

## ANNEXURE 1

### Course Folder -

1. List of all the documents in the Course Folder
2. Syllabus prescribed by the University.
3. Pre-requisites.
4. Course Objectives, Course Outcomes, Program Outcomes, Program Educational Objectives and Program Specific Objectives.
5. Curriculum (Theory and practical) with Augmentation (Use of Questionnaires to collect info from all stakeholders).
6. Modes of delivery of the concepts / courses.
7. Personal Time Table.
8. Lesson plan (Theory, Laboratory, Students, Slow learners and Fast learners).
9. List of prescribed text books from syllabus / Augmentation.
10. List of Reference books / Journals / Articles / URLs / Blogs / other sources.
11. Question bank.
12. Assignment bank.
13. Map of course outcome to assessment methodology.
14. Question Papers (along with their Scheme of valuation) – Theory and Practicals
15. Assessment methodologies and their scores (of all the students).
16. Classification of students (based on all the information).
17. Intervention for Slow / Fast learners.

**Signature of Faculty**

**Signature of Principal**

**Syllabus prescribed by the University (To be given as is)**

**Subject: Atomic, Molecular and Laser Physics**

**Code: PHY – 302**

**Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing six short answer type's questions covering the entire syllabus and will be of 1 mark. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 6 marks each.**

**UNIT – I**

**Brief review of early models of atomic structure, Hydrogen atom spectrum and the Bohr model, Franck-Hertz experiment, reduced mass and the discovery of the hydrogen isotopes, Correspondence principle, spectra of hydrogen-like atoms, magnetic moment due to orbital motion, normal Zeeman effect and limits of Bohr Sommerfeld theory**

**UNIT – II**

**Quantum mechanics applied to the hydrogen atom problem: Stern – Gerlach experiment and electron spin, spin orbit coupling, Fine structure of the hydrogen atom spectrum**

**UNIT – III**

**Many-electron atoms: Hund's rule and the periodic table, spectral terms, doublet structure of alkali spectra, The effective quantum number and quantum defect, penetrating and non-penetrating orbits. Anomalous Zeeman effect, Paschen- Bach effect, Stark effect in hydrogen**

**UNIT – IV**

**Rotational and Vibrational Spectroscopy: diatomic molecule as a rigid rotator, effect of isotopic substitution, non-rigid rotator, vibrational energy of a molecule, diatomic molecule as a simple harmonic oscillator, The anharmonic rotator, rotational- vibrational spectra, population of energy levels, Electronic spectra of molecules, dissociation, Frank-Condon principle. Raman effect: LASER: brief introduction to the principle of LASER, energy level diagram of LASER (He-Ne), relation of Einstein's coefficient, threshold condition of laser formation**

**Books Recommended:**

- 1. Introduction of atomic spectra by white**
- 2. Atomic molecular physics by Rajkumar**
- 3. Lasers – Theory and Applications by K. Thyagrajan and A. K. Ghatak**

#### **4. Physics of Atoms and Molecules by Bransden and Joachain**

Theory (provide the number of hours of teaching)

1. 40

**Course Prerequisites: Physics and Mathematics in 12<sup>th</sup> Class**

#### **Course Objectives,**

1. To inculcate the fundamentals of Thermodynamics
2. To understand the importance of various irreversible engines.
3. To comprehend the dynamics of Heat.
4. To understand various degrees of freedom and molecular movement.
5. To understand the role of Planck's law in origin of Quantum Mechanics

#### **Course Outcomes,**

1. Student gains the knowledge on Fundamentals of Thermodynamics
2. Student gets a thorough knowledge different types of reversible and irreversible engines
3. Student gets a thorough knowledge on dynamics of Heat flow.
4. Student gets a thorough knowledge on various degrees of freedom and molecular movement.
5. Finds the evolution of Quantum Mechanics, a new branch of Physics.

#### **Program Outcomes,**

##### **Programme Specific Outcome (PSO):**

On completion of the 03/ 04 years Degree in PHYSICS students will be able to:

PSO 1 : Culminate in depth knowledge of almost all basic branches of physics such as mechanics, properties of matter, relativity, electricity and magnetism, wave motion, optics, thermal physics, electronics, classical mechanics, quantum mechanics, spectroscopy, nuclear physics, condensed matter physics and also advanced areas like Nanoscience, energy science, astrophysics, instrumentation.

PSO 2 :Communicate effectively physics concepts with examples related to day to day life. Acquire ability of recognizing and distinguishing various aspects of physics found in real life.

PSO 3 : Learn, perform and design experiments in the laboratory to demonstrate the concepts principles, laws of physics, theories learnt in the class rooms and apply the knowledge and skill acquired through experiments of physics in laboratories to solve real life problems

PSO 4 : Acquire ability of critical thinking and logical reasoning in physics problems and their solutions

PSO 5 : Appreciate the importance of physics subjects and its application for pursuing interdisciplinary and multidisciplinary higher education and research in these areas.Pursue advanced studies and research in varied areas of physical science

### **Program Educational Objectives**

PEO 1. Develop ability to analyze physics problem including simple to thought provoking problems and apply the acquired knowledge to solve real life problems.

PEO 2 Appreciate the importance of physics subjects and its application for pursuing interdisciplinary and multidisciplinary higher education and research in these areas.

PEO 3 Understand the vast scope of physics as theoretical and experimental science with application in finding solution of problems in nature spanning from smallest dimension  $10^{-15}$  m to highest dimension  $10^{26}$  m in space, covering energy ranges from 10-10 eV to  $10^{25}$  eV.

PEO 4 think independently and develop algorithm and program using programming techniques for solving real world physics problems.

PEO 5 develop ability of working independently and to make in-depth study of various notions of physics.

### **Program Specific Objectives**

PSO1. Understanding and Exploration of various disciplines of Physics

PSO2. Focus and Immersion in the discipline and gaining perspective of context.

PSO3. In depth learning of major and minor disciplines, Skill sets for employability.

PSO4. Deeper and Advanced Learning of Major Discipline Foundation to pursue Doctoral Studies & Developing Research competencies

PSO5. Deeper and Advanced Learning of the Major Discipline towards gaining proficiency

### **TEACHING PLAN THEORY**

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed			Total Students Enrolled	Remarks
					Planned	Engaged				Correctly Responded	Not Correctly Responded	Total Assessed		
1	Brief review of early models of atomic structure,	1	1	1			a,c,e	I, II	A,C,D	7	13	20	23	
	Hydrogen atom spectrum and the Bohr model,	1	2	1			b,c	I	A,C,D	3	14	17	23	
	Franck-Hertz experiment, ,	1	2	1			g,n,e	I,II,IV	A,C,D	3	14	17	23	
	reduced mass and the discovery of the hydrogen isotopes,	1	3	1			a,b,c,e	I,II,V I	A,C,D	2	14	16	23	
	Correspondence principle,	1	2	1			a,b,c,e	I,II,V I	A,C,D	0	15	15	23	
	spectra of hydrogen-like atoms, ,	1	2	1			a,b,c,e	I,II,V I	A,C,D	5	12	17	23	
	magnetic moment due to orbital motion,	1	4	1			a,b,c,e	I,II,V I	A,C,D	4	14	18	23	
	normal Zeeman	1	5	1			a,b,c,e	I,II,V I	A,C,D	3	13	16	23	

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
	<b>effect and limits of Bohr Somerfield theory</b>	1	5	1			b,d,g	I,III, V	A,C,D	3	15	18	23	
	<b>Problems</b>	1	2	1			a,b,c,e	I, IV,II	A,C,D	1	14	15	23	
<b>2</b>	Quantum mechanics applied to the hydrogen atom problem:	1	2	2			a,b,c,e	I, IV,II	A,C,D	5	15	20	23	
	Stern – Gerlach experiment	1	2	2			d,e,b	I,II,III	A,C,D	3	14	17	23	
	and electron spin,	1	2	2			a,c,e	I, II	A,C,D	6	12	18	23	
	spin orbit coupling,	1	2	2			b,c	I	A,C,D	6	14	20	23	
	, Fine structure of the hydrogen atom spectrum	1	3	2			g,n,e	I,II ,IV	A,C,D	7	9	16	23	
<b>3</b>	Many-electron atoms: Hund's rule and the periodic table,	1	1	3			a,b,c,e	I,II,V I	A,C,D	5	13	18	23	
	spectral terms, doublet structure of alkali spectra,	1	1	3			b,d,g	I,III, V	A,C,D	6	14	20	23	
	The effective quantum number and quantum defect,	1	1	3			b,d,g	I,III, V	A,C,D	4	16	20	23	
	penetrating and non-penetrating orbits.	1	1	3			b,c	I,III	A,C,D	5	12	17	23	

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
	Anomalous Zeeman effect,	1	3	3			b,c	I,III	A,C,D	5	14	19	23	
	Paschen- Bach effect,	1	2	3			a,b,c	I,VI, V	A,C,D	6	13	19	23	
	Stark effect in hydrogen	1	4	4			a,b,c	I,V,V I	A,C,G	6	11	17	23	
	Quiz	1	5	4			a,b,c	I,V,V I	A,C,G	5	13	18	23	
4	Rotational and Vibrational Spectroscopy: diatomic molecule as a rigid rotator,	1	1	5			a,b,c	I,V,V I	A,C,G	4	14	18	23	
	effect of isotopic substitution,	1	1	5			a,b,c	I,V,V I	A,C,G	5	12	17	23	
	non-rigid rotator, vibrational energy of a molecule	1	1	5			a, b,e	I,II,V	A,C,G	5	14	19	23	
	, diatomic molecule as a simple harmonic oscillator,	1	1	5			a, b,e	I,II,V	A,C,G	6	13	19	23	
	The anharmonic rotator, rotational- vibrational spectra, population of energy levels,	1	2	5			a, b,e	I,II,V	A,C,G	6	11	17	23	
	Electronic spectra of molecules, dissociation, Frank-Condon	1	2	5			b,c	I,II	A,C,G	5	13	18	23	
	principle. Raman effect:	1	3	5			a, b,e	I,II,V	A,C,G	4	14	18	23	
LASER: brief introduction to the principle of LASER, energy	1	3	5			a, b,e	I,II,V	A,C,G	5	14	19	23		

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
	level diagram of LASER (He-Ne),													
	relation of Einstein's coefficient, threshold condition of laser formation	1	3	5			a, b,e	I,II,V	A,C,G	5	14	19	23	

**RAFFLES UNIVERSITY, NEEMRANA**  
**SCHOOL OF BASIC AND APPLIED SCIENCES**

**TIME TABLE**

FACULTY NAME: Dr. N. RAKESH CHANDRA

ACADEMIC YEAR - 2022 – 2023

ODD SEMESTER

DAY↓ /TIME→	9:30- 10:20	10:20- 11:10	11:10- 12:00	12:00- 12:50	12:50- 1:50	1:50- 2:40	2:40-3:30	3:30-4:20
MONDAY	PHY - 101	PHY - 201		PHY - 301	LUNCH	ENGG. PHYSICS	PHY - 107	PHY - 107
TUESDAY	PHY - 303	PHY - 203	PHY - 101			ENGG. PHY LAB	ENGG. PHY LAB	
WEDNESDAY	PHY - 105	PHY - 205A	PHY - 305B			ENGG. PHY LAB	ENGG.PHY LAB	
THURSDAY	PHY - 301	PHY - 201	PHY - 105			ENGG. PHYSICS	PHY - 207	PHY - 207
FRIDAY	PHY - 103	PHY - 203	PHY - 305B			ENGG.PHY LAB	ENGG. PHY LAB	
SATURDAY	PHY - 303	PHY - 205A	PHY - 103			ENGG. PHYSICS	PHY - 307	PHY - 307

Convener

Co-convener

HOD

Dean

**Portions for Sessionals examination**

I-Sessional Exam	II- Sessional Exam	III- Sessional Exam	Re-Sessional Exam
Unit – 1	NA	NA	NA
Unit – 2			

**PRACTICAL**

Chapter No.	Title & Contents of the chapter	After completion of the chapter the student shall be able to	Skills and Competency Developed	Course Outcome
	NA	NA	NA	NA
	NA			

**Portions for sessional examination**

I- Sessional Exam	II- Sessional Exam	III- Sessional Exam	Re-Sessional Exam

**Assessment of course outcomes:**

Assessment method	Course outcomes in Percentage				
	CO1	CO2	CO3	CO4	CO5
Unit Test	50	50			
Sessional Examination					
Pre-final Exam					
Assignment					
Others Specify					

**Course Outcomes-Program Outcomes mapping**

<b>COs</b>	<b>Program Outcomes</b>					<b>Total</b>
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	
<b>CO1</b>	<b>x</b>	<b>x</b>		<b>x</b>	<b>x</b>	
<b>CO2</b>	<b>x</b>		<b>x</b>	<b>x</b>	<b>x</b>	
<b>CO3</b>	<b>x</b>	<b>x</b>	<b>x</b>		<b>x</b>	
<b>CO4</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>		
<b>CO5</b>		<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	
<b>Total</b>						

### Modes of delivery of courses

Methodology	Code	% of Delivery
Lecturing	a	20%
Discussion	b	6%
Group discussion	c	5%
Demonstration	d	10%
Power point presentation	e	15%
Tutorial class	f	5%
Assignment	g	10%
Seminar	h	5%
Remedial class	i	10%
Project work	j	
Industrial visit	k	
Role play	l	8%
Quiz	m	4%
Mind mapping	n	2%
Others specify	o	

Assessment Method	Code	% of Scheme of evaluation
Viva	A	10%
Synopsis	B	
Continuous assessment	C	5%
Unit test	D	20%
End Semester exam	E	60%
Prefinal exam	F	
Assignments	G	5%
Others specify	H	

Teaching Aids used	Code
Chalkboard	I
Power point	II
Videos	III
Posters	IV
Charts	V
Models	VI
Flash cards	VII
Others specify	VIII

**List of prescribed text books from University Syllabus**

SI No	Title of the book	Author/s	Edition, Year of Publication	Publisher	No. of copies available in the library
1	Thermodynamics	Enrico Fermi	1956	Courier Dover Publications	Nil
2	A Treatise on Heat : Including Kinetic Theory of Gases, Thermodynamics and Recent Advances in Statistical Thermodynamics	Meghnad Saha, B. N. Srivastava	1958	Indian Press	Nil
3	Heat and Thermodynamics: An Intermediate Textbook	By Mark Waldo Zemansky, Richard Dittman	1981	McGraw-Hill	Nil
4	Thermal Physics by	Garg, Bansal and Ghosh	1993	Tata McGraw-Hill,	Nil

**List of Reference text books from University Syllabus**

SI No	Title of the book	Author/s	Edition, Year of Publication	Publisher	No. of copies available in the library
1	Engineering Physics	MN Avadhanulu, PG Ksheersagar			
2	Modern Physics and Electronics	SL Guptha			
3	Thermodynamics and Statistical Physics	Singhal, Agarwal and Sathya Prakash			
4	Engineering Thermodynamics	PK Nag			

**List of URLs / Blogs / Other e-Sources**

1	<a href="https://www.youtube.com/watch?v=PMpoamNGceM">https://www.youtube.com/watch?v=PMpoamNGceM</a>
2	<a href="https://www.youtube.com/watch?v=PMpoamNGceM&amp;list=RDLVPMpoamNGceM&amp;start_radio=1&amp;rv=PMpoamNGceM&amp;t=52">https://www.youtube.com/watch?v=PMpoamNGceM&amp;list=RDLVPMpoamNGceM&amp;start_radio=1&amp;rv=PMpoamNGceM&amp;t=52</a>
3	<a href="https://www.youtube.com/watch?v=zl3Uj18eHek&amp;list=RDLVPMpoamNGceM&amp;index=11">https://www.youtube.com/watch?v=zl3Uj18eHek&amp;list=RDLVPMpoamNGceM&amp;index=11</a>
4	<a href="https://www.youtube.com/watch?v=bow4rworT-k">https://www.youtube.com/watch?v=bow4rworT-k</a>
5	<a href="https://www.youtube.com/watch?v=etjZmdmrjSU">https://www.youtube.com/watch?v=etjZmdmrjSU</a>
6.	<a href="https://onlinecourses.nptel.ac.in/noc19_mm16/preview">https://onlinecourses.nptel.ac.in/noc19_mm16/preview</a>

**Module / Chapter No 1**

SI No	Question	Max Marks	Related course outcome
1	State and explain First law of thermodynamics.	5	1
2	Define Internal energy.	2	1
3	Derive an expression for work done in Isothermal process.	5	1
4	Derive an expression for work done in Adiabatic process.	5	1
5	With a neat labelled diagram explain the construction and working of carnot Engine	5	1
6	Explain the term thermodynamic scale of temperature.	5	1
7	.Derive an expression for its efficiency. State and explain Carnot's theorem	5	1

**Module / Chapter No 2**

SI No	Question	Max Marks	Related course outcome
1	Define Entropy. Derive an expression for Entropy in reversible and irreversible processes.	5	2
2	State and explain two different statements of Thermodynamics second law	5	2
3	Establish the relationship between Thermodynamic potentials.	5	2
4	Explain Joule Thomson effect. Define Triple point of water.	5	2
5	Derive Maxwell's equations.	5	2

**Module / Chapter No 3**

SI No	Question	Max Marks	Related course outcome
1	Derive Maxwell-Boltzmann Law of Distribution of Molecular Velocities.	5	3
2	Define and derive expressions for r.m.s. velocity, Average and Most Probable Speeds.	5	3
3	. Define Mean Free Path. Transport Phenomenon, Degree of freedom,	5	3
4	State and explain equi-partition of energy	5	3
5	Define specific heat of gases.	5	3

**Module / Chapter No 4**

SI No	Question	Max Marks	Related course outcome
1	Define Emissive and Absorptive Powers.	5	4
2	Write the Kirchhoff's Law of Black Body Radiation.	5	4
3	State and explain Stefan-Boltzmann Law.	5	4
4	Write a short note on Distribution of energy in the spectrum of black body radiation.	5	4
5	Write a short note on Wein's displacement law.	5	4

#### Module / Chapter No 1

SI No	Assignment	Max Marks	Related course outcome
1	With a neat labelled diagram explain the construction and working of carnot Engine	5	1
2	Explain the term thermodynamic scale of temperature	5	1
3	Applications of First law of thermodynamics	5	1

#### Module / Chapter No 2

SI No	Assignment	Max Marks	Related course outcome
1	Illustrate Entropy. List few examples of entropy change in day to day life.	5	2

2	Explain the working of AC. State the law of thermodynamics which governs the working of AC.	5	2
3	Establish the relationship between Thermodynamic potentials.	5	2
4.	Explain Joule Thomson effect. Explain one real time example.	5	2
5.	Derive Maxwell's equations.	5	2

### Module / Chapter No 3

SI No	Assignment	Max Marks	Related course outcome
1	Explain the concept of electron gas. Maxwell Boltzmann distribution law is applicable for it?	5	3
2	The wind velocity estimated in weather report is mean velocity or RMS velocity or Most probable velocity? Justify.	5	3
3	Define Mean Free Path. Transport Phenomenon, Degree of freedom,	5	3
4	State and explain equi-partition of energy. Explain its significance	5	3
5.	Define specific heat of gases.	5	3

### Module / Chapter No 4

SI No	Assignment	Max Marks	Related course outcome
1	Define Emissive and Absorptive Powers.	5	4

2	Write the Kirchhoff's Law of Black Body Radiation. Find the surface temperature of Sun	5	4
3	Discuss the completeness of Blackbody radiation	5	4
4	Write a short note on Distribution of energy in the spectrum of black body radiation.	5	4
5.	Explain the quantization of atomic energy levels	5	4

**RAFFLES UNIVERSITY, NEEMRANA  
SCHOOL OF BASIC AND APPLIED SCIENCES  
MIDTERM EXAMINATIONS (PCM & PCsM)**

**SEMESTER – I YEAR – I      SUB: THERMODYNAMICS      SUB CODE: PHY – 103**

**DATE: 16 – 11 – 2022 TIMINGS: 02:30 – 03:30 HRS MAX MARKS: 10**

**NOTE: ANSWER ANY FOUR OF THE FOLLOWING                      2.5 X 4 = 10 M**

1. State 1st law of thermodynamics and write any three applications of it.
2. State Kelvin Planck and Clausius statements of 2nd law of thermodynamics.
3. Write a brief note on Triple point.
4. Show that in a reversible process entropy remains constant.
5. Derive 4th Maxwell's thermodynamic potential – Gibb's function.

<b>S.No</b>	<b>Classification</b>	<b>Name of the students</b>
	<b>Slow learners (less than 50 %)</b>	
<b>1</b>	Remedial teaching	<b>HEMSINGH GURJAR</b>
<b>2</b>	Questions for practice	<b>MANDEEP JANGIR</b>

3	Special guidance beyond college hour	NIKHIL JANGIR
4	Trace out physical and mental	NITIN KUMAR
5	problems if any	PRATEEK
6	Encourage even for small	RAHUL YADAV
	achievement	SAHIL
7	Giving memory tip	SAHIL KUMAR
8	Review time to time	SHEKHAR YADAV
		SONU YADAV
		SAHIL YADAV
		ARUN KUMAR

S.No	Classification	Name of the students
	Average learners (51-75 %)	
	Actions taken	
1	Motivate students	ANSHIKA YADAV NEETU YADAV NEETU, PUNIT, SUMIT KUMAR NISHIKANT, MAHESH NEHRA, PIYUSH
2	Audio-visual aids	
3	Create confidence level in their interest areas	
	Mind map	

S.No	Classification	Name of the students
	Fast learners (Above 76 %)	
	Actions taken	
1	Solve Engineering Problems	JASMINE, PAYAL YADAV, NIDHI YADAV
2	Study beyond the syllabus	
3	Project work	

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## **Feedback on Curriculum**

Formats have been developed for the following stakeholders

1. Present / Current students
2. Students just passing out (Exit Interview)
3. Alumni
4. Parents
5. Industry based supervisors
6. Placement (campus recruiters)
7. Departmental Advisory Board

### TEACHING PLAN (SLOW LEARNERS)

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
					Planned	Engaged				Correctly Responded	Not Correctly Responded	Total Assessed	Total Students	
1	Brief review of early models of atomic structure,	1	1	1			a,c,e	I, II	A,C,D	3	6	9	12	
	Hydrogen atom spectrum and the Bohr model,	1	2	1			b,c	I	A,C,D	4	6	10	12	
	Franck-Hertz experiment, ,	1	2	1			g,n,e	I,II,IV	A,C,D	2	7	9	12	
	reduced mass and the discovery of the hydrogen isotopes,	1	3	1			a,b,c,e	I,II,VI	A,C,D	2	8	10	12	
	Correspondence principle,	1	2	1			a,b,c,e	I,II,VI	A,C,D	2	9	11	12	
	spectra of hydrogen-like atoms, ,	1	2	1			a,b,c,e	I,II,VI	A,C,D	1	7	8	12	
	magnetic moment due to orbital motion,	1	4	1			a,b,c,e	I,II,VI	A,C,D	2	6	8	12	
	normal Zeeman	1	5	1			a,b,c,e	I,II,VI	A,C,D	2	7	9	12	

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
	<b>effect and limits of Bohr Somerfield theory</b>	1	5	1			b,d,g	I,III, V	A,C,D	3	8	11	12	
	<b>Problems</b>	1	2	1			a,b,c,e	I, IV,II	A,C,D	1	8	9	12	
<b>2</b>	Quantum mechanics applied to the hydrogen atom problem:	1	2	2			a,b,c,e	I, IV,II	A,C,D	2	9	11	12	
	Stern – Gerlach experiment	1	2	2			d,e,b	I,II,III	A,C,D	3	7	10	12	
	and electron spin,	1	2	2			a,c,e	I, II	A,C,D	2	6	8	12	
	spin orbit coupling,	1	2	2			b,c	I	A,C,D	4	7	11	12	
	, Fine structure of the hydrogen atom spectrum	1	3	2			g,n,e	I,II ,IV	A,C,D	2	7	9	12	
	Many-electron atoms: Hund's rule and the periodic table,	1	3	2			a,b,c,e	I,II,V I	A,C,D	3	6	9	12	
	spectral terms, doublet structure of alkali spectra,	1	4	2			a,b,c,e	I,II,V I	A,C,D	2	5	7	12	
The effective quantum number and quantum defect,	1	2	2			a,b,c,e	I,II,V I	A,C,D	2	5	7	12		

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
	penetrating and non-penetrating orbits.	1	1	2			a,b,c,e	I,II,V I	A,C,D	3	7	10	12	
3	Anomalous Zeeman effect,	1	1	3			a,b,c,e	I,II,V I	A,C,D	4	7	11	12	
	Paschen- Bach effect,	1	1	3			b,d,g	I,III, V	A,C,D	4	6	10	12	
	Stark effect in hydrogen	1	1	3			b,d,g	I,III, V	A,C,D	2	7	9	12	
	Quiz	1	1	3			b,c	I,III	A,C,D	2	8	10	12	
	Rotational and Vibrational Spectroscopy: diatomic molecule as a rigid rotator,	1	3	3			b,c	I,III	A,C,D	2	9	11	12	
	effect of isotopic substitution,	1	2	3			a,b,c	I,VI, V	A,C,D	1	7	8	12	
	non-rigid rotator, vibrational energy of a molecule	1	4	4			a,b,c	I,V,V I	A,C,G	2	6	8	12	
	, diatomic molecule as a simple harmonic oscillator,	1	5	4			a,b,c	I,V,V I	A,C,G	2	7	9	12	
4	The anharmonic rotator, rotational- vibrational spectra, population of energy levels,	1	1	5			a,b,c	I,V,V I	A,C,G	2	7	9	12	



Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
1	Brief review of early models of atomic structure,	1	1	1			a,c,e	I, II	A,C,D	4	3	7	8	
	Hydrogen atom spectrum and the Bohr model,	1	2	1			b,c	I	A,C,D	5	2	7	8	
	Franck-Hertz experiment, ,	1	2	1			g,n,e	I,II,IV	A,C,D	5	1	6	8	
	reduced mass and the discovery of the hydrogen isotopes,	1	3	1			a,b,c,e	I,II,V I	A,C,D	4	2	6	8	
	Correspondence principle,	1	2	1			a,b,c,e	I,II,V I	A,C,D	5	1	7	8	
	spectra of hydrogen-like atoms, ,	1	2	1			a,b,c,e	I,II,V I	A,C,D	6	1	7	8	
	magnetic moment due to orbital motion,	1	4	1			a,b,c,e	I,II,V I	A,C,D	6	1	7	8	
	normal Zeeman	1	5	1			a,b,c,e	I,II,V I	A,C,D	4	2	6	8	
	effect and limits of Bohr Somerfield theory	1	5	1			b,d,g	I,III, V	A,C,D	3	2	5	8	
Problems	1	2	1			a,b,c,e	I, IV,II	A,C,D	3	2	5	8		

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
2	Quantum mechanics applied to the hydrogen atom problem:	1	2	2			a,b,c,e	I, IV,II	A,C,D	3	2	5	8	
	Stern – Gerlach experiment	1	2	2			d,e,b	I,II,III	A,C,D	4	2	6	8	
	and electron spin,	1	2	2			a,c,e	I, II	A,C,D	5	2	7	8	
	spin orbit coupling,	1	2	2			b,c	I	A,C,D	5	2	7	8	
	, Fine structure of the hydrogen atom spectrum	1	3	2			g,n,e	I,II,IV	A,C,D	5	2	7	8	
	Many-electron atoms: Hund's rule and the periodic table,	1	3	2			a,b,c,e	I,II,V I	A,C,D	6	2	8	8	
	spectral terms, doublet structure of alkali spectra,	1	4	2			a,b,c,e	I,II,V I	A,C,D	6	2	8	8	
	The effective quantum number and quantum defect, penetrating and non-penetrating orbits.	1	2	2			a,b,c,e	I,II,V I	A,C,D	6	2	8	8	
3	Anomalous Zeeman effect,	1	1	3			a,b,c,e	I,II,V I	A,C,D	4	2	6	8	

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
	Paschen- Bach effect,	1	1	3			b,d,g	I,III, V	A,C,D	4	2	6	8	
	Stark effect in hydrogen	1	1	3			b,d,g	I,III, V	A,C,D	4	2	6	8	
	Quiz	1	1	3			b,c	I,III	A,C,D	2	2	4	8	
	Rotational and Vibrational Spectroscopy: diatomic molecule as a rigid rotator,	1	3	3			b,c	I,III	A,C,D	2	2	4	8	
	effect of isotopic substitution,	1	2	3			a,b,c	I,VI, V	A,C,D	2	2	4	8	
	non-rigid rotator, vibrational energy of a molecule	1	4	4			a,b,c	I,V,V I	A,C,G	3	2	5	8	
	, diatomic molecule as a simple harmonic oscillator,	1	5	4			a,b,c	I,V,V I	A,C,G	3	2	5	8	
4	The anharmonic rotator, rotational- vibrational spectra, population of energy levels,	1	1	5			a,b,c	I,V,V I	A,C,G	4	2	6	8	
	Electronic spectra of molecules, dissociation, Frank-Condon	1	1	5			a,b,c	I,V,V I	A,C,G	3	2	5	8	

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
	principle. Raman effect:	1	1	5			a, b,e	I,II,V	A,C,G	4	2	6	8	
	LASER: brief introduction to the principle of LASER, energy level diagram of LASER (He-Ne),	1	1	5			a, b,e	I,II,V	A,C,G	3	2	5	8	
	relation of Einstein's coefficient, threshold condition of laser formation	1	2	5			a, b,e	I,II,V	A,C,G	4	2	6	8	

### TEACHING PLAN (FAST LEARNERS)

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed			Total Students	Remarks
					Planned	Engaged				Correctly Responded	Not Correctly Responded	Total Assessed		
1	Brief review of early models of atomic structure,	1	1	1			a,c,e	I, II	A,C,D	3	2	5	05	
	Hydrogen atom spectrum and the Bohr model,	1	2	1			b,c	I	A,C,D	2	2	4	05	
	Franck-Hertz experiment, ,	1	2	1			g,n,e	I,II,IV	A,C,D	1	3	4	05	

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed				Remarks
	reduced mass and the discovery of the hydrogen isotopes,	1	3	1			a,b,c,e	I,II,V I	A,C,D	2	2	4	05	
	Correspondence principle,	1	2	1			a,b,c,e	I,II,V I	A,C,D	1	3	4	05	
	spectra of hydrogen-like atoms, ,	1	2	1			a,b,c,e	I,II,V I	A,C,D	1	4	5	05	
	magnetic moment due to orbital motion,	1	4	1			a,b,c,e	I,II,V I	A,C,D	1	4	5	05	
	normal Zeeman	1	5	1			a,b,c,e	I,II,V I	A,C,D	2	2	4	05	
	effect and limits of Bohr Somerfield theory	1	5	1			b,d,g	I,III, V	A,C,D	2	3	5	05	
	Problems	1	2	1			a,b,c,e	I, IV,II	A,C,D	2	3	5	05	
2	Quantum mechanics applied to the hydrogen atom problem:	1	2	2			a,b,c,e	I, IV,II	A,C,D	2	3	5	05	
	Stern – Gerlach experiment	1	2	2			d,e,b	I,II,III	A,C,D	2	2	4	05	

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed			Remarks	
	and electron spin,	1	2	2			a,c,e	I, II	A,C,D	2	3	5	05	
	spin orbit coupling,	1	2	2			b,c	I	A,C,D	2	3	5	05	
	, Fine structure of the hydrogen atom spectrum	1	3	2			g,n,e	I,II,IV	A,C,D	2	2	4	05	
	Many-electron atoms: Hund's rule and the periodic table,	1	3	2			a,b,c,e	I,II,V I	A,C,D	2	3	5	05	
	spectral terms, doublet structure of alkali spectra,	1	4	2			a,b,c,e	I,II,V I	A,C,D	2	3	5	05	
	The effective quantum number and quantum defect,	1	2	2			a,b,c,e	I,II,V I	A,C,D	2	3	5	05	
	penetrating and non-penetrating orbits.	1	1	2			a,b,c,e	I,II,V I	A,C,D	2	3	5	05	
3	Anomalous Zeeman effect,	1	1	3			a,b,c,e	I,II,V I	A,C,D	2	3	5	05	
	Paschen- Bach effect,	1	1	3			b,d,g	I,III, V	A,C,D	2	3	5	05	
	Stark effect in hydrogen	1	1	3			b,d,g	I,III, V	A,C,D	2	2	4	05	
	Quiz	1	1	3			b,c	I,III	A,C,D	2	2	4	05	

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed			Remarks	
	Rotational and Vibrational Spectroscopy: diatomic molecule as a rigid rotator,	1	3	3			b,c	I,III	A,C,D	2	2	4	05	
	effect of isotopic substitution,	1	2	3			a,b,c	I,VI, V	A,C,D	2	2	4	05	
	non-rigid rotator, vibrational energy of a molecule	1	4	4			a,b,c	I,V,V I	A,C,G	2	2	4	05	
	, diatomic molecule as a simple harmonic oscillator,	1	5	4			a,b,c	I,V,V I	A,C,G	2	3	5	05	
4	The anharmonic rotator, rotational- vibrational spectra, population of energy levels,	1	1	5			a,b,c	I,V,V I	A,C,G	2	3	5	05	
	Electronic spectra of molecules, dissociation, Frank-Condon	1	1	5			a,b,c	I,V,V I	A,C,G	2	3	5	05	
	principle. Raman effect:	1	1	5			a, b,e	I,II,V	A,C,G	2	3	5	05	
	LASER: brief introduction to the principle of LASER, energy level diagram of LASER (He-Ne),	1	1	5			a, b,e	I,II,V	A,C,G	2	3	5	05	

Unit	Title & Contents of the chapter	Number of Hours	PO	CO	Date		Methodology	Teaching aids used	Method of Assessment	No. of Students assessed			Remarks	
	relation of Einstein's coefficient, threshold condition of laser formation	1	2	5			a, b,e	I,II,V	A,C,G	2	3	5	05	
	<b>spectra of hydrogen-like atoms, ,</b>	1	4	5			b,e	I,II	A,C,G	2	2	4	05	

