SCHEME & SYLLABUS

B. Sc. Physical Sciences/ Discipline Specific

(3/4 years Honours or Honours with Research)

Four Year Under-Graduate (FYUG) Programme as per NEP

Choice Based Credit System Semester Scheme with Multiple Entry and Exit Options

Programe Code: UG045

(Academic Session 2024-25 onwards)

Department of Physical Sciences

(UIS)

Sant Baba Bhag Singh University

2024

About the Department:

Department of Natural Sciences established in the year 2015, transformed itself into the Department of Physical Sciences under University Institute of Sciences & Humanities in year 2018. Department is actively involved in teaching and research. It offers various programmes and courses at the undergraduate (UG), post-graduate (PG) and doctorate levels in discipline of Physics, Chemistry and Mathematics. Department of Physical Sciences is dynamic and progressive in its development of new course initiatives and to contribute substantially to the goal of SBBSU and becoming a research oriented department. The teaching is by way of interactive sessions between students and teachers. Our courses ensure a coherent degree structure while encouraging interdisciplinary approach. The Department provides a comprehensive curriculum at undergraduate and postgraduate levels with teaching- learning adjunct to cater the need of industry, relevant research and career opportunities in academics.

Salient Features:

- At SBBS University the focus of Department of Physical Sciences is on conducting innovative teaching, fundamental multidisciplinary research in Physical Sciences.
- The Department has highly qualified, young and dynamic faculty in various fields of Physical Sciences.
- The thrust area in **Chemistry** include Green Chemistry, Polymer Chemistry, Advanced controlled drug delivery systems, Nanocomposites, Physiochemical studies of biomolecules etc.
- The thrust area in **Physics** includes Materials Physics, Nuclear Physics, Nanomaterials and their applications.
- The research area in **Mathematics** includes Numerical Analysis, Wavelet methods, qualitative behaviour of dynamical systems, Mathematical modelling via differential equations.
- The Department has well equipped laboratories with a number of instrumental facilities such as muffle furnance, digital water bath, polarimeter, ultrasonic interferometer, ballistic galvanometer**,** deflection and vibration magnetometer**,** ESR, Four Probe Apparatus, Michelson Interferometer apparatus, Hall Effect Apparatus, Planck Constant Apparatus, turbiditimeter, Abbs refractrometer, centrifuge, digital weighing balance/ spring balance, magnetic plate with stirrer, pH meter, conductometer, flame photometer, colorimeter etc.

- Student centric, ICT enabled and interactive teaching is adopted. Outcome based teaching model comprising of theoretical work, regular academic activities such as research projects, seminars, resource learning and hands-on laboratory work have been conducted regularly.

- The department has organized a large number of conferences, seminars, symposia and workshops. National and International eminent scientists of the country have been associated with the Department as visiting and honorary professors.

- Curricular and the co-curricular activities are well balanced in the Teaching Learning environment to provide holistic education to the students.

- The outcome based teaching model of faculty comprising of theoretical work, regular academic activities such as research projects, seminars, resource learning and hands-on laboratory work.

Vision:

- To aspire, achieve and sustain for excellence in academics and research through scientific knowledge so as to provide solutions to global environmental issues and transform graduates into responsible citizens and competent professionals.

Mission:

- Holistic development of learner through academic excellence, acquisition of analytical skills and research.
- To explore new frontiers in Physical Sciences and integration with interdisciplinary sciences through visionary research for the benefit of society
- To develop graduates for lifelong learning and professional growth.

ABOUT THE PROGRAMME

B. Sc. (Honours/ Honours with Research)
[Four Year Under-Graduate (FYUG) Programme as per NEP]

B. Sc. (Honours/ Honours with Research) is a 4 year Under-Graduate (FYUG) Programme as per NEP which is Choice Based Credit System Semester Scheme with Multiple Entry and Exit Options in the Undergraduate and Post-graduate Degree Programmes. This course is fundamentally based on the basic principles of scientific studies namely Physics, Chemistry and Mathematics for the synthesis, analysis and instrumentation. Knowledge of these basic subjects is essential for thorough understanding of the concepts and applications of Physics, Chemistry and Mathematics which will help students to understand the fundamentals laws of nature which are essential in understanding the principles of the technology.

ELIGIBILITY CRITERIA

10+2 (Non Medical) equivalent with Physics, Chemistry & Mathematics as major subjects with 50% marks (45% marks in case of **SC**/ST candidates) in aggregate or equivalent grade.

DURATION

4 Years

CAREER PATHWAYS

The program is designed to meet the growing requirement of qualified professionals in field of IT industry and education. B.Sc. graduates are hired both by Government and private organizations. They may join Post Graduation Courses further.

- **Government Jobs:** Prepare students for various government jobs such as banking sector, civil services etc.
- **Higher Studies:** This pathway prepares students for Higher Studies and helps in their research also.
- **Entrepreneurship:** To set up new ventures.

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

PEO1: To impart quality education in basic physical sciences to achieve excellence in teaching-learning and Graduates will pursue higher studies in related fields.
PEO2: To provide hand on training which enable graduates to get employed in private/government institutions.
PEO3: To construct a bridge between the theoretical and practical aspects of Physical Sciences & inculcate entrepreneur skills.
PEO4: To equip the learners to apply knowledge of Physical Sciences and to analyze the local and global impact of chemistry on individuals, organizations, and society.

PROGRAMME OUTCOMES (PO)

PO1. Disciplinary Knowledge: Students will be able to understand specialised areas and explain major concepts in the Physical sciences and its applications.
PO2: Critical Thinking: Critical thinking as an attribute enables a student to identify, formulate and analyse a complex variety of problems in Physical Sciences (Physics, Chemistry & Mathematics).
PO3: Problem Solving: The student will be well-equipped to solve complex problems related to Physics/ Chemistry & Mathematics that are best approached with critical thinking.
PO4: Practical skills: Student will be able to demonstrate the ability to read, understand, and critically review scientific information.
PO5: Modern Tool Usage: Graduates will be able to use modern tools of analysis and use computers in laboratory works and data analysis.
PO6: Multicultural Competence: Graduates will learn multicultural sensitivity about societal, health, safety, legal and cultural issues through various activities and able to integrate multicultural awareness regarding race, gender, physical ability, age, income and other social variables and create an environment that is, " welcoming for all students"
PO7: Environment & Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8 Research related skills & Ethics: Students will be able to motivate and communicate scientific knowledge in oral and written form accurately using a range of formats.
PO9: Self-directed Learning: Students are encouraged to accept challenges in Physical Sciences by information available to them. Various activities/advanced ideas equip the students to find relevant information and educate themselves.
PO10: Individual and Team Work: Acquire the ability to function effectively as a team to accomplish common goals in classroom learning, laboratory as well as in other diverse fields. The student will be capable of contributing meaningfully to team ethos and goals.

PO11: Communication Skills: Students will be able to communicate effectively about scientific and technical information of basic sciences from various sources and convey it to intended audience, both orally and in writing in an intelligible manner.
PO12: Life long Learning: With strong conceptual framework in the subject along with the skills of teamwork, analytical reasoning, problem solving, critical thinking etc. make the students lifelong learners.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Acquire knowledge and understanding of essential facts, concepts, principles and theories of physics, chemistry and Mathematics
PSO2: Develop Skills to evaluate, analyze and interpret information and data.
PSO3: Solve problems competently by identifying the essential parts of a problem and formulating a strategy for solving the problem.
PSO4: • Use standard laboratory equipments, modern instrumentation and classical techniques to carry out experiments and develop skills to interpret and explain the limits of accuracy of experimental data in terms of significance and underlying theory.

PS5: • Think creatively (divergently and convergently) to propose novel ideas in explaining facts and figures or providing new solution to the problems.

Salient Features of the Four Years Multidisciplinary Undergraduate Programmes with Multiple Entry and Exit Options (Four-Year Choice Based Credit System Semester Scheme)

1. The Undergraduate (UG) degree programmes of either 3 or 4-year duration, shall be structured in a semester mode with multiple exit options with the followings with multiple entry and exit points and re-entry options, with appropriate certifications such as:

a) Certification (UG Certificate) at the completion of first year (1 year = 2 semesters)

b) Diploma (UG Diploma) at the completion of second year (2 years = 4 semesters)

c) Bachelor's Degree at the completion of third year (3 years = 6 semesters)

2. The candidate who completes the four years Undergraduate Program, either in one stretch or through multiple exits and re-entries (within the stipulated maximum period of seven years) would get a Bachelor's degree with Honours or Research. For example:

a) Bachelor's Degree (Honours) at the completion of fourth year (4 years = 8 semesters)

b) Bachelor's Degree (Honours with Research) at the completion of fourth year (4 years = 8 semesters)

3. The four years undergraduate Honours degree holders with a research component and a suitable grade are eligible to enter the

- Ph.D. (Doctoral) Programme in a relevant discipline or
- Two Semester Master's Degree programme with project/research work

4. Candidates who wish to enter the master's/doctoral programme in a discipline other than the major discipline studied at the undergraduate programmes, have to take additional courses in the new discipline to meet the requirement or to make up thegap between the requirement and the courses already studied.

5. There may be parallel five years integrated master's degree programmes with exit options at the completion of third and fourth years, with the undergraduate degree andundergraduate degree with honours in a discipline, respectively.

6. There may also be an integrated doctoral programme with an exit option at the end of the first year with the Master's degree.

7. The students who exit with Certification, Diploma and Basic Bachelor Degree shallbe eligible to re-enter the programme at the exit level to complete the programme or to complete the next level.

8. The areas of specialization which the students are required to choose are either two disciplines/ subjects or a discipline called **'major course'**. Students gain deep disciplinary knowledge through theory and practical experiences in their area of specialization (major). Students should secure the prescribed number of credits (about 50% of total credits) through core courses in the major discipline.

9. The areas of additional discipline which the students are required to choose are called **'minor course'**. Students gain a reasonable understanding of the area of additional study (minor) that they choose.

10. The students may study two disciplines at the same level or breadth up to the sixth semester and choose one of them for study in the fourth year to obtain **the Honours degree in that discipline**. A student who wishes to get **dual honours degrees** may repeat the fourth year of the program in the second discipline.

11. The students may choose one discipline and vocational subject or Teacher Education for their study in the undergraduate program. This will enable them to get an Honours degree either in the discipline or in the vocational subject/ Teacher Education or both,in the discipline and in the vocational subject/ Teacher Education.

12. Students shall be given options to choose courses from a basket of courses being offering.

CURRICULUM STRUCTURE AS PER NEP

B. Sc. (Honours/ Honours with Research) degree programme will have a curriculumwith Syllabi consisting of following type of courses:

Under Graduate (UG) Degree of 3 or 4 (FYUGP – Honours/ Honours with Research) years:

1. **Discipline Specific Core (DSC):** Discipline Specific Core (DSC) is a course of study which is to be pursued by a student as a mandatory requirement of his/her study. The DSCs specified in the framework would be identified by the concerned Department as core courses to be taught in a program. DSC is also known as Major discipline and subject of main focus and the degree will be awarded in that discipline. Students should secure the prescribed number of credits (50% of total credits) through core courses in the major discipline.

   For example, for the award of single discipline specific Honours Degree, such as BA (Honours) History, B.Com (Honours), B.Sc. (Honours) Physics and similar such programs, DSCs shall be the core courses of History, Commerce and Physics respectively.

   However, to pursue Honours Degree Program in a 'Field of Multidisciplinary Courses of study' (rather than a single discipline) such as B.Sc. (Honours) Life Sciences, BA (Honours) Social Sciences/ Humanities, the DSCs shall comprise of core credit courses of more than one discipline. For example, for B.Sc. (Honours) Life Sciences program, a student shall study credit courses of three disciplines i.e., Botany, Zoology and Chemistry. DSC may be of Discipline *viz*., Botany, Zoology and Chemistry. However, the fourth year of such Honours and Honours with Research Degree program shall be devoted to the study of only one discipline. Hence, the DSC courses in the VII and VIII semesters shall be of discipline Botany or Zoology or Chemistry, and not a combination of three disciplines.
2. **Discipline Specific Elective (DSE):** Discipline Specific Elective (DSE) shall be from a pool of credit courses of that particular discipline (single discipline program of study) or those disciplines (multidisciplinary program of study) as the case may be, which a student chooses to study from his/ her particular discipline(s) and framework of DSEs is to be decided by the concerned department.

   For example, to pursue B.Sc. (Honours) Physics, DSEs chosen should be from a pool of DSEs of Physics. Similarly to pursue B.Sc. (Honours) Life Sciences program, the DSEs chosen should be a pool of courses of DSEs of Botany, Zoology and Chemistry, the core subjects for program of study.
3. **Generic Elective (GE)**: Generic Electives shall a pool of courses, which is meant to provide multidisciplinary or interdisciplinary education to students. GEs shall consist of a pool of courses offered by various disciplines of study (excluding the GEs offered by the parent discipline and unrelated to DSC). In case, a student opts for DSEs beyond his/her discipline specific course(s) of study, such DSEs shall be treated as GEs for that student. It can be stated Open Elective (OE) as well.
4. **Multidisciplinary Courses (MDC)**: Student has to go through **3 introductory level courses related to multi-disciplines of 9 credits** and student has to make the choice of the different disciplines in three different semesters.
5. **Ability Enhancement Courses (AEC):** AEC of 8 credits and will be related to languages (Modern Indian Language and English) and in two years (in first four semesters), student will do the course of 2 credits in each semester.
6. **Skills Enhancement Courses (SEC):** SEC of 9 credits will impart practical training and skills, hands-on training, soft skills to enhance the employability of the students. The courses may be designed as per the needs of the students and the resources of the university.
7. **Value Added Courses (VAC)**: VAC of 6 credits will be offered in first two semesters. VAC will be the courses beyond the curriculum domain and is to enhance the personality.
8. **Physical Training (PT):** In this University, in first four semesters, non-credit PT courses of 2 contact hours a week (namely PT-I, PT-II, PT-III and PT-IV) will be offered from bucket of NCC, NSS, NSO, Co-curricular (Literary or Cultural) activities.

Name of Programme: B.Sc. Physical Sciences/Discipline Specific (3/4 years Honours or Honours with research)

Eligibility: In addition to other eligibility criteria, students who have successfully completed Grade 12 School Leaving Certificate shall be eligible for admission to a first degree program.

Nomenclature of Degree/Programme: The Under Graduate Degree will be either of 3/4 year duration, with multiple exit options within this period, with appropriate certifications.

I. **UG Certificate** after completing 1 year in a discipline or field including vocational and professional areas with minimum 40 credits in two semesters and also, to do another vocational course having theory and practical of 4 credits during summer term or internship/apprenticeship (**from 1st June to 30th July) of the first year,** in addition to 6 credits from skill based courses earned during first and second semester as required in first year (if already earned 3 credits from second semester then another 3 credits to be earned: with a total 6 credits to be completed from skill based courses during the summer term).

II. **UG Diploma** after 2 years of study with required credits and complete one vocational course of 4 credits during the summer vocation of the second year.

*****In case, student wants to make exit after 1st and 2nd year for **UG Certificate** (minimum 40 credits) or **UG Diploma** minimum 80 Credits) after two years, he will communicate the University by 31st March by filling the required Proforma, so that necessary arrangement for doing vocational course and pending skill based course if any, could be made in advance, otherwise the University will not be responsible for the required exit. Internship/Apprenticeships may be carried out in a local firm, local industry or organization or Training in Labs with faculty and researchers in their own or other HEI/research institutions, health allied areas, local governments (such as Panchayats, Municipalities, Parliament or elected representatives, media organizations or any other enterprise), in which students may be engaged with the practical side of the training to help them in employability. These students are allowed to re-enter the degree program within three years and complete the degree program within the stipulated maximum period of seven years.

2. NOMENCLATURE USED:

A. Major Courses:

- Discipline Specific Core (DSC)
- Discipline Specific Elective (DSE)

Theory subject (T)
Practical (P)

- Minor Courses

i. Ability Enhancement Courses (AEC)
ii. Skill Enhancement Courses (SEC)
iii. Value added Courses (VAC)
iv. Multi disciplinary Courses (MDC)
v. Generic Elective (GE)
vi. Physical Training (PT)

Course Scheme for B. Sc. Physical Sciences/Discipline Specific
(3/4 years Honours and Honours with Research)
Semester I

I. Theory Subjects

S No.	Course Type	Course Sub-Category	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	Major/Minor	DSC-I	PHY161	Physics I: Mechanics	4:0:0	4:0:0	4	4
2	Major/Minor	DSC-II	CHM161	Chemistry I : Fundamentals of Chemistry	4:0:0	4:0:0	4	4
3	Major/Minor	DSC-III	MAT161	Mathematics I: Calculus	3:1:0	3:1:0	4	4
4	MDC I	MDC-I	MDC074	Multidisciplinary Course-I Artificial Intelligence: Basics	3:0:0	3:0:0	**3**	3
5	AEC I	AEC-I	AEC0010	Ability Enhancement Course-I (Communication Skills in English-I)	2:0:0	2:0:0	2	2
6	VAC-1	VAC-I	VAC036	Value Added Course-I Indian Knowledge System (IKS): Concepts and Applications in Sciences	3:0:0	3:0:0	**3**	3

II. Practical Subjects

1	Major/Minor	DSC	PHY163	Physics I: Mechanics(Practical)	0:0:2	0:0:1	2	1
2	Major/Minor	**DSC**	CHM163	Chemistry I : Chemical Analysis I (Practical)	0:0:2	0:0:1	2	1
3	Physical Training	PT-I	PT161/PT163 /PT165	Physical Training NSO/NCC/NSS	2:0:0	Non-credit	2	NC
				Total			**26**	**22**

Total Contact Hours: 26, Total Credit Hours: 22

Major(DSC): Major Discipline specific Course
AEC-Ability Enhancement Compulsory Courses
MDC: Multidisciplinary/Interdisciplinary
VAC: Value added Course

Please Note: In Value-added courses student can opt for MOOC/SWAYAM Course of equivalent or more credits.

Course Scheme for B. Sc. Physical Sciences/Discipline Specific
(3/4 years Honours and Honours with Research)
Semester II

I. Theory Subjects

S No.	Type of Course	Course Sub-Category	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	Major/ Minor	DSC-IV	PHY162	Physics II: Electricity and Magnetism	4:0:0	4:0:0	4	4
2	Major/ Minor	DSC-V	CHM162	Chemistry II: Inorganic & Physical Chemistry-I	4:0:0	4:0:0	4	4
3	Major/ Minor	DSC-VI	MAT162	Mathematics II: Ordinary Differential Equations	3:1:0	3:1:0	4	4
4	AEC-2	AEC-II	AEC0011	Ability Enhancement Course (Communication Skills in English-II)	2:0:0	2:0:0	2	2
5	SEC-1	SEC-I	SEC025	Skill Enhancement Course Vedic Mathematics	2:0:2	2:0:1	4	3
6	VAC-2	VAC-II	VAC032	Environmental Studies	3:0:1	3:0:0	3	3

II. Practical Subjects

1	Major/ Minor	DSC	PHY164	Physics II: Electricity and Magnetism (Practical)	0:0:2	0:0:1	2	1
2	Major/Minor	DSC	CHM164	Chemical Analysis II(Practical)	0:0:2	0:0:1	2	1
3	Physical training-2	PT-II	PT162/PT164/ PT166	Physical Training NSO/NCC/NSS	NSO/ NCC/ NSS	2:0:0	2	Non-credit
			Total				**27**	**22**

Total Contact Hours: 27; Total Credit Hours: 22

Major(DS): Major Discipline specific Course
AEC-Ability Enhancement Compulsory Courses
SEC: Skill Enhancement Course
MDC: Multidisciplinary/Interdisciplinary
VAC: Value added Course

VOC: *Vocational course/summer internship is mandatory for students who are willing to exit after 2nd sem

	VOC/Summer Internship		VOC	4:0:0	4:0:0	4	4

SEMESTER I

Semester	**I**
Course Code	**PHY161**
Course Title	**Physics I: Mechanics**
Type of course	**Major (DSC)**
L T P	4:0:0
Credits	4
Course prerequisite	10+2 with Physics as core subject
Course Objective (CO)	The aim of this course is to 1. Enhance the knowledge of students in mechanics. 2. Impart the knowledge of Carstein coordinates, central forces, rotational system.
Course Outcomes (CO)	**By the end of this course, students will be able to:** CO1 Explain the concept of Co–ordinate systems and frame of reference. CO2 Understand the concept of central force &Central Force Motion. CO3 Illustrate the concept of rotational dynamics, elasticity & relativity.

UNIT-I

Co–ordinate systems and Frame of references: Introduction to Cartesian, spherical polar co–ordinate and cylindrical coordinates systems, area, volume, velocity and acceleration in these systems; frame of reference, Galilean transformation, Galilean Invariance of space & time intervals; Newton's laws of motion; law of conservation of linear momentum& energy; Inertial and non-inertial frames and fictitious forces; Uniformly rotating frame; Laws of physics in rotating coordinate systems; Centrifugal force; Coriolis force and its applications

UNIT-II

Central forces and Central Force Motion: Background **of** conservative and non-conservative forces; Potential Energy; Force as gradient of potential energy, two body problem and concept of reduced mass; Motion of a body under central force; Differential equation of orbit; Kepler's laws and their derivation; Satellite in circular orbit and applications; Geosynchronous orbits; Weightlessness; Basic idea of global positioning system, Motion of rockets.

UNIT-III

Rotational dynamics and Elasticity: Angular momentum of a particle and system of particles, Principle of conservation of angular momentum, Rotation about a fixed axis, Torque, Moment of Inertia, Calculation of moment of inertia for rectangular, cylindrical and spherical bodies.

Elasticity: Hooke's law, Stress-strain diagram, Relation between elastic constants, Poisson's Ratio, Expression for Poisson's ratio in terms of elastic constants, Work done in stretching and work done in twisting a wire, Twisting couple on a cylinder, Determination of Rigidity modulus by static torsion, Torsional pendulum, Determination of Rigidity modulus and moment of inertia, q, η and σby Searles method.

UNIT-IV

Special Theory of Relativity: Review of Michelson-Morley experiment and its outcome, Postulates of special theory of relativity, Lorentz transformations, Simultaneity and order of events, Length contraction, Time dilation and its experimental verification, Relativistic transformation of velocity, Relativistic addition of velocities, Variation of mass with velocity, Mass-energy equivalence, Relativistic Doppler Effect, Relativistic kinematics, Transformation of energy and momentum.

Text and Reference Books:

S. No.	Title	Author(s)	Publisher
1	Mechanics Berkeley Physics course	Charles Kittel, et. Al.	2007, Tata McGrawHill

2	Engineering Mechanics	Basudeb Bhattacharya	2nd edn., 2015, Oxford University Press
3	An introduction to mechanics	D. Kleppner, R.J. Kolenkow	New Delhi: McGrawHill, 1973.
4	Analytical Mechanics	G.R. Fowles and G.L. Cassiday	New Delhi: Cengage Learning, 2005.

Course Code	**CHM161**
Course Title	**Chemistry I: Fundamental of Chemistry**
Type of course	**Major (DSC)**
L T P	4 0 0
Credits	4
Course prerequisite	10+2 with chemistry as core subject
Course Objective	The aim of the subject is to enhance the knowledge of students in Chemical bonding atomic / molecular structure, About basic concepts of inorganic chemistry.
Course Outcomes	**By the end of the course, students will be able to** CO1 acquire coherent knowledge of models of atomic structure in explaining various chemical phenomenon. CO2 Apply the Concept of periodicity trends in the atomic properties in predicting the chemical behaviour of atoms. CO3 Understand the basic concepts and phenomenon of organic chemistry CO4 Understand the basics of gaseous state. CO5 Derive mathematical expressions for different properties of gas and understand their physical significance.

UNIT I

Introduction to Indian ancient chemistry and contribution of Indian chemists. Atomic Structure: Dual nature of electron, de Broglie hypothesis, Heisenberg uncertainty principle, Schrodinger wave equation, significance of Ψ and Ψ 2 , concept of atomic orbitals, shapes of s, p, d orbitals, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s , 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals.

Significance of quantum numbers, Normalized and orthogonal wave functions. Contour boundary and probability diagrams. Orbital angular momentum and quantum numbers. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Energies of atomic orbitals, Anomalous electronic configurations. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

UNIT II

Periodicity of Elements: s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic radii (van der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electron gain enthalpy, trends of electron gain enthalpy.

(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

UNIT III

Basic Concepts in Organic Chemistry Electronic effects (inductive, resonance, hyperconjugation) and steric effects and their applications (acid/base property). Hydrogen bonding. Electrophiles and nucleophiles, nucleophilicity and basicity.. Energy considerations. Reactive intermediates: carbocations, carbanions, free radicals, carbenes, arynes, and nitrenes. Assigning formal charges in intermediates and other ionic species.

Classification and nomenclature of organic compounds, hybridization-types, shapes of organic molecules, influence of hybridization on bond properties. Nature of bonding in Organic molecules Types of chemical bonding, formation of covalent bond, notations used to represent electron movements and directions of reaction- curly arrows, formal charges. Types of bond breaking- homolytic and heterolytic.

Electronic displacement effects: Inductive effects, Electromeric effect, Resonance effect, Hyperconjugation and steric effects, explanation with examples.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

Types of Organic Reactions: Substitution, addition, elimination, rearrangement and pericyclic reactions, explanation with examples

Unit IV

Gaseous state: Gaseous State Elementary aspects of kinetic theory of gases, Ideal and real gases. Postulates and derivation of the kinetic gas equation, Boyle temperature (derivation not required), Molecular velocity, collision frequency, collision diameter, Collision cross section, collision number and mean free path and coefficient of viscosity, calculation of σ and η, variation of viscosity with temperature and pressure. Maxwell's Boltzmann distribution law of molecular velocities (Most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies. (Mathematical derivation not required), law of equipartition of energy.

Behaviour of real gases: Deviation from ideal gas behaviour. Compressibility factor (Z) and its variation with pressure for different gases. Causes of deviation from ideal behaviour, vander Waals equation of state (no derivation) and application in explaining real gas behaviour. Critical phenomena - Andrews isotherms of CO2, critical constants and their calculation from van der Waals equation, Continuity of states, Law of corresponding states. Numerical problems.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	1.D. Lee	ELBS
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Organic Chemistry	Morrison and Boyd	Prentice Hall
4	Fundamentals of Organic Chemistry	Solomons	John Wiley
5	Physical Chemistry, 10th Ed.	Atkins, P.W. & Paula, J.	Oxford University Press, 2014
6	Organic reaction mechanism	Singh and Mukharje	New age International
	Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.	Morrison, R. T. & Boyd, R. N.	Pearson Education
	Principles of Physical Chemistry,	Puri, Sharma & Pathania,	Vishal Publishing Co.
	Basic Inorganic Chemistry, , 3rd Edition.	F A Cotton, G Wilkinson and P. L. Gaus	Wiley. India

Course Code	**MAT161**
Course Title	**Mathematics I: Calculus**
Type of course	**Major (DSC)**
L T P	**3:1:0**
Credits	4
Course prerequisite	Student must have the knowledge of Basic Mathematics
Course Objective (CO)	The main goal of this course is to deliver the basics of sequences and series; differential and integral calculus, for real as well as multivariate functions.
Course Outcomes (CO)	**At the end of the course, the students will be:** 1. equipped with the basics of differential calculus 2. acquainted with the fundamentals of integral calculus 3. conversant with the essentials of the infinite sequence and series 4. up-to-date with the concepts of polar co-ordinates and multivariate functions able write proofs, particularly for Unit I and Unit III, rather than applying formulas only.

UNIT-I

Differential Calculus: Precise definition of limit, continuity, one-sided limit, limits involving infinity, asymptotes ofgraphs, tangents and the derivative at a point, the derivative of a function, extreme values of functions, mean value theorem, monotone functions and the first derivative test, test for concavity, tracing of curves.

UNIT-II

Infinite sequences and Series: Sequences, infinite series, the integral test, comparison test, the root and ratio test, Gauss test, Raabe's Test, alternating series, absolute and conditional convergence, power series, Taylor and Maclaurin series, Power series, convergence of Taylor series.

UNIT-III

Polar Coordinates: Polar Coordinates, graphing in Polar coordinates, areas and lengths in Polar coordinates.

UNIT-IV

Multivariable Functions: Limits and continuity for functions of several variables, partial derivatives, the chainrule, directional derivatives, gradient vectors, tangent planes, extreme values and saddle points.

Text Books and References:

S. No.	Name	Author(S)	Publisher
1	Integral Calculus	S. Narayan	S. Chand and Company Ltd.
2	Calculus (3^{rd} ed.)	M.J. Strauss, G.L. Bradley and K. J. Smith	Pearson Education, 2007
3	Calculus (7^{th} ed.)	H. Anton, I. Bivens and S. Davis	John Wiley and Sons, 2002
4	Introduction to Calculus and Analysis (Volumes I & II)	R. Courant and F. John	Springer-Verlag, Inc., 1989
5.	Foundations of Analysis, American	J. L. Taylor	Mathematical Society, 2012
6.	Calculus, (12 ed.)	G. B. Thomas, M. D. Weir and J. R. Hass, Thomas	Pearson Education, 2014
7.	Calculus and Analytical Geometry	Thomas and Finney	Addison Wesley Publishing Company

Semester	**I**
Course Code	**PHY163**
Course Title	**Physics I: Mechanics(Practical)**
Type of course	Major (Practical)
L T P	0:0:4
Credits	2
Course prerequisite	10+2 physics with a core subject
Course Objective	**The aim of this course is to** 1. Impart practical knowledge to the students and provide them with exposure of basic measuring instruments in mechanics. 2.Impart practical knowledge of the working principle of instruments
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1.Determine length, height, moment of inertia, young's modulus, modulus of rigidity, elastic constants of various system by using different apparatus. CO2.Verify the Newton's 2nd law. CO3.Demonstrate the experimental techniques for different pendulums.

*** Note:** Students has to perform any of the 12-14 experiments from the given list**.**

1. To determine the Moment of Inertia of a Flywheel.
2. To find torque of a flywheel.
3. To determine the angular acceleration of flywheel.
4. To find the acceleration and distance of the cart in the given interval of time (Newton's 2nd law).
5. To find the Time of flight, Horizontal range and maximum height of a projectile for different velocity, angle of projection, cannon height and environment.
6. To determine g by Kater's Pendulum.
7. To determine g and velocity for a freely falling body using Digital Timing Technique.
8. To find the radius of gyration of objects of different geometrical shapes but of same mass by noting the time period of oscillation.
9. To determine g by Bar Pendulum.
10. To understand the torsional oscillation of pendulum in different liquid and determine the rigidity modulus of the suspension wire using torsion pendulum.
11. To study the Motion of a spring and calculate (a) Spring Constant (b) Value of g.
12. To determine the Elastic Constants of a Wire by Searle's method.
13. To determine the Young's Modulus of a Wire by Optical Lever Method.
14. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
15. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
16. To determine the Height of a Building using a Sextant.

S. No.	Title	Author(s)	Publisher
1	Practical Physics	C. L. Arora	S. Chand
2	Advanced Practical Physics for students	B.L.Flint and H.T.Worsnop	1971, Asia Publishing House
3	Engineering Practical Physics	S.Panigrahi&B.Mallick	Cengage Learning India Pvt. Ltd. 2015
4.	A Text Book of Practical Physics	Indu Prakash and Ramakrishna	11th Edition, 2011, Kitab Mahal, New Delhi.

5.	Advanced level Physics Practicals	Michael Nelson and Jon M. Ogborn,	4th Edition, reprinted 1985, Heinemann Educational Publishers.

Course Code	**CHM 163**
Course Title	**Chemical Analysis I (Practical)**
Type of course	Major (Practical)
L T P	0:0:4
Credits	2
Course prerequisite	10+2 with chemistry as core subject
Course Objective	The aim of this course is to impart practical knowledge to the students about the separation of organic molecules and quantitative estimation of inorganic salt through titrimetric study.
Course outcome	**By the end of the course, students will be able to:** CO1 Weigh accurately compounds up to fourth decimal CO2 Know the importance of calibration of instruments, pipette, burette and volumetric flask CO3 Prepare standard/working solutions, standardization of solutions and determination of the respective analytes CO4 Handle proficiently byproducts and disposal of waste, Learn the importance of green methods over conventional methods. CO5 Enthuse students to conduct experiments by arousing the curiosity which would help them in learning basics and advanced concepts through simulation-based lab

General Instruction in Chemistry Laboratory:

- Green Principles to be adopted in the laboratories
- Specific arrangements to be made for disposal of chemicals and solutions after the experiments
- Calibration of instruments, glasswares etc to be performed in the beginning of the experiments
- Preparation of Standard solution along with calculations to be taught
- Handling and dilution of mineral acids to be emphasized
- Selection and usage of Indicators to be explained

TITRIMETRY

1. Determination of carbonate and hydroxide present in a mixture.
2. Determination of oxalic acid and sodium oxalate in a given mixture using standard KMnO4/NaOH solution
3. Standardization of potassium permanganate solution and determination of nitrite in a water sample
4. Determination of alkali content in antacids
5. Determination of chlorine in bleaching powder using iodometric method.
6. Determination of concentration of Potassium Permanganate solution using Ferrous Ammonium sulphate
7. Standardization of silver nitrate and determination of chloride in a water sample 8. Soil Analysis-Determination of pH of soil

Volumetric Analysis

Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
Estimation of oxalic acid by titrating it with $KMnO_4$.
Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

Organic Chemistry

Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)

Separation of mixtures by Chromatography:

Measure the Rf value in each case (combination of two compounds to be given)
Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
Identify and separate the sugars present in the given mixture by paper chromatography.

**Perform any four experiments from each section*

Text and References Books

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7^{th} Edition).	G Svehla	Prentice Hall
2	Laboratory Manual in Organic Chemistry	R.K. Bansal,	Wiley Eastern
3	Advanced Experimental Chemistry. Vol. I	Physical, J.N. Gurtu and R. Kapoor	S. Chand & CO.
4	Vogel's Qualitative Inorganic Analysis	Svehla	Orient Longman
5	Vogel's Textbook of Quantitative Inorganic Analysis (revised),	J. Basseff, R.C. Dennery, G.H. Jeffery and J. Mendham	ELBS

SEMESTER II

Semester	**II**
Course Code	**PHY162**
Course Title	**Physics II: Electricity and Magnetism**
Type of course	Major (DSC)
L T P	4: 0:0
Credits	4
Course prerequisite	10+2 with physics as core subject.
Course Objective (CO)	The aim of this course is to 1. Enhance the knowledge of students in Electricity and Magnetism. 2. Ehance understanding of Electromagnetic applications.
Course Outcomes (CO)	**By the end of this course, students will be able to:** CO1understand the vector calculus and vector algebra and its applications in electricity and magnetism. CO2 Learn how to analyze various problems in electrostatics& magnetostatics with mathematical methods. CO2 analyze various problems in electromagnetism with mathematical methods and able to solve Maxwell equations.

UNIT-I

Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors.

UNIT-II

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics, Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential, Capacitance of an isolated spherical conductor, Parallel plate, spherical and cylindrical condenser, Energy per unit volume in electrostatic field, Dielectric medium, Polarisation, Displacement vector, Gauss's theorem in dielectrics, Parallel plate capacitor completely filled with dielectric.

UNIT-III

Magnetostatics: Background of Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field, Magnetic vector potential& its expression, Ampere's circuital law, Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, Brief introduction of dia-, para- and ferro-magnetic materials, Relation between B, H and M, B-H curve and hysteresis

UNIT-IV

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils, Energy stored in magnetic field.

Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Text and Reference Books:

Sr No.	Title	Author(s)	Publisher
1	Introduction to Electrodynamics	D J Griffith	Prentice-Hall of India

2	Physics Vol 2	Halliday and Resnik	Tata McGraw-Hill
3	Electricity and Magnetism	A S Mahajan and A ARangwala	Tata McGraw-Hill
4	Berkeley Physics Course, Vol. 1, Mechanics	E M Purcell, Ed	Tata McGraw-Hill
5	Electricity and Magnetism	Edward M. Purcell	1986, McGraw-Hill Education
6	Electricity and Magnetism	J.H. Fewkes& J. Yarwood	Vol. I, 1991, Oxford Univ. Press.

Course Code	**CHM 162**
Course Title	**Chemistry II: Inorganic & Physical Chemistry-I**
Type of course	**Major (DSC)**
L T P	4:0:0
Credits	4
Course prerequisite	10+2 with chemistry as core subject
Course Objective	The aim of the subject is to enhance the knowledge of students regarding chemical bonding, chemistry of noble gases To develop coherent understanding of different states of matter, associated phenomenon and their application
Course outcome	**By the end of the course, students will be able to:** CO1 Acquire the knowledge of chemical bonding, . CO2 Acqure the knowledge of chemistry of noble gases, basic concept, of states of matter CO3 Interpret structures and properties of different crystals, crystal defects

UNIT I

Chemical Bonding:

(i) Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N2, O2, C2, B2, F2, CO, NO, and their ions; HCl, BeF2, CO2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

UNIT II

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds

Liquid State Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, Surface Tension: Definition and its determination using stalagmometer, effect of temperature and solute on surface tension Viscosity: Definition, Coefficient of viscosity. Determination of viscosity of a liquid using Oswald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases

UNIT III

Refraction: Specific and molar refraction- definition and advantages. Determination of refractive index by Abbes Refractometer. Additive and constitutive properties.

Parachor: Definition, Atomic and structure parachor, Elucidation of structure of benzene and benzoquinone. Viscosity and molecular structure. Molar refraction and chemical constitution. Numerical Problems.

UNIT IV

Dilute solutions- Review of colligative properties and concentration terms Determination of molecular mass of a solute by: (i) Berkeley-Hartley's method ; (ii) Beckmann's method (ΔTf) and (iii) Landsberger's method. Numerical problems Distribution Law Nernst Distribution Law – Statement. Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo a) Association b) Dissociation. Application of Distribution Law in Solvent extraction, numerical Problems

Solids Forms of solids: Unit cell and space lattice, anisotropy of crystals, size and shape of crystals. Laws of Crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of symmetry (Symmetry elements), Crystal systems, Bravais lattice types and identification of lattice planes. Miller indices and its calculation, X–Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, Single crystal and powder diffraction methods. Defects in crystals, glasses and liquid crystals. Numerical problems. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	1.D. Lee	ELBS
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Basic Inorganic Chemistry, 3rd Edition.	F A Cotton, G Wilkinson and P. L. Gaus,	Wiley. India
4	Advanced Physical Chemistry,	Gurdeep Raj,	Goel Publishing House (2018)
5	Physical Chemistry, 10th Ed.	Atkins, P.W. & Paula, J.	Oxford University Press, 2014
6	Organic reaction mechanism	Singh and Mukharje	New age International
7	Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.	Morrison, R. T. & Boyd, R. N.	Pearson Education
8	Principles of Physical Chemistry,	Puri, Sharma & Pathania,	1. Vishal Publishing Co.
9	Basic Inorganic Chemistry, , 3rd Edition.	F A Cotton, G Wilkinson and P. L. Gaus	1. Wiley. India
10	Physical Chemistry, Volume 1, States of Matter and Ions	K L Kapoor	Mcmillan

Semester	**II**
Course Code	**MAT162**
Course Title	**Mathematics II: Ordinary Differential Equations**
Type of course	Major (DSC)
L T P	3:1:0
Credits	4
Course prerequisite	Student must have the knowledge of Basic Mathematics
Course Objective (CO)	The main objective is to exhibit the techniques for obtaining solutions to ordinary differential equations, the basic ideas and the theory behind those techniques.
Course Outcomes(CO)	**At the end of the course, the students will be:** 1. able to exhibit the techniques for obtaining solutions to ordinary differential equations 2. aware of the the basic ideas and the theory behind the techniques for solving the ODEs. able to combine the abstract concepts with examples in order to intensify the understanding of the subject

Unit-I

Origin of Differential Equations, Basic definitions, Family of solutions, Geometric interpretation, Isoclines, Initialand boundary value problem. Basic Existence Theorem (Statement).

Unit-II

Equations of Order One, Separation of variables, Exact Equations, Linear Equations, Integrating factors, Bernoulli's equation, Elementary applications.

Unit-III

General linear equations: General solutions, Linear independence of solutions, differential operators. Linear equations with constant coefficients and variable co-efficients: Auxiliary equation and particular integral.

Unit-IV

Non-homogeneous equations: Method of undetermined coefficients, Variation of parameter method, Nonlinear Equations.

Text Books and References:

S. No.	Name	Author(S)	Publisher
1	Elementary differential equations (7^{th} ed.)	Earl D. Rainville and P. E. Benediet	Macmillian,Publishing Company, 1989
2	Differential Equations (3^{rd}ed.)	S. L. Ross	John Wiley and Sons, India 2004
3	An introduction to ordinary differential equations	E. A. Coddington	Prentice- Hall
5	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons Inc.
6	Higher Engineering Mathematics	BS Grewal	Khanna Publishers

Semester	**II**
Course Code	**PHY164**
Course Title	**Physics II: Electricity and Magnetism (Practical)**
Type of course	Major (Practical)
L T P	0:0:4
Credits	2
Course prerequisite	10+2 with physics as core subject
Course Objective	**The aim of this course is to** 1. Impart practical knowledge to the students and provide them with practical exposure of electricity and magnetism. 2.Impart practically the knowledge of role of electric instruments in working of applicances.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1: Determine resistance, voltages, current, fuses, capacitances, field strength by using multimeter, galvanometer, de-sauty bridge, carey foster bridge &solenoid. CO2: To determine characteristic, resonant frequency& quality factor of RC, LCR (series, parallel) circuits. CO3: To determine magnetism by using different apparatus

*** Note:** Students has to perform any of the 12-14 experiments from the given list.

1. To use a Multimeter for measuring (a) Resistances,(b) AC and DC Voltages (c) DC Current (d) Checking electrical fuses.
2. Measurement of charge and current sensitivity.
3. Measurement of CDR.
4. Determine a high resistance by Leakage Method.
5. To determine the reduction factor of the given tangent galvanometer (*K*).
6. To find out the horizontal component of earth's magnetic field (B_h).
7. To compare capacitances using De'Sauty's bridge.
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To find the temperature coefficient of resistance of a given coil.
10. To determine Self Inductance of a Coil by Rayleigh's Method.
11. To determine the self inductance of the coil (L) using Anderson's bridge.
12. To calculate the value of inductive reactance (X_L) of the coil at a particular frequency.
13. To study the Characteristics of a Series RC Circuit.
14. To study the series LCR circuit and determine its: (a) Resonant frequency, (b) Impedance at resonance (c) Quality factor Q (d) Band width
15. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
16. To study the variation of magnetic field with distance along the axis of a circular coil carrying current.
17. To determine the volume magnetic susceptibility of Manganese sulphate solution at different concentrations.
18. To determine the magnetic dipole moment (*m*) of a bar magnet and horizontal intensity (B_H) of earth's magnetic field using a deflection magnetometer.
19. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)

Text and Reference Books

Sr No.	Title	Author(s)	Publisher
1	Practical Physics	C. L. Arora	S. Chand
2	Advanced Practical Physics for students	B.L.Flint&H.T.Worsnop	1971, Asia Publishing House.
3	A Text Book of Practical Physics	Indu Prakash and Ramakrishna	11th Edition, 2011, Kitab Mahal, New Delhi.
4	Engineering Practical Physics	S.Panigrahi&B.Mallick	2015, Cengage Learning India Pvt. Ltd.
5	Advanced level Physics Practicals	Michael Nelson and Jon M. Ogborn	4th Edition, reprinted 1985, Heinemann Educational Publishers

Course Code	**CHM 164**
Course Title	**Chemical Analysis II(Practical)**
Type of course	**Major (Practical)**
L T P	0:0:4
Credits	2
Course prerequisite	10+2 with chemistry as core subject
Course Objective	The aim of this course is to provide practical knowledge about the preparation of organic compounds, Thermo-chemistry and Ionic equilibrium.
Course outcome	**By the end of the course, students will be able to:** CO1 Know the importance of calibration of instruments, pipette, burette and volumetric flask CO2 Understand the significance of standardization of solutions and determination of the respective analytes CO3 Acquire coherent knowledge of thermochemistry, Analyse thermodynamic parameters of solutions and salt mixtures. CO4 Enthuse students to conduct experiments by arousing the curiosity which would help them in learning basics and advanced concepts through simulation-based lab CO2 Find out the acidity, Basicity and pKa Value on pH meter. CO3 Accurately evaluate physical properties of solutions, and perform analysis, separation and purification of mixture applying these properties.

PART-A Inorganic Chemistry

TITRIMETRY

1. Determination of carbonate and hydroxide present in a mixture.
2. Determination of oxalic acid and sodium oxalate in a given mixture using standard KMnO4/NaOH solution
3. Standardization of potassium permanganate solution and determination of nitrite in a water sample
4. Determination of alkali content in antacids
5. Determination of chlorine in bleaching powder using iodometric method

Section B: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Solution Chemistry:

1 Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer (ethyl acetate, toluene, chlorobenzene or any other non-hazardous liquids)

2. Study of the variation of viscosity of sucrose solution with the concentration of a solute

3. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (ethyl acetate, toluene, chlorobenzene or any other non-hazardous liquids)

4. Study of variation of surface tension of detergent solution with concentration.

5. Determination of molar mass of non-electrolyte by Walker-Lumsden method

6. Determination of partition/distribution coefficient of Benzoic acid in water and toluene

7. Determination of composition of liquid mixtures by refractometry. (toluene and alcohol, water and sucrose)

8. Determination of specific and molar refraction by Abbes refractometer (ethyl acetate, methyl acetate, ethylene dichloride)

Virtual Experiments

1. Determination of molar mass of a non-volatile solute by cryoscopic method
2. To reinforce the concept of colligative properties and to study the effect of solute on the FP substances.
3. To reinforce the concept of colligative properties and to study the effect of solute on the BP substances.
4. Determination of viscosity by average molecular weight of a polymer.
5. Determination of partition co-efficient of Iodine between water and carbon tetrachloride

*_Perform any three experiments from each section_

Text and References Books

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7^{th} Edition).	G Svehla	Prentice Hall
2	Laboratory Manual in Organic Chemistry	R.K. Bansal,	Wiley Eastern
3	Advanced Experimental Chemistry. Vol. I	Physical, J.N. Gurtu and R. Kapoor	S. Chand & CO.
4	Vogel's Qualitative Inorganic Analysis	Svehla	Orient Longman
5	Vogel's Textbook of Quantitative Inorganic Analysis (revised),	J. Basseff, R.C. Dennery, G.H. Jeffery and J. Mendham	ELBS
6	Experimental Physical Chemistry	V D Atwale	New Age International Private Limited

Syllabus of MDC/VAC/SEC/VOC/AEC courses fo 1st, 2nd sem

MDC I : MDC074 Artificial Intelligence: Basics
VAC I : VAC 036 Indian Knowledge System (IKS): Concepts and Applications in Sciences
VAC II: VAC032 Environmental Studies

SEC I: SEC025 Vedic Mathematics
AEC I AEC010 :Communication Skill in English -I
AEC II AEC011 Communication Skill in English- II

Multidisciplinary Course (MDC)

Course Code	MDC074
Course Title	**Artificial Intelligence: Basics**
Type of Course	
L T P	3 0 0
Credits	3
Course Prerequisites	Basic knowledge of computers
Course Objective	The objective of the study is to provide basic knowledge representation, terminology and learning methods of Artificial Intelligence
Course Outcome (CO)	The students will be able to: 1. Understand fundamentals and structure of A.I. 2. Understand basic terminology of A.I. 3. Understand Mathematics in coordination with A.I. 4. Understand A.I. values

SYLLABUS

UNIT I:

Introduction: Introduction-AI for everyone, what is AI, History of AI, What is Machine Learning, Difference between conventional programming and machine learning, How is Machine learning related to AI, What is data, Structured and Unstructured Data, Examples of unstructured data- text, images, Deep learning, Reinforcement learning, Machine Learning, Neural Networks.

UNIT II:

Applications and Methodologies: Present day AI and Applications, Key Fields of Application in A.I., Chatbots (Natural Language Processing, speech), Alexa, Siri and others. Computer vision, Weather Predictions, Price forecast for commodities, Self-driving cars, Characteristics and types of AI, Data driven, Autonomous systems, Recommender systems.

UNIT III:

Maths for Artificial Intelligence: Introduction to matrices, Introduction to set theory, Introduction to data table joins, Simple statistical concepts, Visual representation of data, bar graph, histogram, frequency bins, scatter plots, etc. With co-ordinates and graphs introduction to dimensionality of data, Simple linear equation, Least square method of regression.

UNIT IV:

A.I. Values: A.I. Issues, Concerns and Ethical Considerations, Issues and Concerns around A.I., A.I. and Ethical Concerns, A.I. and Bias, A.I.: Ethics, Bias, and Trust, Employment and A.I.

RECOMMENDED BOOKS			
Sr. No.	**Name**	**AUTHOR(S)**	**PUBLISHER**
1.	Artificial Intelligence Basics	Kevin Warvick	Routledge Publications
2.	Artificial Intelligence: The Basics	Russell A Stultz	BPB Publication

Value Added Course

Course Code	**VAC036**
Course Name	**Indian Knowledge System (IKS): Concepts and Applications in Sciences**
Course Category	Value Added Course (VAC)
Course Type	Lecture
Contact Hours (L:T:P)	3:0:0
Credits (L:T:P)	3:0:0
Course Objective (CO)	1. To sensitize the students about context in which they are embedded i.e., Indian culture and civilization including its Knowledge System and Tradition. 2. To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system.
Course Outcomes (CO)	1. Students will be able to learn and understand the enriched scientific Indian heritage. 2. Students will be introduced to the contribution from Ancient Indian system & tradition to modern science & Technology. 3. Students will build a deep rooted pride in Indian knowledge, committed to universal human right, well-being and sustainable development

SYLLABUS

UNIT-1

Introduction and Historical aspects: Broad overview of disciplines included in the Indian Knowledge System (IKS), and historical developments. An overview of Indian contributions to technology, Technological Innovations, Vocabulary of IKS.

UNIT-2

Health, Wellness and Psychology, Ayurveda Sleep and Food, Role of water in wellbeing Yoga way of life Indian approach to Psychology, the Triguṇa System Body-Mind-Intellect Consciousness Complex. Governance, Public Administration & Management reference to Ramayana, Artha Sastra, Kauṭilyan State

UNIT-3

Introduction to Indian Science and Technology in IKS: Indian S & T Heritage, sixty-four art forms and occupational skills (64 Kalas) Metals and Metalworking technology (Copper, Gold, Zinc, Mercury, Lead and Silver), Iron & Steel, Dyes and Painting Technology)

UNIT-4

Ecology and Environment: *Nakshatrara Gyaan* and Agriculture, Vernacular Architecture, Forest Management and Urban Planning, Agroforestry, Tank, Lakes, and Stepwells. India and the World**:** Influence of IKS on the world, knowledge exchanges with other classical civilizations, and inter-civilizational exchanges, India's Contribution to the World.

Books/References:

S. No.	Name of Book	Authors/Editors	Publisher
1.	Pride of India: A Glimpse into India's Scientific Heritage'	R.M. Pujari, Pradeep Kolhe, N. R. Kumar	Samskrita Bharati Publication
2.	Indian Contribution to science	Vijnana Bharati	Vijnana Bharati
3.	Knowledge traditions and practices of India	Kapil Kapoor, Michel Danino	CBSE, India
4.	Indian Science and Technology in the Eighteenth Century, Academy of Gandhian Studies, Hyderabad, 1971, republic.	Dharampal	Other India Bookstore, Goa
5.	Sciences of the Ancient Hindus: Unlocking Nature in the Pursuit of Salvation	Alok Kumar	CreateSpace Independent Publishing
6.	Science in India: A Historical Perspective	B.V. Subbarayappa	Rupa, New Delhi
7.	Vedic Mathematics and Science in Vedas	S. Balachandra Rao	Navakarnataka Publications, Bengaluru
8.	The Crest of the Peacock	George Gheverghese Joseph	Penguin Books, London & New Delhi
9.	Ancient Cities, Sacred Skies: Cosmic Geometries and City Planning in Ancient India	J. McKim Malville &Lalit M. Gujral	IGNCA & Aryan Books International, New Delhi
10.	Jantar Mantar: Maharaja Sawai Jai Singh's Observatory in Delhi	Anisha Shekhar Mukherji	AMBI Knowledge Resources, New Delhi
11.	The Iconography of Water: Well and Tank Forms of the Indian Subcontinent	Fredrick W. Bunce	DK Printworld, New Delhi

Value Added Course

Course Code	**VAC032**
Course Name	**Environmental Studies**
Course Category	Value Added Course (VAC)
Course Type	Lecture
Contact Hours (L:T:P)	3:0:0
Credits (L:T:P)	3:0:0
Course Objective (CO)	3. To sensitize the students about the scope and importance of environmental studies, different natural resources and their utilization as well as conservation methods 4. Awareness of the consequences of population explosion; diseases such as HIV/AIDS and various family welfare programs. 5. To inculcate the awareness and responsibility about environment and need of maintaining it with best possible knowledge. 6. Develop an attitude of concern for the environment.
Course Outcomes (CO)	4. Students will gain knowledge about the environment, ecosystem and effects of environmental pollution and remediation. 5. Students will be able to learn and understand the role of individual in conservation of environment. 6. Students will gain knowledge on environmental protection Acts and Rule, which will acquaint them with the legal aspects towards conservation of environment. 7. Students will understand the impact of human population, and study social issues related to environment.

SYLLABUS

UNIT-I

Introduction to Environment and Ecosystem: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness, Concept of Ecosystem, Structure, interrelationship, producers, Consumers and decomposers, ecological pyramids. Biodiversity, its importance and conservation: Introduction – Definition: genetic, species and ecosystem diversity. Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values. Biodiversity at global, national and local levels. India as a mega-diversity nation and Hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts. Endangered and endemic species of India. Conservation of Biodiversity.

UNIT-II

Environmental Pollution & Natural Resources: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes..Role of an individual in prevention of pollution. Pollution case studies. Disaster Management: Floods, earthquake, cyclone and landslides. **Natural Resources: Renewable and non-renewable resources**: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.

UNIT-III

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and

holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation

UNIT-IV

Human Population and the Environment & Field Work: Population growth, variation among nations. Population explosion –Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. Case studies

Visit to a local area to document environemntal assetsriver/forest/grassland/hill/mountain;Visit to a local polluted site-Urban/Rural/Industrial/Agricultural;Study of common plants, insects, birds; Study of simple ecosystems-pond, river, hill slopes, etc.

Text and reference books:

S. No	Title	Author(S)	Publisher
1	A Textbook for Environmental Studies	Erach Bharucha	Universities Press, Hyderabad
2	Environmental Biology	Agarwal, K.C. 2001	Nidi Publ. Ltd. Bikaner.
3	Environmental Science	Miller T.G. Jr.	Wadsworth
4	A Text Book in Environmental Sciences	Subramanian, V.	Narosa Publishing House, New Delhi
5	Global Biodiversity Assessment	Heywood, V.H. &Waston, R.T.	Cambridge House, Delhi
6	Essentials of Environmental Studies	Joseph, K. & Nagendran, R	Pearson Education (Singapore) Pvt. Ltd., Delhi
7	Perspective in Environmental Studies	Kaushik, A. & Kaushik, C.P.	New Age International (P) Ltd, New Delhi
8	Environmental Studies from Crisis to Cure	Rajagopalan, R.	Oxford University Press, New Delhi
9	Comprehensive Environmental Studies	Sharma, J. P., Sharma. N.K. & Yadav, N.S.	Laxmi Publications, New Delhi
10	Ecology and Environment	. Sharma, P. D.	Rastogi Publications, Meerut

Ability Enhancement Course

Course Code	**AEC0010**
Course Title	**Communication Skills in English-I**
Type of course	Theory
L T P	2 0 0
Credits	2
Course prerequisite	+2 with any stream
Course Objective (CO)	The course will introduce learners to the role and importance of effective communication at work. It presents theories and principles of communication responsible for good interpersonal interaction. Students will be prepared to communicate effectively in a variety of contexts and different mediums. The Units are structured around the communication tasks of managers.

Syllabus

UNIT-I

Basics of Communication Skills: Communication, Process of Communication, Types of Communication Verbal and Non-verbal communication, Channels of Communication- Upward, Downward, Horizontal, Barriers to Communication, Role of Communication in society.

UNIT-II

Listening Skills: Listening Process, Hearing and Listening, Types of Listening, Effective Listening, Barriers to Effective Listening, Note Taking.

Reading Skills: Purpose of reading, Process of reading, Reading skills Models and strategies, scanning, skimming, SQ3R, Approaches of Reading, Comprehension passages for practice.

UNIT III

Writing Skills: Purpose of writing, Effective writing, Types of writing, Business Correspondence, Precis writing, Memo writing, Minutes of meeting.

UNIT-IV

Speaking Skills: Speech Mechanism, Sounds System, Articulation, Vowels & Consonants, Skills for effective speaking, Role of audience, Feedback Skill, Oral Presentation.

Recommended Books:

Sr No	**Author(s)**	**Title**	**Publisher**
1.	Bhupender Kour	Effectual Communication Skills	S.K. Kataria and Sons
2.	R. Datta Roy and K.K. Dheer	Communications Skills	Vishal Publishing Company
3	The Essence of Effective Communication	Ludlow and Panton	Prentice Hall of India
4	Essentials of Business Communication	Pal and Korlahalli	S. Chand and Sons. New Delhi

Ability Enhancement Course

Course Code	**AEC0011**
Course Title	**Communication Skills in English-II**
Type of Course	**Theory**
L T P	**2 0 0**
Credits	**2**
Course pre-requisite	**NA**
Course Objectives	To enhance employability skills of the learners by enabling them to write an effective resume and face the interview with confidence.

UNIT I

PUBLIC SPEAKING: Introduction to Public Speaking, Business Conversation, Effective Public Speaking Art of Persuasion

UNIT II

INTERVIEW SKILLS: Types of Interview, Styles of Interview, Facing Interviews-Fundamentals and Practice Session ,Conducting Interviews- Fundamentals and Practice Session, Mock interview sessions

UNIT III

Writing Skills: Resume Writing, Covering Letters, Interview Follow Up Letters, Email, Fax, Assessment through employability score card

UNIT IV

ETIQUETTES: Business Etiquette, Dressing up Sense, Exchanging Business card, Shaking hands, Dining etiquette.

Recommended Books

S.no	Name	Author(s)	Publisher
1	Jeremy Comfort	Speaking Effectively	CUP
2	N.Krishnaswamy	Creative English for Communication	Macmillan
3	Raman Prakash	Business Communication	CUP
4	Anjanee Sethi & Bhavana Adhikari	Business Communication	Tata McGraw Hill

Skill Enhancement Course

Semester	**II**
Course Code	**SEC025**
Course Title	**Vedic Mathematics**
Type of course	**Skill Enhancement**
L T P	3:0:0
Credits	3
Course prerequisite	10+2 with knowledge of basic mathematics
Course Objective(CO)	To train the learners to use the ideas of Vedic Mathematics in daily calculations and make those calculations with accuracy and speed. To enable the learners to explore the power of Vedic Mathematics and to recognize and understand simple techniques of Arithmetic Calculations and Numerical Mathematics.
Course outcome	**By successfully completing this course, the learner will be able to:** CO1: Perform simple arithmetic calculations with speed and accuracy. CO2: Will be able to generate tables of any number. CO3: To perform products of large numbers quickly. CO4: Perform difficult calculations speedily. CO5: Face Numerical Aptitude part of any Competitive Examination confidently.

UNIT-I:
History and Evolution of Vedic Mathematics, Introduction of Basic Vedic Mathematics Techniques for Multiplication and Division, Divisibility tests, Division of numbers near base, Comparison of fractions, Basic Vedic Mathematics Techniques for LCM & HCF.

UNIT–II:
Quadratic Equations, Solution of Linear Simultaneous equations, Definitions of Trigonometric Ratios, Trigonometric Identities, Complex Numbers (Multiplication, Division and Square root).

UNIT-III:
Square (two digit numbers), Different methods of Squares (General method, Base method, Duplex method etc.), Cube (two digit numbers), Square root (four-digit number), Cube root (four- digit numbers)

UNIT-IV:
Contribution of Indian Mathematicians (In light of Arithmetic) such as Aryabhatt, Brahmagupt, Mahaveeracharya and Bharti Krishna Tirtha. Use of various Vedic Techniques for answering numerical aptitude questions from Competitive Examinations.

Text and Reference Books:-

S. No	Name	Author(s)	Publisher
1	Vedic Mathematics		Motilal Banarsi Das, New Delhi
2	Vedic Mathematics: Past, Present and Future		Siksha Sanskriti Uthana Nyasa, New Delhi.
3	Vedic Ganita: Vihangama Drishti-1		Siksha Sanskriti Uthana Nyasa, New Delhi.

Vocational Course

Semester	**II**
Course Code	**VOC022**
Course Title	**Analytical Techniques for Pollution detection and Pharma Industry**
Type of course	Vocational
L T P	2:0:4
Credits	4
Course prerequisite	12^{th} with Chemistry as main subject
Course Objective	To impart knowledge on various analytical methods, instrumentation, and sampling techniques commonly used in environmental monitoring and pollution control and pharma industry.
Course Outcomes	The students will be able to: 1. To learn various analytical methods used for Environmental, Water and soil pollution. 2. To understand the principles of chemical techniques used in pharmaceutical research and development. 3. To interpret the results to assess environmental quality.

Syllabus

Unit-I Methods for Detection of Environmental Pollution:

Theory

Overview of environmental pollution and its types, Sources and causes of pollution, Impact of pollution on ecosystems and human health, Regulatory framework for pollution control, Principles of sampling in environmental analysis, Types of sampling: grab sampling, composite sampling, passive sampling.

Practical

1. Sampling methods for (Water, Soil and Air)
2. Quality assurance and quality control in sampling

Unit-II Analytical Methods for Water Pollution Detection

Theory

Treatment of sewage: Primary and secondary treatment (activated sludge and trickling filters); Organisms associated with secondary treatment; Septic tanks; Stabilization ponds; Oxidation ditch; Sludge digestion, Biological assays for water toxicity assessment, Biochemical oxygen demand (BOD), Hard Water and Soft water, EDTA method for determination of the hardness of water.

Practical

1. Visit to wastewater and drinking water treatment plants under short tours and long tours
2. Winkler method for calculating dissolved oxygen (BOD).
3. EDTA method for determination of hardness

Unit-III: Analytical Methods for Soil Pollution Detection

Theory

Classification, structure, chemical composition and properties of clay minerals; genesis and transformation of crystalline and non-crystalline clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate minerals and their identification; clay minerals in Indian soils, pH meter.

Practical

1. Determination of pH of soil
2. Determination of organic matter in soil
3. Determination of percent composition of soluble and insoluble components of community solid waste

Unit-IV Analytical Methods used in pharma industry

Theory

Overview of the pharmaceutical industry, Drug discovery and development process, Role of chemical techniques in drug development, Good Manufacturing Practices (GMP), Quality control tests for raw materials, Thermal analysis techniques (DSC, TGA), Chromatographic techniques (HPLC, GC).

Practical

1. Analysis of real-world pharmaceutical products
1. Application of chemical techniques in solving pharmaceutical challenges.
2. Characterization of the Sublimation and Vapor Pressure of drugs Using Thermogravimetric Analysis

Text & Reference Books:

S.No.	Name/Title	Author	Publisher
1	Analytical Techniques for Studying the Physical Chemistry of Water Pollution"	by Samuel N. Levine and Craig L. Patterson.	Springer
2	Environmental Analytical Chemistry for Pollution Control"	by Santiago Aparicio and Elena Molero.	Wiley
3	Analytical Techniques for Soil Pollution Research	" by Margarida Mateus and Fernando Gonçalves.	Elsevier
4	Pharmaceutical Chemistry	David G. Watson	ChurchHill Livingstone

Vocational Course

Semester	**II**
CourseCode	**VOC023**
CourseTitle	**Computational Methods in Physics**
Type of course	**Vocational Course**
L TP	2:0:4
Credits	4
Courseprerequisite	
CourseObjective	To understand the use of computation in the field of physics
CourseOutcomes	

Unit 1: Introduction to Computational Physics
- Overview of computational methods in physics
- Introduction to scientific computing
- Numerical representation of physical quantities
- Error analysis and numerical stability

Unit 2: Numerical Methods for Differential Equations
- Numerical differentiation and integration
- Solving ordinary differential equations (ODEs):
- Euler method
- Runge-Kutta methods
- Boundary value problems
- Practical: Implementing the Lorenz attractor

Unit 3: Advanced Topics in Computational Physics
- Partial differential equations (PDEs) and their numerical solutions
- Finite difference and finite element methods
- Monte Carlo methods:
- Basics of Monte Carlo simulations
- Applications in statistical physics and quantum mechanics

Unit 4: Applications in Modern Physics
- Molecular dynamics simulations
- Quantum mechanics simulations:
- Numerical techniques for solving the Schrödinger equation
- Variational methods

Textbook:
- "Computational Physics" by Mark Newman
- Additional lecture notes and online resources will be provided.

Software:
- Students may use any programming language of their choice, such as Python, MATLAB, Julia, or C/C++, along with relevant libraries for scientific computing.

Vocational Course

Semester	**II**
Course Code	**VOC007**
Course Title	**Mental Ability Test and Training in Mathematics**
Type of course	
L T P	3:0:2
Credits	4
Course prerequisite	Student must have the knowledge of Basic Mathematics
Course Objective (CO)	To acquaint the students with the formulas and concepts of logical reasoning.
Course Outcomes(CO)	At the end of the course, the students will be able to 1. Identify different number patters. 2. Solve questions based on relations and able to decode numbers and letters. 3. Solve problems of decision making 4. Think differently and increase their capability for competitive exams.

UNIT –I Identify Patterns: Number patterns, Letter Patterns, Mixed Patterns, Word Patters. Using patters Identify relations between two things in order to predicts how they are interrelated.

UNIT-II Blood relations, Clocks and calendar, coding-decoding. Seating arrangements.

UNIT-III : Distance and direction: Solve different questions related to direction and distance between two or more persons, products and elements , Number puzzles, Practice Questions of competitive and entrance tests related to number puzzles, Dices to learn about random numbers and mathematical probabilities.

UNIT-IV : Ranking test, Analytical decision making: Practice Questions related to making informed, rational, and consistent decisions about goals and values.

Text Books and References:

S.No	Name	Author(S)	Publisher
1	Verbal and Non Verbal Reasoning.	Oswaal Editorial Board	Oswaal
2	A modern approach to logical reasoning	R.S Aggarwal	S. Chand