Sh. L. N. Hindu College, Rohtak (Haryana)
Course Plan

Department of Chemistry

Program: BSc III

Inorganic Chemistry (CH-501)

SCHEME

Course Name	**Inorganic Chemistry**		**Course Type**	**Theory**
Course Code	**CH-501**		**Class**	BSc V Sem.
Instruction Delivery	**Per week Lectures: 2, Tutorial:2, Practical:** **Total No. Classes Per Sem: 32(L), (T), -(P)** **Assessment in Weightage: Sessional (20%), End Term Exams (80%)**			
Course Coordinator	Dr Manish Kumar	**Course Instructors**	Theory: Dr Manish Kumar Practical: -- Dr Manish Kumar	

COURSE OVERVIEW

Inorganic chemistry deals with synthesis and behavior of inorganic and organometallic compounds. This field covers chemical compounds that are not carbon-based, which are the subjects of organic chemistry. The distinction between the two disciplines is far from absolute, as there is much overlap in the subdiscipline of organometallic chemistry. It has applications in every aspect of the chemical industry, including catalysis, materials science, pigments, surfactants, coatings, medications, fuels, and agriculture.

PREREQUISITE

Inorganic chemistry, Coordination chemistry, magnetic properties and Thermodynamic and kinetic stability

COURSE OBJECTIVE

The objective of this course is to study the bonding between the different metals with carbon atom of various organic groups. It also helps in study of metal carbonyls, metal ethylenic complexes: bonding, stability and their reactions.

It reflects the kinetic and thermodynamics stability of the complexes. It makes us understand about stability between different metal complexes with different type of ligands. The objective is to study the importance of different metals complexes and their magnetic properties. It also reflects the study of electronic spectra of different metal complexes.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO No.	Course Outcomes
1	Remember the bonding in metal and different type of ligands.
2	Remember the Splitting of d-orbitals in octahedral and tetrahedral field.
3	Understand the paramagnetic and diamagnetic nature of metal complexes

4	Understand the spectra of coordination compounds.

COURSE CONTENT

Content
Organometallic Chemistry **Metal-ligand Bonding in Transition Metal Complexes** Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal field split ting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters. **Thermodynamic and Kinetic Aspects of Metal Complexes** A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes of Pt (II). **Magnetic Properties of Transition Metal Complexes** Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of s and eff values, orbital contribution to magnetic moments, application of magnetic moment data for 3dmetal complexes. **Electron Spectra of Transition Metal Complexes** Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for d1 and d9 states, discussion of the electronic spectrum of [Ti(H2O)6]3+ complex ion

LESSON PLAN (THEORY AND TUTORIAL CLASSES)

L. No	Topic to be Delivered	Tutorial Plan	Unit
1	Limitations of VBT and points of CFT	Practice Questions on calculation of CFSE of metal complexes.	1
2	Splitting of metal orbitals in octahedral field		
3	Splitting of metal orbitals in tetrahedral and square planar complexes		
4	CFSE and spectrochemical series	Practice PYQ on CFT and spectrochemical series	
5	Various factors effecting CFSE		

6	Revision of structures of d-orbitals	Practice Questions on Factors effecting CFSE	1
7	Revision on CFSE		
8	Revision on factors effecting CFSE		
9	Thermodynamic stability of metal complexes	Practice questions on thermodynamic and kinetic stability	2
10	Factors effecting Thermodynamic stability		
11	Kinetic stability of metal complexes		
12	Factors effecting Kinetic stability	Practice questions on trans effect of thiourea	
13	Inert and labile complexes		
14	Trans effect		
15	Polarization theory and pi-bonding theory for trans effect		
16	Type of magnetic behaviour of substances	Revise type of magnetic properties	3
17	Magnetic susceptibility, Diamagnetic correction		
18	Curie temp., Neel's temp. and their graphs		
19	Spin only formula and L-S coupling	Practice PYQ on Curie and Neels temp.	
20	Correction in spin and orbital effective magnetic moment	Practice orbital contribution of	
21	Orbital contribution in complexes		

22	Application of magnetic character of 3d elements	metal complexes. Practice questions on calculation of mag. moment	
23	Revision of PYQ of curie temp.		
24	Revision of PYQ of orbital contribution		
25	Revision of PYQ on calculation of magnetic moment of various metals.		

26	Introduction of electronic spectra	Learn questions on electronic spectra and selection rule Learn questions on orgel energy level diagrams	4
27	Type of different electronic transitions		
28	Term symbol and ground state		
29	Orgel energy level diagrams of d^1 and d^9 systems		
30	Orgel energy level diagrams of d^2 and d^3 systems		
31	Question on ground state term symbol		
32	Revision of PYQ of this chapter		

Text Book

Concise Coordination chemistry by Gopalan and Ramalingam
A text book for Inorganic chemistry, vol II by Ajai Kumar

Reference Books

Concise Inorganic Chemistry by J.D. Lee
Advanced Inorganic Chemistry vol I by S.P. Tuli, Basu and Madan

Web/Links for e-content

https://en.wikipedia.org/wiki/Inorganic_chemistry
https://www.youtube.com/live/2LOUTZvcnz8?si=GfcjkSh5llURO2Xr
https://www.youtube.com/live/2LOUTZvcnz8?si=Iawv5RIDxtZBmaBb
https://youtube.com/playlist?list=PLqUcmwsbGS_GhYwACsmG4-ckDdIygVZme&si=QkITdaQRqceGedFh

PRACTICE QUESTIONS (QUESTION BANK)

S No	Problem
1	What is CFSE?
2	$[NiCl_4]^{2-}$ is tetrahedral in shape. Why?

3	Distinguish between VBT and CFT
4	What are shapes of different d-orbitals?
5	What do you understand splitting of orbitals in octahedral complexes?
6	Discuss the splitting of d-orbitals in tetrahedral and squre planer complexes.
7	Discuss the structure and magnetic behaviour of complex $[Fe(CN)_6]^{4-}$
8	What is relation between CFSE in octahedral field and tetrahedral field?
9	Describe different types of magnetic substances
10	Defien Curie’s and Neel’s temperature
11	What is spin only formula for calculating magnetic moment?
12	Explain the linde’s factor and calculate it for different compounds.
13	Describe temperature independent magnetism.
14	Discuss Orbital contribution in metal complexes.
15	Why Cu(I) is diamagnetic and Cu(II) is paramagnetic?
16	Define Curie-Weiss law.
17	Calculate the g value for a free electron.
18	Define nucleophilicity and basicity.
19	Discuss thermodynamic stability of the complexes.
20	Draw relationship between stepwise and overall formation constant.
21	Discuss various theories which explain trans effect.

22	What is kinetic stability of the complexes?
23	What are inert and labile complexes?
24	How does polarization theory differ from pi-bonding theory
25	Arrange the various ligands according to the increasing value of trans effect.
26	What are the selection rules in electronic spectra?
27	What are microstates? Calculate them for d^1 and p^2 configuration.
28	Why the $[Ti(H_2O)_6]^{3+}$ appears violet in colour?
29	What do you mean by term symbol? Also explain spin multiplicity
30	Write a short note on orgel energy level diagrams.
31	Calculate ground state term symbol for Cr (Z= 24)
32	Explain spin allowed and spin forbidden transitions.

Sh. L. N. Hindu College, Rohtak (Haryana)
Course Plan

Department of Chemistry

Program: BSc IIIrd

Organic Chemistry (CH-503)

SCHEME

Course Name	Organic Chemistry	Course Type	Theory
Course Code	CH-503	Class	BSc V Sem.
Instruction Delivery	**Per week Lectures: 2, Tutorial:1, Practical: 1** **Total No. Classes Per Sem: 32(L), (T), -(P)** **Assessment in Weightage: Sessional (20%), End Term Exams (80%)**		
Course Coordinator	Dr Manish Kumar	**Course Instructors**	Theory: Dr Manish Kumar Practical: -- Dr Manish Kumar

COURSE OVERVIEW

Organic chemistry is a subdiscipline within chemistry involving the scientific study of the structure, properties, and reactions of organic compounds and organic materials, i.e., matter in its various forms that contain carbon atoms. Study of structure determines their structural formula. Study of properties includes physical and chemical properties, and evaluation of chemical reactivity to understand their behavior. The study of organic reactions includes the chemical synthesis of natural products, drugs, Heterocyclic compounds and polymers, and study of individual organic molecules in the laboratory and via theoretical (in silico) study.

PREREQUISITE

Organic chemistry, NMR spectroscopy, biomolecules and Proteins

COURSE OBJECTIVE

The objective of this course is to study the principle of nuclear magnetic resonance spectroscopy, determination of compounds structure.

It helps in study of Chemistry of carbohydrates and structure of glucose and fructose. It also objects the structures of disaccharides: maltose, sucrose and lactose

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO No.	Course Outcomes
1	Remember the principle of nuclear magnetic resonance spectroscopy
2	Remember the Chemical shift of various functional group in organic compounds.
3	Understand the monosaccharides structures and their properties.
4	Understand the disaccharides carbohydrates, structures and their properties.

COURSE CONTENT

Content
NMR Spectroscopy-I Principle of nuclear magnetic resonance, the PMR spectrum,number of signals, peak areas, equivalent and nonequivalent protons positions of signals and chemical shift,shielding and deshielding of protons, proton counting,splitting of signals and coupling constants, magnetic equivalence of protons. **NMR Spectroscopy-II** Discuss ion of PMR spectra of the molecules: ethyl bromide, npropyl bromide, isopropyl bromide, 1,1-dibromoethane, 1,1,2-tribromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde and acetophenone. Simple problems on PMR spectroscopy for structure determination of organic compounds **Carbohydrates-I** Classification and nomenclature. Monosaccharides, mechanism of osazone formation, inte rconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose in to mannose. Formation of glycos ides, ethers and esters. Determination of ring size of glucose and fructose. Open chain and cyclic structure of D(+)-glucose & D(-) fructose. Mechanism of mutarotation. Structures of ribose and deoxyribose. **Carbohydrates-II** An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

LESSON PLAN (THEORY AND TUTORIAL CLASSES)

L. No	Topic to be Delivered	Tutorial Plan	Unit
1	Principle of nuclear magnetic resonance	Practice Questions on equivalent protons.	1
2	PMR spectrum, number of signals, peak areas		
3	equivalent and nonequivalent protons positions of signals		
4	chemical shift, shielding and deshielding of protons	Practice Questions on chemical shift and factors effecting shift of	

5	proton counting and splitting of signals	protons.	

6	coupling constants, magnetic equivalence of protons.	Practice Questions on electrophilic substitution and Basicity of heterocycles.	1
7	Questions on calculation of no. of peaks		
8	Questions on Chemical shift in different organic molecules		
9	Discuss ion of PMR spectra of the molecules	Practice questions on structure determination of organic molecules.	2
10	ethyl bromide, npropyl bromide, isopropyl bromide, 1,1-dibromoethane,		
11	1,1,2-tribromoethane, ethanol, acetaldehyde, ethyl acetate, toluene		
12	benzaldehyde and acetophenone		
13	Simple problems on PMR spectroscopy		
14	structure determination of organic compounds		
15	Questions on PMR spectra different molecules		
16	Classification and nomenclature. Monosaccharides	Practice questions on osazone formation	3
17	mechanism of osazone formation, interconversion of glucose and fructose		
18	chain lengthening and chain shortening of aldoses		
19	Erythro and threo diastereomers. Conversion of glucose in to mannose	Practice questions on cyclic ring structure of glucose and fructose	
20	Formation of glycosides, ethers and esters	Practice questions on chain shortening and leangthening. Practice questions on ribose ans deoxyribose	
21	Determination of ring size of glucose and fructose		
22	Structures of ribose and deoxyribose		
23	Open chain and cyclic structure of D(+)-glucose & D(-) fructose		
24	Mechanism of mutarotation		
25	Revision of open and closed chain structures of glucose and fructose.		

26	Disaccharides : maltose, sucrose and lactose.	Practice questions on Structure of disaccharides Practice questions on organometallic reactions.	4
27	Ring chain structure of Disaccharides		
28	Polysaccharides starch and cellulose		
29	Grignard reagent		
30	Organozinc reaction		
31	Organolithium compounds		
32	Revision of PYQ of this chapter		

Text Book

A text book of Organic Chemistry by Bahl and Arun Bahl,
A text book of Organic Chemistry by L Finar Vol I

Reference Books

Oxford Organic Chemistry Second edition by J Clayden, N Greeves, S Warren

Web/Links for e-content

https://en.wikipedia.org/wiki/Heterocyclic_compound
https://youtu.be/omU8jC3Kzzw?si=FMr9lFfDlZg-kDHb
https://youtube.com/playlist?list=PLLFRJm7-ej7QD3NJgy7jip_7skHzdGKv_&si=VVHzHsUkMsC1DNgv

PRACTICE QUESTIONS (QUESTION BANK)

S No	Problem
1	Discuss principle of NMR spectra
2	What is saturated state in NMR spectra?
3	Define equivalent and non-equivalent protons.
4	Discuss nuclear spin state.
5	What do you mean by chemical shift?
6	What is relaxation process in NMR spectroscopy?

7	How many equivalent protons in vinyl chloride?
8	How many signals in toluene, ethanol and Dibromoethane.
9	What is coupling constant?
10	Explain shielding and deshielding of protons.
11	1,1-Dibromoethane give 2 signals but 1,2- Dibromoethane gives one signal. Why?
12	How does electronegativity effect the chemical shift ?
13	How does H-bonding effect the chemical shift
14	Ethene absorbs at high signal than acetylene. Why?
15	What you expect from the spectra of p-dichlorobenzene?
16	Differentiate between starch and cellulose
17	Give the Ruff's degradation
18	How can ring size of glucose can be determined?
19	Give Haworth formula of amylose and sucrose
20	How will you convert fructose into glucose and mannose?
21	Explain kilani-fischer synthesis
22	What is mutarotation? give it for glucose.
23	Give reaction of both glucose and fructose with fehling's solution.
24	What is invert sugar?

25	Convert ethyl magnesium bromide into tret-butyl alcohol.
26	How the ring structure of glucose is determind?
27	Draw Haworth structure of maltose and lactose.
28	Discuss reaction alkyllithium with CO_2.
29	What is glucopyranose form and fructo furanose form?

30	Differentiate glucose and lactose
31	Discuss reaction of Grignard reagent to prepare carboxylic acids.
32	What do you understand chain lengthening of saccharide group?

Sh. L. N. Hindu College, Rohtak (Haryana)
Course Plan

Department of Physics

Program: B.Sc. Non Medical

Session (2024-25)

Solid state Physics (PHY 501)

SCHEME

Course Name	Solid state Physics	**Course Type**	**Theory**
Course Code	**PHY 501**	**Class**	B.Sc. N.M. V Sem
Instruction Delivery	**Per week Lectures: 6, Theory (02), Tutorial:0, Practical:04** **Total No. Classes Per Sem: 72(L), 24(T), - 48(P)** **Assessment in Weightage: Sessional (20%), End Term Exams (80%)**		
Course Coordinator	Dr. Savita Devi	**Course Instructors**	Theory: Dr. Savita Devi Practical: -- Ms. Jyoti

COURSE OVERVIEW

Matter offers in four forms example plasma, gas, liquid and solid in the universe. Most of the matter in the universities in the stars and galaxies were the matrix mainly in the plasma state.

PREREQUISITE

Crystal, lattice

COURSE OBJECTIVE

Objective of the solid state Physics is to understand the crystal structure and lattice formation in two dimensional and three dimensional.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO No.	Course Outcomes
1	Understand the crystal structure and lattice formation,crystal planes ,Miller indices
2	Define and explain the laws of diffraction
3	Get an introduction to the reciprocal letters and its physical significance
4	Solve the problems based on crystal structure and lattice formation

Sh. L. N. Hindu College, Rohtak (Haryana)
Course Plan

COURSE CONTENT

Content
Crystalline and glassy forms, liquid crystals, crystal structure, periodicity, lattice and basis crystal translational vectors and axes, unit cell and primitive cell, winger Seitz primitive cell, symmetry operations for two dimensional crystal, Bravais lattice in two and three dimensions. Crystal planes and Miller indices, interplaner spacing, crystal structures of zinc sulphide, sodium chloride and diamond , X - ray diffraction, Bragg's law and experimental X-Ray diffraction methods , K space. Reciprocal lattice and its physical significance, reciprocal lattice vectors, reciprocal letters to a simple cubic lattice, b.c.c. and f.c.c. Specific heat: specific heat of solids, Einstein theory of specific heat, Debye model of specific heat of solids

LESSON PLAN (THEORY AND TUTORIAL CLASSES)

L. No	Topic to be Delivered	Tutorial Plan	Unit
1	Crystalline and glassy forms	Define, expression, explanation	1
2	Liquid crystals		
	Crystal structure		
4	Periodicity		
5	Lattice and basis crystal translation vectors and axis		

6	Unit cell and primitive cell	Itroduction, derivation	1
7	Winger Seitz primitive cell	Define, expression, explanation	
8	Symmetry operations for a two dimensional crystal		

9	IBravais lattice in two and three dimensions		
10	Revision	Discussion ,explanation , calculations	
11	Question		
12	Crystal planes and Miller indices	Define, expression, explanation 2	
13	Interplaner spacing	State , explanation	
14	Crystal structures of zinc sulphide		
15	Structure of sodium chloride	State, Explanation	2
16	Crystal structure of diamond	Expression and explanation	
17	X-ray refraction		
18	Bragg's law	State,Expression and explanation	
19	Experimental x-ray diffraction methods		
20	K space		
21	Revision	Explanation	
22	Questions	Explanation, Calculations	
23	Reciprocal lattice and its physical significance		
24	Reciprocaller is vectors	State, expression	
25	Reciprocal latest ve simple cubic letters		
26	B.C.C., F.C.C.	Introduction, explanation	3
27	Specification of solids, Einstein theory of specific heat	State, expression and explanation	
28	Debye model of specific heat of solids		
29	Revision		
30	Questions	Explanation , Calculations	

Text Book

Dr. M.S.Sheoran, Jaivir Singh, Amar Singh, Pradeep Ahlawat

Reference Books

Charles Kittel, J.R.Hook & H.E.Hall, James Patterson , Bernard Bailey

Web/Links for e-content

- https://www.bscphysicsnotes.me/2021/05/physics-e-book.html?m=1

PRACTICE QUESTIONS (QUESTION BANK)

Sr. No.	Problem
1	Define and explain Miller indices and write down their important features
2	Draw a diagram of the unit cell for the simple cubic, body centred cubic and face centred cubic lattices.
3	Explain x-ray diffraction and hence deduce an expression for Bragg's law
4	Explain Bravais lattice. Find the number of atoms present in the primitive cell of a diamond.
5	DDeduce an expression for the specific heat of solid according to Einstein theory also discuss its limitations.
6	Discuss the variation of specific heat of solids with temperature.
7	Discuss the Debye theory of specific heat of solids.What are its successes or failures
8	Write a short note on phonons.

Sh. L. N. Hindu College, Rohtak (Haryana)

Course Plan

Department of Mathematics

Real Analysis

SCHEME

Course Name	Real Analysis		Course Type	Theory
Course Code	BM 351		**Class**	B.A. / B .Sc.5thSem.
Instruction Delivery	**Per week Lectures: 4, Tutorial: 1, Practical: Nill** **Total No. Classes Per Sem: (L) 45, (T)15, (P)Nill** **Assessment in Weightage: Sessional (20%), End Term Exams (80%)**			
Course Coordinator	Dr Meenakshi Gugnani	**Course Instructors**	Theory: Dr Meenakshi Gugnani	

COURSE OVERVIEW

Real Analysis course provides a detailed study of the real number system and the foundational concepts of calculus in a rigorous, proof-based manner. The course covers topics such as sequences and series, limits, continuity, differentiation, and Riemann integration. Students explore key theorems like the Intermediate Value Theorem, Mean Value Theorem, and the Fundamental Theorem of Calculus, while learning to construct formal mathematical proofs. The course emphasizes the importance of precise definitions, logical reasoning, and abstract thinking, preparing students for advanced mathematics and related disciplines.

COURSE OBJECTIVE

The objective of an undergraduate Real Analysis course is to develop a rigorous understanding of fundamental concepts like limits, continuity, differentiation, and integration. The course aims to enhance students' mathematical reasoning and proof-writing skills, providing a strong foundation for advanced studies in mathematics. Additionally, it seeks to cultivate critical thinking and problem-solving abilities by engaging students with challenging problems and applications of real analysis in various fields.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

Co No.	
1	**Understanding Core Concepts**: Mastery of real numbers, sequences, series, limits, continuity, differentiability, and integrability.
2	**Proficiency in Proof Techniques**: Ability to construct and apply rigorous mathematical proofs.
3	**Problem-Solving Skills**: Development of skills to solve complex mathematical problems using analysis techniques.
4	**Prepare for Advanced Mathematics**: Students will be equipped to pursue higher-level mathematics courses and research.

COURSE CONTENT

Content
Note: The question paper will consist of-**five** sections. Each of the first four sections(I-IV) will contain two questions(each carrying 4.5 marks for B.A. and 7 marks for B.sc) and the students shall be asked to attempt **one** question from each section. **Section-V** will contain six short answer type questions(each carrying 1.5 marks for B.A. and 2 marks for B.sc) without any internal choice covering the entire syllabus and shall be-**compulsory.** *Section – I* Riemann integral, Integrability of continuous and monotonic functions, The Fundamental theorem of integral calculus. Mean value theorems of integral calculus. *Section – II* Improper integrals and their convergence, Comparison tests, Abel’s and Dirichlet’s tests, Frullani’s integral, Integral as a function of a parameter. Continuity, Differentiability and integrability of an integral of a function of a parameter. *Section – III* Definition and examples of metric spaces, neighborhoods, limit points, interior points, open and closed sets, closure and interior, boundary points, subspace of a metric space, equivalent metrics, Cauchy sequences, completeness, Cantor’s intersection theorem, Baire’s category theorem, contraction Principle *Section – IV* Continuous functions, uniform continuity, compactness for metric spaces, sequential compactness, Bolzano-Weierstrass property, total boundedness, finite intersection property, continuity in relation with compactness, connected-ness, components, continuity in relation with connectedness.

Sh. L. N. Hindu College, Rohtak (Haryana)

Course Plan

LESSON PLAN (THEORY AND TUTORIAL CLASSES)

L No	Topic to be Delivered	Tutorial Plan	No. of Lecture Delivered	Unit
1	Partition, Norm of partition , Refinement of partition & theorems on it , upper sum lower sum and theorems.		2	1
2	Lower Riemann integral , upper Riemann integral and numerical		2	
3	Darboux'x condition of Integer-ability	Revision of theorems	2	
4	Integrebilityof continuous functions and numericals	Practice Questions	2	
5	Properties of Riemann integral and numerical		2	
6	Fundamental theorem of integral calculus and numerical	Revision	2	
7	Revision problems		1	
8	Improper integrals and examples	Practice questions of improper integral	2	2
9	Comparison test and numerical	Revision	3	
10	Absolute convergence and convergence at infinity		2	
11	Abel's and Dirichlet's tests and examples	Practice questions	2	

12	Frullani's integrals and numericals	Practice Questions	2	3
13	Integral as a function of a parameterContinuity and examples of it		2	
14	Differntiabiliy and integer-ability of an integral functions of a parameter and examples on it	Practice questions on Metric Space	1	
15	Definition and examples of metric spaces		1	
16	Nbd , limit points , interior points and eg on it		1	
17	Open and closed sets , closure , boundary points and eg of topic covered theorems	Revision of theorems	1	
18	Adherent point , derived set and theorems , exterior point , equivalent metrics		1	
20	Cantor's intersection theorem	Revision of theorems	1	
21	Baire's category theorem, contraction principle and eg		1	
22	Revision		2	
23	Continuous functions , uniform continuity and theorems	Practice questions of continuous and uniform continuous in metric space	2	4
24	Numerical		1	
25	Compactness in metric spaces, BWP boundedness and FIP theorems		3	
26	Connectedness , continuity in relation with connectedness		3	

27	Continuity and compactness	Practice questions	1	
28	Revision and problems	Revision and problems		

Text Book

Real Analysis :By Jeevansons Publications

References:

1. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985

2. R.R. Goldberg : Real analysis, Oxford & IBH publishing Co., New Delhi, 1970

3. D. Somasundaram and B. Choudhary : A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997

4. Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.

5. R.G. Bartle - D.R. Sherbet, Introduction to Real analysis, John Wiley & Sons.

6. J. E. Marsden- A. J. Tromba- A. Weinstein, Basic multi-variable calculus, Springer.

7. Ajit Kumar & S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.

8. J. Stewart, Calculus, Brooke/Cole Publishing Co, 1994.

Web/Links for e-content

- https://www.google.com/search?q=metric+space&oq=metric+space&gs_lcrp=EgZjaHJvbWUyDAgAEEUYORixAxiABDIHCAEQABiABDIHCAIQABiABDIHCAMQABiABDIHCAQQABiABDIHCAUQLhiABDIHCAYQABiABDIHCAcQABiABDIHCAgQABiABDIHCAkQLhiABNIBCTEzNzQ0ajBqNKgCALACAQ&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:4f77a6b6,vid:yvaFeNLZ9s8,st:0
- https://www.google.com/search?q=convergence+in+metric+space&oq=convergence&gs_lcrp=EgZjaHJvbWUqDQgAEAAYkQIYgAQYigUyDQgAEAAYkQIYgAQYigUyDwgBEEUYORiDARixAxiABDINCAIQABiRAhiABBiKBTINCAMQABiRAhiABBiKBTINCAQQABiRAhiABBiKBTINCAUQABiRAhiABBiKBTIHCAYQABiABDIKCAcQABixAxiABDIHCAgQABiABDIQCAkQABiDARixAxiABBiKBdIBCDUzNTlqMGo3qAIIsAIB&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:815277c0,vid:VXWFgpwzMyk,st:0
- https://www.google.com/search?q=riemann+integral&oq=reimamm+&gs_lcrp=EgZjaHJvbWUqDAgCEAAYDRixAxiABDIGCAAQRRg5MgwIARAAGA0YsQMYgAQyDAgCEAAYDRixAxiABDIJCAMQABgNGIAEMgkIBBAAGA0YgAQyCQgFEAAYDRiABDIJCAYQABgNGI

Sh. L. N. Hindu College, Rohtak (Haryana)

Course Plan

AEMgkIBxAAGA0YgAQyCQgIEAAYDRiABDIPCAkQABgNGIMBGLEDGIAE0gEJMTEx
MTVqMGo3qAIIsAIB&sourceid=chrome&ie=UTF-
8#fpstate=ive&vld=cid:c180ed49,vid:kpNTFEbN_3Q,st:0

As PRACTICE QUESTIONS (QUESTION BANK)

S No	Problem
1	Prove that a continuous function for [a, b] is integrable on [a, b]. Is the converse true? Justify
2	Evaluate$^{\pi/2}/_{0}\,Sinx$ using definition of Riemann Sum
3	Evaluate the values of integral $\int \frac{sinx}{1+x2}$ by using Mean Value theorm
4	Examine the Convergence of $\int_{\circ}^{\infty} \frac{dx}{ex+e-x}$
5	If a>b>o, prove that $\int_{\circ}^{\infty} \frac{e^{-ax}-e^{-bx}}{x} dx = log\frac{b}{a}$
6	$\int_{\circ}^{\infty} \frac{tan^{-1}dx}{x(1+x^2)}\,dx\ if\ \alpha \geq 0$
7	Let (X , d) be a metric space Define d*: X X X – R by d*(x ,y)=min {2,d(x, y)} Show that d*((x ,y) is a metric on X
8	In a metric space, if A C B the A° C B°
9	The usual-metric space (R,d) is complete.
10	Let (X , d*) & (Y , d*) be two metric spaces & Let f:X-Y Then f is continuous iff the inverse image under 'f' of every closed subset of Yis closed subset of X.

11	Prove that every contraction mapping f: (X,d) –(X,d)is uniformly continuous on X.
12	Prove that the usual metric space (R,d) is not compact.
13	If f is a bounded function on [a,b] & P'is a refinement of a partition P of [a,b] then L (f,P') $\geq$ L(f,P) & U (f,P') $\geq$U (f,P)
14	The necessary & sufficient condition for a bounded unction f to be integrable on [a,b] is that to each €>O, there exists a partition P of [a,b] s.t U(f,P)-L(f,P) <€
15	Show that $^{\pi/2}/_{0}$ Sinx log(Sinx) dx is Convergent with the value log $\frac{2}{e}$
16	Prove that $\int_{\circ}^{\infty} \frac{e^{-ax} sinbx}{x} dx = tan^{-}$ b/a and hence deduce that $\int_{\circ}^{\infty} \frac{sinbx}{x} dx = \frac{\pi}{2}$
17	Let X be the set of all real valued bounded functions defined on [a ,b] and let 'd' be a function such that d(f,g) = Sup |f(x) – g(x)|for all f ,g,€X. show that (X, d) is a metric space.
18	In any metric space (X,d), each closed sphere is a closed set.
19	Let (X,d)) &(Y,d) be metric spaces & f be a function of X into Y. Then fis cont at a€X iff to every sequence <an>In X converging to a, the sequence <f (an)> in Yconverges to f(a) i.e an – a implies f(an) – f(a)
20	Show that the function f :[0,1] – R such that f (x) = x^2 is uniformly continuous.

Sh. L. N. Hindu College, Rohtak (Haryana)
Course Plan

Department of Chemistry

Program: B.Sc.(Non medical & Medical)

Physical Chemistry (CH-502)

SCHEME

Course Name	Physical Chemistry	**Course Type**	**Theory**
Course Code	CH-502	**Class**	B.Sc 5th sem
Instruction Delivery	**Per week Lectures: 2,Tutorial -1, Practical: -** **Total No. Classes Per Sem: 72(L), 28(T), -(P)** **Assessment in Weightage: Sessional (20%), End Term Exams (80%)**		
Course Coordinator	Mrs. Ritu	**Course Instructors**	Theory: Mrs. Ritu Practical: --

COURSE OVERVIEW

Physical chemistry is concerned with the quantum mechanics, spectroscopy & molecular structure.

PREREQUISITE

Basics of chemistry, Knowledge of physical chemistry terms.

COURSE OBJECTIVE

The objective of this course is to explore the knowledge of molecular spectroscopy. This course will also provide us knowledge of quantum mechanics & molecular structure.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO No.	Course Outcomes
1	Remember the basic concept of quantum mechanics.
2	Understand the physical properties & molecular structure.
3	Apply the various concepts of spectroscopy.
4	Analyze the application of Vibrational & Raman spectroscopy.

COURSE

CONTENT

Content
Quantum mechanics:- black body radiation, Planck's radiation law ,Photoelectric effect, heat capacity of solids, Compton effect, wave function & significance of postulates of quantum mechanics quantum mechanical operator ,commutation relations ,hamiltonian operator, Hermitian operator average value of square of Hermitian as a positive quantity ,role of operator in Quantum Mechanics, to show Quantum mechanically that position and Momentum can't be predicted simultaneously determination of wave function and energy of a particle in one dimensional box. Physical properties and molecular structure:- optical activity, orientation of dipole in an electric field, dipole moment included dipole moment, measurement of dipole moment- temperature method and refractivity method, dipole moment and structure of molecules ,magnetic permeability, magnetic susceptibility and its determination, application of magnetic susceptibility, magnetic properties -paramagnetism, and ferromagnetism. Spectroscopy:- introduction ,electromagnetic radiation, region of spectrum, basic feature of Spectroscopy, degrees of freedom, Rotational spectrum, selection rule ,energy level of rigid rotator ,rotational spectra of diatomic molecules, spectral intensity distribution using population distribution, determination of Bond length and isotopic effect ,vibrational spectrum selection rules ,energy levels of simple harmonic oscillator, pure vibrational spectrum of diatomic molecules, determination of force and qualitative relation of force and bond energy, Raman spectra of di atomic molecule ,selection rules ,Quantum theory of Raman spectra.

LESSON PLAN (THEORY AND TUTORIAL CLASSES

L. No	Topic to be Delivered	Tutorial Plan	Unit
1	Introduction- electromagnetic radiation ,region of spectrum		1
2	Basic features of spectroscopy		
3	Born Oppenheimer approximation ,degrees of freedom		
4	Rotational spectrum -selection rules, energy levels of rigid rotator		
5	Rotational spectra of diatomic molecules, spectral intensity distribution using population distribution		

6	Determination of Bond length and isotopic effect	Discussion of previous year questions	
7	Vibrational spectrum -selection rules, energy levels of simple harmonic oscillator		2
8	Pure vibrational spectrum of diatomic molecules		
9	Determination of force constant and qualitative relation of force constant and bond energy, idea of vibrational frequency of different functional group		
10	Raman spectrum- concept of polarizibility ,pure rotational Raman spectra	Practice questions on vibrational frequency & force constant	
11	Pure vibrational Raman spectra of diatomic molecules ,selection rules		
12	Quantum theory of Raman spectra		
13	Revision of spectra		
14	Black body radiation, plancks Radiation Law, Photoelectric effect, postulates of quantum mechanics, quantum mechanical operator ,commutation relations		3
15	Hamiltonian operator ,average value of square of hermitian as a positive quantity.		
16	Role of operator in quantum mechanics ,To show Quantum mechanically that position and Momentum can't be predicted simultaneously.		
17	Determination of wave function and energy of a particle in one dimensional box		
18	Optical activity -polarization, clausius Mossotti equation.	Practice of Hamiltonian & Hermitian operator	4
19	Orientation of dipoles in an electric field ,dipole moment, measurement of dipole moment		
20	Temperature method and refractivity method		
21	Dipole moment and structure of molecules, magnetic		

	permeability, magnetic susceptibility and its determination		
22	Applications of magnetic susceptibility and magnetic properties -paramagnetism, diamagnetism and ferromagnetism		

23	Revision of molecular structure and physical properties	Discussion of previous year questions paper		
24	Revision of syllabus			
25	Practice of numericals of quantum			
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Text Book

Modern approach to physical chemistry by S.Kiran kavya"

Physical chemistry by Pardeep publication

Reference Books

- " Fundamentals of molecular spectroscopy by C.N.Banwell".
- "Spectroscopy by H. Kaur"

Web/Links for e-content

- https://youtu.be/NZUnoTR-AL8?si=B7A1Ejd95ZMRKSg3
- https://youtu.be/BVJhfFoYAvk?si=KIc_N3gG5OlxE0wj
- https://youtu.be/kt0PZtoXL4Y?si=x70sf94GlRlw9lEg

PRACTICE QUESTIONS (QUESTION BANK)

S No	Problem
1	State and explain Born oppenheimer approximation.
2	Write note on Population of energy level in rotational spectrum.
3	Discuss force constant and its variation .How it is determined?
4	Discuss vibrational Raman spectrum of the atomic molecules.How P, Q,R branches appear?
5	Discuss planck's radiation law.
6	Explain the terms magnetic permeability & magnetic susceptibility.
7	Define Hermitian operator .Give characteristics of Hermitian operator.
8	Explain concept of particle in one dimensional box.
9	What is dipole moment ? Write its important applications.
10	What is eigen value and eigen function?
11	Discuss the temperature method for the measurement of dipole moment.

12	Explain in detail the rotational spectra of a diatomic molecule.

Sh. L. N. Hindu College, Rohtak (Haryana)
Course Plan (Odd Sem 2024-25)

Department of Mathematics

Program: BA / BSc

Groups and Rings

SCHEME

Course Name	Groups and Rings		Course Type	Theory
Course Code	12BAM352/12BSM352		Class	BA / BSc V Sem.
Instruction Delivery	**Per week Lectures: 4, Tutorial:1** **Total No. Classes Per Sem: 48(L), 12(T)** **Assessment in Weightage: Sessional (20%), End Term Exams (80%)**			
Course Coordinator	Dr. Sunny Kapoor	Course Instructor	Theory: Dr. Sunny Kapoor	

COURSE OVERVIEW

Groups and Rings is the branch of Mathematics which deals with definitions and properties of Groups and Rings as well as their substructure and homomorphism. It has many real life applications including Algebraic Geometry, Cryptography, Coding theory, Computer Vision, Quantum Computing and Mechanics.

PREREQUISITE

Sets, Polynomials, Functions and Relations, Number Theory.

COURSE OBJECTIVE

The objective of this course is to develop a clear understanding of concepts of Groups, Rings, Integral domains and their examples. Student should understand the significance of Unique Factorization in rings and integral domains. They learn to apply theorems such as fundamental theorem of Homomorphism for groups to examples. They are trained in logical thinking and in constructions of mathematical proofs. They will be able to recognize and use algebraic structure in engineering and Science subjects.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO No.	Course Outcomes
1	The students will be able to acquire the basic knowledge of Group, Subgroup,Cyclic group and Normal subgroup and their properties and analyze the consequences of lagranges theorem.
2	The students will understand the concept of Homomorphisms and Automorphisms and they will able to find cycles and transpositions of a given permutations and prove caley's theorem.
3	This course will enable the students to Know the fundamental concepts in ring theory

	such as the concepts of ideals, quotient rings, integral domains, and fields.
4	The students will be able to learn in detail about polynomial rings and irreducibility criterion.

COURSE CONTENT

Content
Section – I Definition of a group with example and simple properties of groups, Subgroups and Subgroup criteria, Generation of groups, cyclic groups, Cosets, Left and right cosets, Index of a sub-group Coset decomposition, Largrage's theorem and its consequences, Normal subgroups, Quotient groups. **Section – II** Homomorphisms, isomophisms, automorphisms and inner automorphisms of a group. Automorphisms of cyclic groups, Permutations groups. Even and odd permutations. Alternating groups, Cayley's theorem, Center of a group and derived group of a group. **Section – III** Introduction to rings, subrings, integral domains and fields, Characteristics of a ring. Ring homomorphisms, ideals (principle, prime and Maximal) and Quotient rings, Field of quotients of an integral domain. **Section – IV** Euclidean rings, Polynomial rings, Polynomials over the rational field, The Eisenstein's criterion, Polynomial rings over commutative rings, Unique factorization domain, R unique factorization domain implies so is R[X1 , X2……Xn]

LESSON PLAN (THEORY AND TUTORIAL CLASSES)

S. No	Topic to be Delivered	Tutorial Plan	No. of Lectures Required	Unit
1	Definition of Groups, Abelian Group, order of a Group & examples based on it	Practice Questions on Groups	2	1
2	General Properties of Groups & Theorems & based Problems		1	

3	Subgroups & based Theorems & Examples		1	
4	Cyclic Groups & based Theorems	Practice Questions on Subgroups & Cyclic Groups	2	
5	Cosets, Theorems & based Examples		1	
6	Normal Subgroups, Theorems & based Examples		2	
7	Quotient Groups, Theorems & based Examples	Practice Theorems on Cosets, Quotient Groups	2	
8	Homomorphism, Isomorphism of Groups, theorems & based Examples		1	2
9	Kernel of Homomorphism & based Theorems		1	
10	Fundamental Theorem of Homomorphism, Second & Third Theorem of Isomorphism & based examples		1	
11	Automorphism of Groups, Group of Automorphism of a Group, Inner Automorphism, Theorems & based Examples	Practice Theorems on Homomorphism and Automorphism	2	
12	Group of Automorphism of a Cyclic Group, Theorems & based Examples		1	
13	Centre of a Group, Characteristic Subgroups, Theorems & based Examples	Practice Examples on Automorphisms of a Cyclic Group	2	
14	Normalizer of an Element, Derived Group, theorems & based Examples		1	
15	Permutation Groups, Cyclic	Practice Examples on Permutation	2	

	Permutations, Disjoint Cycles, Even & Odd Permutations, Theorems & based Examples	Groups		
16	Rings, Types of Ring & based Examples	. Practice Theorems & Examples on Rings and Fields	1	3
17	Rings without or with Zero Divisors, Integral Domain, Division Ring, Field, Theorems & based examples		2	
18	Subring, Centre of a Ring, Characteristic of a ring, Theorems & based Examples	. Practice Theorems & Examples on Subring & Ideal	2	
19	Ideal, sum & product of two ideals, Ideal generated by a set & based theorems		2	
20	Unity Ideal, Zero Ideal, Prime Ideal, maximal & Co-maximal Ideal , Theorems & based Examples		2	
21	Ring Homomorphism, Kernel of a Ring Homomorphism, theorems & based examples	Practice Theorems & Examples on Ring Homomorphism	2	
22	Fundamental Theorem of Homomorphism of Rings, Converse, Ist & IInd Theorem of Isomorphism & based Examples		2	
23	Embedded Ring, Sets of Quotient of a Ring, Field of Quotient of an Integral Domain, Theorem & based Examples	Practice Theorems & Examples on Integral Domain	2	
24	Euclidean Ring Introduction, some important Definitions, Theorems & based Examples		1	4
25	Principal Ideal Domain, Theorems & based Examples	Practice Theorems & Examples on Euclidean Ring & Principal Ideal Domain	2	
26	Polynomial Rings, polynomials over an Integral Domain, Field & based Theorems		2	

27	Divisibility of Polynomials, based Theorems & Examples		2	
28	Unique Factorization Domain, Principal Ideal Domain & based Theorems	Practice Theorems & Examples on Polynomial Rings	2	
29	Eisenstein's Irreducibility Criterian & based Examples		2	

Text Book

Groups and Rings (New College), Jeevansons Publications.

Reference Books

- I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
- P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2nd edition).
- Vivek Sahai and Vikas Bist : Algebra, NKarosa Publishing House.
- I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Norsa Publishing House.
- J.B. Gallian: Abstract Algebra, Narosa Publishing House.

Web/Links for e-content

- https://www.youtube.com/watch?v=newmGKDkZg8&list=PLuOC6MWwpRdrpu7_a32cUt9Zuv_HLE1Y4
- https://www.youtube.com/watch?v=qqcoKJbJAZ4&list=PLo6GH294UqWXm6-PmtGJY03mCIjBW0u5-
- https://www.youtube.com/watch?v=qAqyTZU_Y_A&list=PLrt1YsMQhC9iCUAOJ0IqcZHwYxv84IB6e

PRACTICE QUESTIONS (QUESTION BANK)

S No	Problem
1	Prove that every cyclic group is an abelian group.
2	Define centre of a group.
3	Prove that every field is an Euclidean ring.

4	Define characteristic of a ring.
5	If S is an ideal of a ring R with unity such that 1∈S then show that S=R.
6	Prove that every subgroup of an abelian group is always normal.
7	Prove that an ideal of a ring of integers is maximum iff it is generated by some prime Integers.
8	Let f be a ring isomorphism of R onto R'. Show that if R is an integral domain, then R' is also an integral domain
9	If a group has four elements, then show that it must be abelian.
10	Prove that every subgroup of a cyclic group is cyclic.
11	If an abelian group of order 6 contains an element of order 3, show that it must be a cyclic group.
12	Prove that order of every element of finite group is a divisor of the order of the group.
13	Prove that an element in a principal ideal domain is a prime element iff it is irreducible.
14	Prove that every Euclidean ring is a unique factorization domain.
15	Prove that every finite non-zero integral domain is a field.
16	Prove that every field is a Principal ideal ring.
17	Prove that the orders of the elements α and $x^{-1}ax$ are the same, where a, x are the two elements of a group.
18	Show that the union of two subgroups is a subgroup if and only if one is contained in the other.
19	Prove that the number of generators of a finite cyclic group of order n is $\Phi(n)$, where $\phi(n)$ is the Euler's ϕfunction.
20	Prove that the order of every element of a finite group is a divisor of the order of the group.

21	State and prove second theorem of isomorphism.
22	If G is a finite abelian group of order n and m is a positive integer such that $(m, n) = 1$, then show that $f: G \to G$ defined by $f(x) = x^m$ is an automorphism.
23	Let G be a non-abelian group such that $O(G) = p^3$, where p is a prime. Show that $O(Z(G)) = p$.
24	Find the centre of permutation group S_3.

Sh. L. N. Hindu College, Rohtak (Haryana)
Course Plan (Odd Sem 2024-25)

Department of Mathematics

Program: BA / BSc

Numerical Analysis

SCHEME

Course Name	Numerical Analysis		Course Type	Theory & Practical
Course Code	12 BAM 353/ 12BSM 353		Class	BA / BSc V Sem.
Instruction Delivery	**Per week Lectures: 4, Practical: 2** **Total No. Classes Per Sem: 40(L), 20(P)** **Assessment in Weightage: Sessional (13%), Practical(13%)End Term Exams (74%)**			
Course Coordinator	Dr. Sunny Kapoor	Course Instructor	Theory: Dr. Sunny Kapoor	

COURSE OVERVIEW

Numerical Analysis is the branch of Mathematics which concerns with the development of efficient methods for getting numerical solution to complex mathematical problems. It is used in many fields including engineering, physics, finance and Life Sciences. It is useful when exact solution to a problem is difficult to find. Numerical Analysis also simplifies the conventional method to solve problems like definite integration, solution of differential equations, Interpolation etc. these are basic algorithms underpinning computer predictions in modern system science.

PREREQUISITE

Differentiatial Equations, calculus, Linear Algebra, Programming Language C.

COURSE OBJECTIVE

The primary objective of this course is to develop the basic understanding of numerical algorithms and skills to implement algorihm to solve mathematical problems on the computer. Students understand the numerical methods, learn how to apply numerical methods for solving engineering and mathematical problems. They learn about limitations of analytical methods and need of numerical methods. They learn how to report their analysis, solutions and results in a standard engineering format.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO No.	Course Outcomes
1.	This course will enable students to obtain numerical solutions of algebraic and transcendental equations
2.	Students will be able to find numerical solutions of system of linear equations and check the accuracy of the solutions.

3.	They will learn about various interpolating and extrapolating methods.
4.	It will help them to solve initial and boundary value problems in differential equations using numerical methods.
5.	They will acquire the knowledge how to evaluate approximate numerical value of definite integral using different numerical methods.
6.	Students will be able to apply various numerical methods in real life problems.

COURSE CONTENT

Content
Finite Differences operators and their relations. Finding the missing terms and effect of error in a difference tabular values, Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Interpolation with unequal intervals: Newton's divided difference, Lagrange's Interpolation formulae, Hermite Formula. Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. Probability distribution of random variables, Binomial distribution, Poisson's distribution, Normal distribution: Mean, Variance and Fitting. Numerical Differentiation: Derivative of a function using interpolation formulae as studied in Sections –I & II. Eigen Value Problems: Power method, Jacobi's method, Given's method, House-Holder's method, QR method, Lanczos method. Numerical Integration: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's onethird and three-eighth rule, Chebychev formula, Gauss Quadrature formula. Numerical solution of ordinary differential equations: Single step methods-Picard'smethod. Taylor's series method, Euler's method, Runge-Kutta Methods. Multiple step methods; Predictor-corrector method, Modified Euler's method, Milne-Simpson's method.

LESSON PLAN (THEORY AND PRACTICAL CLASSES)

S. No	Topic to be Delivered	Practical Plan	No. of Lectures Required	Unit
1	Forward and Backward differences	Revision of Basics of C Language	2	1
2	Properties of forward operator and Shift operator	Revision of syntax of C Language	2	

3	Locating Error and finding missing term	Revision of flowchart symbols, Loops, if, if-else statements	2	
4	Newton Gregory Forward Formula Newton Gregory Backward Formula	Revision of c language basics	2	
5	Newton's divided difference Formula	Write a flowchart to demonstrate Newton-forward Interpolation formula	2	
6	Lagrange's interpolation formula Hermite Formula	Writing program to execute Newton forward Interpolation	2	
7	Central Difference Interpolation Formulae: Gauss Forward Formula and Gauss Backward Formula	Write a flowchart to demonstrate Newton-backward Interpolation formula	3	2
8	Central Difference Interpolation Formulae: Sterling formula Bessel's formula	Writing program to execute Newton backward Interpolation	2	
9	Probability distribution of a Random variable	Flowchart to demonstrate Lagrange's Interpolation formula	2	
10	Binomial distribution	Writing program to execute Lagrange's Interpolation formula	1	
11	Poisson distribution	Revision of Previous Programs	2	
12	Normal distribution	Revision of Previous Programs	2	
13	Numerical Integration:Introduction Trapezoidal Rule	Flowchart and program to demonstrate Trapezoidal Rule	1	4
14	Simpson's one third Rule		1	
15	Simpson's three eight Rule		1	
16	Chebychev formula	Flowchart and program to demonstrate Simpson's one-third rule	1	

17	Gauss Quadrature Formula	Flowchart and program to demonstrate Simpson's three-eighth rule	1	
18	Euler's method to solve ordinary differential equation		1	
19	Runge kutta method	Flowchart and program to demonstrate Euler's Method	2	
20	Picard's method	Flowchart to demonstrate Ranga Kutta Method	1	
21	Milne simpson's method		1	
22	Numerical differentiation: Derivation using Interpolation formulas	Program to demonstrate Ranga Kutta Method	2	3
23	Maxima and Minima of a tabulated function		1	
24	Eigen values and vectors	Flowchart to demonstrate Milne Simpson's Method	1	
25	Power method to find largest Eigen value &correspondinf Eigen vector		1	
26	Jacobi's method to find eigen values and eigen vectors	Program to demonstrate Milne Simpson's Method	1	
27	Given's Method to transform matrix to tridiagonal form		1	
28	House Holder's method	Revision of programs	1	

Text Book

Numerical Analysis (New College), Jeevansons Publications.

Reference Books

- Babu Ram: Numerical Methods, Pearson Publication
- R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

- M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, New Age International (P) Ltd., 1996
- M.K. Jain, S.R.K. Iyengar, R.K. Jain : Numerical Method for Scientific and EngineeringComputation, New Age International (P) Ltd., 1999

Web/Links for e-content

- https://youtu.be/oiV7I8xQ4sU?si=IDNWGMxgI6uCurLy
- https://youtu.be/6fnCdwc4XFA?si=MYXp16KIPzewzwPm
- https://youtu.be/aepkRB73YS8?si=AP0SqfgCrZ_yTRTS

PRACTICE QUESTIONS (QUESTION BANK)

S No	Problem
1	State and prove Newton-Gregory Forward interpolation formula.
2	State and prove Newton-Gregory Backward interpolation formula.
3	Use power method to find the largest eigen value of the matrix $A = \begin{bmatrix} 4 & 2 \\ 1 & 3 \end{bmatrix}$ upto five steps only.
4	Using Given's method, reduce the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 1 & -1 \\ 3 & -1 & 1 \end{bmatrix}$ to tri-diagonal form.
5	Derive Trapezoidal rule.
6	State and prove Bessel's formula
7	Evaluate the integral $\int_0^3 (x^2 + 2x)dx$ by using Gauss's quadrature formula.
8	Evaluate : $\int_0^6 \frac{1}{1+x^2} dx$ by using Trapezoidal rule.
9	Evaluate : $\int_0^4 e^x \, dx$ by Simpsom's rule using the data. $e = 2.72, e^2 = 7.39, e^3 = 20.09, e^4 = 54.60$ and compare it with the actual value.
10	Using House-holder's method, reduce the matrix $\begin{bmatrix} 1 & 4 & 3 \\ 4 & 1 & 2 \\ 3 & 2 & 1 \end{bmatrix}$ to tri-diagonal form.

11	Using Jacobi's method, find all the eigen values and eigen vectors of the matrix $\begin{bmatrix} 1 & \sqrt{3} & 4 \\ \sqrt{3} & 5 & \sqrt{3} \\ 4 & \sqrt{3} & 1 \end{bmatrix}$
12	Using Runge-Kutta method, compute $y(0.2)$ and $y(0.4)$ from $$10\frac{dy}{dx} = x^2 + y^2\ , y(0) = 1$$ Using Power method find the largest eigen values and eigen vectors of the matrix $$\begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$
13	Solve the differential equation: $$\frac{dy}{dx} = -xy^2, y = 2 \text{ at } x = o,$$ by modified Euler's method and obtain y at $x = 0.2$ in two steps of 0.1 each.
14	Apply Picard's method upto third approximation to solve $\frac{dy}{dx} = 3e^x + 2y$, where y=0 when x=0
15	The values of the function $f(x)$ for values of x are given as: $$f(1) = 4, f(2) = 5, f(7) = 5, f(8) = 4$$ Find the value of $f(6)$ and also the values of x for which is $f(x)$ maximum or minimum.
16	State and prove Bessel's formula
17	State and prove Gauss Backward formula

Sh. L. N. Hindu College, Rohtak (Haryana)
Course Plan

Department of Physics

Program: B.Sc. (Non - Medical)

(PHY-502)

SCHEME

Course Name	Quantum Mechanics	**Course Type**	**Theory**
Course Code	PHY-502	**Class**	B.Sc. V Sem.
Instruction Delivery	**Per week Lectures: 2, Tutorial:0, Practical: -4** **Total No. Classes Per Sem: 72(L) 24(T), -(P) 48** **Assessment in Weight-age: Sessional (30%), End Term Exams (70%)**		
Course Coordinator	Dr. Savita Devi	**Course Instructors**	Theory: Ms. Jyoti Practical: --Ms. Jyoti

COURSE OVERVIEW

Quantum Mechanics is the study of physics that explains how very small objects can have the characteristics of both waves and particle simultaneously.It's a probabilistic field that emphasizes wave -particle duality and acknowledges that precise predictions and impossible.

PREREQUISITE

Calculus, Linear algebra, and basic of classical mechanics.

COURSE OBJECTIVE

The objective of this course is to learn application of schrodinger wave equation,

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO No.	Course Outcomes
1	To understand how to interpret wave functions and apply operators to them to learn about a particle properties.
2	Learning how to apply quantum mechanics to calculates observables for known wave functions.
3	Learning about different theories of atomic models and quantum numbers.
4	Learning about how classical physics fails at the microscopic level.

Sh. L. N. Hindu College, Rohtak (Haryana)
Course Plan

COURSE CONTENT

Content
Failure of (Classical) E.M Theory of radiation(old quantum theory),Photon, Photoelectric effect and Einstein's photoelectric equation , Compton effect(Theory and Result). Inadequacy of old quantum theory,de Broglie hypothesis. Davison and Germ-er Experiment. G.P Thomson experiment. Phase velocity,Group velocity,Heisenberg uncertainty principle. Time -Energy and angular momentum,position uncertainty. Uncertainty principle from de- broglie wave,(wave particle duality). Gamma ray Microscope,Electron diffraction from a slit. Derivation of time dependent Schrödinger wave equation, Eigen values, Eigen functions,wave functions and its significance .Normalisation of wave function,concept of observable and operator.Solution of Schrödinger equation for harmonic oscillator ground state and excited state. Application of Schrödinger equation in the solution of the following one dimensional problem;Free particle in one dimensional box(solution of Schrödinger wave equation, eigen functions, eigen values , quantization of energy and momentum, nodes, anti nodes and anti nodes , zero potential energy). (i) One dimensional potential barrier $E>V_O$ (Reflection and transmission coefficient) (ii) One dimensional potential barrier ,$E>V_O$ (Reflection Coefficient , penetration coefficient , penetration depth).

LESSON PLAN (THEORY AND TUTORIAL CLASSES)

L. No	Topic to be Delivered	Tutorial Plan	Unit
1	Failure of classical(e.m)theory and quantum theory of radiation(old quantum theory) And inadequacy of old quantum theory	Explanation	1
2	Photoelectric effect and Einstein photoelectric equation.	Derivation and Diagram explanation	
3	Compton effect	Theory,derivation , Result	

4	Davison and Germ-er experiment	Diagram explanation,Theory ,derivation	
5	GP THOMSON experiment	Diagram explanation,Theory ,derivation	

6	Phase velocity and group velocity	Explanation and derivation	
7	Heisenberg Uncertainty Principle	Explanation	2
8	Time energy and Angular momentum.	Theory Derivation and Theory	
9	Uncertainty principle from debroglie wave (wave particle duality)		
10	Gamma ray microscope	Explanation ,Expression	
11	Electron diffraction from a slit	Explanation, Derivation	
12	Derivation of time dependent Schrondier wave equation	Derivation	3
13	Eigen values ,eigen functions,	Explanation	
14	Wave function and its significance	Theory	
15	Normalisation of wave function	Theory and Explanation	
16	Concept of observable and operator	State and Explanation	
17	Solution of Schrondinger equation for harmonic oscillator ground states and excited state	Theory and Derivation	
18	Revision	Practice the questions on Schroedinger equations	
19	Application of Schrödinger equation in the solution of the following one dimensional problems	Theory	4
20	Free particle in one	Theory and Derivation	

	dimensional box(solution of schrodinger wave equation)		
21	Eigen values,Eigen function	Explanation	
22	Quantisation of energy and momentum,	Theory and explanation	

23	Nodes and Antinodes	Derivation	
24	Zero point energy		
25	One dimensional potential barrier E>V_0 (Reflection and Transmission cofficient)	Theory and Derivation	
26	One dimensional potential barrier E>V_0 (Reflection cofficient ,Penetration of leakage cofficient ,Penettration depth		
27	Revision		
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Text Book

Quantum Mechanics by Dr. J.M.Sehgal

Quantum Mechanics by Dr. S.K. Bansal

Reference Books

- “. Quantum Mechanics Prentice Hall,1951
- Quantum Mechanics by W.A Benjamin In,1964

Web/Links for e-content

- https://youtu.be/ZHAqd4FzdpE?si=Gou822L8Mg-j8ud-

  https://youtu.be/p9Oux5hS_xU?si=rmh4oJ9q2yxgcYuk

  https://youtu.be/mvI9Whpq5ao?si=BHCI_wQGBTfcleU-

PRACTICE QUESTIONS (QUESTION BANK)

Sh. L. N. Hindu College, Rohtak (Haryana)
Course Plan

S No	Problem
1	Write short note on (i) Old Quantum Theory. (ii) Gamma Ray Microscope
2	Derive phase and group velocity and derive equation for their derivation.
3	What is Photoelectric effect? Derive Einstein Photoelectric equation ?
4	Calculate de broglie wavelength of neutron of energy 28.8 eV.
5	Write limitations of old quantum theory.
6	State laws of Photoelectric equation.
7	Derive Schrödinger wave equation for linear harmonic oscillator and find expression for the energy level of oscillator?
8	Derive both time independent and time dependent Schrödinger equation for non -relativistic free particle.
9	An electron is confined to a box of length 10^{-8} m.Calculate minimum uncertainty in its velocity.
10	Define eigen values and eigen functions?
11	Write short note on Orthogonality of wave functions?
12	What do you mean by Potential barrier?
13	Solve Schrodinger's wave equation for a particle in one dimension potential barrier when $E>V_O$ .Calculate Transmission and reflection co efficient.
14	Explain nodes and anti nodes?
15	Find the values of momentum for an electron in one dimensional box of length 0.5 A^O . for the first three levels.
16	What is operator ? Explain with examples.
17	Explain the terms Probability current density?

18.	Calculate Reflection and Transmission coefficient of a particle through a one dimensional rectangular potential barrier?
19	Explain significance of wave function?
20	Define Quantum Mechanical Tunnelling?
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