

**Detailed Course Scheme**  
**Bachelor of Science (B. Sc.)**  
**(Physics, Chemistry & Mathematics)**

**Semester -IV**  
**(2020-2021)**

DOC202002260005



**RNB GLOBAL UNIVERSITY**

RNB Global City, Ganganagar Road,  
Bikaner, Rajasthan 334601

## **OVERVIEW**

RNB Global University follows Semester System along with Choice Based Credit System as per latest guidelines of University Grants Commission (UGC). Accordingly, each academic year is divided into two semesters, **Odd (July-December)** and **Even (January-June)**. Also, the university follows a system of continuous evaluation along with regular updating in course curricula and teaching pedagogy.

The curriculum for B. Sc. (PCM) Program along with examination pattern is as follows.

### **Course Scheme**

#### **Semester – IV**

S. No.	Course Code	Course Name	L	T	P	Credits
1.	13001800	Waves and Optics	4	0	0	4
2.	13001900	Waves and Optics Lab	0	0	4	2
3.	13002000	Chemistry-IV	4	0	0	4
4.	13002100	Chemistry-IV Lab	0	0	4	2
5.	13002200	Algebra	5	1	0	6
6.	13003000	Ability & Skill Enhancement - IV	2	0	0	2
7.	13014500	Renewable Energy and Energy Harvesting	2	0	0	2
8.	99002800	Workshops & Seminars	-	-	-	1
9.	99002700	Human Values & Social Service/NCC/NSS	-	-	-	1
<b>Total</b>			<b>17</b>	<b>1</b>	<b>8</b>	<b>24</b>

### **EVALUATION SCHEME -THEORY**

The evaluation of the theory paper of B.Sc. program would be based on Internal and External Assessments. Internal Assessment would consist of 50% of the marks (50 marks) and external assessment (in form of End Term Exam) would consist of remaining 50% marks (50 marks). Detailed scheme of Internal and External Assessments as follows:

#### **Internal Assessment**

The distribution of Internal Assessment Marks is as follows:

Type	Details	Marks
Mid Term	Two Mid-term Sessional of 15 marks each (15+15)	30
Marks obtained in various Tests, Assignments, Presentations, Quiz, Tutorials, etc.	Average of marks obtained	15
Attendance	75%+ : 5 marks	5
<b>TOTAL</b>	<b>50</b>	

### **External Assessment**

Type	Marks
Theory	50

### **EVALUATION SCHEME -PRACTICAL**

The evaluation of the practical paper of B.Sc. program would be based on Internal and External Assessments. Internal Assessment would consist of 50% of the marks (50 marks) and external assessment (in form of End Term Exam) would consist of remaining 50% marks (50 marks). Detailed scheme of Internal and External Assessment is as follows:

### **Internal Assessment**

Type	Details	Marks
Marks obtained in various manuals, practical file, participation, any model prepared, output of practical	Average of marks obtained	45
Attendance	75%+ : 5 marks	5
<b>TOTAL</b>	<b>50</b>	

### **External Assessment**

Type	Marks
Practical	50

### **EVALUATION SCHEME- WORKSHOPS & SEMINARS AND HUMAN VALUES & SOCIAL SERVICE/NCC/NSS**

1. The evaluation of Workshops & Seminar and Human Values & Social Service/NCC/NSS will be completed from Semester I – Semester VI. It will be evaluated internally by the various Forums & Schools Concerned. The credit for this will be given at the end of each Semester.
2. The students have to join club/clubs/Forums with the active participation in different activities of club. The students would be continuously assessed from Semester-I to Semester-IV and credits and marks would be given after the end of each Semester.

### **SUMMER INTERNSHIP**

Internships are taken after the end of the 4<sup>th</sup> semester for a period of 4-5 weeks. It carries 4 credits & the student needs to submit their Summer Internship Report in the 5<sup>th</sup> semester. For the ease of students understanding, Summer internship is evaluated for a total of 150 marks for Weekly Reports, Project report, Presentation & Viva Voce & later converted into grade & grade points as per the University Examination Policy.

### **CURRICULUM**

**Course Name: Waves and Optics**

**Course Code: 13001800**

#### **Objectives:**

1. To aware the students about various phenomenon of waves and optics.
2. To solve many types of problems involving wave motion.
3. The understand the phenomenon like Interference, Diffraction through practice mode.

In this subject students will learn through lectures, assignments, webinars and seminars about Superposition of Two Collinear Harmonic oscillations, Superposition of Two Perpendicular Harmonic Oscillations, Waves Motion, Fluids: Surface Tension, Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem, Electromagnetic nature of light, Interference, Michelson's Interferometer, Fraunhofer diffraction: Single slit; Double Slit and Polarization.

### **Course Outline:**

#### **Unit I**

Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).

Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their uses.

#### **Unit II**

Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

#### **Unit III: Fluids**

Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaeger's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Physics of low pressure - production and measurement of low pressure - Rotary pump - Diffusion pump - Molecular pump - Knudsen absolute gauge - penning and piraniga pump - Molecular pump - Knudsen absolute gauge - penning and pirani gauge - Detection of leakage.

#### **Unit IV: Sound**

Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

#### **Unit V: Wave Optics**

Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

#### **Unit VI: Interference**

Division of amplitude and division of wave front. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in

Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.

### **Unit VII**

Michelson's Interferometer: Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes.

### **Unit VIII: Diffraction**

Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

### **Unit IX: Polarization**

Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

### **Suggested Readings:**

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill.
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing.
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication.
4. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley.

## **Course name: Waves and Optics Lab**

**Course Code: 13001900**

### **Course Outline**

1. To investigate the motion of coupled oscillators.
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify  $\lambda^2 - T$  Law.
3. To study Lissajous Figures.
4. Familiarization with Schuster's focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a given Prism using Mercury Light.
8. To determine the value of Cauchy Constants of a material of a prism.

9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating.
14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photo sensor and laser in diffraction patterns of single and double slits.

## **Course Name: Chemistry- IV**

### **Course Code: 13002000**

#### **Objectives:**

To facilitate the student with graduate level Inorganic and Physical Chemistry Concepts. Students will learn about transition elements, coordination chemistry, Crystal field theory etc. Also, in Physical chemistry students will learn chemistry of Solids, Liquids, Gases and Chemical Kinetics.

#### **Course Outline:**

##### **Unit I: Transition Elements (3d series)**

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

##### **Unit II: Coordination Chemistry**

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature.

##### **Unit III: Crystal Field Theory**

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

#### **Unit IV: Kinetic Theory of Gases**

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO<sub>2</sub>. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

#### **Unit V: Liquids**

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

#### **Unit VI: Solids:**

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

#### **Unit VII: Chemical Kinetics:**

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

#### **Suggested Readings:**

1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
5. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).



6. Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
7. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
8. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
9. Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.

## **Course Name: Chemistry-IV Lab**

### **Course Code: 13002100**

#### **Objectives:**

To facilitate the students about practical aspects of undergraduate Inorganic and Physical Chemistry. Students will be versed with qualitative salt analysis, water analysis, kinetics, surface tension and viscosity of liquids as well as gravimetric analysis.

#### **Course Outline:**

##### **Section A: Inorganic Chemistry**

Semi-micro qualitative analysis (using H<sub>2</sub>S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following: Cations : NH<sub>4</sub><sup>+</sup>, Pb<sup>2+</sup>, Bi<sup>3+</sup>, Cu<sup>2+</sup>, Cd<sup>2+</sup>, Fe<sup>3+</sup>, Al<sup>3+</sup>, Co<sup>2+</sup>, Ni<sup>2+</sup>, Mn<sup>2+</sup>, Zn<sup>2+</sup>, Ba<sup>2+</sup>, Sr<sup>2+</sup>, Ca<sup>2+</sup>, K<sup>+</sup> Anions : CO<sub>3</sub><sup>2-</sup>, S<sup>2-</sup>, SO<sub>3</sub><sup>2-</sup>, S<sub>2</sub>O<sub>3</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>2</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, BO<sub>3</sub><sup>3-</sup>, C<sub>2</sub>O<sub>4</sub><sup>2-</sup>, F<sup>-</sup> (Spot tests should be carried out wherever feasible)

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximate)nickel(II) or aluminium as oximate in a given solution gravimetrically.
2. Estimation of (i) Mg<sup>2+</sup> or (ii) Zn<sup>2+</sup> by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.

##### **Section B: Physical Chemistry**

- (I) Surface tension measurement (use of organic solvents excluded). a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer. b) Study of the variation of surface tension of a detergent solution with concentration.
- (II) Viscosity measurement (use of organic solvents excluded)
  - a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

- b) Study of the variation of viscosity of an aqueous solution with concentration of solute.  
(III) Chemical Kinetics Study the kinetics of the following reactions. 1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method: a. Acid hydrolysis of methyl acetate with hydrochloric acid. b. Saponification of ethyl acetate. c. Compare the strengths of HCl and H<sub>2</sub>SO<sub>4</sub> by studying kinetics of hydrolysis of methyl acetate.

**Course Name: Algebra**

**Course Code: 13002200**

**Objectives:**

In its most general form, algebra is the study of mathematical symbols and the rules for manipulating these symbols; it is a unifying thread of almost all of mathematics. As such, it includes everything from elementary equation solving to the study of abstractions such as groups, rings, and fields.

**Course Outline:**

**Unit I**

Definition and examples of groups, examples of abelian and non-abelian groups, the group  $Z_n$  of integers under addition modulo  $n$  and the group  $U(n)$  of units under multiplication modulo  $n$ . Cyclic groups from number systems, complex roots of unity, circle group, the general linear group  $GL_n(n, R)$ , groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group  $Sym(n)$ , Group of quaternions.

**Unit II**

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

**Unit III**

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems,  $Z_n$  the ring of integers modulo  $n$ , ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions.

**Unit IV**

Subrings and ideals, Integral domains and fields, examples of fields:  $Z_p$ ,  $Q$ ,  $R$ , and  $C$ . Field of rational functions.

## **Suggested Readings**

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
4. George E Andrews, Number Theory, Hindustan Publishing Corporation, 1984.

## **Course Name: Renewable Energy and Energy Harvesting**

**Course Code: 13014500**

### **Course Outline**

#### **Unit I: Fossil fuels and Alternate Sources of energy**

Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, bio gas generation, geothermal energy tidal energy, Hydroelectricity.

**Solar energy: Solar energy**, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

#### **Unit II: Wind Energy harvesting: Fundamentals of Wind energy**

Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and gridinter connection topologies.

**Ocean Energy:** Ocean Energy Potential against Wind and Solar, Wave Characteristic sand Statistics, Wave Energy Devices.

**Tide characteristics and Statistics**, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

#### **Unit III: Geothermal Energy**

Geothermal Resources, Geothermal Technologies.

**Hydro Energy:** Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

**Piezoelectric Energy harvesting:** Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.

#### **Unit IV: Electromagnetic Energy Harvesting**

Linear generators, physics mathematical models, recent applications

**Carbon captured technologies**, cell, batteries, power consumption. Environmental issues and Renewable sources of energy, sustainability.

#### **Demonstrations and Experiments**

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

#### **Suggested Readings:**

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

### **Course Name: Ability & Skill Enhancement - IV**

**Course Code: 13003000**

#### **Course Outline - Final Assessment – Mock Interviews & PI Kit Submission**

##### **Unit I: Tele – Etiquettes**

Receiving Calls, Placing a call, Ending Calls, Transferring calls, Taking Message/ Voice Mails, Placing call on hold, Handling Complaints.

##### **Unit II : Confidence Building & Brain Storming**

How to build confidence by positive thinking, identifying negative thoughts, how to control negative thoughts entering our mind, identifying personal talents, and its ways to improve, how to develop good habits and having principles and follow them at all times.

Need to learn new things, ideas and skills, what is brain storming, why do we need it, what are the different ways of brain storming through logics and reasoning, Brain Storming Session.

##### **Unit III : PI Kit**

What is resume, Format of Resume, Formatting, Resume Preparation, Covering Letter, PI Kit.

##### **Unit IV : Interview Skills**

Mastering the art of giving interviews in - selection or placement interviews, web /video conferencing, Mock Interview, HR Expert Mock Interview, Telephonic Interviews.

**Unit V: Internship Preparation: Company Specific Research and Presentation**  
Identifying domain specific industries, researching the industry, Industry analysis,  
Presentation on specific industry/company.

**Note:** The review of Syllabus happens on periodic basis for the benefit of the students. In case there are changes in curriculum due to review, students would be intimated in writing.

----- **End of document**-----