

PO Attainment

Faculty Name: Dr. Sanjeev Kumar Verma
 Course Name: Atomic and Molecular Physics

Class-Sem: BSC-5
 Course Code: BHP-502
 Academic Year: 2022-23
 Program Name: BSC H Physics

CO-PO MAPPING:

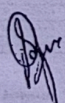
Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2			3	2			2			
CO2	1		2	3			3	3				
CO3		1	2			1	3				1	
CO4				3	1			3	1	3		
CO5	2		3		1						2	2
CO6		2		3		1	1	1	3	2		2

CO ATTAINMENT:

Dr. Sanjeev Kumar Verma	Att. Level
CO1	3.00
CO2	3.00
CO3	2.40
CO4	2.20
CO5	2.09
CO6	2.20

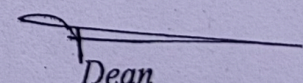
PO ATTAINMENT :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Overall PO Attainment	2.5	2.6	2.4	2.5	2.7	2.7	2.6	2.5	2.5	2.2	2.2	2.1



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Faculty Name: Dr. Sanjeev Kumar Verma

Class/Sem: BSC-5

Academic Year: 2022-23

Course Name: Atomic and Molecular Physics

Course Code: BHP-502

Program Name: BSC H Physics

S. No.	University Reg. No.	Student Name	Internal Marks Scheme									Total Internal Marks	End Sem Exam Marks	Total Marks	
			First Unit Test	Second Unit Test	First Class Test	Second Class Test	Best One From Unit Test	Best One From Class Test	Unit Test(UT)	Attendance(AT)	Teacher Assessment(TA)				
			Theory (30)	Theory (30)	Theory (10)	Theory (10)	Theory (30)	Theory (10)	12	12	6	Theory (30)	Theory (70)	Theory (100)	
1	BSP2018028	AYUSH PAL	25	20	7	5	25	7	10	9	4	23	64	87	
2	BSP2022007	AKSHITABHARADWAJ	28	22	8	7	28	8	11	10	5	26	49	75	
3	BSP2022008	ABHISHEK KUMAR	28	22	8	7	28	8	11	11	5	27	43	70	
4	BSCA2020070	UTKARSH SAXENA	30	24	10	8	30	10	12	12	6	30	68	98	
5	BSP2020003	SHUBHANKARSINGH	20	16	5	4	20	5	8	8	3	19	32	51	
6	BSP2020005	SHRISHTI RATHORE	30	24	10	8	30	10	12	12	6	30	69	99	
7	BSP2020006	KASHISH VAISH	30	24	8	7	30	8	12	12	5	29	69	98	
8	BSP2020007	RISHABH RAJ SINGHPAN	13	10	3	3	13	3	5	5	2	12	57	69	
9	BSP2020008	HARSH PRATAPSINGH	20	16	5	4	20	5	8	8	3	19	47	66	
10	BSP2020009	HARSH KUMARSINGH	13	10	3	3	13	3	5	5	2	12	40	52	
11	BSP2020011	SHIVANI CHAND	30	24	8	7	30	8	12	11	5	28	54	82	
12	BSP2020012	ASHUTOSH YADAV	28	22	8	7	28	8	11	10	5	26	49	75	
13	BSP2020004	PRASHANT RAGHAV	13	10	3	3	13	3	5	5	2	12	40	52	
14	BSP2020013	VATAN GANGWAR	13	10	3	3	13	3	5	5	2	12	31	43	
Students appeared for the examination			1	1	1	1	1	1	1	1	1	1	1	1	1
Target / satisfactory mark set as benchmark			12	12	4	4	12	4	5	5	2	12	28	40	
Students scored above the target set			1	0	0	0	1	0	1	1	0	1	1	1	1
% Students scored above the target set			100%	0%	0%	0%	100%	0%	100%	100%	0%	100%	100%	100%	100%
Attainment Level			3	1	1	1	3	1	3	3	1	3	3	3	3

	CO1	CO2	CO3	CO4	CO5	CO6	Overall
CO1	3				3		3.00
CO2	3				3		3.00
CO3	3		1		3	1	2.40
CO4		1		1	3	1	2.20
CO5		1	1	1	3	1	2.09
CO6		1		1	3	1	2.20

Rubric:		Overall attainment	2.48
% Students	Level		
<50%	1		
50-75%	2		
>75%	3		

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Q.No	Questions	Marks (70)	CO	BL
1-I	Write down the name of experiment that experimentally verify Orbital-space quantization.	01	CO1	L2
1-II	Write down difference between rigid rotator and non-rigid rotator.	01	CO2	L1
1-III	Write down the expression for orbital, spin and, total angular momentum and corresponding associated quantum numbers.	01	CO2	L2
1-IV	Write down the conditions for rotational spectroscopy and vibrational spectroscopy with examples.	01	CO3	L3
1-V	What is elastic and inelastic scattering?	01	CO2	L1
1-VI	Write down the Born-Oppenheimer approximation for diatomic vibrating rotator.	01	CO1	L1
1-VII	Calculate the values of L, S and J for the states (i)	01	CO1	L1
2-I	Describe the Larmor precession?	01	CO1	L1
2-II	Is Raman scattering is elastic or inelastic? Explain.	01	CO1	L1
2-III	What is symmetric and antisymmetric wave function?	01	CO1	L1
2-IV	Compare normal Zeeman effect and, anomalous Zeeman effect.	01	CO1	L2
2-V	Draw the energy spectrum of following (i) Rigid Rotator (ii) Non-Rigid Rotator (iii) Harmonic Oscillator (iv)	01	CO1	L1
2-VI	Describe Rayleigh scattering.	01	CO1	L3
2-VII	Describe Stark effect	01	CO1	L1
3-I	a) Using the Lennard-Jones potential derive the internuclear distance for a diatomic molecule. OR b) Describe the Vector-Atom model of atom.	7	CO2	L2
3-II	a) Calculate the expression of Landé g factor. OR b) Using the L-S coupling scheme find out all the spectroscopy terms of d2 electrons.	7	CO3	L2
4-I	a) Following the J-J coupling scheme, calculate all the spectroscopic terms for the atomic state 4p14d1 and present it in the discrete energy levels. OR b) Show that gyromagnetic ratio for the electron is independent of atomic details.	7	CO3	L5
4-II	a) Using L-S coupling scheme find out all the spectroscopy terms of p2 electrons OR b) Discuss the space quantization of orbital motion and calculate all the orientation for $\ell=3$.	7	CO4	L3
5-I	a) Discuss the Stern-Gerlach experiment in detail OR b) What is Raman Effect? Explain how stokes and anti-stokes line appear in Raman spectrum. Describe the rotational and vibrational Raman spectrum? Write down the expression of wave number and selection rule in each case	7	CO5	L4
5-II	a) Following the L-S coupling scheme, calculate all the spectroscopic terms for the atomic state (i) 4p14d1 (ii) 3p14p1 and present it in the discrete energy levels. Or b) both Sylow 3-SSG and Sylow 5-SSG is normal in G.	7	CO6	L6
6-I	a) Draw the graph of the function and discuss the continuity and differentiability of the function in this interval. OR b) Apply Cauchy's integral test to show that	7	CO5	L4

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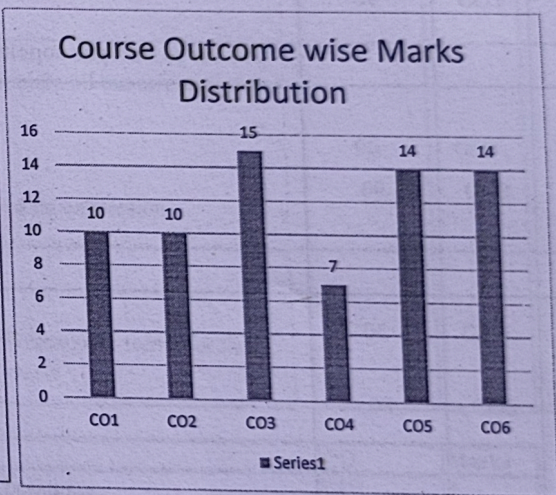
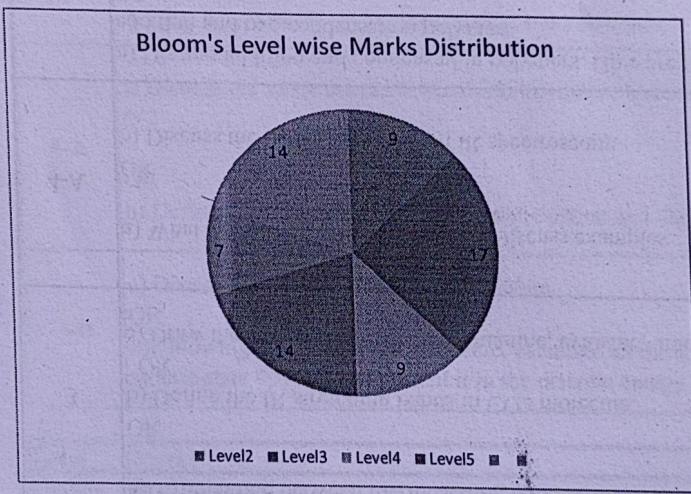
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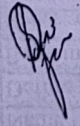
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6-II	a) Show that for rigid-rotator the wave number for transition from the level J to the level J+1 is given by $\frac{2B}{h}$, where B is rotational constant and prove that the wave number between any two rotational energy levels is 2B. OR b) Explain Machine learning and how does it work ?	7	CO6	L6
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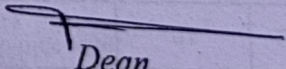
BL – Bloom’s Taxonomy Levels
(1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)
CO – Course Outcomes PO – Program Outcomes; PI Code – Performance Indicator Code

Level	Marks	CO	Marks
Level1	9	CO1	10
Level2	17	CO2	10
Level3	9	CO3	15
Level4	14	CO4	7
Level5	7	CO5	14
Level6	14	CO6	14
Total	70	Total	70



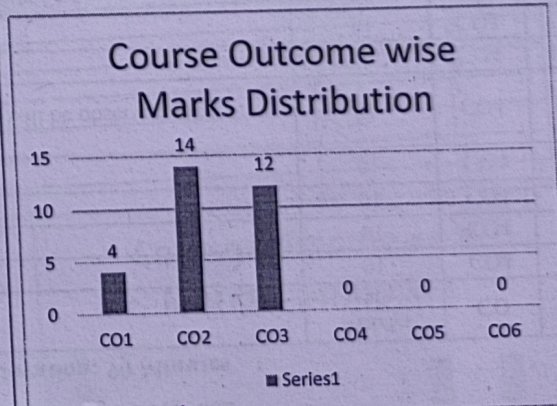
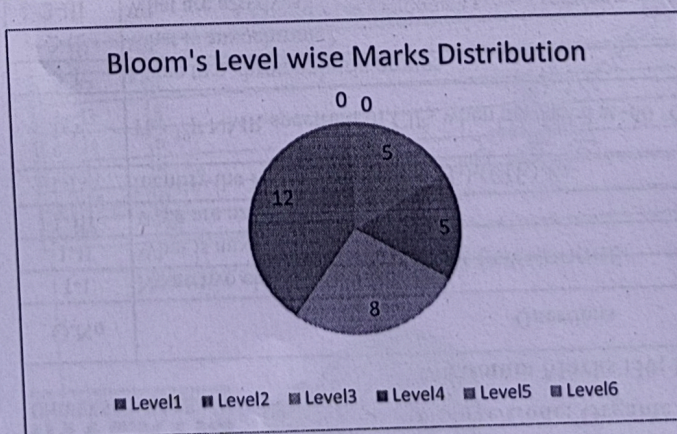

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Q.No	Questions	Marks (30)	CO	BL
1-I	Write down the expression of magnetic dipole moment in terms of	01	CO1	L1
1-II	What are the values of L, S and J for the states	01	CO1	L1
1-III	Write down difference between rigid rotator and non-rigid rotator.	01	CO2	L2
1-IV	Write down the expression for orbital, spin and, total angular momentum and correspond	01	CO1	L2
1-V	What is Larmor precession?	01	CO1	L1
2-I	Write down the expression for orbital, spin and, total angular momentum and correspond	01	CO2	L2
2-II	Write down the name of experiment that experimentally verify	01	CO2	L1
2-III	What is Larmor precession?	01	CO2	L2
2-IV	Write down the expression for orbital, spin and, total angular momentum and correspond	01	CO2	L2
2-V	Compare normal Zeeman effect and, anomalous Zeeman effect.	01	CO2	L1
3	a) What is normal Zeeman effect and, anomalous Zeeman effect? b) Find the limit of sequence c) What is symmetric and antisymmetric wave function?	08	CO2	L3
4-A	a) Discuss the space quantization of orbital motion and calculate all the orientation for $\ell=2$ OR b) Define the Gyromagnetic ratio for the electron and derive its expression.	06	CO3	L4
4-B	a) Discuss the Vector-Atom model of atom. OR b) Following the L-S coupling scheme, calculate all the spectroscopic terms for the atomic state $4p14d1$ and present it in the discrete energy levels	06	CO3	L4

Level	Marks	CO	Marks
Level1	5	CO1	4
Level2	5	CO2	14
Level3	8	CO3	12
Level4	12	CO4	0
Level5	0	CO5	0
Level6	0	CO6	0
Total	30	Total	30



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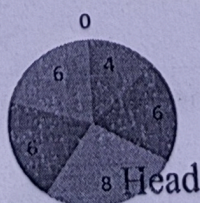
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Q.No	Questions	Marks (30)	CO	BL
1-I	What is the difference between rigid rotator and non-rigid rotator?	01	CO4	L1
1-II	A molecule may have permanent or temporary dipole moment	01	CO4	L1
1-III	Write down the conditions for rotational spectroscopy with examples	01	CO4	L2
1-IV	What is elastic and inelastic scattering?	01	CO4	L1
1-V	Is Raman scattering is elastic or inelastic? Explain.	01	CO4	L1
2-I	Write down the Born-Oppenheimer approximation for diatomic vibrating rotator.	01	CO4	L2
2-II	A molecule may have permanent or temporary dipole moment	01	CO5	L2
2-III	Write down the conditions for vibrational spectroscopy with examples	01	CO5	L2
2-IV	Is Raman scattering is elastic or inelastic? Explain.	01	CO5	L2
2-V	Write down the Born-Oppenheimer approximation for diatomic vibrating rotator.	01	CO5	L2
3	a) Show that in rigid rotator the wave number between any two rotational energy levels is $2B$. OR b) Draw the energy spectrum of following (i) Rigid Rotator OR c) Draw the energy spectrum of following Non-Rigid Rotator (iii) Harmonic Oscillator (iv) Anharmonic Oscillator.	08	CO5	L3
4-A	a) What is rotational and vibrational Raman spectrum? Write down the expression of Wave number and selection rule in each case. OR b) What is diatomic vibrating rotator? Write down the expression of term value for diatomic vibrating rotator and using selection rules show the transition for P-branch and R-branch of spectrum.	06	CO6	L4
4-B	a) Show that for rigid-rotator the wave number for transition from the level J to the level $J+1$ is given by $2B(J+1)$, where B is rotational constant. OR b) What is Raman Effect? Explain how stokes and anti-stokes line appear in Raman spectrum.	06	CO6	L5

BL – Bloom's Taxonomy Levels
(1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)
CO – Course Outcomes PO – Program Outcomes; PI Code – Performance Indicator Code

Level1	4	CO1	0
Level2	6	CO2	0
Level3	8	CO3	0
Level4	6	CO4	6
Level5	6	CO5	12
Level6	0	CO6	12
Total	30	Total	30

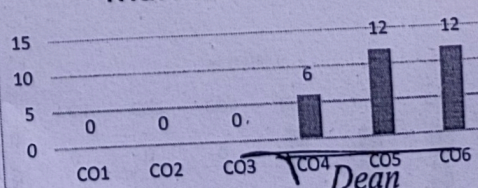
Bloom's Level wise Marks Distribution



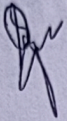
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Course Outcome wise Marks Distribution



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First Class Test 2022-23

BSC-5 Semester

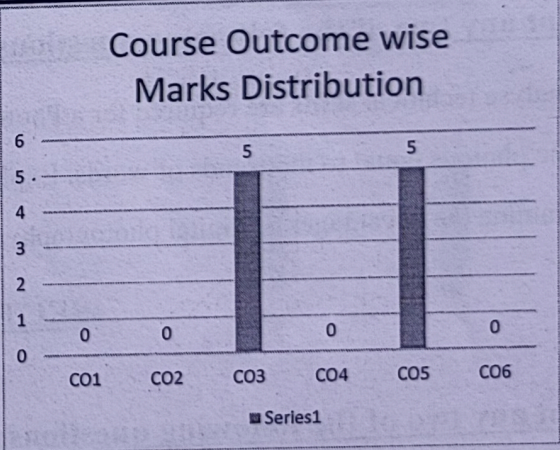
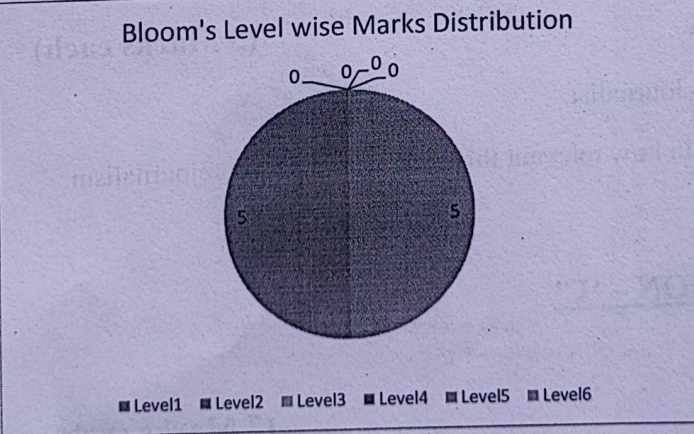
Course/Code: Atomic and Molecular Physics / BHP-502

Maximum Marks :10; Duration: 30 Minutes

Q.No	Questions	Marks (10)	CO	BL
1	Define the Gyromagnetic ratio for the electron and derive its expressio	05	CO3	L2
2	Discuss the Stern-Gerlach experiment in detail.	05	CO5	L1

BL – Bloom’s Taxonomy Levels
 (1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)
 CO – Course Outcomes PO – Program Outcomes; PI Code – Performance Indicator Code

Level	Marks	CO	Marks
Level1	5	CO1	0
Level2	5	CO2	0
Level3	0	CO3	5
Level4	0	CO4	0
Level5	0	CO5	5
Level6	0	CO6	0
Total	10	Total	10



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Second Class Test 2022-23

BSC-5 Semester

Course/Code: Atomic and Molecular Physics / BHP-502

Maximum Marks :10; Duration: 30 Minutes

Q.No	Questions	Marks (10)	CO	BL
1	What is diatomic vibrating rotator?	05	CO4	L1
2	Using the Lennard-Jones potential derive the internuclear distance for a diatomic molecule	05	CO6	L2

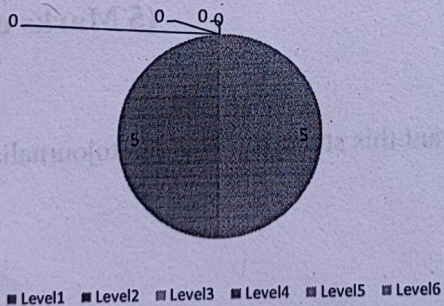
BL – Bloom’s Taxonomy Levels

(1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)

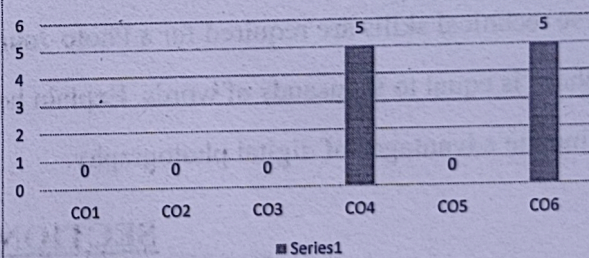
CO – Course Outcomes PO – Program Outcomes; PI Code – Performance Indicator Code

Level	Marks	CO	Marks
Level1	5	CO1	0
Level2	5	CO2	0
Level3	0	CO3	0
Level4	0	CO4	5
Level5	0	CO5	0
Level6	0	CO6	5
Total	10	Total	10

Bloom's Level wise Marks Distribution



Course Outcome wise Marks Distribution



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Bareilly-Lucknow National Highway, Bareilly - 243123 (UP)
Tabulation Sheet

PROGRAM : BACHELOR OF SCIENCE HONOURS (PHYSICS)
SEMESTER : FIFTH
SESSION : 2022-23
COLLEGE : Faculty of Sciences

Sl No.	Enrollment No.	Roll No.	Student ID	Student Name	BHP501			BHP502			BHP505			BHP504			BHP506			BHP501			BHP503			CR	Grand Total	Credits Secured	GPA	CPI															
					Max Marks	CR		Max Marks	CR		Max Marks	CR		Max Marks	CR		Max Marks	CR		Max Marks	CR		Max Marks	CR																					
					70	80	100	70	80	100	70	80	100	70	80	100	70	80	100	70	80	100	70	80	100																				
1	181619	1810805022	BSP2018023	AYUSHI PAL	65	28	83	4	4	64	23	87	4	4	48	29	77	4	4	60	29	88	4	4	51	27	78	4	4	30	13	43	2	30	14	44	2	30	15	45	2	534	24	0.00	82.08
2	204308	2010807010	BSP2022007	ANGHITA BHARADWAJ	60	28	88	4	4	49	26	75	4	4	54	29	83	4	4	68	30	88	4	4	66	25	91	4	4	30	18	43	2	30	14	40	2	507	24	0.00	77.17				
3	204323	2010805001	BSP2022008	ABHISHEK KUMAR	67	29	86	4	4	43	27	70	4	4	51	28	79	4	4	60	29	86	4	4	68	29	97	4	4	32	14	46	2	34	14	48	2	569	24	0.00	87.25				
4	204324	2010805002	BSCA2030070	UTKARSH KANENA	64	29	85	4	4	58	30	86	4	4	51	21	63	4	4	70	30	100	4	4	68	29	88	4	4	30	13	43	2	34	15	46	2	555	24	0.00	86.23				
5	204325	2010805004	BSP2020003	BHUBHANKAR SINGH	61	26	77	4	4	33	19	51	4	4	31	21	63	4	4	46	26	72	4	4	64	29	83	4	4	32	13	45	2	34	15	46	2	454	24	0.00	84.25				
6	204328	2010805006	BSP2020005	SIRISHTI KATHORE	69	30	99	4	4	69	30	99	4	4	68	30	88	4	4	69	29	98	4	4	69	28	97	4	4	30	13	43	2	34	14	48	2	565	24	0.00	86.23				
7	204329	2010805007	BSP2020006	KARISHMI VAHNI	67	29	86	4	4	69	29	88	4	4	63	29	83	4	4	65	19	84	4	4	68	23	80	4	4	30	13	43	2	34	14	48	2	555	24	0.00	86.23				
8	204330	2010805008	BSP2020007	RISHABH RAJ SINGH PASTAR	69	12	71	4	4	67	12	69	4	4	61	13	43	4	4	65	19	84	4	4	68	23	80	4	4	30	13	43	2	34	14	48	2	555	24	0.00	86.23				
9	204331	2010805009	BSP2020008	HARSH PRATAP SINGH	62	21	83	4	4	47	19	66	4	4	33	25	68	4	4	46	26	72	4	4	65	21	70	4	4	28	12	40	2	28	14	43	2	385	24	0.00	58.58				
10	204332	2010805010	BSP2020009	HARSH KUMAR SINGH	65	19	67	4	4	40	12	62	4	4	42	12	64	4	4	58	13	70	4	4	60	18	67	4	4	28	12	40	2	30	14	44	2	501	24	0.00	78.25				
11	204334	2010805012	BSP2020011	SHIVANI CHAND	63	25	88	4	4	64	28	82	4	4	66	28	84	4	4	61	27	88	4	4	65	27	92	4	4	30	13	43	2	34	15	46	2	565	24	0.00	86.23				
12	204335	2010806013	BEP2020012	ARHOSH YADAV	67	27	84	4	4	49	25	76	4	4	38	28	66	4	4	43	25	72	4	4	63	30	93	4	4	31	13	43	2	35	15	47	2	481	24	0.00	72.58				
13	204337	2010805005	BEP2020004	FRABHANT KACHAV	31	13	43	4	4	49	13	62	4	4	10	12	22	0	0	30	12	42	0	0	14	22	36	0	0	17	18	65	4	29	12	41	2	204	20	0.00	-				
14	204356	2010805014	BSP2020013	VATAN GANGWAR	45	12	57	4	4	31	12	43	4	4	0	12	12	0	0	14	22	36	0	0	17	18	65	4	4	29	12	41	2	21	14	35	2	289	16	0.00	-				

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Vice Chancellor

>> CPI of Re-Appeal Students are not Calculated.
Passing marks - 40% in each course
Legend:-
E- External Marks / I- Internal Marks
T- Total Marks
Insr- Table 8, 5923
* Passed with Grace Marks
CR-Credit
AB - Absent DT - Detained
DR - Dropped CB - Credit Secured

BHP502 : ATOMIC AND MOLECULAR PHYSICS
BHP505 : FUNDAMENTALS & PROGRAMMING IN C

BHP503 : QUANTUM MECHANICS
BHP501 : PHYSICS LAB V

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