

2.6.1 Teachers and students are aware of the stated programme and course outcomes of the programmes offered by the institution.



**LPCPS**  
LUCKNOW PUBLIC COLLEGE  
OF PROFESSIONAL STUDIES

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**BACHELOR OF SCIENCE B.Sc (PCM)**

**(SESSION 2022-2023)**

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### BACHELOR OF SCIENCE B.Sc (PCM)

Program Outcomes Bachelor of Science (B. Sc) offers theoretical as well as practical knowledge on different subject areas. These subject areas include Physics, Chemistry, Mathematics and other fields depending on the specialization & combinations a student opts for this programme course is most beneficial for students who have a strong interest and background in Science and Mathematics. The course is also beneficial for students who wish to pursue multi and interdisciplinary science careers in future. It is also the gateway for post-graduation in research in topics pertaining to science.

#### Programme Outcomes (PO):

- This course forms the basis of science and comprises of the subjects like physics, chemistry and mathematics.
- It helps to develop scientific temper and thus can prove to be more beneficial for the society as the scientific developments can make a nation or society to grow at a rapid pace, especially in medicine, engineering & research.
- After the completion of this course students have the option to go for higher studies i.e., M. Sc and then do some research for the welfare of mankind.
- After higher studies students can join as scientist and can even look for professional job-oriented courses.
- This course also offers opportunities for serving in Indian Army, Indian Navy and Indian Air Force as officers.
- Students after this course have the option to join Indian administrative Services such as IAS, IFS, Allied services IPS etc.
- Science graduates can go to serve in industries or may opt for establishing their own industrial unit.
- After the completion of the B. Sc degree there are various other options available for the science students. Often, in some reputed universities or

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colleges in India and abroad the students are recruited directly by big MNC's after their completion of the course.

- Apart from the research jobs, students can also work or get jobs in Marketing, Business & Other technical fields. Science graduates also gets recruited in the banking sector working as customer service executives. Students can also find employment in various government sectors.

### Program Specific Outcomes (PSO):

- B.Sc. student is able to concentrate on Chemistry, Physics and Mathematics.
- A student will demonstrate a scientific knowledge of the core physics principles in Mechanics, Electromagnetism, Modern Physics, and Optics.
- He is able to demonstrate basic manipulative skills in algebra, geometry, trigonometry, and beginning calculus.
- The student will determine the appropriate level of technology for use in:
  - a) Experimental design and implementation.
  - b) Analysis & interpretation of experimental data.
  - c) Numerical and mathematical methods in problem solutions.
- He will be able to apply the underlying unifying structures of mathematics (i.e., sets, relations and functions, logical structure) and establish the relationships among them.
- He can investigate and apply mathematical problems and solutions in a variety of contexts related to science, technology, business and industry, and illustrate these solutions using symbolic, numeric, or graphical methods.
- The student will acquire knowledge of Chemical Thermodynamics, Kinetics, Electrochemistry, Atomic Structure, Organic Chemistry, Spectroscopy and Skill in Industrial Chemistry.
- He will gain knowledge of Geography in Indian Context and also Global Geography. He will know about forests, mountains, lakes, rivers, soil & environment pollution

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- He can join as a scientist in research institutes of immense knowledge having a great scope for growth and development. He can prove to be an asset for the society by producing something more innovative schemes.
- Banking sector is another good option for students of science with good mathematical background.

Session 2022-23

### Syllabus

#### Proposed Structure of UG- Mathematics

Year	Sem.	Major1		
			Mathematics	Credits
2	Sem.3	P-5	Ordinary Differential Equations	4
		P-6	Mechanics	4
	Sem. 4	P-7	Mathematical Methods	4
		P-8	Linear & Abstract Algebra	4

#### Proposed structure of UG- Physics

Year	Semester	Name of the Paper	Credits
Second Year	III	P5 PHY301 Heat and Thermodynamics	4
		P6 PHY302 Perspectives of Quantum Physics	4
	IV	P7 PHY401 Electronics	4
		P8 PHY402 Heat and Electronics Lab	4

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### Proposed structure of UG- Chemistry of Semester III

Paper	Major Branch	Type	Credits	Total Credits
Paper 5 (P5)	Physical Chemistry 2	Theory	4	4
Paper 6 (P6)	Chemistry Practical 2	Practical	4	4

### Proposed structure of UG- Chemistry of Semester IV

Paper	Major Branch	Type	Credits	Total Credits
Paper 7 (P7)	Inorganic Chemistry 2	Theory	4	4
Paper 8 (P8)	Organic Chemistry 2	Theory	4	4

COURSE		PAPER No.	PAPER NAME	MARKS	CREDITS	
YEAR-3	SEM-V	<b>PHYSICS</b>				
		PAPER-1	ELECTRONICS	100	4	
		PAPER-2	NUCLEAR PHYSICS	100	4	
		PAPER-3	PRACTICAL PHYSICS	100	4	
		<b>CHEMISTRY</b>				
		PAPER-1	ORGANIC CHEMISTRY	100	4	
		PAPER-2	PHYSICAL CHEMISTRY	100	4	
		PAPER-3	PRACTICAL CHEMISTRY	100	4	
		<b>MATHEMATICS</b>				
		PAPER-1	NUMERICAL ANALYSIS	100	4	
		PAPER-2	LINEAR ABSTRACT ALGEBRA	100	4	
		PAPER-3	LINEAR PROGRAMMING	100	4	
	SEM-VI	<b>PHYSICS</b>				
		PAPER-1	MATHEMATICAL METHODS AND NUMERICAL TECHNIQUES	100	4	
		PAPER-2	ELEMENTS OF RELATIVISTIC AND CLASSICAL MECHANICS	100	4	
		PAPER-3	SOLID STATE PHYSICS	100	4	
		<b>CHEMISTRY</b>				
		PAPER-1	INORGANIC CHEMISTRY	100	4	
		PAPER-2	INORGANIC CHEMISTRY	100	4	
		PAPER-3	PHYSICAL AND ORGANIC CHEMISTRY	100	4	
		<b>MATHEMATICS</b>				
		PAPER-1	ANALYSIS	100	4	
		PAPER-2	DIFFERENTIAL GEOMETRY AND TENSOR ANALYSIS	100	4	
		PAPER-3	DISCRETE MATHEMATICS	100	4	

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## COURSE OUTCOMES

### SEMESTER III

#### MATHEMATICS

##### THEORY

##### Ordinary Differential Equations:

##### PAPER 5:

##### Course Outcomes:

- Formulate Differential Equations for various Mathematical models.
- Solve first order non-linear differential equation and linear differential equations of higher order using various techniques.
- Apply these techniques to solve and analyze various mathematical models.

##### THEORY

##### MECHANICS

##### PAPER 6:

##### Course outcome:

- The significance of mathematics involved in physical quantities and their uses.
- To understanding the various concepts of basic mechanics like simple harmonic motion, motion under other laws and forces.
- To study and to learn the cause-effect related to these.
- The applications in observing and relating real situations/structures.

#### PHYSICS

##### THEORY

##### HEAT AND THERMODYNAMICS

##### Paper: P5 PHY301

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### Course outcomes

- The students will understand the fundamental principles of thermodynamics, including the first and second laws.
- They would learn the idea of entropy and associated theorems, and the thermodynamic potentials and their physical meanings.
- Students will have an understanding of Maxwell's thermodynamic relations.
- They will acquire the knowledge about the fundamentals of gas kinetic theory and transport phenomenon.

### THEORY

#### Perspectives of Quantum Physics

Paper: P6 PHY302

#### COURSE OUTCOME

Study of the syllabus in Perspectives of Quantum Physics will have the following outcomes:

- It will help students understand the basics concepts of Quantum Physics.
- It will make students understand the development of quantum mechanics as a continuity of classical concepts and also as a leap jump from classical to quantum world of Physics.
- A student will be able to understand as to how the inadequacies of classical Physics were overcome by various concepts and theoretical developments of modern Physics i.e. Understand how major concepts developed and changed over time.
- A study of the Heisenberg's Uncertainty principle and its applications will make students understand the most modern concept of wave particle duality as to how a wave could behave like a particle and how a particle could behave like a wave.

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- An appreciation of the Schrödinger Wave Equation and its application to various problems in quantum mechanics will make students more analytical. This will give them the needed tool to solve problems across science subjects as Schrödinger equation appears in multidisciplinary subjects.
- It will make students capable of analyzing and solving problems using reasoning skills based on the concepts of modern physics.

**THEORY**

**Physical Chemistry 2**

**Paper 5**

**Course outcome:**

- **CO-1-** After the completion of the semester, student will acquire knowledge of first law and second law of thermodynamics, thermochemistry, entropy enthalpy etc.
- **CO-2-** It will also make them familiar with conductance, equivalent conductance, Kohlrausch's law, Ostwald dilution law, Debye-Huckel Onsager equation, e.m.f. of cell, types of cell, liquid junction potential, pH and pka, Henderson- Hazel equation etc.

**THEORY**

**Chemistry Practical 2**

**Paper 6 (P6)**

**Course Outcome:**

- **CO-1.** By interpreting the real gases, the student will be able to solve the problems.
- **CO-2.** Describes the ideal and real gases.
- **CO-3.** By interpreting some properties of liquids and solids, the student will be able to solve the problems.
- **CO-4.** Interpreting the phase equilibrium in simple systems, the student will be able to answer the questions.
- **CO-5.** Adopt distribution law to explain various phases.
- **CO-6.** By describing the ideal solution, the student will be able to recognize, use and compare the colligative



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properties.

- **CO-7.** Explain various reactions based on kinetics.
- **CO-8.** describe the kinds of solutions.

## SEMESTER IV

### THEORY

#### Mathematical Methods:

#### PAPER 7:

##### Course Outcomes:

- To develop mathematical skills in calculus and analysis.
- To get knowledge of Laplace Transforms and Fourier series.
- To get acquainted with the essentials of calculus of variations.

### THEORY

#### Linear & Abstract Algebra

#### PAPER 8:

##### Course Outcomes:

- The fundamental concept of Rings, Fields, subrings, integral domains and the corresponding morphisms.
- The concept of linear independence of vectors over a field, the idea of basis and the dimension of a vector space.
- Basic concepts of linear transformations, the Rank-Nullity Theorem, matrix of a linear transformation and the change of basis.
- Automorphisms for constructing new groups from the given group.
- Group actions, Sylow theorems and their applications to check non simplicity.

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- Compute inner products and determine orthogonality on vector spaces.

## PHYSICS THEORY

### Electronics

Paper: P7 PHY401

#### Course Outcomes:

The learning of this paper on electronics will enhance the understanding of the

- Utility of resonant circuits and AC bridges.
- The basic electronic devices and their applications.
- Transistor biasing.
- Concept of frequency response, bandwidth and audio amplifiers.
- Feedback circuits
- The importance of amplitude modulation and demodulation
- Applications of various electronic instruments.

## THEORY

### Heat and Electronics LAB

Paper: P8 PHY402

#### Course Outcomes:

- Experimental physics has the most striking impact on the industry wherever the instruments are used to determine the thermal and electronic properties.
- Measurement precision and perfection is achieved through Lab Experiments.
- Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

## CHEMISTRY

### THEORY

Inorganic Chemistry

Paper 7

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**Course outcome:**

- **CO-1** Chemistry of transition and inner-transition elements. These insights are important as they help in the rational selection of the cations of these elements for tailor-made syntheses of newer complexes
- **CO-2** Concepts of coordination chemistry and their applications
- **CO-3** Importance of different acid-base concepts which forms the basis of rational ligand designing and coordination complex formation for specific bio-inorganic, materials and optoelectronic applications.
- **CO-4** Importance and different chemical aspects of non-aqueous solvents which now-a-days are gaining importance in varied targeted syntheses of drugs and materials for technological applications

**THEORY**

**Organic Chemistry 2**

**Paper 8 (P8)**

**Course outcome**

The completion of this course enables the student to understand the subject initially

- **CO-1** The preparation and chemical reactions of Alcohols and Epoxides -Alcohols Dihydric alcohols: (Ethylene Glycol)
- **CO-2** Understanding the order of reactivity of different carboxylic acid derivatives and the reactivity of different carboxylic acid derivatives.
- **CO-3** Able to recognize structures of acid halides, esters, amides, acid anhydrides.
- **CO-4** Able to write down structure of phenol and phenoxide ion and chemical reactions of phenols.
- **CO-5** Know the mechanism of named reactions of carbonyl compounds and condensation reactions as well as

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their use in food and pharmaceuticals.

## SEMESTER V

### THEORY

#### NUCLEAR PHYSICS

##### PAPER CODE:

- Grasp the knowledge about basic nuclear properties and nuclear models for a better understanding of nuclear reaction dynamics.
- Analyze quantum mechanical phenomena in nuclear physics and develop an understanding of quantum mechanics also.
- Comprehend the general understanding of phenomena like nuclear fusion and fission and develop the skills required for solving basic problems in nuclear physics at different nuclear energy ranges.
- Develop the basic understanding of accelerator physics and particle detectors.
- Acquire and apply basic nuclear physics knowledge in subjects such as medicinal, archaeology, geology, and other multidisciplinary fields of Physics and Chemistry.

### PRACTICAL

#### PRACTICAL PHYSICS

##### PAPER CODE:

- The student will get an introduction to the discipline of optics and its role in daily life.
- The optics course will give the student a basic knowledge of interference, diffraction and polarization.
- The student will be able to analyze and calculate interference between light waves and application of the theory to various interferometers along with their practical applications.

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- The student would know the conditions for near and far-field diffraction and be able to calculate the far-field diffraction from gratings and simple aperture functions.
- The student would understand how the polarization of light changes at reflection and transmission at interfaces.

**THEORY  
ELECTRONICS  
PAPER CODE:**

- The student will understand about Utility of Zener Diode and Uni-junction Transistor.
- The student will be able to understand basic electronic devices and their applications.
- The student will be able to learn Transistor biasing.
- The student will understand the concept of frequency response, bandwidth and audio amplifiers.
- The student will be able to Feedback circuits.
- The student will be able to get the importance of amplitude modulation and demodulation.
- The student will understand the applications of various Logic Gates and Special Photonic Devices.

**THEORY  
NUMERICAL ANALYSIS  
PAPER CODE:**

- Understand solution of system of equations using various methods.
- Solution of linear and non-linear equations.
- Learns about boundary value problems and characteristic value problems.
- To describe matrix concept and linear equations.
- Identifies numerical differentiation.
- Evaluate numerical integrations.
- Understand the concept of difference equations.

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- Distinguish methods of Taylor series, Euler's, Modified Euler's and Runge Kutta methods to find solutions of differential equations.
- Estimates the numerical solutions of first order differential equations.

**THEORY**

**LINEAR & ABSTRACT ALGEBRA**

**PAPER CODE:**

- The fundamental concept of Rings, Fields, subrings, integral domains and the corresponding morphisms.
- The concept of linear independence of vectors over a field, the idea of basis and the dimension of a vector space.
- Basic concepts of linear transformations, the Rank-Nullity Theorem, matrix of a linear transformation and the change of basis.
- Automorphisms for constructing new groups from the given group.
- Group actions, Sylow theorems and their applications to check no simplicity.
- Compute inner products and determine orthogonality on vector spaces.

**THEORY**

**LINEAR PROGRAMMING PROBLEM**

**PAPER CODE:**

- Student will be able to understand the concept of linear programming problems and their basic feasible solutions.
- Student will be able to understand the concept of convex set and simplex method.
- Student will be able to discuss artificial variable with big M method, Two phase method and revised simplex method.
- Student will be able to discuss the problems of duality in linear programming problem, dual simplex method as well as particle dual method as well as primal dual method integer programming.

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## **THEORY**

### **ORGANIC CHEMISTRY:**

#### **PAPER CODE:**

- The organometallic compounds such as Grignard reagent which have been widely used on both laboratory and commercial scale and is one of the most common organometallic reagents used for the formation of carbon-carbon bonds. Organosulphur compounds which have therapeutic use and pharmacology.
- Understanding Carbohydrate, its classification and use in the food industry etc.
- Understand Protein, amino acid and peptides. Chemical structure of RNA and DNA.
- Determination of saponification value, acid value and iodine value of oil. Synthetic detergent.
- Various polymers, their method of polymerization and their use in industry.

## **THEORY**

### **PHYSICAL CHEMISTRY:**

#### **PAPER CODE:**

- After the completion of the semester student will acquire knowledge of introductory quantum mechanics, dipole moment and photochemistry. He will also be get familiar with dilute solutions, colligative properties and experimental methods of determining various colligative properties. He will learn the third law of thermodynamics, distribution law, phase rule and their derivation.

## **PRACTICAL**

### **PRACTICAL CHEMISTRY:**

#### **PAPER CODE:**

- Student will be able to synthesize different type of coordination compounds in laboratory like potassium trioxalatoferrate (III),  $K_3[Fe(C_2O_4)_3]$ , Ni-DMG

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complex,  $[\text{Ni}(\text{DMG})_2]$ , copper tetraamine complex,  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ , cis- and trans-bisoxalatodiaqua chromate (III) ion.

- Students will be able to verify Beer-Lambert law for  $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$  and determine the concentration of the given solution.
- Students will be able to determine of  $\text{Fe}^{3+}$  content by thiocyanate method and Separation and estimation of  $\text{Mg}(\text{II})$  and  $\text{Zn}(\text{II})$ . Chromatographic separation of metal ions
- Students will be able to separate and identify the mixture of two organic compounds and one step preparation.
- Students will be able to determine the strength of the given acid conductometrically using standard alkali solution.
- Students will be able to determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
- Students will be able to determine the ionization constant of a weak acid conductometrically.
- Students will be able to verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer.
- Students will be able to determine the specific rotation of cane sugar solution by polarimeter.
- Students will be able to determine of molecular weight of a non-volatile solute by Rast method/Beckmann freezing point method.
- Students will be able to determine the apparent molecular weight of non volatile solute at different concentration and determine Van't Hoff factor by ebullioscopy.

## SEMESTER-VI

### THEORY

#### INORGANIC CHEMISTRY:

#### PAPER CODE: PAPER-9

- Semi-modern concepts of metal ligand bonding in coordination complexes.
- Theories of electronic absorption and magnetic properties of coordination complexes The fine tuning these two very important parameter lead to the design and fabrication of compound, metal-organic frameworks, coordination polymers for optoelectronic and single-molecular magnets (SMM).



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### **THEORY**

#### **INORGANIC CHEMISTRY:**

##### **PAPER CODE: PAPER-10**

- Inorganic polymers viz. silicones which find applications in materials pharmaceutical industries and surgery too. Phosphazenes which in last couple of years had witnessed significant development as emerging smart materials.
- Class-a and class-b donor-acceptors, symbiotic relationship.
- Organometallic and bioinorganic concepts which in any of the previous semesters have not been accounted.

### **THEORY**

#### **ORGANIC & PHYSICAL CHEMISTRY:**

##### **PAPER CODE: PAPER-11**

- Infrared spectroscopy in which characteristic absorptions of various functional groups.
- Ultraviolet absorption spectroscopy, Beer Lambert Law, types of electronic transitions and the effect of conjugation and concept of chromophore and auxochrome.
- Nuclear magnetic resonance, interpretation of nmr spectra of simple organic molecule.
- Quantum mechanics as well as of spectroscopy. They will have comprehensive understanding of valence bond model and molecular orbital model.

### **THEORY**

#### **ELEMENTS OF RELATIVISTIC AND CLASSICAL MECHANICS**

##### **PAPER CODE:**

- Understand the frame of reference (Earth), different transformation equations, special theory of relativity given by Einstein, D' Alembert Principle, Lagrangian and Hamiltonian equation.

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- Understand the variation of mass with velocity, energy mass equivalence formula, rigid body problems and their solutions.
- Understand the reduced mass, inadequacy of classical mechanics, phase space, Inverse square Kepler's law, Liouville's theorem, ensembles, connection between different ensembles, thermodynamic quantities and classification of orbits.
- Understand the Maxwell Boltzmann statistics, Maxwell velocity distribution law, Fermi – Dirac and Bose – Einstein statistics, electron gas, Vander Wall's gas and Plank's oscillator.

**THEORY**

**SOLID STATE PHYSICS**

**PAPER CODE:**

- Understand the classification of crystal structure, Primitive vectors, lattice constant, miller indices, point groups and space groups, crystal structure of NaCl, CsCl, ZnS and Diamond.
- Understand the Packing fraction, Reciprocal lattice, spacing between lattice planes, Diffraction pattern in crystal structure, Brag's Law.
- Understand the lattice vibration, Laue method, Powder method, Band theory of solids, concept of holes, Bloch theorem.

**THEORY**

**MATHEMATICAL METHODS AND NUMERICAL TECHNIQUES**

**PAPER CODE:**

- Understand the measurement precision and perfection is achieved through Lab Experiments.
- Understand the the experiments in advance laboratory will enable students to be industry ready in the field of electronics.
- Understand the exposure to this laboratory will enable students to do research in applied optics and optoelectronics.

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- The students will be able to appreciate the concept of electronic communication.
- Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

**THEORY**

**MATHEMATICAL ANALYSIS:**

**PAPER CODE:**

- Understand the metric space, converges of series of arbitrary terms, uniform convergence of series of sequences and series of functions, Power series etc.
- Understand complex number as ordered pairs, Geometric representation of complex numbers and analytic function.
- Understand complex integration, Cauchy's Integral formula and mapping by elementary functions etc.
- Understand Residues theorem and expansion in series and singularities etc.

**THEORY**

**DIFFERENTIAL GEOMETRY & TENSOR ANALYSIS:**

**PAPER CODE:**

This course gives students basic knowledge of classical differential geometry of curves and surfaces. Among other students will learn and understand the particular interest of some curves and surfaces such as the catenary, the tractrix, the cycloid, the surfaces of constant Gaussian curvature and the minimal surfaces. After successful completion of the course students will be able to:

- Calculate the curvature and torsion of a curve.
- Find the moving trihedron of a curve and write its intrinsic and canonical equations.
- Find the osculating surface and the osculating curve at any point of a given curve.
- Calculate the first and the second fundamental forms of a surface.

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- Calculate the Gaussian curvature, the mean curvature, the curvature lines, the asymptotic lines, the geodesics of a surface. Use efficiently the mathematical tool of tensor calculus in the study of surfaces.
- Symmetric and antisymmetric tensors. Tensor fields. Stress and strain tensors. Hooke's law. Navier-Stokes equation.

## **THEORY**

### **DISCRETE MATHEMATICS:**

#### **PAPER CODE:**

- This course aims at introducing the concepts of lattices, Boolean algebras, switching circuits and graph theory. The course discusses some important applications of Boolean algebra and graph theory in real life situations through switching circuits and shortest path algorithms.