partial \dot{q}}\frac{\partial \dot{q}}{\partial q}$$

$$\frac{dp}{dt} = -\frac{\partial H}{\partial q}$$

There are the Hamiltons eq'n of motion.

05

Section	Q. No.												
	Marks												

प्र. क्र.

Q. No. 3

i) The relativistic law of addition of velocities is a key concept in Einstein's theory of special relativity, which is given as,

$$v = \frac{u + u'}{1 + \frac{uu'}{c^2}}$$

v - relative velocity betn two objects
u - velocity of one object in that reference frame
c - speed of light in vacuum $= 3 \times 10^8$ m/s.

Lorentz transformation u_x', u_y', u_z' can be obtained by switching primed and unprimed and changing v to -v.

$$u_x' = \frac{u_x - v}{1 - \frac{u_x v}{c^2}}$$

03

$$u_y' = \frac{u_y - v}{1 - \frac{u_y v}{c^2}}$$

$$u_z' = \frac{u_z - v}{1 - u_z v / c^2}$$

09932

Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या ——— या विषयाच्या प्रयोग परीक्षा

Internal ~~Practical~~ Examination in Classical Mechanics

at the M.Sc - I Internal Examination - 2022 Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) 1809

विभाग (Section)

10/20

ESTD JUNE 1964 (Autonomous)

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.

२. उपकरणांच्या वापराबाबत तुम्हांला काही माहीत नसेल तर परीक्षक किंवा प्रयोगशाळा सहाय्यक यांना तुम्हाला मदत करण्याविषयी विनंती करा.

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५. प्रारंभिक किंवा अंतिम निरीक्षणात संख्यावाचक आकडे एकावर एक लिहू नयेत. जर लिहिलेला कोणताही आकडा नको असेल तर त्यावर एक रेघ ओढून पाहिजे असलेला आकडा त्याच्याजवळ लिहा.

६. प्रयोगशाळेतून बाहेर पडण्यापूर्वी आपले टेबल चांगल्या स्थितीत आहे याची खात्री करा.

INSTRUCTIONS TO CANDIDATES

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(येथून लेखनास सुरवात करा.) (Begin writing here.)

Q 1.

i) Proton

ii) J.J. Thomson

iii) near 1119

Section	Q. No.												
	Marks												

प्र. क्र. Q. No.

iv) Electron

03 v) α-particle

Q.2. ii) Hamiltonian: is a function denoted by H is defined in terms of generalized co-ordinates and conjugate momenta (p)

$$H(q_i, p_i, t) = \sum_i \dot{q}_i p_i - L$$

L - Lagrangian of the system.

$\dot{q}$ - time derivative of generalized co-ordinate 'q' and time (t).

The Hamilton's eq'n of motion are a set of first order differential eq'n that describe the time evolution of the generalized co-ordinate (q_i) and their conjugate momenta (p_i)

The equation are as follows,

① $\frac{dq}{dt} = \frac{\partial H}{\partial p}$ -- generalized co-ordinates.

② $\frac{dp}{dt} = -\frac{\partial H}{\partial q}$ --- conjugate momenta

① $\frac{dq}{dt} = \frac{\partial}{\partial t}\left(\sum_i \dot{q}_i p_i - L\right)$

03

$$= \dot{q} - \frac{\partial L}{\partial \dot{q}} \cdot \frac{\partial \dot{q}}{\partial p}$$

$$\frac{dq}{dt} = \frac{\partial H}{\partial p}$$

② $\frac{dp}{dt} = -\frac{\partial}{\partial q}\left(\sum_i p_i \dot{q}_i - L\right)$

$$= -\frac{\partial L}{\partial q} - \frac{\partial L}{\partial \dot{q}} \cdot \frac{\partial \dot{q}}{\partial q} = -\frac{\partial H}{\partial q}$$

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

These are the Hamiltons eqn of motion.

Q. 3.

ii) The Poisson's bracket is a mathematical operation used in classical mechanics to describe dynamics of a system.

The poissons bracket $\{f, g\}$ is defined as,

$$\{f, g\} = \frac{\partial f}{\partial q} \cdot \frac{\partial g}{\partial p} - \frac{\partial f}{\partial p} \cdot \frac{\partial g}{\partial q}$$

Here, q and p are the generalized co-ordinates and conjugate momenta

It represents a measure of the rate of change of one quantity w.r.t another.

The Hamiltonian eqn of motion is expressed as,

$$\frac{dq}{dt} = \{q, H\}$$

$$\frac{dp}{dt} = \{p, H\}$$

$\{q, H\}$, $\{p, H\}$ are the Poisson's bracket betn generalised co-ordinate and conjugate momenta.

04

$$\frac{dq}{dt} = \frac{\partial H}{\partial p}$$

$$\frac{dp}{dt} = -\frac{\partial H}{\partial q}$$

Seat No.

Vivekanand College, Kolhapur (Autonomous).

M. Sc. Part-I (Semester- I) Internal Examination Oct/Nov.2022

Subject: Physics

Title: Quantum Mechanics I

Total Marks: 20

Time: 12.00 – 1.00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Figures to the right indicate full marks.
4) Use of Scientific calculator or Log table is allowed.

Q. 1 Select most correct alternative **(05)**

1.The expectation or mean value of <A> of an operator A with respect to state |Ψ> is defined as

a) $< A >= \frac{<\Psi|A|\Psi>}{<\Psi|\Psi>}$ b) $< A >= \frac{<\Psi|\Psi>}{<\Psi|A|\Psi>}$

c) $< A >=< \Psi|A|\Psi >$ d) $< A >=< \Psi|\Psi >$

2. The Laplacian operator ∇^2=_____

a) $\frac{\partial}{\partial x}+\frac{\partial}{\partial y}+\frac{\partial}{\partial z}$ b) $i\frac{\partial}{\partial x}+j\frac{\partial}{\partial y}+k\frac{\partial}{\partial z}$ c) $\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}+\frac{\partial^2}{\partial z^2}$ d) none of the above.

3. Botzmann equation is …….

a) $(\frac{\partial F}{\partial t})_{collision} = 0$ b) $(\frac{\partial F}{\partial t})_{collision} = 1$ c) $(\frac{\partial F}{\partial t})_{collision} = b - a$ d) $(\frac{\partial F}{\partial t})_{collision} = \infty$

4. Sommerfeld Model consider potential inside a box to be equal to ……..

a) 0 b) 1 c) ∞ d) None of above

5. The number of electrons crossing the plane A is ……..

a) $^{nP}/_{6}$ b) $^{nV}/_{6}$ c) $^{n}/_{6}$ d) None of above

Q.2 Attempt any one of the following. **(10)**

1. . Give difference between Classical and Quantum mechanically Stern-Gerlach experiment.
2. Write short note on linear vector space.

Q.3 Attempt any one of the following. **(5)**

1. . What is the difference between Classical and Quantum mechanics? Give at-least three examples.
2. Write note on sequential Stern-Gerlach experiment.

"Dissemination of Education for Knowledge Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College (Autonomous) Kolhapur

Department of Physics

M.Sc. I Internal Examination, May-2022

Attendance Sheet

Date: **Quantum Mechanics-I**
Time: 12.00-1.00 p.m.

Roll. No.	Name of Candidate	Sign
1331	Ahiwale Snehal Nitin	Ahiwale
1332	Biradar Anand Nagappa	Arab
1333	Jarkoli Smith Kallappa	Jarkoli
1334	Kavatagi Shivraj C.	S.C Kavatagi
1335	Mithari Shweta Sardar	Mithari
1336	Randive Rajshree Mahesh	Randive
1337	Sagar Shivani Dattatryay	Sagar
1338	Chuhan Aditi S.	Aditi
1339	Shirke Pranali Pradip	Pranali
1340	Shirodkar Shubham R.	Shirodkar
1341	Todkar Dnyaneshwari Pandit	Todkar

VIVEKANAND COLLEGE KOLHAPUR (Autonomous) ESTD JUNE 1964

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

$$\frac{\partial u}{\partial x} = \frac{-\partial v}{\partial y}$$

$$f'(z) = \frac{\partial u}{\partial x} + i\frac{\partial v}{\partial x} = \frac{\partial v}{\partial y} - i\frac{\partial u}{\partial y}$$

05/20

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Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या ——— या विषयाच्या प्रयोग परीक्षा

~~Practical~~ Examination in Quantum Mechanics

at the M.Sc - I Internal examination ~~2021-22~~ Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) 1619

विभाग (Section)

VIVEKANAND COLLEGE KOLHAPUR (Autonomous) ESTD JUNE 1964

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.

२. उपकरणांच्या वापराबाबत तुम्हांला काही माहीत नसेल तर परीक्षक किंवा प्रयोगशाळा सहाय्यक यांना तुम्हाला मदत करण्याविषयी विनंती करा.

३. कोणताही विद्युतप्रयोग करण्यापूर्वी, प्रत्यक्ष पुरविलेली सर्व उपकरणे आणि सर्व 'कनेक्शन' नीट पाहून घेऊन संबंधित कामाची नीटनेटकी कार्ययोजना करण्याची नितांत आवश्यकता आहे आणि ह्या नंतर, पुढे काम चालू करण्याविषयी परीक्षकांची परवानगी मिळविणे आवश्यक आहे.

४. सर्व निरीक्षणे कोष्टकवजा तक्त्यात भरावी. मधल्या सर्व गणना आणि निर्णय हे शक्य तितक्या सुवाच्चपणे आणि स्पष्टपणे नोंदविलेले असणे हे हितावह आहे.

५. प्रारंभिक किंवा अंतिम निरीक्षणात संख्यावाचक आकडे एकावर एक लिहू नयेत. जर लिहिलेला कोणताही आकडा नको असेल तर त्यावर एक रेघ ओढून पाहिजे असलेला आकडा त्याच्याजवळ लिहा.

६. प्रयोगशाळेतून बाहेर पडण्यापूर्वी आपले टेबल चांगल्या स्थितीत आहे याची खात्री करा.

INSTRUCTIONS TO CANDIDATES

1. Read the question carefully and perform the experiment as required.
2. If there be anything the apparatus that you do not know, ask the examiner or the laboratory assistant to help you,
3. Before doing any electrical experiment, it is obsolutely essential that you make a neat working sketch of all apparatus actually provided and of the necessary connection, and obtain the examiner's permission to proceed.
4. Express all observations in a tabular form.
   It is also desirable that all intermediate calculations and results should be entered as neatly and clearly as possible
5. No numerical figures should be written over either in the preliminary or final observations. If any figure is shought to be discarded it should be run through and the desired figure written near to it.
6. Please see that your table is in good order before you leave the laboratory.

(येथून लेखनास सुरवात करा.) (Begin writing here.)

Q1.

1. $|\psi_{sc}| \geq 1$

2. even

3. $\frac{4\pi}{k}$

"Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe
Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Vivekanand College, Kolhapur (Autonomous)
Department of Physics

M.Sc. Part-I SEM I Internal Examination (2022-23)
Condensed Matter Physics

Time : 3.30 pm -4.30 pm Total Marks: 20

Instructions:- 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of log table and calculator is allowed.

Q1: **Choose the correct alternative.** **(5)**

1. The energy released per fission of uranium is about ……

   a)100 MeV b)200 MeV

   c)400 MeV d) 150MeV

2. For flat spiral spring the angle between plane of spring and axis is ……..

   a)60^0 b)45^0 c)90^0 d)180^0

3. X-rays are the …… waves

   a) electromagnetic b)longitudinal c)mechanical d)elastic

4. According to Weins displacement law……..

   a)λT_{max}=constant b) λT=constant

   c) $\lambda_{max}T$= constant d) $\lambda_{min}T$=constant

5. A perfectly black body is……concept.

   a) an ideal b) a practical

   c) an achievable d) none of these

Q2: **Attempt any ONE.** **(10)**

1. Derive the expression for Frenkel defect
2. Derive an expression of intrinsic semiconductor for n-type material.

Q3: **Attempt any ONE.** **(5)**

1. Explain Bragg's law in reciprocal lattice
2. Explain construction and working of UJT

"Dissemination of Education for Knowledge Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College (Autonomous) Kolhapur

Department of Physics

M.Sc. I Internal Examination, May-2022

Attendance Sheet

Date: **Condensed Matter Physics**
Time: 2.00-3.00 p.m.

Roll. No.	Name of Candidate	Sign
1331	Ahiwale Snehal Nitin	
1332	Biradar Anand Nagappa	Anand Biradar
1333	Jarkoli Smith Kallappa	Jsmith
1334	Kavatagi Shivraj C.	Shivraj Kavatagi
1335	Mithari Shweta Sardar	Mithari
1336	Randive Rajshree Mahesh	Rajndive
1337	Sagar Shivani Dattatryay	
1338	Chuhan Aditi S.	Achauhan
1339	Shirke Pranali Pradip	Pshirke
1340	Shirodkar Shubham R.	SR. shirodkar
1341	Todkar Dnyaneshwari Pandit	I Podkar

VIVEKANAND COLLEGE ESTD JUNE 1964 KOLHAPUR (Autonomous)

13/20

08207

Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत्त) कोल्हापूर.

परीक्षेच्या _____ या विषयाच्या प्रयोग परीक्षा

Practical Examination in Condensed Matter Physics

at the M.Sc-2 Internal Examination 2022-23 Examination

उमेदवाराचा आसन क्रमांक (Candidate's Seat No.) _____ विभाग (Section) _____

VIVEKANAND COLLEGE KOLHAPUR (Autonomous) ESTD JUNE 1964

उमेदवारांना सूचना

१. प्रश्न काळजीपूर्वक वाचा आणि त्याप्रमाणे विचारलेला प्रयोग करा.
२. उपकरणांच्या वापराबाबत तुम्हांला काही माहीत नसेल तर परीक्षक किंवा प्रयोगशाळा सहाय्यक यांना तुम्हाला मदत करण्याविषयी विनंती करा.
३. कोणताही विद्युतप्रयोग करण्यापूर्वी, प्रत्यक्ष पुरविलेली सर्व उपकरणे आणि सर्व 'कनेक्शन' नीट पाहून घेऊन संबंधित कामाची नीटनेटकी कार्ययोजना करण्याची नितांत आवश्यकता आहे आणि ह्या नंतर, पुढे काम चालू करण्याविषयी परीक्षकांची परवानगी मिळविणे आवश्यक आहे.
४. सर्व निरीक्षणे कोष्टकवजा तक्त्यात भरावी. मधल्या सर्व गणना आणि निर्णय हे शक्य तितक्या सुवाच्चपणे आणि स्पष्टपणे नोंदविलेले असणे हे हितावह आहे.
५. प्रारंभिक किंवा अंतिम निरीक्षणात संख्यावाचक आकडे एकावर एक लिहू नयेत. जर लिहिलेला कोणताही आकडा नको असेल तर त्यावर एक रेघ ओढून पाहिजे असलेला आकडा त्याच्याजवळ लिहा.
६. प्रयोगशाळेतून बाहेर पडण्यापूर्वी आपले टेबल चांगल्या स्थितीत आहे याची खात्री करा.

INSTRUCTIONS TO CANDIDATES

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3. Before doing any electrical experiment, it is obsolutely essential that you make a neat working sketch of all apparatus actually provided and of the necessary connection, and obtain the examiner's permission to proceed.
4. Express all observations in a tabular form.
   It is also desirable that all intermediate calculations and results should be entered as neatly and clearly as possible
5. No numerical figures should be written over either in the preliminary or final observations. If any figure is shought to be discarded it should be run through and the desired figure written near to it.
6. Please see that your table is in good order before you leave the laboratory.

(येथून लेखनास सुरवात करा.) (Begin writing here.)

Q1)

(i) 200 MeV

1

(ii) 45°

1

(iii) Electromagnetic

1

Section	Q. No.											
	Marks											

II. III.
Q. No.

(iv) $\lambda_{max} T$ = constant

(v) Ideal

(Q2)

(i) Frankel defect is a type of point defect in crystals particularly ionic crystals It occurs when a cation leaves its normal lattice site and occupies an interstitial site. The expression for frankel effect is given as

Frankel effect = Cation Vacancy + cation interstitial

This defect doesn't involve a change in the overall change neutrality of the crystal but leads to distribution in the crystal structure.

Section	Q. No.												
	Marks												

Q. No. Q3)

(i) A Unijunction Transistor (UJT) is a three layer, two junction semiconductor device commonly used in pulse generator circuits.

Construction:-

UJT consists of three layers of semiconductor material, N-type layer between two p-type layers.

① Emitter:- One end of the N-type material is the emitter terminal (E).

② Base:- The P-type material on either side of the N-type region forms the base terminals.

Working:

When a voltage is applied to the emitter relative to either base, the UJT is in forward bias. This forward bias allows a small emitter current to flow from the emitter to the N-type material.

Section	Q. No.												
	Marks												

प्र. क्र.

Q. No.

As the emitter current flows, there is a voltage drop across the N-type region, leading to a voltage gradient. When the emitter current reaches a certain threshold called the valley current, UJT undergoes a sharp decrease in impedance.

This decrease in impedance results in a negative resistance region, which is exploited in UJT relaxation oscillator circuit.

08205

Signature of Jr. Super.

विवेकानंद कॉलेज (स्वायत) कोल्हापूर.

[illegible] या विषयाच्या प्रयोग परीक्षा

[illegible] Learned [illegible] Physics

[illegible] M.Sc. I Terminal Examination [illegible] Examination

[illegible] (Candidate's Seat No.) [illegible] (Center)

ESTD JUNE 1964

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]

INSTRUCTIONS TO CANDIDATES

1. [illegible] as required.
2. If you are in doubt about any apparatus that you do not know, ask the examiner or the laboratory assistant to help you.
3. [illegible] It is obviously essential that you make a neat working sketch of all apparatus [illegible] obtain the examiner's permission to proceed.
4. [illegible]
5. [illegible] results should be entered as neatly and clearly as possible [illegible] in the preliminary or final observations. If any figure is sought [illegible] figure written beside it.
6. [illegible] before you leave the laboratory.

([illegible] लिहायला सुरुवात करा.) (Begin writing here.)

Q1.

1. 2000 Hz

2. 45°

2. Electromagnetic

Section	Q. No.												
	Marks												

प्र. क्र. Q. No. 4. $\lambda_{max} T$ = constant

5) 5 ideal

Q2.

1) Frankel defect is a type of point defect in crystals particularly ionic crystals. It occurs when a cation leaves its normal lattice site and occupies an interstitial site. The expression for Frankel effect is given as,

Frankel effect = cation vacancy + cation interstitial

4 This defect doesn't involve a change in the overall charge neutrality of the crystal but leads to distortions in the crystal structure.

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No. 3

1) A Unijunction Transistor (UJT) is a three layer, two junction semiconductor device commonly used in pulse generator ckts.

Construction :-

UJT consists of three layers of semiconductor material, N-type layer bet'n two p-type layers.

(1) emitter :- One end of the N-type material is the emitter terminal. (E)

(2) Base - The p-type material on either side of the N-type region forms the base terminals.

Working :-

When a voltage is applied to the emitter relative to either base, the UJT is in forward bias. This forward bias allows a small emitter current to flow from the emitter to the N-type material.

As the emitter current flows, there is a voltage drop across the N-type region, leading to a voltage gradient. When the emitter current reaches a certain threshold called the valley current, UJT undergoes a sharp decrease in impedance

Section	Q. No.												
	Marks												

प्र. क्र.
Q. No.

This decreases in impedance results in a negative resistance region, which is exploited in UJT relaxation oscillator ckts.