

# **Scheme of Instruction**

**of**

# **Bachelor of Science**

**(Physics, Chemistry & Mathematics)**

**(Based on NEP-2020)**

**(Effective from the academic session 2022-2023)**

Faculty of Science  
**Invertis University**  
NH-24, Bareilly-Lucknow Highway, Bareilly

## B.Sc. (PCM) First year

Semester-I								
Sl.No.	Lecture Type	Course Type	Course Code	Course Name	Teaching Scheme			
					L	T	P	Credit
1	Theory	Major	B010101T	Mathematical Physics & Newtonian Mechanics	4	0	0	4
2	Lab		B010102P	Mechanical Properties of Matter	0	0	2	2
3	Theory	Major	B020101T	Fundamentals of Chemistry	4	0	0	4
4	Lab		B020102P	Quantitative Analysis	0	0	2	2
5	Theory	Major	B030101T	Differential Calculus & Integral Calculus	4	0	0	4
6	Lab		B030102P	Calculus Lab	0	0	2	2
7	Theory	Vocational	V-I	Vocational Course will be selected from list offered by university.	3	0	0	3
8	Theory	Co-Curricular	Z010101T	Food, Nutrition and Hygiene	2	0	0	2
<b>Total</b>					<b>17</b>		<b>6</b>	<b>23</b>
Semester-II								
1	Theory	Major	B010201T	Thermal Physics & Semiconductor Devices	4	0	0	4
2	Lab		B010202P	Thermal Properties of Matter & Electronic Circuits	0	0	2	2
3	Theory	Major	B020201T	Bioorganic and Medicinal Chemistry	4	0	0	4
4	Lab		B020202P	Biochemical Analysis (Practical)	0	0	2	2
5	Theory	Major	B030201T	Matrices and Differential Equation & Geometry	6	0	0	6
6	Theory	Minor-1		Course offered by other faculty.	4	0	0	4
7	Theory	Vocational	V-II	Vocational Course will be selected from list offered by university.	3	0	0	3
8	Theory	Co-Curricular	Z020201	First Aid and Health	2	0	0	2
<b>Total</b>					<b>23</b>		<b>4</b>	<b>27</b>

**Note -** The examination of each course will be conducted based on 25 percent internal evaluation and 75 percent external evaluation.

## List of Vocational Courses

<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>1</b>	<b>0</b>	<b>2</b>	<b>3</b>

S.N.	CODE	Vocational Course Name	Nature
1	VOI001	Introduction of MS – Office (MS Word, MS Excel, MS Power Point)	Independent
2	VOI002	Mathematical Software- MATLAB, SPSS, Mathematica, Maple, LaTeX (Anyone)	Independent
3	VOI003	Chemical Technology & Society	Independent
4	VOI004	Pharmaceutical Chemistry	Independent
5	VOI005	Aquarium and fish keeping	Independent
6	VOI006	Apiculture	Independent
7	VOI007	Sericulture	Independent
8	VOI008	Retail Management	Independent
9	VOI011	Ethnobotany	Independent
10	VOI012	Intellectual Property Rights (IPR)	Independent
11	VOI012	MS Office and Networking	Independent
12	VOI012	Fundamentals Of Digital Marketing	Independent
13	VOI015	Banking and Finance	Independent
14	VOI016	Basic Computer Skill	Independent
15	VOI017	COMPREHENSIVE PROGRAM ON STOCK MARKET	Independent
16	VPA101	Handling of Electrical and Electronic Products.	Progressive
17	VPB101	Yoga Science	Progressive
18	VPC101	Multimedia and Animation	Progressive
19	VPD101	Agribusiness Management	Progressive
20	VPE101	COMPUTER OFFICE MANAGEMENT	Progressive
21	VPF101	Public Relation officer	Progressive
22	VPG101	TECHNOLOGY ADVANCEMENT BOOTCAMP	Progressive
23	VPH101	Electronics Technician	Progressive
24	VPI101	Domestic Data Entry Operator	Progressive
25	VPJ101	Yoga Instructor	Progressive

**Vocational course will be opted in I, II, III and IV Semester**

**List of Minor Courses offered by Faculty of Science  
(For students of other faculty)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

<b>S N</b>	<b>Minor Course</b>
FSM001	Fundamentals of Operation Research
FSM002	Public Health and Hygiene
FSM003	Biofertilizers
FSM004	Medicinal Botany
FSM005	Business Mathematics`
FSM006	Environmental Sciences

**Minor courses will be opted in II and IV Semester**

## PROGRAMME OUTCOMES (POs)

The practical value of science for productivity, for raising the standard of living of the people is surely recognized. Science as a power, which provides tools for effective action for the benefit of mankind or for conquering the forces of Nature or for developing resources, is surely highlighted everywhere. Besides the utilitarian aspect, the value of Science, lies in the fun called intellectual enjoyment. Science teaches the value of rational thought as well as importance of freedom of thought.

Our teaching so far has been aimed more at formal knowledge and understanding instead of training and application oriented. Presently, the emphasis is more on training, application and to some extent on appreciation, the fostering in the pupils of independent thinking and creativity. Surely, teaching has to be more objective based. The process of application-based training, whether we call it a thrill or ability, is to be emphasized as much as the content.

Science attempts to explain the natural phenomenon in as simple a manner as possible. It is an intellectual activity aimed at interpreting the Multiverse. The starting point of all sciences lies in experience. Experiment, whether done outside or in the laboratory, is an important ingredient of learning science and hence the present programme integrates experimental science papers focusing on various aspects of modern technology based equipments. With all the limitations imposed (even the list of experiments as given in the syllabus) if the spirit of discovery by investigation is kept in mind, much of the thrill can be experienced.

1. The main aim of this programme is to help cultivate the love for Nature and its manifestations, to transmit the methods of science (the contents are only the means) to observe things around, to generalize, to do intelligent guessing, to formulate a theory & model, and at the same time, to hold an element of doubt and thereby to hope to modify it in terms of future experience and thus to practice a pragmatic outlook.
2. The programme intends to nurture the proficiency in functional areas of sciences, which is in line with the international standards, aimed at realizing the goals towards skilled India.
3. Keeping the application-oriented training in mind; this programme aims to give students the competence in the methods and techniques of theoretical, experimental and computational aspects of sciences so as to achieve an overall understanding of the subjects for holistic development. This will cultivate in specific application-oriented training leading to their goals of employment.
4. The Bachelor's Project (Industrial Training / Survey / Dissertation) is intended to give an essence of research work for excellence in explicit areas. It integrates with specific job requirements / opportunities and provides a foundation for Bachelor (Research) Programmes.

**FIRST SEMESTER**  
**DETAILED SYLLABUS FOR**  
**CERTIFICATE**  
**IN**  
**BACHELOR OF SCIENCE**

## B010101T: Mathematical Physics & Newtonian Mechanics

Programme/Class: Certificate	Year: First	Semester: First
<b>Subject: Physics</b>		
Course Code: B010101T	Course Title: Mathematical Physics & Newtonian Mechanics	
<b>Course Outcomes (COs)</b>		
<ol style="list-style-type: none"> <li>1. Recognize the difference between scalars, vectors, pseudo-scalars and pseudo-vectors.</li> <li>2. Understand the physical interpretation of gradient, divergence and curl.</li> <li>3. Comprehend the difference and connection between Cartesian, spherical and cylindrical coordinate systems.</li> <li>4. Know the meaning of 4-vectors, Kronecker delta and Epsilon (Levi Civita) tensors.</li> <li>5. Study the origin of pseudo forces in rotating frame.</li> <li>6. Study the response of the classical systems to external forces and their elastic deformation.</li> <li>7. Understand the dynamics of planetary motion and the working of Global Positioning System (GPS).</li> <li>8. Comprehend the different features of Simple Harmonic Motion (SHM) and wave propagation.</li> </ol>		
Credits: 4	Core Compulsory / Elective	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	No. of Lectures
<b><u>PART A</u></b> <b>Basic Mathematical Physics</b>		
	Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).	
I	Vector Algebra Coordinate rotation, reflection and inversion as the basis for defining scalars, vectors, pseudo- scalars and pseudo-vectors (include physical examples). Component form in 2D and 3D. Geometrical and physical interpretation of addition, subtraction, dot product, wedge product, cross product and triple product of vectors. Position, separation and displacement vectors.	7
II	Vector Calculus Geometrical and physical interpretation of vector differentiation, Gradient, Divergence and Curl and their significance. Vector integration, Line, Surface (flux) and Volume integrals of vector fields. Gradient theorem, Gauss-divergence theorem, Stoke-curl theorem, Greens theorem and Helmholtz theorem (statement only). Introduction to Dirac delta function.	8

III	<p style="text-align: center;"><b>Coordinate Systems</b></p> <p>2D &amp; 3D Cartesian, Spherical and Cylindrical coordinate systems, basis vectors, transformation equations. Expressions for displacement vector, arc length, area element, volume element, gradient, divergence and curl in different coordinate systems. Components of velocity and acceleration in different coordinate systems. Examples of non-inertial coordinate system and pseudo-acceleration.</p>	8
IV	<p style="text-align: center;"><b>Introduction to Tensors</b></p> <p>Principle of invariance of physical laws w.r.t. different coordinate systems as the basis for defining tensors. Coordinate transformations for general spaces of nD, contravariant, covariant &amp; mixed tensors and their ranks, 4-vectors. Index notation and summation convention. Symmetric and skew-symmetric tensors. Invariant tensors, Kronecker delta and Epsilon (Levi Civita) tensors. Examples of tensors in physics.</p>	7
<p><b><u>PART B</u></b></p> <p><b>Newtonian Mechanics &amp; Wave Motion</b></p>		
V	<p style="text-align: center;"><b>Dynamics of a System of Particles</b></p> <p>Review of historical development of mechanics up to Newton. Background, statement and critical analysis of Newton's axioms of motion. Dynamics of a system of particles, centre of mass motion, and conservation laws &amp; their deductions. Rotating frames of reference, general derivation of origin of pseudo forces (Euler, Coriolis &amp; centrifugal) in rotating frame, and effects of Coriolis force.</p>	8
VI	<p style="text-align: center;"><b>Dynamics of a Rigid Body</b></p> <p>Angular momentum, Torque, Rotational energy and the inertia tensor. Rotational inertia for simple bodies (ring, disk, rod, solid and hollow sphere, solid and hollow cylinder, rectangular lamina). The combined translational and rotational motion of a rigid body on horizontal and inclined planes. Elasticity, relations between elastic constants, bending of beam and torsion of cylinder.</p>	8
VII	<p style="text-align: center;"><b>Motion of Planets &amp; Satellites</b></p> <p>Two particle central force problem, reduced mass, relative and centre of mass motion. Newton's law of gravitation, gravitational field and gravitational potential. Kepler's laws of planetary motion and their deductions. Motions of geo-synchronous &amp; geo-stationary satellites and basic idea of Global Positioning System (GPS).</p>	7
VIII	<p style="text-align: center;"><b>Wave Motion</b></p> <p>Differential equation of simple harmonic motion and its solution, use of complex notation, damped and forced oscillations, Quality factor. Composition of simple harmonic motion, Lissajous figures. Differential equation of wave motion. Plane progressive waves in fluid media, reflection of waves and phase change, pressure and energy distribution. Principle of superposition of waves, stationary waves, phase and group velocity.</p>	7
<p><b>Suggested Readings</b></p>		
<p><b>PART A</b></p>		
<ol style="list-style-type: none"> <li>Murray Spiegel, Seymour Lipschutz, Dennis Spellman, "Schaum's Outline Series: Vector Analysis", McGraw Hill, 2017, 2e</li> <li>A.W. Joshi, "Matrices and Tensors in Physics", New Age International Private Limited, 1995, 3e</li> </ol>		



**PART B**

1. Charles Kittel, Walter D. Knight, Malvin A. Ruderman, Carl A. Helmholz, Burton J. Moyer, “Mechanics (In SI Units): Berkeley Physics Course Vol 1”, McGraw Hill, 2017, 2e
2. Richard P. Feynman, Robert B. Leighton, Matthew Sands, “The Feynman Lectures on Physics - Vol. 1”, Pearson Education Limited, 2012
3. Hugh D. Young and Roger A. Freedman, “Sears & Zemansky's University Physics with Modern Physics”, Pearson Education Limited, 2017, 14e
4. D.S. Mathur, P.S. Hemne, “Mechanics”, S. Chand Publishing, 1981, 3e

Books published in Hindi & Other Reference / Text Books may be suggested / added to this list.

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology, <https://openlearning.mit.edu/>
2. National Programme on Technology Enhanced Learning (NPTEL), <https://www.youtube.com/user/nptelhrd>
3. Uttar Pradesh Higher Education Digital Library, <http://heecontent.upsdc.gov.in/SearchContent.aspx>
4. Swayam Prabha - DTH Channel, [https://www.swayamprabha.gov.in/index.php/program/current\\_he/8](https://www.swayamprabha.gov.in/index.php/program/current_he/8)

Course Prerequisites

Physics in 12<sup>th</sup> / Mathematics in 12<sup>th</sup>

This course can be opted as an Elective by the students of following subjects

Open to all

Suggested Continuous Internal Evaluation (CIE) Methods

20 marks for Test / Quiz / Assignment / Seminar  
05 marks for Class Interaction

Suggested Equivalent Online Courses

1. Swayam - Government of India, <https://swayam.gov.in/explorer?category=Physics>
2. National Programme on Technology Enhanced Learning (NPTEL), <https://nptel.ac.in/course.html>
3. Coursera, <https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy>
4. edX, <https://www.edx.org/course/subject/physics>
5. MIT Open Course Ware - Massachusetts Institute of Technology, <https://ocw.mit.edu/courses/physics/>

Further Suggestions

- Other Digital Platforms / Web Links and Equivalent Online Courses may be suggested / added to the respective lists.
- In End-Semester University Examinations, equal weightage should be given to Part A (units I to IV) and Part B (units V to VIII) while framing the questions.

**B010102P: Mechanical Properties of Matter**

Programme/Class: Certificate		Year: First	Semester: First
<b>Subject: Physics</b>			
Course Code: B010102P		Course Title: Mechanical Properties of Matter	
<b>Course Outcomes (COs)</b>			
Experimental physics has the most striking impact on the industry wherever the instruments are used to study and determine the mechanical 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.			
Credits: 2		Core Compulsory / Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4			
Unit	Topics		No. of Lectures
	<b>Lab Experiment List</b>		
	<ol style="list-style-type: none"> <li>1. Moment of inertia of a flywheel</li> <li>2. Moment of inertia of an irregular body by inertia table</li> <li>3. Modulus of rigidity by statistical method (Barton's apparatus)</li> <li>4. Modulus of rigidity by dynamical method (sphere / disc / Maxwell's needle)</li> <li>5. Young's modulus by bending of beam</li> <li>6. Young's modulus and Poisson's ratio by Searle's method</li> <li>7. Poisson's ratio of rubber by rubber tubing</li> <li>8. Surface tension of water by capillary rise method</li> <li>9. Surface tension of water by Jaeger's method</li> <li>10. Coefficient of viscosity of water by Poiseuille's method</li> <li>11. Acceleration due to gravity by bar pendulum</li> <li>12. Frequency of AC mains by Sonometer</li> <li>13. Height of a building by Sextant</li> <li>14. Study the wave form of an electrically maintained tuning fork / alternating current source with the help of cathode ray oscilloscope.</li> </ol>		60
	Online Virtual Lab Experiment List / Link		
	Virtual Labs at Amrita Vishwa Vidyapeetham <a href="https://vlab.amrita.edu/?sub=1&amp;brch=74">https://vlab.amrita.edu/?sub=1&amp;brch=74</a>		
	<ol style="list-style-type: none"> <li>1. Torque and angular acceleration of a flywheel</li> <li>2. Torsional oscillations in different liquids</li> <li>3. Moment of inertia of flywheel</li> <li>4. Newton's second law of motion</li> </ol>		

- |   |
|---|
| <ol style="list-style-type: none"> <li>5. Ballisticpendulum</li> <li>6. Collisionballs</li> <li>7. Projectilemotion</li> <li>8. Elastic and inelasticcollision</li> </ol> |
|---|

**Suggested Readings**

1. B.L. Worsnop, H.T. Flint, “Advanced Practical Physics for Students”, Methuen & Co., Ltd., London, 1962,9e
2. S. Panigrahi, B. Mallick, “Engineering Practical Physics”, Cengage Learning India Pvt. Ltd., 2015,1e
3. R.K. Agrawal, G. Jain, R. Sharma, “Practical Physics”, Krishna Prakashan Media (Pvt.) Ltd., Meerut,2019
4. S.L. Gupta, V. Kumar, “Practical Physics”, Pragati Prakashan, Meerut, 2014,2e

Books published in Hindi & Other Reference / Text Books  
may be suggested / added to this list.

**Suggestive Digital Platforms / Web Links**

1. Virtual Labs at Amrita Vishwa Vidyapeetham,<https://vlab.amrita.edu/?sub=1&brch=74>
2. DigitalPlatforms/WebLinksofother virtual labs maybesuggested /addedtothislistsbyindividualUniversities.

**Course Prerequisites**

Opted / Passed Semester I, Theory Paper-1 (B010101T)

This course can be opted as an Elective by the students of following  
subjects

Botany / Chemistry / Computer Science / Mathematics / Statistics / Zoology

**Suggested Continuous Internal Evaluation (CIE) Methods**

15 marks for Record File (depending upon the no. of experiments performed out of the total assigned experiments) 05 marks for Viva Voce  
05 marks for Class Interaction

**Suggested Equivalent Online Courses**

**Further Suggestions**

- The institution may add / modify / change the experiments of the same standard in the subject.
- The institution may suggest a minimum number of experiments (say 6) to be performed by each student per semester from the Lab Experiment List.
- The institution may suggest a minimum number of experiments (say 3) to be performed by each student per semester from the Online Virtual Lab Experiment List / Link.

## B020101T: Fundamentals of Chemistry

<b>Programme / Class: Certificate</b>	<b>Year: First</b>	<b>Semester: First</b>
<b>Subject: Chemistry</b>		
<b>Course Code: B020101T</b>	<b>Course title: Fundamentals of Chemistry</b>	
<p><b>Course outcomes:</b></p> <p>There is nothing more fundamental to chemistry than the chemical bond. Chemical bonding is the language of logic for chemists. Chemical bonding enables scientists to take the 100-plus elements of the periodic table and combine them in myriad ways to form chemical compounds and materials. Periodic trends, arising from the arrangement of the periodic table, provide chemists with an invaluable tool to quickly predict an element's properties. These trends exist because of the similar atomic structure of the elements within their respective group families or periods, and because of the periodic nature of the elements. Reaction mechanism gives the fundamental knowledge of carrying out an organic reaction in a step-by-step manner. This course will provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective. Students will gain an understanding of</p> <p>Molecular geometries, physical and chemical properties of the molecules.</p> <p>Current bonding models for simple inorganic and organic molecules in order to predict structures and important bonding parameters.</p> <p>The chapter Recapitulation of basics of organic chemistry gives the most primary and utmost important knowledge and concepts of organic Chemistry.</p> <p>This course gives a broader theoretical picture in multiple stages in an overall chemical reaction. It describes reactive intermediates, transition states and states of all the bonds broken and formed. It enables to understand the reactants, catalyst, stereochemistry and major and minor products of any organic reaction.</p> <p>It describes the types of reactions and the Kinetic and thermodynamic aspects one should know for carrying out any reaction and the ways how the reaction mechanism can be determined.</p> <p>The chapters Stereochemistry gives the clear picture of two-dimensional and three-dimensional structure of the molecules, and their role in reaction mechanism.</p>		
<b>Credits: 4</b>	<b>Compulsory</b>	
<b>Max. Marks: 25+75</b>	<b>Min. Passing Marks: As per rule</b>	
<b>Total No. of Lectures = 60</b>		
<b>Unit</b>	<b>Topics</b>	<b>No. of Lectures</b>
<b>I</b>	Introduction to Indian ancient Chemistry and contribution of Indian Chemists, in context to the holistic development of modern science and technology, should be included under Continuous Evaluation (CIE)	<b>10</b>
	<p><b>Molecular polarity and Weak Chemical Forces:</b></p> <p>Resonance and resonance energy, formal charge, Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, dipole moment and molecular Structure (Diatomic and polyatomic molecules), Percentage ionic character from dipole moment, polarizing power and polarizability. Fajan's rules and consequences of polarization. Hydrogen bonding, van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction.</p>	

<b>II</b>	<p><b>Simple Bonding theories of Molecules</b>            Atomic orbitals, Aufbau principle, multiple bonding (<math>\sigma</math> and <math>\pi</math> bond approach) and bond lengths, the valence bond theory (VBT), Concept of hybridization, hybrid orbitals and molecular geometry, Bent's rule, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H<sub>2</sub>O, NH<sub>3</sub>, PCl<sub>5</sub>, SF<sub>6</sub>, SF<sub>4</sub>, - + ClF<sub>3</sub>, I<sub>3</sub> , and H<sub>3</sub>O . Molecular orbital theory (MOT). Molecular orbital diagrams bond orders of homonuclear and heteronuclear diatomic molecules and ions (N<sub>2</sub>, O<sub>2</sub>, C<sub>2</sub>, B<sub>2</sub>, F<sub>2</sub>, CO, NO, and their ions)</p>	<b>10</b>
<b>III</b>	<p><b>Periodic properties of Atoms (with reference to s &amp; p-block):</b>            Brief discussion, factors affecting and variation trends of following properties in groups and periods. Effective nuclear charge, shielding or screening effect, Slater rules, Atomic and ionic radii, Electronegativity, Pauling's/ Allred Rochow's scales, Ionization enthalpy, Electron gain enthalpy.</p>	<b>05</b>
<b>IV</b>	<p><b>Recapitulation of basics of Organic Chemistry:</b> Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, Van der Waals interactions, inclusion compounds, Clathrates, Charge transfer complexes, hyperconjugation, Dipole moment; Electronic Displacements: Inductive, electromeric, resonance mesomeric effects and their applications</p>	<b>05</b>
<b>V</b>	<p><b>Mechanism of Organic Reactions:</b> Curved arrow notation, drawing electron movements with allows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations. Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples).</p>	<b>10</b>
<b>VI</b>	<p><b>Stereochemistry</b>-Concept of isomerism, Types of isomerism; Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomer, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D &amp; L and R &amp; S systems of nomenclature. Geometric isomerism – determination of configuration of geometric isomers, E &amp; Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism – conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae, Difference between configuration and conformation.</p>	<b>10</b>
<b>VII</b>	<p><b>Basic Computer system (in brief)</b>-Hardware and Software; Input devices, Storage devices, Output devices, Central Processing Unit (Control Unit and Arithmetic Logic Unit); Number system (Binary, Octal and Hexadecimal Operating System); Computer Codes (BCD and ASCII); Numeric/String constants and variables. Operating Systems (DOS, WINDOWS, and Linux); Introduction of Software languages: Low level and High Level languages (Machine language, Assembly language; QBASIC, FORTRAN) Software Products (Office, chemsketch, scilab, matlab, hyperchem, etc.), internet application.</p>	<b>05</b>

<b>VIII</b>	<p><b>Mathematical Concepts for Chemistry</b></p> <p>Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like <math>Kx</math>, <math>e^x</math>, <math>X^n</math>, <math>\sin x</math>, <math>\log x</math>; maxima and minima, partial differentiation and reciprocity relations, Integration of some useful/relevant functions; permutations and combinations, Factorials, Probability.</p>	<b>05</b>
<p><b>Suggested Readings:</b></p> <p>Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010</p> <p>Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.</p> <p>Douglas, B.E. and Mc Daniel, D.H., Concepts &amp; Models of Inorganic Chemistry, Oxford, 1970</p> <p>Shriver, D.D. &amp; P. Atkins, <i>Inorganic Chemistry 2nd Ed.</i>, Oxford University Press, 1994.</p> <p>Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.</p> <p>Singh J., Yadav L.D.S., Advanced Organic Chemistry, Pragati Edition</p> <p>Morrison, R. N. &amp; Boyd, R. N. <i>Organic Chemistry</i>, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).</p> <p>Carey, F. A., Giuliano, R. M. <i>Organic Chemistry</i>, Eighth edition, McGraw Hill Education, 2012.</p> <p>Loudon, G. M. <i>Organic Chemistry</i>, Fourth edition, Oxford University Press, 2008.</p> <p>Clayden, J., Greeves, N. &amp; Warren, S. <i>Organic Chemistry</i>, 2<sup>nd</sup> edition, Oxford University Press, 2012.</p> <p>Graham Solomons, T.W., Fryhle, C. B. <i>Organic Chemistry</i>, John Wiley &amp; Sons, Inc.</p> <p>Sykes, P. <i>A guidebook to Mechanism in Organic Chemistry</i>, Pearson Education, 2003</p> <p>Francis, P. G. Mathematics for Chemists, Springer, 1984</p> <p><b>Note:</b> For the promotion of Hindi language, course books published in Hindi may be prescribed by the University</p> <p><b>Suggested online links:</b></p> <p><a href="http://heecontent.upsdc.gov.in/Home.aspx">http://heecontent.upsdc.gov.in/Home.aspx</a></p> <p><a href="https://nptel.ac.in/courses/104/106/104106096/">https://nptel.ac.in/courses/104/106/104106096/</a></p> <p><a href="http://heecontent.upsdc.gov.in/Home.aspx">http://heecontent.upsdc.gov.in/Home.aspx</a></p> <p><a href="https://nptel.ac.in/courses/104/106/104106096/">https://nptel.ac.in/courses/104/106/104106096/</a></p> <p><a href="https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm">https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm</a></p> <p><a href="https://nptel.ac.in/courses/104/103/104103071/#">https://nptel.ac.in/courses/104/103/104103071/#</a></p>		
<p><b>This course is compulsory for the students of following subjects: Chemistry in 12<sup>th</sup> Class</b></p>		
<p><b>Suggested Continuous Evaluation Methods:</b> Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others .</p>		
<p>Assessment and presentation of Assignment</p>		10 marks
<p>04 tests (Objective): Max marks of each test = 10(average of all 04 tests)</p>		10 marks
<p>Overall performance throughout the semester, Discipline, participation in different activities)</p>		05 marks
		<b>25</b>
<p><b>Course prerequisites: To study this course, a student must have had the chemistry in class 12<sup>th</sup></b></p>		
<p><b>Suggested equivalent online courses:</b></p>		
<p><b>Further Suggestions:</b></p>		

## B020102P: Quantitative Analysis

<b>Programme: Certificate</b>	<b>Year: First</b>	<b>Semester: First</b>
<b>Subject: Chemistry</b>		
<b>Course Code: B020102P</b>	<b>Course Title: Quantitative Analysis</b>	
<b>Course outcomes:</b> Upon completion of this course the students will have the knowledge and skills to: understand the laboratory methods and tests related to estimation of metals ions and estimation of acids and alkali contents in commercial products. <ul style="list-style-type: none"> <li>• Potability tests of water samples.</li> <li>• Estimation of metal ions in samples</li> <li>• Estimation of alkali and acid contents in samples</li> <li>• Estimation of inorganic salts and hydrated water in samples</li> </ul>		
<b>Credits: 2</b>	<b>Elective</b>	
<b>Max. Marks: 25+75 = 100</b>	<b>Min. Passing Marks: As per rule</b>	
<b>Total lectures=60 h</b>		
Unit	Topics	No of Lectures
<b>I</b>	<b>Water Quality analysis</b> 1. Estimation of hardness of water by EDTA. 2. Determination of chemical oxygen demand (COD). 3. Determination of Biological oxygen demand (BOD).	<b>16</b>
<b>II</b>	<b>Estimation of Metals ions</b> 1. Estimation of ferrous and ferric by dichromate method. 2. Estimation of copper using thiosulphate.	<b>14</b>
<b>III</b>	<b>Estimation of acids and alkali contents</b> 1. Determination of acetic acid in commercial vinegar using NaOH. 2. Determination of alkali content – antacid tablet using HCl. 3. Estimation of oxalic acid by titrating it with KMnO <sub>4</sub> .	<b>14</b>
<b>IV</b>	<b>Estimation of inorganic salts and hydrated water</b> 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. 2. Estimation of calcium content in chalk as calcium oxalate by permanganometry. 3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO <sub>4</sub> .	<b>16</b>

**Suggested Readings:**

1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
2. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.
3. Harris, D.C. *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
4. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
5. Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition

**Note:** For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

**Suggestive digital platforms web links**

6. <https://www.labster.com/chemistry-virtual-labs/>
7. <https://www.vlab.co.in/broad-area-chemical-sciences>
8. <http://chemcollective.org/vlabs>

**This course can be opted as an elective by the students of following subjects: Chemistry in 12<sup>th</sup> Class**

**Suggested Continuous Evaluation Methods:**

Viva voce	10 marks
Mock test	10 marks
Overall performance	05marks
	<b>25</b>

**Course prerequisites: To study this course, a student must have had the chemistry in 12<sup>th</sup> Class**

Suggested equivalent online courses:

Further Suggestions:



### B030101T: Differential Calculus & Integral Calculus

Programme: Certificate Class: B.Sc.	Year: First	First Semester
<b>Subject: Mathematics</b>		
Course Code: B030101T	Course Title: Differential Calculus & Integral Calculus	
<b>Course outcomes:</b>		
CO1: The programme outcome is to give foundation knowledge for the students to understand basics of mathematics including applied aspect for developing enhanced quantitative skills and pursuing higher mathematics and research as well.		
CO2: By the time students complete the course they will have wide ranging application of the subject and have the knowledge of real valued functions such as sequence and series. They will also be able to know about convergence of sequence and series. Also, they have knowledge about curvature, envelope and evolutes and trace curve in polar, Cartesian as well as parametric curves.		
CO3: The main objective of the course is to equip the student with necessary analytic and technical skills. By applying the principles of integral he learns to solve a variety of practical problems in science and engineering.		
CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking more advance level course in mathematics.		
Credits: 4	Core Compulsory / Elective	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
<b>Part- A</b> <b>Differential Calculus</b>		
Unit	Topics	No. of Lectures
I	Introduction to Indian ancient Mathematics and Mathematicians should be included under Continuous Internal Evaluation (CIE). Definition of a sequence, theorems on limits of sequences, bounded and monotonic sequences, Cauchy's convergence criterion, Cauchy sequence, limit superior and limit inferior of a sequence, subsequence, Series of non-negative terms, convergence and divergence, Comparison tests, Cauchy's integral test, Ratio tests, Root test, Raabe's logarithmic test, de Morgan and Bertrand's tests, alternating series, Leibnitz's theorem, absolute and conditional convergence.	9
II	Limit, continuity and differentiability of function of single variable, Cauchy's definition, Heine's definition, equivalence of definition of Cauchy and Heine, Uniform continuity, Borel's theorem, boundedness theorem, Bolzano's theorem, Intermediate value theorem, extreme value theorem, Darboux's intermediate value theorem for derivatives, Chain rule, indeterminate forms.	7
III	Rolle's theorem, Lagrange and Cauchy Mean value theorems, mean value theorems of higher order, Taylor's theorem with various forms of remainders, Successive differentiation, Leibnitz theorem, Maclaurin's and Taylor's series, Partial differentiation, Euler's theorem on homogeneous function.	7
IV	Tangent and normals, Asymptotes, Curvature, Envelops and evolutes, Tests for concavity and convexity, Points of inflexion, Multiple points, Parametric representation of curves and tracing of parametric curves, Tracing of curves in Cartesian and Polar forms.	7

<b>Part-B</b>		
<b>Integral Calculus</b>		
<b>Unit</b>	<b>Topics</b>	<b>No. of Lectures</b>
V	Definite integrals as limit of the sum, Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Differentiation under the sign of Integration.	9
VI	Improper integrals, their classification and convergence, Comparison test, $\mu$ -test, Abel's test, Dirichlet's test, quotient test, Beta and Gamma functions.	7
VII	Rectification, Volumes and Surfaces of Solid of revolution, Pappus theorem, Multiple integrals, change of order of double integration, Dirichlet's theorem, Liouville's theorem for multiple integrals.	7
VIII	Vector Differentiation, Gradient, Divergence and Curl, Normal on a surface, Directional Derivative, Vector Integration, Theorems of Gauss, Green, Stokes and related problems.	7
<p style="text-align: center;"><b>Suggested Readings (Part- A Differential Calculus):</b></p> <ol style="list-style-type: none"> <li>1. R.G. Bartle &amp; D.R. Sherbert, Introduction to Real Analysis, John Wiley &amp; Sons</li> <li>2. T.M. Apostol, Calculus Vol. I, John Wiley &amp; Sons Inc.</li> <li>3. S. Balachandra Rao &amp; C. K. Shantha, Differential Calculus, New Age Publication.</li> <li>4. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.</li> <li>5. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.</li> <li>6. Suggestive digital platforms web links: NPTEL/SWAYAM/MOOCs</li> <li>7. Course Books published in Hindi may be prescribed by the Universities.</li> </ol> <p style="text-align: center;"><b>Suggested Readings (Part-B Integral Calculus):</b></p> <ol style="list-style-type: none"> <li>1. T.M. Apostol, Calculus Vol. II, John Wiley Publication</li> <li>2. Shanti Narayan &amp; Dr. P.K. Mittal, Integral Calculus, S.Chand</li> <li>3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley &amp; Sons.</li> <li>4. Suggestive digital platforms web links: NPTEL/SWAYAM/MOOCs</li> <li>5. Course Books published in Hindi may be prescribed by the Universities.</li> </ol>		
This course can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Chemistry/Biochemistry/Life Sciences(UG), Economics(UG/PG), Commerce(UG), BBA/BCA, B.Sc.(C.S.)		
Suggested Continuous Evaluation Methods: Max. Marks: 25		
<b>SN</b>	<b>Assessment Type</b>	<b>Max. Marks</b>
1	Class Tests	10
2	Online Quizzes/ Objective Tests	5
3	Presentation	5
4	Assignment (Introduction to Indian ancient Mathematics and Mathematicians).	5
Course prerequisites: To study this course, a student must have subject Mathematics in class 12 <sup>th</sup>		

**B030102P: Calculus Lab**

Programme: Certificate Class: B.A./B.Sc.	Year: First
<b>Subject: Mathematics</b>	
Course Code: B030102P	Course Title: Practical
<p>Course outcomes:</p> <p>CO1: The main objective of the course is to equip the student to plot the different graph and solve the different types of equations by plotting the graph using different computer software such as Mathematica /MATLAB /Maple /Scilab/Maxima etc.</p> <p>CO2. After completion of this course student would be able to know the convergence of sequences through plotting, verify Bolzano-Weierstrass theorem through plotting the sequence, Cauchy's root test by plotting <math>n^{\text{th}}</math> roots and Ratio test by plotting the ratio of <math>n^{\text{th}}</math> and <math>(n + 1)^{\text{th}}</math> term.</p> <p>CO3. Student would be able to plot Complex numbers and their representations, Operations like addition, subtraction, Multiplication, Division, Modulus and Graphical representation of polar form.</p> <p>CO4: Student would be able to perform following task of matrix as Addition, Multiplication, Inverse, Transpose, Determinant, Rank, Eigenvectors, Eigenvalues, Characteristic equation and verification of the Cayley-Hamilton theorem, Solving the systems of linear equations.</p>	
Credits: 2	
Max. Marks: 25+75	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4	
Unit	
Topics	
(i) $ax$	
(ii) $[x]$ (greatest integer function)	
(iii) $x^{2n}$ ; $n \in \mathbb{N}$	
(iv) $x^{2n-1}$ ; $n \in \mathbb{N}$	
(v) $x^{2n-1}$ ; $n \in \mathbb{N}$	

**SECOND SEMESTER**  
**DETAILED SYLLABUS FOR**  
**CERTIFICATE**  
**IN**  
**BACHELOR OF SCIENCE**

## B010201T: Thermal Physics & Semiconductor Devices

Programme/Class: Certificate	Year: First	Semester: Second
<b>Subject: Physics</b>		
Course Code: B010201T	Course Title: Thermal Physics & Semiconductor Devices	
Course Outcomes (COs)		
<ol style="list-style-type: none"> <li>1. Recognize the difference between reversible and irreversible processes.</li> <li>2. Understand the physical significance of thermodynamical potentials.</li> <li>3. Comprehend the kinetic model of gases w.r.t. various gas laws.</li> <li>4. Study the implementations and limitations of fundamental radiation laws.</li> <li>5. Utility of AC bridges.</li> <li>6. Recognize the basic components of electronic devices.</li> <li>7. Design simple electronic circuits.</li> <li>8. Understand the applications of various electronic instruments.</li> </ol>		
Credits: 4	Core Compulsory / Elective	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
<b>Unit</b>	<b>Topics</b>	<b>No. of Lectures</b>
<b><u>PART A</u></b> Thermodynamics & Kinetic Theory of Gases		
I	<p style="text-align: center;">0<sup>th</sup> &amp; 1<sup>st</sup> Law of Thermodynamics</p> <p>State functions and terminology of thermodynamics. Zeroth law and temperature. First law, internal energy, heat and work done. Work done in various thermodynamical processes. Enthalpy, relation between CP and CV. Carnot's engine, efficiency and Carnot's theorem. Efficiency of internal combustion engines (Otto and diesel).</p>	8
II	<p style="text-align: center;">2<sup>nd</sup> &amp; 3<sup>rd</sup> Law of Thermodynamics</p> <p>Different statements of second law, Clausius inequality, entropy and its physical significance. Entropy changes in various thermodynamical processes. Third law of thermodynamics and unattainability of absolute zero. Thermodynamical potentials, Maxwell's relations, conditions for feasibility of a process and equilibrium of a system. Clausius- Clapeyron equation, Joule-Thompson effect.</p>	8
III	<p style="text-align: center;">Kinetic Theory of Gases</p> <p>Kinetic model and deduction of gas laws. Derivation of Maxwell's law of distribution of velocities and its experimental verification. Degrees of freedom, law of equipartition of energy (no derivation) and its application to specific heat of gases (mono, di and poly atomic).</p>	7
IV	<p style="text-align: center;">Theory of Radiation</p> <p>Black body radiation, spectra distribution, concept of energy density and pressure of radiation. Derivation of Planck's law, deduction of Wien's distribution law, Rayleigh-Jeans law, Stefan- Boltzmann law and Wien's displacement law from Planck's law.</p>	7

<u>PART B</u>		
Circuit Fundamentals & Semiconductor Devices		
V	<b>DC &amp; AC Circuits</b> Growth and decay of currents in RL circuit. Charging and discharging of capacitor in RC, LC and RCL circuits. Network Analysis - Superposition, Reciprocity, Thevenin's and Norton's theorems. AC Bridges - measurement of inductance (Maxwell's, Owen's and Anderson's bridges) and measurement of capacitance (Schering's, Wein's and de Sauty's bridges).	7
VI	<b>Semiconductors &amp; Diodes</b> P and N type semiconductors, qualitative idea of Fermi level. Formation of depletion layer in PN junction diode, field & potential at the depletion layer. Qualitative idea of current flow mechanism in forward & reverse biased diode. Diode fabrication. PN junction diode and its characteristics, static and dynamic resistance. Principle, structure, characteristics and applications of Zener, Tunnel, Light Emitting, Point Contact and Photo diodes. Half and Full wave rectifiers, calculation of ripple factor, rectification efficiency and voltage regulation. Basic idea about filter circuits and voltage regulated power supply.	8
VII	<b>Transistors</b> Bipolar Junction PNP and NPN transistors. Study of CB, CE & CC configurations w.r.t. active, cutoff & saturation regions; characteristics; current, voltage & power gains; transistor currents & relations between them. Idea of base width modulation, base spreading resistance & transition time. DC Load Line analysis and Q-point stabilisation. Voltage Divider Bias circuit for CE amplifier. Qualitative discussion of RC coupled amplifier (frequency response not included).	8
VIII	<b>Electronic Instrumentation</b> Multimeter: Principles of measurement of dc voltage, dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, electron gun, electrostatic focusing and acceleration (no mathematical treatment). Front panel controls, special features of dual trace CRO, specifications of a CRO and their significance. Applications of CRO to study the waveform and measurement of voltage, current, frequency & phase difference.	7
Suggested Readings		

PART A

1. M.W. Zemansky, R. Dittman, “Heat and Thermodynamics”, McGraw Hill, 1997,7e
2. F.W. Sears, G.L. Salinger, “Thermodynamics, Kinetic theory & Statistical thermodynamics”, Narosa Publishing House, 1998
3. Enrico Fermi, “Thermodynamics”, Dover Publications,1956
4. S. Garg, R. Bansal, C. Ghosh, “Thermal Physics”, McGraw Hill, 2012,2e
5. Meghnad Saha, B.N. Srivastava, “A Treatise on Heat”, Indian Press, 1973,5e

PART B

1. R.L. Boylestad, L. Nashelsky, “Electronic Devices and Circuit Theory”, Prentice-Hall of India Pvt. Ltd., 2015,11e
2. J. Millman, C.C. Halkias, Satyabrata Jit, “Electronic Devices and Circuits”, McGraw Hill, 2015,4e
3. B.G. Streetman, S.K. Banerjee, “Solid State Electronic Devices”, Pearson Education India, 2015,7e
4. J.D. Ryder, “Electronic Fundamentals and Applications”, Prentice-Hall of India Private Limited, 1975,5e
5. A. Sudhakar, S.S. Palli, “Circuits and Networks: Analysis and Synthesis”, McGraw Hill, 2015,5e
6. S.L. Gupta, V. Kumar, “Hand Book of Electronics”, Pragati Prakashan, Meerut, 2016,43e

Books published in Hindi & Other Reference / Text Books  
may be suggested / added to this list.

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology, <https://openlearning.mit.edu/>
2. National Programme on Technology Enhanced Learning (NPTEL), <https://www.youtube.com/user/nptelhrd>
3. Uttar Pradesh Higher Education Digital Library, <http://heecontent.upsdc.gov.in/SearchContent.aspx>
4. Swayam Prabha - DTH Channel, [https://www.swayamprabha.gov.in/index.php/program/current\\_he/8](https://www.swayamprabha.gov.in/index.php/program/current_he/8)

Course Prerequisites

Physics in 12<sup>th</sup> / Chemistry in 12<sup>th</sup>

This course can be opted as an Elective by the students of following  
subjects

Open to all

Suggested Continuous Internal Evaluation (CIE) Methods

20 marks for Test / Quiz / Assignment /  
Seminar 05 marks for Class Interaction

Suggested Equivalent Online Courses

1. Swayam - Government of India, <https://swayam.gov.in/explorer?category=Physics>
2. National Programme on Technology Enhanced Learning (NPTEL), <https://nptel.ac.in/course.html>
3. Coursera, <https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy>
4. edX, <https://www.edx.org/course/subject/physics>
5. MIT Open Course Ware - Massachusetts Institute of Technology, <https://ocw.mit.edu/courses/physics/>

Further Suggestions

- Other Digital Platforms / Web Links and Equivalent Online Courses may be suggested / added to the respective lists.
- In End-Semester University Examinations, equal weightage should be given to Part A (units I to IV) and Part B (units V to VIII) while framing the questions.

## B010202P: Thermal Properties of Matter & Electronic Circuits

Programme/Class: Certificate	Year: First	Semester: Second
Subject: Physics		
Course Code: B010202P	Course Title: Thermal Properties of Matter & Electronic Circuits	
Course Outcomes (COs)		
<p>Experimental physics has the most striking impact on the industry wherever the instruments are used to study and 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.</p>		
Credits: 2	Core Compulsory / Elective	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4		
Unit	Topics	No. of Lectures
	Lab Experiment List	
	<ol style="list-style-type: none"> <li>1. Mechanical Equivalent of Heat by Callender and Barne's method</li> <li>2. Coefficient of thermal conductivity of copper by Searle's apparatus</li> <li>3. Coefficient of thermal conductivity of rubber</li> <li>4. Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method</li> <li>5. Value of Stefan's constant</li> <li>6. Verification of Stefan's law</li> <li>7. Variation of thermo-emf across two junctions of a thermocouple with temperature</li> <li>8. Temperature coefficient of resistance by Platinum resistance thermometer</li> <li>9. Charging and discharging in RC and RCL circuits</li> <li>10. A.C. Bridges: Various experiments based on measurement of L and C</li> <li>11. Resonance in series and parallel RCL circuit</li> <li>12. Characteristics of PN Junction, Zener, Tunnel, Light Emitting and Photo diode</li> <li>13. Characteristics of a transistor (PNP and NPN) in CE, CB and CC configurations</li> <li>14. Half wave &amp; full wave rectifiers and Filter circuits</li> <li>15. Unregulated and Regulated power supply</li> <li>16. Various measurements with Cathode Ray Oscilloscope (CRO)</li> </ol>	60
	Online Virtual Lab Experiment List / Link	
	Thermal Properties of Matter: Virtual Labs at Amrita Vishwa Vidyapeetham <a href="https://vlab.amrita.edu/?sub=1&amp;brch=194">https://vlab.amrita.edu/?sub=1&amp;brch=194</a> <ol style="list-style-type: none"> <li>1. Heat transfer by radiation</li> <li>2. Heat transfer by conduction</li> <li>3. Heat transfer by natural convection</li> <li>4. The study of phase change</li> <li>5. Black body radiation: Determination of Stefan's constant</li> </ol>	



6. Newton's law of cooling 7. Lee's disc apparatus 8. Thermo-couple: Seebeck effects	
Semiconductor Devices: Virtual Labs an initiative of MHRD Govt. of India <a href="http://vlabs.iitkgp.ac.in/be/#">http://vlabs.iitkgp.ac.in/be/#</a>	
9. Familiarisation with resistor 10. Familiarisation with capacitor 11. Familiarisation with inductor 12. Ohm's Law 13. RC Differentiator and integrator 14. VI characteristics of a diode 15. Half & Full wave rectification 16. Capacitative rectification 17. Zener Diode voltage regulator 18. BJT common emitter characteristics 19. BJT common base characteristics 20. Studies on BJT CE amplifier	
<b>Suggested Readings</b>	
1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e 2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e 3. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015, 11e 4. A. Sudhakar, S.S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 2015, 5e	
Books published in Hindi & Other Reference / Text Books may be suggested / added to this list.	
<b>Suggestive Digital Platforms / Web Links</b>	
1. Virtual Labs at Amrita Vishwa Vidyapeetham, <a href="https://vlab.amrita.edu/?sub=1&amp;brch=194">https://vlab.amrita.edu/?sub=1&amp;brch=194</a> 2. Virtual Labs an initiative of MHRD Govt. of India, <a href="http://vlabs.iitkgp.ac.in/be/#">http://vlabs.iitkgp.ac.in/be/#</a> 3. Digital Platforms /Web Links of other virtual labs may be suggested / added to this lists by individual Universities.	
<b>Course Prerequisites</b>	
Opted / Passed Semester II, Theory Paper-1 (B010201T)	
This course can be opted as an Elective by the students of following subjects	
Botany / Chemistry / Computer Science / Mathematics / Statistics / Zoology	
<b>Suggested Continuous Internal Evaluation (CIE) Methods</b>	
15 marks for Record File (depending upon the no. of experiments performed out of the total assigned experiments) 05 marks for Viva Voce 05 marks for Class Interaction	
<b>Suggested Equivalent Online Courses</b>	
<b>Further Suggestions</b>	

- The institution may add / modify / change the experiments of the same standard in the subject.
- The institution may suggest a minimum number of experiments (say 6) to be performed by each student per semester from the Lab Experiment List.
- The institution may suggest a minimum number of experiments (say 3) to be performed by each student per semester from the Online Virtual Lab Experiment List / Link.

## B020201T: Bioorganic and Medicinal Chemistry

Programme / Class: Certificate	Year: First	Semester: Second
<b>Subject: Chemistry</b>		
Course Code: B020201T	Course Title: Bioorganic and Medicinal Chemistry	
<p><b>Course outcomes:</b> Biomolecules are important for the functioning of living organisms. These molecules perform or trigger important biochemical reactions in living organisms. When studying biomolecules, one can understand the physiological function that regulates the proper growth and development of a human body. This course aims to introduce the students with basic experimental understanding of carbohydrates, amino acids, proteins, nucleic acids and medicinal chemistry. Upon completion of this course students may get job opportunities in food, beverage and pharmaceutical industries.</p>		
<b>Credits: 4</b>	<b>Elective</b>	
<b>Max. Marks: 25+75</b>	<b>Min. Passing Marks: As per rule</b>	
<b>Total No. of Lectures = 60</b>		
Unit	Topics	No. of Lectures
<b>I</b>	<p><b>Chemistry of Carbohydrates:</b> Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Mechanism of mutarotation. Determination of configuration of Glucose (Fischer's proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Inter conversions of sugars (ascending and descending of sugar series, conversion of aldoses to ketoses). Lobry de Bruyn-van Ekenstein rearrangement; stepping-up (Kiliani-Fischer method) and stepping-down (Ruff's &amp; Wohl's methods) of aldoses; end-group-interchange of aldoses Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose.)</p>	10
<b>II</b>	<p><b>Chemistry of Proteins:</b> Classification of <i>amino acids</i>, zwitter ion structure and Isoelectric point. Overview of primary, secondary, tertiary and quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C-terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection &amp; C-activating groups and Merrifield solid phase synthesis. Protein denaturation/ renaturation Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions).</p>	10
<b>III</b>	<p><b>Chemistry of Nucleic Acids:</b> Constituents of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), Nucleosides and nucleotides (<b>nomenclature</b>), Synthesis of nucleic acids, Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (<b>types of RNA</b>), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation</p>	05

<b>IV</b>	<p><b>Introductory Medicinal Chemistry :</b> Drug discovery, design and development; Basic Retrosynthetic approach. Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group,-NH<sub>2</sub> group, double bond and aromatic ring. Mechanism of action of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), HIV-AIDS related drugs (AZT- Zidovudine</p>	10
<b>V</b>	<p><b>Solid State</b>            Definition of space lattice, unit cell. Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices and iii) Symmetry elements in crystals and law of symmetry .X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (powder method).</p>	05
<b>VI</b>	<p><b>Introduction to Polymer</b>            Monomers, Oligomers, Polymers and their characteristics, Classification of polymers: Natural synthetic, linear, cross linked and network; plastics, elastomers, fibres, Homopolymers and Co-polymers, Bonding in polymers : Primary and secondary bond forces in polymers ; cohesive energy, and decomposition of polymers. Determination of Molecular mass of polymers: Number Average molecular mass (M<sub>n</sub>) and Weight average molecular mass (M<sub>w</sub>) of polymers and determination by (i) Viscosity (ii) Light scattering method (iii) Gel permeation chromatography (iv) Osmometry and Ultracentrifuging. <b>Silicones and Phosphazenes</b> –Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.</p>	10
<b>VII</b>	<p><b>Kinetics and Mechanism of Polymerization</b>            Polymerization techniques, Mechanism and kinetics of copolymerization, Addition or chain-growth polymerization, Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers, Condensation or step growth-polymerization, Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes.</p>	05
<b>VIII</b>	<p><b>Synthetic Dyes:</b> Colour and constitution (electronic Concept), Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein, fluorescein, Alizarin and Indigo.</p>	05

**Suggested Readings:**

1. Davis, B. G., Fairbanks, A. J., *Carbohydrate Chemistry*, Oxford Chemistry Primer, Oxford University Press.
2. Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
3. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*, W. H. Freeman.
4. Berg, J. M., Tymoczko, J. L. & Stryer, L. *Biochemistry 7th Ed.*, W. H. Freeman.
5. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Patrick, G. L. *Introduction to Medicinal Chemistry*, Oxford University Press, UK, 2013.
7. Singh, H. & Kapoor, V.K. *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New Delhi, 2012.
8. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry Ed.*, Oxford University Press 13 (2006).
9. Ball, D. W. *Physical Chemistry Thomson Press, India (2007)*.
10. Castellan, G. W. *Physical Chemistry 4th Ed. Narosa (2004)*.
11. R.B. Seymour & C.E. Carraher: *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc. New York, 1981.
12. G. Odian: *Principles of Polymerization*, 4<sup>th</sup> Ed. Wiley, 2004.
13. F.W. Billmeyer: *Textbook of Polymer Science*, 2<sup>nd</sup> Ed. Wiley Interscience, 1971.
14. P. Ghosh: *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991

**Note:** For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

**Suggested online links:**

<http://heecontent.upsdc.gov.in/Home.aspx>  
<https://nptel.ac.in/courses/104/105/104105124/>  
<https://nptel.ac.in/courses/103/106/105106204/>  
<https://nptel.ac.in/courses/104/105/104105034/>  
<https://nptel.ac.in/courses/104/103/104103121/>  
<https://nptel.ac.in/courses/104/102/104102016/>  
<https://nptel.ac.in/courses/104/106/104106106/>  
<https://nptel.ac.in/courses/104/105/104105120/>

**This course can be opted as an elective by the students of following subjects: Chemistry in 12<sup>th</sup> Class**

**Suggested Continuous Evaluation Methods:**

Assessment and presentation of Assignment	10 marks
04 Unit tests (Objective): Max marks of each unit test =	
10 (average of all 04 unit tests)	10 marks
Overall performance throughout the semester (Discipline, participation in different activities)	05 marks
	<b>25</b>

**Course prerequisites:** To study this course, a student must have Passed Sem-I, Theory paper-1

Suggested equivalent online courses:

Further Suggestions:

### B020202P: Biochemical Analysis

Programme/Class: Certificate	Year: First	Semester: Second
<b>Subject: Chemistry</b>		
Course Code: B020202P	Course Title: Biochemical Analysis	
<b>Course outcomes:</b> This course will provide basic qualitative and quantitative experimental knowledge of biomolecules such as carbohydrates, proteins, amino acids, nucleic acids drug molecules. Upon successful completion of this course students may get job opportunities in food, beverage and pharmaceutical industries.		
Credits: 2	Elective	
Max. Marks: 25+75 = 100	Min. Passing Marks: As per rule	
<b>Practical</b>		<b>60-h</b>
<b>Unit</b>	<b>Topics</b>	<b>No of Lectures</b>
<b>I</b>	<b>Qualitative and quantitative analysis of Carbohydrates:</b> <ol style="list-style-type: none"> <li>1. Separation of a mixture of two sugars by ascending paper chromatography</li> <li>2. Differentiate between a reducing/ nonreducing sugar</li> <li>3. Synthesis of Osazones.</li> </ol>	<b>15</b>
<b>II</b>	<b>Qualitative and quantitative analysis of Proteins, amino acids and Fats</b> <ol style="list-style-type: none"> <li>1. Isolation of protein.</li> <li>2. Determination of protein by the Biuret reaction.</li> <li>3. TLC separation of a mixture containing 2/3 amino acids</li> <li>4. Paper chromatographic separation of a mixture containing 2/3 amino acids</li> <li>5. Action of salivary amylase on starch</li> <li>6. To determine the concentration of glycine solution by formylation method.</li> <li>7. To determine the saponification value of an oil/fat.</li> <li>8. To determine the iodine value of an oil/fat</li> </ol>	<b>20</b>
<b>III</b>	<b>Determination and identification of Nucleic Acids</b> <ol style="list-style-type: none"> <li>1. Determination of nucleic acids</li> <li>2. Extraction of DNA from onion/cauliflower</li> </ol>	<b>12</b>
<b>IV</b>	<b>Synthesis of Simple drug molecules</b> <ol style="list-style-type: none"> <li>1. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.</li> <li>2. Synthesis of barbituric acid</li> <li>3. Synthesis of propranolol</li> </ol>	<b>13</b>

**Suggested Readings:**

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson(2012).
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education.
3. *Vogel's Qualitative Inorganic Analysis*, Revised by G. Svehla.
4. Vogel, A.I. *A Textbook of Quantitative Analysis*, ELBS. 1986
5. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, ELBS.
6. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Pres
7. Cooper, T.G. *Tool of Biochemistry*. Wiley-Blackwell (1977).
8. Wilson, K. & Walker, J. *Practical Biochemistry*. Cambridge University Press (2009).
9. Varley, H., Gowenlock, A.H & Bell, M.: *Practical Clinical Biochemistry*, Heinemann,

**Note:** For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

**Suggestive digital platforms web links**

1. <https://www.labster.com/chemistry-virtual-labs/>
2. <https://www.vlab.co.in/broad-area-chemical-sciences>
3. <http://chemcollective.org/vlabs>

**This course can be opted as an elective by the students of following subjects: Chemistry in 12<sup>th</sup> Class**

**Suggested Continuous Evaluation Methods:**

<i>Viva voce</i>	10 marks
Mock test	10 marks
Overall performance	05marks
	<b>25</b>

**Course prerequisites: To study this course, a student must have Opted Sem-II, Theory Ppaer-1.**

Suggested equivalent online courses:

Further Suggestions:

## B030201T: Matrices and Differential Equations & Geometry

Programme: Certificate Class: B.Sc.	Year: First	Semester: Second
<b>Subject: Mathematics</b>		
Course Code: B030201T	Course Title: Matrices and Differential Equations & Geometry	
<b>Course outcomes:</b>		
<p>CO1: The subjects of the course are designed in such a way that they focus on developing mathematical skills in algebra, calculus and analysis and give in depth knowledge of geometry, calculus, algebra and other theories.</p> <p>CO2: The student will be able to find the rank, eigen values of matrices and study the linear homogeneous and non-homogeneous equations. The course in differential equation intends to develop problem solving skills for solving various types of differential equation and geometrical meaning of differential equation.</p> <p>CO3: The subjects learn and visualize the fundamental ideas about coordinate geometry and learn to describe some of the surface by using analytical geometry.</p> <p>CO4: On successful completion of the course students have gained knowledge about regular geometrical figures and their properties. They have the foundation for higher course in Geometry.</p>		
Credits: 6	Core Compulsory / Elective	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-: 6-0-0		
<b>PART-A</b>		
<b>Matrices and Differential Equations</b>		
Unit	Topics	No. of Lectures
I	Types of Matrices, Elementary operations on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix, Inverse of a Matrix by elementary operations, System of linear homogeneous and non-homogeneous equations, Theorems on consistency of a system of linear equations.	12
II	Eigen values, Eigen vectors and characteristic equation of a matrix, Caley-Hamilton theorem and its use in finding inverse of a matrix, Complex functions and separation into real and imaginary parts, Exponential and Logarithmic functions Inverse trigonometric and hyperbolic functions.	11
III	Formation of differential equations, Geometrical meaning of a differential equation, Equation of first order and first degree, Equation in which the variables are separable, Homogeneous equations, Exact differential equations and equations reducible to the exact form, Linear equations.	11



IV	First order higher degree equations solvable for $x$ , $y$ , $p$ , Clairaut's equation and singular solutions, orthogonal trajectories, Linear differential equation of order greater than one with constant coefficients, Cauchy- Euler form.	11
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<b>PART-B Geometry</b>		
<b>Unit</b>	<b>Topics</b>	<b>No. of Lectures</b>
V	General equation of second degree, System of conics, Tracing of conics, Confocal conics, Polar equation of conics and its properties.	12
VI	Three-Dimensional Coordinates, Projection and Direction Cosine, Plane (Cartesian and vector form), Straight line in three dimension.	11
VII	Sphere, Cone and Cylinder.	11
VIII	Central conicoids, Paraboloids, Plane section of conicoids, Generating lines, Confocal conicoids, Reduction of second degree equations.	11
<p>Suggested Readings (PART-A Matrices and Differential Equations):</p> <ol style="list-style-type: none"> <li>1. Stephen H. Friedberg, A.J Insel &amp; L.E. Spence, Linear Algebra, Person</li> <li>2. B. Rai, D.P. Choudhary &amp; H. J. Freedman, A Course in Differential Equations, Narosa</li> <li>3. D.A. Murray, Introductory Course in Differential Equations, Orient Longman</li> <li>4. Suggested digital platform:NPTEL/SWAYAM/MOOCs</li> <li>5. Course Books published in Hindi may be prescribed by the Universities.</li> </ol> <p>Suggested Readings (Part-B Geometry):</p> <ol style="list-style-type: none"> <li>1. Robert J.T Bell, Elementary Treatise on Coordinate Geometry of three dimensions, Macmillan India Ltd.</li> <li>2. P.R. Vittal, Analytical Geometry 2d &amp; 3D, Pearson.</li> <li>3. S.L. Loney, The Elements of Coordinate Geometry, McMillan and Company, London.</li> <li>4. R.J.T. Bill, Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd., 1994.</li> <li>5. Suggested digital platform:NPTEL/SWAYAM/MOOCs</li> <li>6. Course Books published in Hindi may be prescribed by the Universities.</li> </ol>		
<p>This course can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Economics(UG/PG), Commerce(UG), BBA/BCA B.Sc.(C.S.)</p>		
<p>Suggested Continuous Evaluation Methods: Max. Marks: 25</p>		
S N	Assessment Type	Max. Marks
1	Class Tests	10
2	Online Quizzes/ Objective Tests	5
3	Presentation	5
4	Assignment	5
<p>Course prerequisites: To study this course, a student must have subject Mathematics in class 12<sup>th</sup></p>		
<p>Suggested equivalent online courses:</p>		
<p>Further Suggestions:</p>		