REVA UNIVERSITY

Bengaluru, India

REVA UNIVERSITY
Bengaluru, India

School of Applied Sciences

B. Sc., (Physics, Chemistry, Mathematics)

HAND BOOK

2021-24

Rukmini Knowledge Park,
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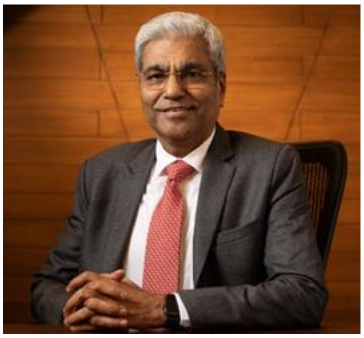
Rukmini Educational
Charitable Trust

www.reva.edu.in

Chancellor's Message

"Education is the most powerful weapon which you can use to change the world."

- Nelson Mandela.



There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is Power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju
The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of REVA University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from

industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students. REVA University has entered into collaboration with many prominent industries to bridge the gap between Industry and University. Regular visits to Industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr. M. Dhanamjaya
Vice-Chancellor, REVA University

Director's Message

Higher education across the globe is opening doors of its academic disciplines to the real-world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

Indian economy is experiencing an upward growth right from the beginning of 21st century necessitating well qualified science graduates to work as scientists, teachers, algorithm developers, computer programmers, professionals and often administrators. At present more than 400 million youth are below 18 years of age and government is committed to increase the GER to 30% by 2020, further necessitating a greater number of teachers and professors to work in schools and colleges. Research has also been given equal importance. Pivate sector and Corporates are also looking for smart science graduates in a big way. The B.Sc. (PCM) degree program of REVA University is designed to prepare physists, chemists, mathematiciens, scientists, teachers, professionals & administrators who are motivated, enthusiastic & creative thinkers to meet the challenges of growing economy as well as to fulfill the growing aspirations of the youth.

The program has been developed with an emphasis on knowledge assimilation, application, national and international job market and its social relevance. The curriculum caters to and has relevance to local, regional, national and global developmental needs. The outcome-based curriculum designed and followed imbibes required theoretical concepts and practical skills in the domain. By undergoing this program, you will develop critical, analytical thinking and problem-solving abilities for a smooth transition from academic to real-life work environment. The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge-based society. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environmental and sustainability.

This handy document containing brief information about B.Sc. (PCM) program, scheme of instruction and detailed course content will serve as a guiding path to you to move forward in a right direction.

I am sure you will enjoythe curriculum, teaching and learning environment, the vast infrastructure and the experienced teacher's involvement and guidance. We will strive to provide all needed comfort andcongenial environment for your studies. I wish you and all students' pleasant stay in REVA and grand success in your career.

Prof. Shilpa B R
Director
School of Applied Sciences

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RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. Rukmini Educational Charitable Trust (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 15,000+ students' study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27th February, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well-planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

REVA consistently ranked as one of the top universities in various categories because of the diverse community of international students and its teaching excellence in both theoretical and technical education in the fields of Engineering, Management, Law, Science, Commerce, Arts, Performing Arts, and Research Studies. REVA offers 28 Undergraduate Programmes, 22 Full-time and 2 Part-time Postgraduate Programmes, 18 Ph. D Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines.

The curriculum of each programme is designed with a keen eye for detail by giving emphasis on hands-on training, industry relevance, social significance, and practical applications. The University offers world-class facilities and education that meets global standards.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated

many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano-Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nana Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much-required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor& Dean, and supported by well experienced Trainers, Counsellors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal VikasYojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitate students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat RatnaProf. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. P. Balaram, Former Director IISc., and noted Scientist, Dr. V. S. Ramamurthy, Former Secretary, DST, Government of India, Dr. V. K. Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

REVA organises various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this

occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognised by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga class's everyday to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Vision

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards.

Mission

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centres
- To provide student-centric learning environment through innovative pedagogy and education reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation and development
- To organize society development programs for knowledge enhancement in thrust areas
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines
- Smooth transition from teacher - centric focus to learner - centric processes and activities
- Performing all the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position
- Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation
- Accepting the challenges of globalization to offer high quality education and other services in a competitive manner

ABOUT SCHOOL OF APPLIED SCIENCES

The School of Applied Sciences offers graduate and post graduate programs in Biotechnology, Biochemistry, Chemistry, Physics and Mathematics which are incredibly fascinating. It aims to attract talented youth and train them to acquire knowledge and skills useful to industrial sectors, research laboratories, and educational institutions. The School presently offers M.Sc. degree programs in Bio-Chemistry, Bio-Technology, Chemistry, Physics, Mathematics, Bioinformatics, Microbial Technology and B Sc with various combinations viz, Biotechnology Biochemistry and Genetics, Medical Laboratory Technology, Physics Chemistry and Mathematics, Physics Mathematics and Computer Science, Mathematics Statistics and Computer Science, Bioinformatics, Computer Science and Mathematics, Chemistry Microbiology and Genetics and also Post Graduate Diploma in Clinical Embryology and Artificial Reproductive Technology. The school also facilitates research leading to PhD in Biotechnology, Biochemistry, Physics, Chemistry, Mathematics and related areas of study.

The School of Applied Sciences is shouldered by well qualified, experienced and highly committed faculty. The state-of-the-art infrastructure digital classrooms, well equipped laboratories, conference rooms and the serene academic atmosphere at REVA University will enhance the transfer as well as creation of knowledge. The school provides an interactive, collaborative peer tutoring environment that encourages students to break down complex problems and develop strategies for finding solutions across a variety of situations and disciplines. The school aims to develop a learning community of critical thinkers who serves as models of innovative problems solving in the university environment to enrich their academic and professional careers.

Vision

To nurture intellect, creativity, character and professionalism among students and impart contemporary knowledge in various branches of Chemical, Biological, Physical and Mathematical Sciences that are socially relevant and transform them to become global citizens.

Mission

- To achieve excellence in studies and research through pedagogy and support interface between industry and academia.
- To create intellectual curiosity, academic excellence, and integrity through multidimensional exposure.
- To establish state of the art laboratories to support research and innovation and promote mastery of science.
- To inculcate an ethical attitude and make students competitive to serve the society and nation.

BOS MEMBERS

Name and Position	
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B. Sc – PCM (Physics, Chemistry, Mathematics)

Programme Overview

Physics and Chemistry are parts of physical sciences belong to the group of natural science. Natural science is concerned with description, prediction and understanding of natural phenomenon based on empirical evidence from observation and experimentation. Mathematics helps in developing empirical relations among various parameters for better understanding of the Phenomenon. Since centuries, study of physics, chemistry and mathematics in universities has become a practice because of their importance for understanding nature and life on the Universe.

The School of Applied Sciences at REVA UNIVERSITY has designed to offer B.Sc. in Physics, Chemistry and Mathematics as an undergraduate degree programme to create motivated, enthusiastic, thinking and creative graduates to fill the roles as teachers, professors, scientists, professionals and administrators.

Indian economy is experiencing an upward growth right from the beginning of 21st century except for a short stint during the mid of present decade necessitating well qualified science graduates to work as teachers, professors, scientists, professionals and often administrators. At present more than 400 million youth are below 18 years of age and government is committed to increase the GER to 30% by 2020, further necessitating a greater number of teachers and professors to work in schools and colleges. The proposed B.Sc. (PCM) programme designed will act as a foundation and first degree to prepare teachers, professors, scientists, professionals and administrators to meet the challenges of growing economy as well as to meet the growing aspirations of the youth.

The B.Sc. (PCM) programme at the School of Applied Sciences, has been developed by the members of the faculty based on interactions with various universities, research establishments and industries in India and abroad.

The curriculum is outcome based and it imbibes required theoretical concepts and practical skills in the domain. By undergoing this programme, students develop critical, analytical thinking and problem-solving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in communication skills and interdisciplinary topics to enhance their scope. The above-mentioned features of the programme, advanced teaching and learning resources, and experience of the faculty members with their strong connections with industry and research organizations makes this programme unique.

Program Educational Objectives (PEO's)

The programme educational objectives of the **B Sc (P.C.M)** course is to prepare graduates to

PEO-1	Demonstrate problem solving skills in physics, chemistry and mathematics by communicating effectively either leading a team or as a team member.
PEO-2	Express oral and written interpersonal skills in order to understand, learn and advance their careers through research developments and seeking higher education.
PEO-3	Understand the professional, ethical and social responsibilities through lifelong learning skills

Program Outcomes (POs)

1. Demonstrate the knowledge in the areas of physics, chemistry and mathematics
2. Apply the fundamentals of physics, chemistry and mathematics to formulate, solve and interpret complex problems.
3. Comprehend, analyze, model and solve complex problems in the areas of physics, chemistry and mathematics.
4. Recognize the need to expertise in the areas of physics, chemistry and mathematics by self-upgradation through lifelong learning.
5. Communicate with clarity and coherence, both written and verbally.
6. Exhibit professional and ethical responsibility.
7. Encourage collaborative learning through group activities and hands-on learning.
8. Use latest computer techniques and tools to carry out scientific investigations and develop new solutions and solve problems related to environment and society.

Programme Specific Outcomes (PSOs)

After successful completion of the programme, the graduates shall be able to

1. Acquire a strong conceptual foundation in the area of physics, chemistry and mathematics using latest software tools and technologies, along with analytical and managerial skills to arrive at cost effective and optimum solutions.
2. Implant the capacity to apply theoretical concepts to design and develop solutions.

Eligibility for B.Sc (PCM) program

Pass in PUC/10+2 examination with Physics, Mathematics and Chemistry as compulsory subjects and obtained minimum 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together of any Board recognized by the respective State Government /Central Government/Union Territories or any other qualification recognized as equivalent thereto.

REVA University Academic Regulations

Bachelor Degree (3 years) Programs

(Applicable for the programs offered from 2021-22 Batch)

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of the REVA University Act, 2012)

1. Title and Commencement:

1.1 These Regulations shall be called **"REVA University Academic Regulations – Bachelor Degree Programs 2021-22 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management''.**

1.2 These Regulations shall come into force from the date of assent of the Chancellor.

2. The Programs:

These regulations cover the following Bachelor Degree Programs of REVA University offered during 2021-22:

B Com (Industry Integrated)
B Com (Honors)
BBA (Industry Integrated)
BBA (Honors)
BBA (Entrepreneurship)
BA - Journalism, English and Psychology
BA - Tourism, History and Journalism
BA - Political Science, Economics and Journalism
BA - Performing Arts, English and Psychology
BCA
BSc (Honours) Cloud Computing and Big Data
BSc in Physics, Chemistry and Mathathematics
BSc in Mathematics, Statistics and Computer Science
BSc in Bioinformatics, Computer Science and Mathematics
BSc in Biotechnology, Biochemistry and Genetics
BSc in Medical Lab Technology
BSc in Physics, Mathematics and Computer Science
BSc in Microbiology, Chemistry and Genetics

3. Duration and Medium of Instructions:

3.1 Duration: The Bachelor Degree program is of 6 Semesters duration. A candidate can avail a maximum of 12 semesters - 6 years as per double duration norm, in one stretch to complete the Bachelor Degree, including blank semesters, if any. Whenever a candidate opts for blank semester, s/he has to study the prevailing courses offered by the school when s/he resumes his/her studies.

3.2 The medium of instruction shall be English.

4. Definitions:

4.1 Course: "Course" means a subject, either theory or practical or both, listed under a program; Example: "Business Research Methodology" in BBA (Honors) program, "Auditing and Corporate Governance" in B Com (Industry Integrated) program are examples of courses to be studied under respective programs.

Every course offered will have three components associated with the teaching-learning process of the course, namely:

L	**Lecture**
T	**Tutorial**
P	**Practice**

Where:

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands-on Experience / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much-required skill component.

4.2 Classification of Courses

Courses offered are classified as: Foundation Courses, Core Courses, Hard Core Courses, Soft Core Courses, Open Elective Courses, Project work/Dissertation

4.2.1 **Foundation Course:** The foundation Course is a mandatory course which should be completed successfully as a part of graduate degree program irrespective of the program of study

4.2.2 **Core Course:** A course which should compulsorily be studied by a candidate choosing a particular program of study

4.2.3 **Hard Core Course (HC) simply core course:** The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any, that the candidates have to complete compulsorily

4.2.4 **Soft Core Course (SC) (also known as Professional Elective Course)**

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study

4.2.5 **Open Elective Course (OE):**

An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an **Open Elective Course**

4.2.6 **Project Work / Dissertation:**

School can offer project work/dissertation as a course. Depending on the duration required for completing the project/dissertation work, credits can be assigned. Normally 26 hours of practical work/project work/dissertation work is considered to be equivalent to a credit. School can classify project as a minor or a major project depending on the credits allotted. Normally, a minor project carries 4-6 credits and a major project carries double the number of credits of a minor project.

4.2.7 **"Program"** means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma or such other degrees instituted and introduced in REVA University.

5. Eligibility for Admission:

5.1. The eligibility criteria for admission to **Three Years Bachelor Degree** Programs (6 Semesters) is given below:

Sl. No.	Program	Duration	Eligibility
1	Bachelor of Commerce (Industry Integrated)	6 Semesters (3 years)	Pass in PUC/10+2 with minimum 50% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
2	Bachelor of Commerce (Honours)		Pass in PUC/10+2 with minimum 75% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.

3	Bachelor of Business Administration (Industry Integrated)	6 Semesters (3 years)	Pass in PUC/10+2 with minimum 50% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
4	Bachelor of Business Administration (Honours)	6 Semesters (3 years)	Pass in PUC/10+2 with minimum 75% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
5	Bachelor of Business Administration (Entrepreneurship)	6 Semesters (3 years)	
6	**Bachelor of Arts in** a) Journalism, English & Psychology (JEP) b) Political Science, Economics, Journalism (PEJ) c) Tourism, Journalism & History (TJH)	6 Semesters (3 years)	Pass in PUC /10+2 of any recognized Board / Council or any other qualification recognized as equivalent there to.
7	Bachelor of Arts in Performing Arts, English & Psychology	6 Semesters (3 years)	
8	Bachelor of Computer Applications	6 Semesters (3 years)	Pass in PUC/10+2 with at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council of any other qualification recognized as equivalent there to.
9	Bachelor of Science (Hons.) in Computer Science (with specialization in Cloud Computing & Big Data)	6 Semesters (3 years)	Pass in PUC/10+2 examination with Mathematics / Computer Science / Statistics as compulsory subject along with other subjects and obtained minimum 45% marks (40% in case of candidates belonging to SC/ST category) in the above subjects taken together from any Board recognized by the respective State Government /Central Government/Union Territories or any other qualification recognized as equivalent thereto.
10	**B Sc in** a) Physics, Chemistry and Mathematics (PCM) b) Mathematics, Statistics and Computer Science (MStCs) c) Physics, Mathematics and Computer Science (PMCs) d) Microbiology, Chemistry and Genetics (MCG)	6 Semesters (3 years)	Pass in PUC/10+2 with Mathematics as compulsory subjects and at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council or any other qualification recognized as equivalent there to.

11	**B Sc in** a) Bioinformatics – Biology, Computer Science & Mathematics (BCsM) b) Biotechnology, Biochemistry, Genetics c) Medical Laboratory Technology (BMLT)	6 Semesters (3 years)	Pass in PUC/10+2 with Biology as compulsory subject and at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council or any other qualification recognized as equivalent there to.

5.2 Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies, University from time to time.

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

6.2 Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for IAs and final examination, evaluation and announcement of results.

6.3 The credit hours defined as below

In terms of credits, every one-hour session of L amounts to 1 credit per Semester and a minimum of two-hour session of T or P amounts to 1 credit per Semester or a three-hour session of T / P amounts to 2 credits over a period of one Semester of 16 weeks for teaching-learning process.

1 credit = 13 credit hours spread over 16 weeks or spread over the semester

The total duration of a semester is 20 weeks inclusive of semester-end examination.

For Example: The following table describes credit pattern

Table -2: Credit Pattern

Lectures (L)	Tutorials (T)	Practice (P)	Credits (L:T:P)	Total Credits	Total Contact Hours
4	2	0	4:1:0	5	6
3	2	0	3:1:0	4	5
3	0	2	3:0:1	4	5
2	2	2	2:1:1	4	6
0	0	6	0:0:3	3	6
4	0	0	4:0:0	4	4

a. The concerned BoS will choose the convenient Credit Pattern for every course based on size and nature of the course

7. Different C**ourses of Study**:

Different C**ourses of Study** are labeled as follows:

a. Foundation Course (FC)
b. Core Course (CC)
c. Hard Core Course (HC)
d. Soft Core Course (SC)
e. Open Elective Course (OE)
f. Project Work / Dissertation: School can offer project work/dissertation as a course. Depending on the duration required for completing the project/dissertation work, credits can be assigned. Normally 26 hours of practical work/project work/dissertation work is considered to be equivalent to a credit. School can classify project as a minor or a major project depending on the credits allotted. Normally, a minor project carries 4-6 credits and a major project carries double the number of credits of a minor project.

These are defined under Section 4 of these regulations.

8. Credits and Credit Distribution

Registered candidates are required to earn the credits stated in the below table for the award of degree in the respective program:

Credits	Programs
120	**B.Com (Industry Integrated) degree, BBA (Industry Integrated) degree, and BCA**
120	**B.Com (Honors), BBA (Honors), BBA (Entrepreneurship) and B Sc (Honors)**
120	**BA - Journalism, English, Psychology, BA - Tourism, History & Journalism, BA - Political Science, Economics & Journalism, BA - Performing Arts, English Psychology, BSc in Physics, Chemistry, Maths, BSc in Maths, Statistics, Comp Sci., BSc in Bioinformatics Biology, Maths, Computer Science, BSc in Biotechnology, Biochemistry, Genetics, BSc in Medical Lab Technology, and BSc in Physics, Maths, Computer Science**

The following courses are foundation courses and they are mandatory courses. Students registering for any of the programs mentioned in the table above are required to successfully complete the courses for the award of the degree.

1. Communicative English
2. Languages K / H / Additional English
3. Indian Constitution
4. Human Rights

8.2. The concerned BoS shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, field work, self-study elective and classify the courses as **Foundation Course (FC), Hard Core (HC), Soft Core (SC) and Open Elective (OE).**

8.3**.** The concerned BoS shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program.

8.4. A candidate can enrol during each semester for credits as prescribed in the scheme of the program.

8.5 Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VI semester and complete successfully prescribed number of credits for the award of the degree for three year program in 6 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

8.6 Add on Proficiency Diploma / Minor degree/ Honor Degree:

To acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:, a candidate can opt to complete a minimum of 18-20 extra credits either in the same discipline /subject or in different discipline / subject in excess to prescribed number of credits for the award of 3 year degree in the registered program.

The Add on Proficiency Certification / Diploma/ Minor degree/ Honor Degree: so issued to the candidate contains the courses studied and grades earned.

9 Assessment and Evaluation

9.1 The Scheme of Assessment will have two parts, namely;

i. Internal Assessment (IA); and
ii. Semester End Examination (SEE)

9.2 Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of for 3 year programs shall carry 50:50 marks respectively (i.e., 50 marks internal assessment; 50 marks semester end examination).

9.3 The 50 marks of internal assessment shall comprise:

Internal Test	30 marks
Assignments / Seminars / Quizzes / Presentations / Case Studies etc.	20 marks

9.4 There shall be **two Internal Tests** conducted as per the schedule announced below. **The Students' shall attend both the Tests compulsorily.**

- 1st test is conducted for 15 marks during **8th week** of the Semester;
- 2nd test is conducted for 15 marks during **16th week** of the of the Semester;
- Suitable number of Assignments/quizzes/presentations are set to assess the remaining 20 marks of IA at appropriate times during the semester

9.5 The coverage of syllabus for the said tests shall be as under:

- Question paper of the **1st test should be based on first 50% of the total syllabus**;
- Question paper of the **2nd test should be based on second 50% of the total syllabus**;

9.6 The Semester End Examination for 50 marks shall be held in the 18th and 19th week of the beginning of the semester and the syllabus for the semester end examination shall be entire syllabus.

9.7 A test paper is set for a maximum of 30 marks to be answered as per the pre-set time duration (1 hr / 1 hr 15 minutes / 1 hr 30 minutes). Test paper must be designed with School faculty members agreed pattern and students are assessed as per the instructions provided in the question paper. Questions must be set using Bloom's verbs. The questions must be set to assess the student's outcomes described in the course document.

9.8 The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question paper(s). However, these question papers shall be scrutinized by School specific Question Paper Scrutiny Committee formed by the respective School Head /Director to bring in the uniformity in the question paper pattern and as well to maintain the necessary standards.

9.9 The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.

9.10 Assignment/seminar/Project based learning/simulation-based problem solving/field work should be set in such a way, students be able to apply the concepts learnt to a real-life situation and students should be able to do some amount self-study and creative thinking. While setting assignment care should be taken such that the students will not be able to plagiarise the answer from web or any other resources. An assignment / Quiz or combination thereof can be set for a maximum of 20 marks. Course instructor at his/her discretion can design the questions as a small group exercise or individual exercise. This should encourage collaborative learning and team learning and also self-study.

9.11 Internal assessment marks must be decided well before the commencement of Semester End examinations

9.12 Semester End Examination: The Semester End Examination is for 50 marks shall be held in the 18th and 19th week of the semester and the entire course syllabus must be covered while setting the question paper.

9.13 Semester End Examination paper is set for a maximum of 100 marks to be answered in 3 hours duration. Each main question be set for a maximum of 25 marks, main questions can have 3-4 sub questions. A total of 8 questions are set so that students will have a choice. Each question is set using Bloom's verbs. The questions must be set to assess the students

outcomes described in the course document. (Please note question papers have to be set to test the course outcomes)

9.14 There shall be three sets of question papers for the semester end examination of which one set along with scheme of examination shall be set by the external examiners and two sets along with scheme of examination shall be set by the internal examiners. All the three sets shall be scrutinized by the Board of Examiners. It shall be responsibility of the Board of Examiners particularly Chairman of the BOE to maintain the quality and standard of the question papers and as well the coverage of the entire syllabus of the course.

9.15 There shall be single evaluation by the internal teachers who have taught the subject. However, there shall be moderation by the external examiner. In such cases where sufficient number of external examiners are not available to serve as moderators internal senior faculty member shall be appointed as moderators.

9.16 Board of Examiners, question paper setters and any member of the staff connected with the examination are required to maintain integrity of the examination system and the quality of the question papers.

9.17 There shall also be an **Program Assessment Committee (PAC)** comprising at-least 3 faculty members having subject expertise who shall after completion of examination process and declaration of results review the results sheets, assess the performance level of the students, measure the attainment of course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the School. **Program Assessment Committee (PAC)** shall also review the question papers of both Internal Tests as well Semester End Examinations and submit reports to the Director of the respective School about the scope of the curriculum covered and quality of the questions.

9.18 The report provided by the **Program Assessment Committee (PAC)** shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program

9.19 During unforeseen situation like the Covid-19, the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC

9.20 University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper

9.21 Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor

9.22 Online courses may be offered as per BACHELOR norms.
For online course assessment guidelines would be as follows:

1. If the assessment is done by the course provider, then the School can accept the marks awarded by the course provider and assign the grade as per REVA University norms.

2. If the assessment is not done by the course provider then the assessment is organized by the concerned school and the procedure explained in the regulation will apply

3. In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

IAs for online courses could be avoided and will remain at the discretion of the School.

9.23 The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy, Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

9.24 Utilization of one or two credit online courses would be:

4-week online course – 1 credit – 15 hours
8-week online course / MOOC – 2 credits – 30 hours
12-week online course / MOOC – 3 credits – 45 hours

9.25 **Summary of Internal Assessment, Semester End Examination and Evaluation** Schedule is provided in the table given below.

Summary of Internal Assessment and Evaluation Schedule

S. No	Type of Assessment	when	Syllabus Covered	Max Marks	Reduced to	Date by which the process must be completed
1	Test-1	During 8th week	First 50%	30	15	8th week
2	Assignment / quiz / presentation / any other assessment method as decided by the School	On or before 8th week (10 marks)				
3	Test -2	During 16th Week	Second 50%	30	15	16th Week
4	Assignment / quiz / presentation / any other assessment method as decided by the School	On or before 16th Week (10 marks)				
5	SEE	19/20th Week	100%	100	50	20th Week

Note: 1. Examination and Evaluation shall take place concurrently and Final Grades shall be announced as per the notification from COE.
2. Practical examination wherever applicable shall be conducted after 2nd test and before semester end examination. The calendar of practical examination shall be decided by the respective School Boards and communicated well in advance to the Controller of Examination who will notify the same immediately

10 Assessment of Students Performance in Practical Courses

The performance in the practice tasks / experiments shall be assessed on the basis of:

a) Knowledge of relevant processes;
b) Skills and operations involved;
c) Results / products including calculation and reporting.

10.1 The 50 marks meant for Internal Assessment (IA) of the performance in carrying out Practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment.	20 marks
	Total	**50 marks**

10.2 The 50 marks meant for Semester End Examination (SEE), shall be allocated as under:

i	Conducting of semester end practical examination	30 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

The duration for semester-end practical examination shall be decided by the concerned School Board.

10.3 For MOOC and Online Courses assessment shall be decided by the BOS of the School.

11. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	Periodic Progress and Progress Reports (25%)
Component – II	Demonstration and Presentation of work (25%)
Component – III	Evaluation of Report (50%)

All assessments must be done by the respective Schools as per the guidelines issued by the Controller of Examinations. However, the responsibility of announcing final examination

results and issuing official transcripts to the students lies with the office of the Controller of Examinations.

12. Requirements to Pass a Course:

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 , SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) which is compulsory.

The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below:

Marks, P	**Grade, G**	**Grade Point (GP=V x G)**	**Letter Grade**
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A
60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P=[IA + SEE]) secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

a. Computation of SGPA and CGPA

The Following examples describe computation of Semester Grade Point Average (SGPA).

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e : **SGPA (Si) = ∑(Ci x Gi) / ∑Ci** where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Examples on how SGPA and CGPA are computed

Example No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	3	A+	9	3X9=27
Course 2	3	A	8	3X8=24
Course 3	3	B+	7	3X7=21
Course 4	4	O	10	4X10=40
Course 5	1	C	5	1X5=5
Course 6	2	B	6	2X6=12
	16			129

Thus, **SGPA = 129 ÷ 16 = 8.06**

Example No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	C	5	3X5=15
	20			141

Thus, **SGPA = 141 ÷ 20 = 7.05**

b. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits for the respective programs are calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : **CGPA = $\sum$(Ci x Si) / $\sum$Ci**

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Example:

CGPA after Final Semester

Semester (ith)	**No. of Credits (Ci)**	**SGPA (Si)**	**Credits x SGPA (Ci X Si)**
1	20	6.83	20 x 6.83 = 136.6
2	19	7.29	19 x 7.29 = 138.51
3	21	8.11	21 x 8.11 = 170.31
4	20	7.40	20 x 7.40 = 148.00
5	22	8.29	22 x 8.29 = 182.38
6	18	8.58	18 x 8.58 = 154.44
Cumulative	**120**		**930.24**

Thus, **CGPA** = 930.24/120 = 7.75

c. Conversion of grades into percentage:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Example: CGPA Earned 7.75 x 10=77.5

d. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

13. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	Grade (Numerical Index)	Letter Grade	Performance	FGP
	G			Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass
< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

a. **Provisional Grade Card**: The tentative / provisional grade card will be issued by the Controller of Examinations at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average (SGPA).**

b. **Final Grade Card:** Upon successful completion of three-year Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Controller of Examinations.

14. Attendance Requirement:

14.1 All students must attend every lecture, tutorial and practical classes.

14.2 In case a student is on approved leave of absence (e g:- representing the University in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be

minimum of 75% of the classes taught.

14.3 Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc., during a semester shall not be permitted to appear to the end semester examination and such student shall seek re-admission

15. Re-Registration and Re-Admission:

15.1 In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for semester end examination and S/he shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

15.2 In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and s/he shall seek re-admission to such dropped semester.

16. Absence during Internal Test:

In case a student has been absent from an internal test due to the illness or other contingencies s/he may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

17. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and Assignments), s/he can approach the Grievance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. S/he can do so before the commencement of respective semester-end examination. The Grievance Cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the University on the candidate if his/her submission is found to be baseless and unduly motivated. This Cell may recommend for taking disciplinary/corrective action on an evaluator if s/he is found guilty. The decision taken by the Grievance committee is final.

18. Grievance Committee:

In case of students having any grievances regarding the conduct of examination, evaluation and announcement of results, such students can approach Grievance Committee for redressal of grievances. Grievance committees will be formed by CoE in consultation with VC.

For every program there will be one grievance committee. The composition of the grievance committee is as follows:-

- The Controller of Examinations - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

19. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc., as part of the program shall be eligible to appear for Semester End Examination

20. Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

21. Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in a given number of courses in odd and even semesters shall move to next semester of immediate succeeding year and final year of the study. However, s/he shall have to clear all courses of all semesters within the double duration, i.e., with six years of admission of the first semester failing which the student has to re-register to the entire program.

Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script(s) of semester end examination by paying the prescribed fee within 10 days

after the announcement of the results. S/he can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Controller of Examinations within 10 days after the announcement of the results. This challenge valuation is only for semester end examination.

b. The answer scripts (in whatever form) for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

22. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0101	CO1	3	2	2						3	2
	CO2	2	2	2						3	2
	CO3	3	2	2						3	3
	CO4	3	2	2						3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0101	CO1	3	3	3	3	2		1	3	3	3
	CO2	3	3	3	3	2		3	3	3	3
	CO3	3	3	3	2	2		2	3	3	3
	CO4	3	3	3	2	2				2	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0101	CO1	3	3	2	1			1	1	2	2
	CO2	3	2	2	1			1	2	2	3
	CO3	2	3	2	2		1		2	2	3
	CO4	3	3	2	1					2	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0102	CO1	3	2	2		1				3	3
	CO2	3	2	2		1				3	3
	CO3	2	2	2		1				3	2
	CO4	3	2	2		1				2	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0102	CO1	2			3		2	2	2	2	2
	CO2	3	2		3		2	1	3	3	3
	CO3	3	3	3	3			2	2	3	2
	CO4	3	3	2	2		2	2	3	3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0102	CO1	2			3		2	2	2	2	2
	CO2	3	2		3		2	1	3	3	3
	CO3	3	3	3	3			2	2	3	2
	CO4	3	3	2	2		2	2	3	3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0201	CO1	3	2	2						3	2
	CO2	2	2	2						3	3
	CO3	3	2	2						3	3
	CO4	3	2	2						3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0201	CO1	3	2	2	3					3	2
	CO2	2	2	2	2					3	3
	CO3	3	2	2	3					3	3
	CO4	3	2	2	2					3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0201	CO1	3	3	2	3			2	1	2	2
	CO2	3	3	3	2			1	2	2	3
	CO3	3	2	2	2			2	1	2	3
	CO4	3	2	1	2			2	3	3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2

B21MT0202	CO1	3	2	2				1	1	3	3
	CO2	3	2	2	1			1	1	3	3
	CO3	2	2	2	1			1	1	3	3
	CO4	3	2	2				1	1	3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0202	CO1	3	2	2		1				3	3
	CO2	3	2	2	1	1				3	3
	CO3	2	2	2	2	2				3	3
	CO4	3	2	2		1				3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0202	CO1	2	2	3	2	1		2	2	1	3
	CO2	3	3	3	3	1		2	3	2	2
	CO3	3	2	2	3			2	2	3	2
	CO4	2	3	2	2	1		2	3	2	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0301	CO1	3	3	3	3			1	3	3	3
	CO2	3	2	1	2			1	2	3	3
	CO3	3	2	2	2			1	2	3	3
	CO4	3	3	3	3			1	3	3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0301	CO1	3	3	3	3	1				3	3
	CO2	3	3	3	3					3	3
	CO3	3	2	2	2	1				3	2
	CO4	3	3	2	2					3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0301	CO1	1	2	1	1				1	2	2
	CO2	2	2	1	1				1	2	2
	CO3	1	2	1	2				1	1	1
	CO4	2	1	1	2				1	1	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0302	CO1	3	2	2	1	1	1		1	3	2
	CO2	3	2	2	1	1			1	3	3
	CO3	3	2	2	1	1			1	3	2
	CO4	3	2	2	1			1	1	2	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0302	CO1	3	3	3	3					3	1
	CO2	3	3	2	1					2	2
	CO3	3	3	2	2					2	1
	CO4	3	3	3	1					3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0302	CO1	1	2	1	1	1	1	1	1	2	1
	CO2	2	2	1	1	1	2	1	2	2	2
	CO3	1	2	1	2	2	2	1	1	1	1
	CO4	2	1	2	2	1	2	2	2	1	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
	CO1	3	3	2	3	2				3	3
	CO2	3	3	2	3	2				3	3

B21MT0401	CO3	3	3	2	3	2				3	2
	CO4	3	2	1	2	2				3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0401	CO1	3	2	1	1					3	2
	CO2	3	2	3	2					3	2
	CO3	3	3	3	3					3	3
	CO4	3	2	2	2					3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0401	CO1	1	2	1	1	1	1	1	1	2	1
	CO2	2	2	1	1	1	2	1	1	2	2
	CO3	1	2	1	2	1	2	1	1	1	1
	CO4	2	1	1	2	1	1	2	1	1	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0402	CO1	3	2	2	2				1	3	2
	CO2	3	2	2	2				1	3	3
	CO3	3	2	2	2				1	3	2
	CO4	3	2	2	2				1	2	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0402	CO1	3	2	1	1			1	3	3	2
	CO2	3	2	3	2				2	3	2
	CO3	3	3	3	3			2	3	3	3
	CO4	3	2	2	2			2	2	3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0402	CO1	1	2	1	1			1	1	2	1
	CO2	2	2	1	1			1	1	2	2
	CO3	1	2	1	2			1	1	1	1
	CO4	2	1	1	2			2	1	1	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0501	CO1	3	3	3	2	3				3	2
	CO2	3	3	3	3	3				3	3
	CO3	3	3	2	3	2				3	2
	CO4	3	3	2	3	3				3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0501	CO1	3	3	2	3	2				2	1
	CO2	3	3	2	3	2				3	3
	CO3	3	3	1	3	2				3	2
	CO4	3	3	2	3	2				3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0501	CO1	2	1	1	1			1	2	1	2
	CO2	3	2	2	1			1	2	2	2
	CO3	2	1	1							2
	CO4	2	1	1	1			1	1	2	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0502	CO1	3	3	2	2					2	3
	CO2	3	2	2	3					3	2

	CO3	3	2	3	2					3	2
	CO4	3	3	3	2					3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0502	CO1	3	3	3	2					2	3
	CO2	3	3	3	2					3	3
	CO3	2	2	1	3					3	2
	CO4	3	2	3	1					2	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0502	CO1	1	2	2	1			2		3	1
	CO2	1	2	1	3			3		3	1
	CO3	1	2	2	2			2		3	1
	CO4	1	1	2	1			2	2	3	1
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0601	CO1	3	3	3	3			1	2	3	3
	CO2	3	3	3	3			1	2	3	3
	CO3	3	2	2	2			2	2	3	3
	CO4	3	2	2	2			2	2	3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0601	CO1	3	3	2	3	2				2	1
	CO2	3	3	2	3	2				3	3
	CO3	3	3	1	3	2				3	2
	CO4	3	3	2	3	2				3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0601	CO1	2	2	2	1		1		1		1
	CO2	3	2	1	1				2	1	1
	CO3	2	1	2	2		1		2	2	1
	CO4	2	3	1	2		1	1	2	1	1
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0602	CO1	3	3	2	2			1	2	2	3
	CO2	3	2	2	3			1	2	3	2
	CO3	3	2	3	2			2	2	3	2
	CO4	3	3	3	2			2	2	3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0602	CO1	3	3	3	2	2				2	3
	CO2	3	3	3	2	2				3	3
	CO3	2	2	1	3	2				3	3
	CO4	2	2	1	2	1				2	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0602	CO1	3	3	3	3			2	2	3	2
	CO2	3	3	2	3			2	2	3	1
	CO3	3	3	2	3			2	2	3	2
	CO4	2	2	3	3			2	2	3	3

B. Sc – PCM
(Physics, Chemistry, Mathematics)
Scheme of Instruction and Detailed Syllabus
(Effective from the Academic Year 2021-24)

Scheme of Instruction **Duration: 6 Semesters (3 Years)**

Sl. No	Course Code	Title of the Course	CC/FC/ HC/SC	Credit Pattern				
				L	T	P	Total	Hours
FIRST SEMESTER								
1	B21AHK101	Language – II: Kannada-I	FC	1	1	0	2	3
2	B21AHH101	Language – II: Hindi-I						
3	B21AHA101	Language – II: Additional English-I						
4	B21AHE101	Communicative English-I	FC	1	1	0	2	3
5	B21MT0101	Mathematics-I	HC	3	0	0	3	4
6	B21PH0101	Mechanics and Properties of matter	HC	3	0	0	3	4
7	B21CH0101	Chemistry-I	HC	3	0	0	3	4
8	B21MTS111	Elementary Number Theory	SC	3	0	0	3	4
9	B21MTS112	Discrete Mathematics and Graph theory						
10	B21MTS113	Fuzzy Mathematics						
11	B21LSM101	Constitution of India and Professional Ethics	MC	0	0	0	0	2
		Practicals						
12	B21MT0102	Mathematics practicals-I	HC	0	0	1.5	1.5	3
13	B21PH0102	Physics Practicals-I	HC	0	0	1.5	1.5	3
14	B21CH0102	Chemistry Practicals-I	HC	0	0	1.5	1.5	3
Total Credits				**14**	**2**	**4.5**	**20.5**	**33**
SECOND SEMESTER								
15	B21AHK201	Language – II: Kannada-II	FC	1	1	0	2	3
16	B21AHH201	Language – II: Hindi-II						
17	B21AHA201	Language – II: Additional English-II						
18	B21AHE201	Communicative English - II	FC	1	1	0	2	3
19	B21MT0201	Mathematics-II	HC	3	0	0	3	4
20	B21PH0201	Heat and Thermodynamics	HC	3	0	0	3	4
21	B21CH0201	Chemistry-II	HC	3	0	0	3	4
22	B21PHS211	Physics of Clouds	SC	3	0	0	3	4
23	B21PHS212	Renewable Energy Resource						
24	B21PHS213	Lasers and Fibre Optics						
25	B21ASM201	Environmental Science	MC	0	0	0	0	2
		Practicals						
26	B21MT0202	Mathematics practicals-II	HC	0	0	1.5	1.5	3
27	B21PH0202	Physics Practicals-II	HC	0	0	1.5	1.5	3
28	B21CH0202	Chemistry Practicals-II	HC	0	0	1.5	1.5	3
Total Credits				**14**	**2**	**4.5**	**20.5**	**33**

THIRD SEMESTER								
29	B21AHK301	Language – II: Kannada-III	FC	1	1	0	2	3
30	B21AHH301	Language – II: Hindi-III						
31	B21AHA301	Language – II: Additional English-III						
32	B21MT0301	Mathematics-III	HC	3	0	0	3	4
33	B21PH0301	Optics and spectroscopy	HC	3	0	0	3	4
34	B21CH0301	Chemistry-III	HC	3	0	0	3	4
35	B21CHS311	Heterocyclic Chemistry & Chemistry of Natural Products	SC	3	0	0	3	4
36	B21CHS312	Polymer Chemistry						
37	B21CHS313	Solid State Chemistry						
38		NCC	OE	3	0	0	3	3
39	B21ASO301	Classical Optimization						
40	B21ASO303	Physics in Everyday Life						
41	B21ASO304	Water Technology						
42	B21SGM301	Skill Development Program	SC	0	0	0	0	2
		Practicals						
43	B21MT0302	Mathematics practicals-III	HC	0	0	1.5	1.5	3
44	B21PH0302	Physics Practicals-III	HC	0	0	1.5	1.5	3
45	B21CH0302	Chemistry Practicals-III	HC	0	0	1.5	1.5	3
Total Credits				**16**	**1**	**4.5**	**21.5**	**33**
FOURTH SEMESTER								
46	B21AHK401	Language – II: Kannada-IV	FC	1	1	0	2	3
47	B21AHH401	Language – II: Hindi-IV						
48	B21AHA401	Language – II: Additional English-IV						
49	B21MT0401	Mathematics-IV	HC	3	0	0	3	4
50	B21PH0401	Electricity and Electromagnetism	HC	3	0	0	3	4
51	B21CH0401	Chemistry-IV	HC	3	0	0	3	4
52	B21MTS411	Complex Analysis	SC	3	0	0	3	4
53	B21MTS412	Operations Research						
54	B21MTS413	Topology						
55	B21PTM401	Soft Skill Training	MC	0	0	0	0	2
56	B21SGM401	Skill Development Program	MC	0	0	0	0	2
		Practicals						
57	B21MT0402	Mathematics practicals-IV	HC	0	0	1.5	1.5	3
58	B21PH0402	Physics Practicals-IV	HC	0	0	1.5	1.5	3
59	B21CH0402	Chemistry Practicals-IV	HC	0	0	1.5	1.5	3
		Total Credits		**13**	**1**	**4.5**	**18.5**	**32**
FIFTH SEMESTER								
60	B21MT0501	Mathematics-V	HC	3	0	0	3	4
61	B21PH0501	Quantum Mechanics and Nuclear Physics	HC	3	0	0	3	4
62	B21CH0501	Chemistry-V	HC	3	0	0	3	4
63	B21PHS511	Astronomy and Astro Physics	SC	3	0	0	3	4
64	B21PHS512	Nano Materials						
65	B21PHS513	Optoelectronics						
66	B21SGON01	MOOC/SWAYAM	SC	2	0	0	2	2

67	B21SGM501	Skill Development Program	MC	0	0	0	0	2
		Practicals						
68	B21MT0502	Mathematics practicals-V	HC	0	0	0	1.5	3
69	B21PH0502	Physics Practicals-V	HC	0	0	0	1.5	3
70	B21CH0502	Chemistry Practicals-V	HC	0	0	0	1.5	3
		Total Credits		**14**	**0**	**4.5**	**18.5**	**29**
	SIXTH SEMESTER							
71	B21MT0601	Mathematics-VI	HC	3	0	0	3	4
72	B21PH0601	Solid State Physics	HC	3	0	0	3	4
73	B21CH0601	Chemistry-VI	HC	3	0	0	3	4
74	B21CHS611	Industrial Chemistry	SC	3	0	0	3	4
75	B21CHS612	Chemistry of Bio Molecules						
76	B21CHS613	Electro Analytical Chemistry						
77	B21SG0601	Project	HC	0	0	4	4	8
		Practicals						
78	B21MT0602	Mathematics practicals-VI	HC	0	0	1.5	1.5	3
79	B21PH0602	Physics Practicals-VI	HC	0	0	1.5	1.5	3
80	B21CH0602	Chemistry Practicals-VI	HC	0	0	1.5	1.5	3
		Total Credits		**12**	**0**	**8.5**	**20.5**	**33**
		Total Credits of all Semesters					**120**	**193**

Semester-wise Summary of Credit Distribution

Semester	L	T	P	Total	Total Hours
I	14	2	4.5	20.5	33
II	14	2	4.5	20.5	33
III	16	1	4.5	21.5	33
IV	13	1	4.5	18.5	32
V	14	0	4.5	18.5	29
VI	12	0	8.5	20.5	33
Total Credits	831	**6**	**31**	120	**193**

B. Sc – Physics, Chemistry, Mathematics (PCM)
Detailed Syllabus

(effective from Academic Year 2021)

FIRST SEMESTER

Course Code	Language-II: Kannada-I	Type	L	T	P	C	Hrs/Week
B21AHK101		FC	1	1	0	2	3

Course Objectives:

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÉÆzÀ®£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß ªÀÄÆr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀé «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀåzÀÄ UÀÄjAiÀiÁVzÉ
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èèlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£ÀºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. ¸ÁªÀiÁfPÀ CjªÀÅ ªÀÄÆr¸ÀÄvÀÛzÉ
4. GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÉAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.

Course Outcomes:

Unit-I: **7 hrs**

1. ¸ÀvÀåªÀAvÉ ºÀqÉzÀªÀé - d£À¥ÀzÀ VÃvÉ
2. £É®QjªÉ£ÉAzÀÄ §UÉ«gÉ bÀ®QjªÉA- gÀ£Àß
3. avÀæªÀÄ¥ÁvÉæ gÀªÀÄvÉÃ £Áj- d£Àß

Unit-II: **7 hrs**

1. C©ÞAiÀÄÄªÉÆªÉÄð PÁ®ªÀ±À¢A ªÀÄgÁåzÉAiÀÄA zÁAlzÉÃ.... - £ÁUÀZÀAzÀæ

2. ªÀZÀ£ÀUÀ¼ÀÅ - §¸À ªÀtÚ
3. wgÀÄ¤Ã®PÀAoÀgÀ gÀUÀ¼É - ºÀjºÀgÀ

Unit-III: **6 hrs**

1. PÀ¯ÁärAiÀÄ PÉÆÃt - ªÀiÁ¹Û
2. AiÀiÁgÀÆ CjAiÀÄzÀ «ÃgÀ - PÀÄªÉA¥ÀÄ
3. ¸À ªÀÄ¸ÉåAiÀÄ ªÀÄUÀÄ - wæªÉÃtÂ

Unit-IV: **6 hrs**

1. mÉÆ¼ÀÄîUÀnÖ - n.¦. PÉÊ¯Á¸ÀA

¥ÀgÁªÀÄ±Àð£À UÀæAxÀUÀ¼ÀÄ:

1. ªÀÄÄUÀ½ gÀA. ²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¸ÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.J¯ï., ZÁjwæPÀ d£À¥ÀzÀ PÀxÀ£À PÁªÀåUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2008
3. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
4. ¸ÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.J¯ï., PÀ£ÀßqÀ d£À¥ÀzÀ PÀxÀ£À PÁªÀåUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2007
5. ºÀA¥À £ÁUÀgÁdAiÀÄå, ¸ÁAUÀvÀå PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
6. £ÁgÁAiÀÄt ¦. «, ZÀA¥ÀÆ PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
7. PÁ¼ÉÃUËqÀ £ÁUÀªÁgÀ, wæ¥À¢, gÀUÀ¼É ªÀÄvÀÄÛ eÁ£À¥ÀzÀ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
8. ¸ÀA. ¨É£ÀUÀ¯ï gÁªÀÄ gÁªï ªÀÄvÀÄÛ ¥Á£ÀåA ¸ÀÄAzÀgÀ ±Á¹ÛçÃ, ¥ÀÄgÁt £ÁªÀÄ ZÀÆqÁªÀÄtÂ, ¥ÀæPÁ±ÀPÀgÀÄ ¥Àæ¸ÁgÁAUÀ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ. 2010
9. qÁ. azÁ£ÀAzÀ ªÀÄÆwð, ªÀZÀ£À ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013
10. ¸ÀA. §¸ÀªÀgÁdÄ J¯ï. ¸ÀªÀðdÕ£À ªÀZÀ£ÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2012
11. ¸ÀA. §¸ÀªÀgÁdÄ J¯ï. CPÀÌ£À ªÀZÀ£ÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 1997
12. ¸ÀA ªÀÄgÀÄ¼À¹zÀÝ¥Àà PÉ, £ÁUÀgÁd Q.gÀA. ªÀZÀ£À PÀªÀÄäl, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
13. £ÀgÀ¹AºÁZÁgï. r.J¯ï., ¥ÀA¥À ¨sÁgÀvÀ ¢Ã¦PÉ, ¥ÀæPÁ±ÀPÀgÀÄ r.«.PÉ ªÀÄÆwð ¥ÀæPÁ±À£À, ªÉÄÊ¸ÀÆgÀÄ. 2012
14. gÀAeÁ£ï zÀUÁð, ±ÀgÀtgÀ ¸ÀªÀÄUÀæ PÁæAw, ¥ÀæPÁ±ÀPÀgÀÄ. ¯ÉÆÃ»AiÀiÁ ¥ÀæPÁ±À£À, §¼Áîj. 2015
15. zÉÃ±À¥ÁAqÉ J¸ï.J¯ï. ¨ÉÃAzÉæ ±ÀjÃ¥sÀgÀ PÁªÁåAiÀiÁ£À, ¥ÀæPÁ±ÀPÀgÀÄ zÉÃ¹ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2013
16. ¸ÀA. ©.J¸ï. PÉÃ±ÀªÀgÁªï. PÉÊ¯Á¸ÀA PÀ£ÀßqÀ £ÁlPÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ CAQvÀ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2005
17. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
18. ²ªÀgÀÄzÀæ¥Àà f.J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHK101	**CO1**					2	3				
	CO2					2	3				
	CO3						3				
	CO4							3	2		

Course Code	Language-II: Hindi-I	Type	L	T	P	C	Hrs/Week
B21AHH101		FC	1	1	0	2	3

Course Objectives:

This course aims to provide for the student to

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना।
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना।
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना।
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना।

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

1. सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है।
2. साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है।
3. समाज में अंतर्निहित पद्धतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है।
4. साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है।

Course Contents:

इकाई – 1: कहानी, संस्मरण **7 hrs**

कहानी – नशा – प्रेमचंद
कहानी – सुखमय जीवन – चंद्रधर शर्मा गुलेरी
संस्मरण – शरत के साथ बिताया कुछ समय – अमृतलाल नागर

इकाई – 2: कहानी, आत्मकथा **7 hrs**

कहानी – मरने से पहले – भीष्म साहनी
कहानी – लाल हवेली – शिवानी
रेखाचित्र – घीसा – महादेवी वर्मा

इकाई – 3: एकांकी, व्यंग्य रचना **6 hrs**

एकांकी – आवाज का नीलाम – धर्मवीर भारती
व्यंग्य रचना – भेड़े और भेडियें – हरिशंकर परसाई

इकाई – 4: अनुवाद **6 hrs**

अनुवाद : अंग्रेज़ी – हिन्दी (शब्द एवं अनुच्छेद)

सूचना : प्रत्येक इकाई 25 अंक केलिए निर्धारित है |

References:

1. सुबोध व्यवहारिक हिन्दी – डॉ. कुलदीप गुप्त
2. अभिनव व्यवहारिक हिन्दी – डॉ.परमानन्द गुप्त
3. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
4. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
5. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
6. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
7. कार्यालय अनुवाद निदेशिका
8. संक्षेपण और पल्लवन - के.सी.भाटिया&तुमन सिंग

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHH101	**CO1**					2	3	2			
	CO2					2	2	3			
	CO3					3	3	3			
	CO4					3	2	3			

Course Code	Language-II: Additional English-I	Type	L	T	P	C	Hrs/Week
B21AHA101		FC	1	1	0	2	3

Course Objectives:

This course aims to provide for the student:

1. To develop linguistic prowess of the students.
2. To appraise different genres of literature.
3. To illustrate the fundamentals of creative language.
4. To enhance consistent reading habits.

Course Outcomes:

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

1. Demonstrate a thorough understanding of sensitive and critical social issues.
2. Develop reading skills and a wide range of vocabulary.
3. Critically analyze a piece of prose or poetry.
4. Explain their opinion in a coherent and communicable manner.

Course Contents:

Unit-I: Values and Ethics **7 hrs**

Literature: Rabindranath Tagore - Where the Mind is Without Fear; Saki – The Lumber-room; William Shakespeare – Extract from *Julius Caesar* (Mark Antony's Speech); **Language**: Vocabulary Building.

Unit-II: Natural & Supernatural **6 hrs**

Literature: John Keats – La Belle Dame Sans Merci; Charles Dickens – The Signal Man; Hans Christian Anderson - The Fir Tree; **Language**: Collective Nouns.

Unit-III: Travel and Adventure **7 hrs**

Literature: R.L. Stevenson – Travel, H.G. Wells – The Magic Shop, Jonathan Swift – Excerpt from Gulliver's Travels Book – I; **Writing Skills**: Travelogue.

Unit-IV: Success Stories **6 hrs**

Literature: Emily Dickinson – Success is Counted Sweetest; Dr. Martin Luther King - I Have a Dream; Helen Keller – Excerpt from The Story of My Life; **Writing Skills**: Brochure & Leaflet.

Reference Books:

1. Tagore, Rabindranath. *Gitanjal*i. Rupa Publications, 2002.
2. Wordsworth, William. *The Complete Works of William Wordsworth*. Andesite Press, 2017.
3. Munro, Hector Hugh. *The Complete Works of Saki*. Rupa Publications, 2000.
4. Shakespeare, William. *The Complete Works of William Shakespeare*. Sagwan Press, 2015.
5. Chindhade, Shirish. *Five Indian English Poets: Nissim Ezekiel, A.K. Ramanujan, ArunKolatkar, DilipChitre, R. Parthasarathy*. Atlantic Publications, 2011.
6. Dickens, Charles. *The Signalman and Other Horrors: The Best Victorian Ghost Stories of Charles Dickens: Volume 2*. Createspace Independent Publications, 2015.
7. Anderson, Hans Christian. *The Fir Tree*. Dreamland Publications, 2011.
8. Colvin, Sidney (ed). *The Works of R. L. Stevenson. (Edinburgh Edition)*. British Library, Historical Prints Edition, 2011.
9. Bishop, Elizabeth. *Poems*. Farrar, Straus and Giroux, 2011.
10. Swift, Jonathan. *Gulliver's Travels*. Penguin, 2003.
11. Dickinson, Emily. *The Complete Poems of Emily Dickinson*. Createspace Independent Publications, 2016.
12. Brooke, Rupert. *The Complete Poems of Rupert Brooke*. Andesite Press, 2017.
13. King, Martin Luther Jr. &James M. Washington. *I Have a Dream: Writings and Speeches That Changed The World.* Harper Collins, 1992.
14. Keller, Helen. *The Story of My Life*. Fingerprint Publishing, 2016.
15. Green, David. *Contemporary English Grammar Structures and Composition*. New Delhi: MacMillan Publishers, 2010.
16. Thorpe, Edgar and Showick Thorpe. *Basic Vocabulary*. Pearson Education India, 2012.
17. Leech, Geoffrey and Jan Svartvik. *A Communicative Grammar of English*. Longman, 2003.
18. Murphy, Raymond. *Murphy's English Grammar with CD*. Cambridge University Press, 2004.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHA101	**CO1**					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Code	Communicative English-I	Type	L	T	P	C	Hrs/Week
B21AHE101		FC	1	1	0	2	3

Course Objectives:

This course aims to provide for the student:

1. To enhance functional communication skills.
2. To develop functional use of language in professional contexts.
3. To utilize oral presentations in multiple contexts.
4. To apply effective written skills in formal communication.

Course Outcomes:

After successful completion of the course, students will be able to

1. Identify pressing issues relating to society, environment and media.
2. Develop a process-oriented approach to writing.
3. Apply the grammatical skills developed during the course aptly.
4. Demonstrate a good command over language usage and refined interpersonal skills.

Course Contents:

UNIT – I: Functional English **7 hrs**

Remedial Grammar: Past Simple; Past Continuous; Irregular Verbs**; Writing Skills:** Paragraph Writing**; Activities:** Conversations; Leaving Phone Messages; **Literature:** Chief Seattle – The End of Leaving and Beginning of Survival.

UNIT – II: Interpersonal Skills **6 hrs**

Remedial Grammar: Present Simple & Present Continuous; Activity & State Verbs**; Writing Skills:** Official Letters**; Activities:** Making Apologies; Invitations & Making Arrangements**; Literature:** Ruskin Bond – Tiger in the Tunnel

UNIT – III: Multitasking Skills **7 hrs**

Remedial Grammar: Present Perfect; For, Since & How Long; -ed& -ing adjectives; Prefix & Opposites of Adjectives**; Writing Skills:** Note Making**; Activities:** Agreeing & Disagreeing with Opinions**; Literature:** Jesse Owens - My Greatest Olympic Prize.

UNIT – IV: Communication Skills **6 hrs**

Remedial Grammar: Collocations; Prepositions**; Writing Skills:** Precise Writing**; Activities:** Offers, Suggestions & Requests**; Literature:** Avijit Pathak – Onscreen Magic.

Reference Books:

1. Green, David. *Contemporary English Grammar Structures and Composition*. New Delhi: MacMillan Publishers, 2010.
2. Thorpe, Edgar and Showick Thorpe. *Basic Vocabulary*. Pearson Education India, 2012.
3. Leech, Geoffrey and Jan Svartvik. *A Communicative Grammar of English*. Longman, 2003.
4. Murphy, Raymond. *Murphy's English Grammar with CD*. Cambridge University Press, 2004.
5. Rizvi, M. Ashraf. *Effective Technical Communication*. New Delhi: Tata McGraw-Hill, 2005.
6. Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 2011.
7. Sen et al. Communication and Language Skills. Cambridge University Press, 2015.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHE101	**CO1**					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Code	Mathematics-I	Type	L	T	P	C	Hrs/Week
B21MT0101		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the student to:

1. Familiarize the concepts of matrix and its applications in various fields.
2. Understand the concepts of successive differentiation and n^{th} order derivative.
3. Learn about reduction formula with limit and without limit and differentiation under integral sign - Leibnitz rule.
4. Understand the concept of partial differentiation

Course Outcomes:

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

1. Apply the matrix theory to solve the system of linear equations.
2. Compute derivatives of any order and apply Leibniz' theorem to find n^{th} derivative of product of two functions.
3. Gain the Knowledge of reduction formulae and differentiation under integral sign by Leibnitz rule to solve integral equations.
4. Master the fundamental concepts of partial differentiation and apply Euler's theorem for homogeneous functions.

Course Contents:

Unit-I: Differential Calculus **12 hrs**

Recap of differentiation, Successive differentiation, nth derivatives of standard functions $\left(e^{ax},(ax+b)^n,\frac{1}{(ax+b)},\log(ax+b),\sin(ax+b),\cos(ax+b),e^{ax}\sin(bx+c),e^{ax}\cos(bx+c)\right)$

Leibnitz theorem (without proof)-problems. Indeterminate forms $\left(\frac{0}{0},\frac{\infty}{\infty},\ 0X\infty,\ \infty-\infty,\ 0^0,1^\infty\right)$, L' Hospital rule and problems. Taylor's and McLaurin's theorem for a function of one variable and problems (without proof).

Unit-II: Partial differentiation **12 hrs**

Partial derivatives – definition and simple problems, Euler's theorem (with proof) , Eulers extension theorem (without proof) problems, total derivatives, differentiation of implicit functions, partial differentiation of composite functions- problems. Jacobians – Definition, properties and problems.

Unit-III: Integral Calculus **12 hrs**

Reduction formulae for $\int \sin^n x\,dx, \int \cos^n x\,dx, \int \tan^n x\,dx$ and $\int sin^m x\, cos^n x\ dx,$

evaluation of theses integrals with standard limits and problems.($Illutration\ of\ reduction\ formulae\ for\ \int cot^n x\,dx,\ \int sec^n x\,dx,\ \int cosec^n x\,dx,$) **.** Leibnitz's rule- differentiation under integral sign and problems. Applications of Integral Calculus: Computation of length of arc and plane area for standard curves in Cartesian and polar forms.

Unit-IV: Linear Algebra **12 hrs**

Elementary operations - Rank of a Matrix, – Inverse of a matrix using row operations - Echelon Forms

- Normal Forms - System of Homogeneous and non-homogeneous equations- Gauss elimination method and Gauss-Jordon method. Eigenvalues - Eigenvectors - Cayley Hamilton Theorem (without proof) and diagonalization.

Text Books:

1. Shanthi Narayan and P.K. Mittal, Differential Calculus, Reprint. New Delhi: S. Chand & Company Ltd., 2011.
2. Shanthi Narayan, Integral Calculus, Reprint. New Delhi: S. Chand and Company Ltd., 2004.
3. G K Ranganath, Text book of B.Sc. Mathematics, Revised ed. New Delhi, India: S Chand and Company Ltd., 2011.
4. A R Vashista, Matrices, Krishna PrakashanaMandir, 2003.
5. Krishnamoorty V K and Mainra V P and Arora J L, An Introduction to Linear Algebra, Reprint. New Delhi, India: Affiliated East West Press Pvt. Ltd., 2003.
6. G K Ranganath, Text book of B.Sc., Mathematics, Revised ed. New Delhi, India: S Chand and Co., 2011.
7. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.

Reference Books:

1. Serge Lang – First Course in Calculus
2. S. Narayanan & T. K. Manicavachogam Pillay, Calculus: S. Viswanathan Pvt. Ltd., 1996, vol. I & II.
3. S. Narayanan and T.K. Manicavachogam Pillay, Calculus (I & II). Chennai, India: S. Viswanathan Pvt. Ltd., 1996.
4. Joseph Edwards, An elementary treatise on the differential calculus: with applications and numerous examples, Reprint. Charleston, USA: BiblioBazaar, 2010.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0101	**CO1**	3	2	2						3	2
	CO2	2	2	2						3	2
	CO3	3	2	2						3	3
	CO4	3	2	2						3	2

Course Code	Mechanics and Properties of Matter	Type	L	T	P	C	Hrs/Week
B21PH0101		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the student to:

1. Impart the knowledge about relative motion. Inertial and non- inertial reference frames
2. Familiarize with the concepts of conservation of energy and momentum to elastic and inelastic collisions.
3. Familiarize with the concepts of fluid mechanics for practical application.
4. Equip with the basics of physics related to elasticity and to solve problems involving Forces, Moments, Centroids and Moment of inertia the relationship between the motion of bodies and moment of inertia.

Course Outcomes:

On successful completion of this course; the student will be able to:

1. Describe inertial and non-inertial frames and relative motion of the objects.
2. Apply the concepts of conservation of energy and momentum to elastic and inelastic Collisions.
3. Summarize the concepts of surface tension and viscosity and calculate critical velocity of the fluid.
4. Apply Newton's laws of the motion to ascertain the state of the systems and calculate the moment of inertia using free body diagrams and to compute the elastic properties of materials.

Course Contents:

UNIT-I **12 hrs**

Motion of a particle: The position vector r (t) of a moving particle and its Cartesian components, Velocity and acceleration as the vector derivatives, radial and transverse component of velocity and acceleration for arbitrary planar motion, deduction of results for uniform circular motion centripetal force, Numerical problems.

Frames of reference: Inertial reference frames with examples and uniform rectilinear motion in an inertial frame, The Galilean principle of relativity, Galilean transformation equation. Motion in a non-inertial reference frame uniformly accelerated rectilinear motion, Illustration of an earth as non–inertial frame, concept of weightlessness by freely falling elevator, Qualitative discussion on centrifugal force, Coriolis force, Numerical problems.

UNIT-II **12 hrs**

Conservation Laws

Conservation of linear momentum for a system of two particles, Rocket motion in a uniform gravitational field (single stage rocket equation -- with and without gravity), Multistage rocket, Elastic and inelastic collisions, Elastic Head on collision, Elastic oblique collision in lab frame, reduced mass, Numerical problems.

Conservation of energy: Conservative and non-conservative forces with examples, conservation of energy in a conservative force field, Applications – **1.** Vertical oscillations of loaded light spiral spring, **2.** Calculation of escape velocity in the gravitational field of the earth, Numerical problems. Numerical problems.

Conservation of Angular Momentum: Relation between torque and angular momentum, Law of conservation of angular momentum concept of Central forces, Kepler's laws of planetary motion – derivation using Newton's law of gravitation, Numerical problems.

UNIT-III **12 hr** s

Fluid Dynamics: Streamline and Turbulent Flow Viscosity -|Basic concepts, Variation of viscosity of liquids with temperature and pressure, Expression for critical velocity, Reynold's number and its significance, coefficient of viscosity, Stokes law (no derivation) terminal velocity-Expression for terminal velocity of small ball falling through viscous fluid, Numerical problems.

Surface Tension: Basic concepts-pressure inside curved liquid surface-examples, Surface tension by drop-weight method, surface tension of mercury by Quincke's method, Numerical problems.

UNIT-IV **12 hrs**

Rigid body Dynamics: Moment of Inertia of a body, radius of gyration. Theorem of Moment of Inertia-Parallel and perpendicular axes theorem with proofs (2-D case), Expression for kinetic energy of a rigid body, Calculation of moment of inertia of a disc, annular ring, solid sphere, and rectangular bar, Conservation of angular momentum with illustrations, Numerical problems.

Elasticity: Hooke's law, Moduli of elasticity, Poisson's ratio Relation between elastic constants - limiting values, bending moment, Theory of single cantilever, Torsion-calculation of couple per UNIT twist, The torsion pendulum, Static Torsion, Numerical problems.

Reference Books:

1. J C Upadhyay. Classical Mechanics, 11th edition, Himalaya, 2014.
2. David Halliday. Robert Resnick, and Jearl Walker, Fundamentals of Physics, Sixth Edition, John Wiley & Sons, Inc. 2001.
3. Charles Kittel etal., Berkeley. Physics -Vol. 1, 2nd edition McGraw Hill Education (India),2011.
4. D.S. Mathur. Mechanics, 5th edition, S Chand publications 2016.
5. Brijlal & Subramanyam. Properties of Matter, S Chand and Co., New Delhi 2002.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0101	**CO1**	3	3	3	3	2		1	3	3	3
	CO2	3	3	3	3	2		3	3	3	3
	CO3	3	3	3	2	2		2	3	3	3
	CO4	3	3	3	2	2				2	2

Course Code	Chemistry-I	Type	L	T	P	C	Hrs/Week
B21CH0101		HC	3	0	0	3	4

Course objectives:

This course aims to provide for the student to:

1. Provide brief descriptions of the accomplishments of Planck, Einstein, Rutherford, Rydberg, Bohr, de Broglie and Schrodinger; and how these contributed to understanding the structure of atom
2. Calculate the energy and wavelength of a given electronic transition in hydrogen atom.
3. Discuss the periodic properties of the elements, and their variations across the period and down the group.
4. Explain the preparation, properties and reactions of alkanes, alkens and alkynes.
5. Applications of various reagaents and reactions on organic synthesis.
6. Focuses on the Maxwell-Boltzmann distribution of molecular velocities.

Course Outcomes:

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

1. Formulate Rydberg equation to calculate all spectral lines of hydrogen atom.
2. Discuss the importance of atomic number in constructing periodic table.
3. Examine the role of reagents, named reactions and their applications in organic chemistry.
4. Utilize the concepts of different types of molecular velocities and establish the relationship between them.

Course Contents:

Unit-I:

Atomic Structure: Fundamental particles of atoms, Bohr's theory and its limitations, Hydrogen atomic spectra, Derivation of expressions for radius and energy of hydrogen like atoms. Planck Quantization - Black body radiation, dual nature of electron, de Broglie's hypothesis.

Quantum Mechanics: Introduction, Heisenberg Uncertainty principle. wave functions, time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2. Application of Schrodinger wave equation. Quantum numbers, Shapes of s, p and d orbitals. Radial and angular parts of the hydrogenic wave functions and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals. Radial and angular nodes and their significance. Electronic configuration, Aufbau principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity and (n+l) rule.

Unit-II:

Periodic Table and Periodicity

Introduction, Modern periodic law, Periodic classification of elements, Periodic properties and Causes:

i. Atomic radius: Definitions of covalent, metallic & van der Wall's radius; calculation of atomic radius from inter nuclear distance.
ii. Ionic radius: Definition, calculation by Pauling's method, Slater's rules.
iii. Ionization energy and electron affinity: Definitions, methods of determination.
iv. Electronegativity evaluation by Pauling's and Mullikan's methods.

Comparative study of groups 1, 2, 16 and 17. Halides, oxides and carbonates of alkali and alkaline earth metals. Hydrides of chalcogens and halogens.

General study of d and f block elements.

Transition elements: electronic configuration, atomic and ionic radii, ionization energy, oxidation states, redox potentials, spectral and magnetic properties, catalytic activity, interstitial compound formation.

Unit-III:

Introduction to Organic Chemistry

Nomenclature (IUPAC) of bifunctional, aliphatic and aromatic compounds.

Alkanes: Methods of formation (corey-house reaction etc.,), physical and chemical properties. Halogenation, Nitration, Oxidation and Combustion reactions.

Alkenes: Preparation by wittig, Hoffmann's elimination. Mechanism of electrophilic addition, oxymercuration, reduction, hydroboration – oxidation and epoxidation. Chemical oxidation of alkene with $KMnO_4$ and OsO_4, ozonolysis. **Dienes:** Types, relative stabilities of dienes, conjugated dienes – 1,3 butadiene-structure, 1,2 and 1,4- addition reactions with H_2 and halogens, Diel's Alder reaction with an example.

Alkynes: Methods of preparation – Dehydrohalogenation, vicinal and gem dihalides, reactions of alkynes –Electrophilic additions with HCN, CH_3COOH and H_2O.

Alkyl halides: Isomerism and classification, nomenclature. Substitution reaction-S_N1, S_N2, with mechanism. Effect of substrate and nucleophiles. Nature of leaving group.

Relative reactivity of alkyl, allyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Reactive intermediates: Generation, stability of carbocations, carbanions, free radicals, nitrene, carbenes, benzynes and ylides.

Electronic effects (resonance, inductive, hyperconjugation) and steric effects and its applications (acid/base property).

Unit-IV:

Gaseous state: Maxwell-Boltzmann distribution of molecular velocities. Effect of temperature. Mean free path, collision frequency and collision number. Definition and expressions using SI units (no derivations). Boltzmann factor. Energy distribution as a function of temperature. Types of molecular velocities and relationships between them and numerical.

The critical phenomena – Andrew's experiments on CO_2, critical constants – Tc, Pc and Vc. Relation between Vander Waal's Constants 'a' and 'b' and critical constants Tc, Pc and Vc to be derived using isotherms of CO_2. Law of corresponding states and reduced equation of state. Liquefaction of gases – Principle underlying liquefaction of gases – Joule Thomson effect, Joule Thomson coefficient, Inversion temperature, definitions and its relation between Van der Waal's constants ('a' and 'b').

Phase Rule: Definition of terms: Phase, components and degrees of freedom – Derivation of Gibbs phase rule. One component system: Water and Sulphur system, Reduced phase rule.

Two component system: Simple eutectic system: Pb–Ag system, KI–water system freezing mixtures. Thermal analysis and cooling curves. Compound formation with congruent melting point Zn–Mg, $FeCl_3$–Water system.

Suggested Text Books and References:

1. A. Bahl, and B.S. Bahl, Advanced Organic Chemistry, S. Chand, 2010.
2. A. Bahl, and B.S. Bahl, Advanced Physical Chemistry, S. Chand, 2010.
3. J.N. Gurtu and A. Gurtu, Advanced Physical Chemistry, Pragati Prakashan, Vol I, 4th Edition, 2017.
4. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Vishal Publishing Co., 33rd Edition, 2020.
5. P.A. Sykes, Guide book to Mechanism in Organic Chemistry, Orient Longman, New Delhi, 1988.
6. R.T. Morrison and R.N. Boyd, Organic Chemistry, Pearson, 2010.
7. B.H. Mahan, University Chemistry, Narosa, 3rd Edition, 1998.
8. J.D. Lee, Concise Inorganic Chemistry, Oxford University Press, 3rd Edition, 2008.
9. F.A. Cotton, G. Wilkinson and P.L. Gaus, Basic Inorganic Chemistry, Wiley, 3rd ed, 1995.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0101	**CO1**	3	3	2	1			1	1	2	2
	CO2	3	2	2	1			1	2	2	3
	CO3	2	3	2	2		1		2	2	3
	CO4	3	3	2	1					2	3

Course Code	Elementary Number Theory	Type	L	T	P	C	Hrs/Week
B21MTS111		SC	3	0	0	3	4

Course objectives:

This course aims to provide for the student to:

1. Concepts of divisibility, congruence, greatest common divisor and prime factorization.
2. The concept of congruence and use various results related to congruences.
3. Certain number theoretic functions and their properties.

Course Outcomes:

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

1. Define, interpret and apply the concepts and principles of number theory to perform numerical and symbolic computations.
2. Apply different types of proof writing techniques in number theory to related situations.
3. Develop an in-depth understanding of the principles of number theory.
4. Communicate the number theory concepts, techniques and principles effectively in both written and oral form.

Course Contents:

Unit-I: **12 hrs**

Divisibility, Greatest common divisor, The Fundamental theorem of Arithmetic, Euclid's algorithm, prime numbers and Prime number theorem.

Unit-II: **12 hrs**

Definition and basic properties of congruence, Residue and complete residue systems.

Unit-III: **12 hrs**

Linear congruence's, The Euler-Fermats Theorem, Chinese remainder theorem and applications.

Unit-IV: **12 hrs**

Arithmetic functions- Mobius function $\mu(n)$, Euler quotient function $\varphi(n)$, relation connecting μ and φ, Product formula for $\varphi(n)$ and properties of φ.

Suggested Text Books and References:

1. D. M. Burton – Elementary Number Theory, Tata McGraw-Hill, New Delhi, 6th Ed.,
2. Niven, H. S. Zuckerman and H. L. Montgomery – An Introduction to the Theory of Numbers, New York, John Wiley and Sons, Inc., 2004, 5th Ed.,
3. G. A. Jones and J. M. Jones – Elementary Number Theory, Springer,1998
4. T. M. Apostal – Mathematical Analysis, Addison Wesley, Narosa, New Delhi, 2nd Ed.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MTS111	CO1	3	3	2	1	1				3	2
	CO2	3	3	2	2	1				3	2
	CO3	3	3	2	2	1				3	2
	CO4	3	3	2	2	1				3	2

Course Code	Discrete Mathematics and Graph Theory	Type	L	T	P	C	Hrs/Week
B21MTS112		SC	3	0	0	3	4

Course objectives:

This course aims to provide for the student:

1. To study the set theory, logic, Recurrence relations and functions and to know the application of Boolean Algebra to switching theory
2. To understand and apply the fundamental concepts in graph theory
3. To apply graph theory-based tools in solving practical problems

Course Outcomes:

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

1. Apply operations on discrete structures such as sets, relations, functions and Recurrence relations.
2. Apply Boolean Algebra to switching theory and their minimization techniques and Phase structure grammars and languages, Finite state Machine, Recognition in regular languages.
3. Apply principles and concepts of graph theory in practical situations
4. Apply the theory and applications of graphs, fundamental theorems and their proofs and computer applications such as networks of communication, data organizations, computational devices, the flow of computation.

Course Contents:

Unit-I: Set Theory & Logic **12 hrs**

Set theory fundamental operations; propositions; negation; disjunction and conjunction; implication and equivalence; truth tables; laws of Logic; predicates.

Unit-II: Logic & Relations 12 **hrs**

Quantifiers; rules of Inference; methods of proofs.

Relations; representation of relations by graphs; properties of relations; equivalence relations and partitions. Hasse diagrams.

Unit-III: Graph Theory -1 **12 hrs**

Konigsberg's Bridge problem, Utilities problem, Seating Problems, graphs, Representation of graphs, directed graphs, incidence, adjacency, degree, Indegree, out degree, regular graphs, complete graphs, Null graphs, Bipartite graphs, Isomorphism, directed graphs, sub graphs, Walk, Trail, Path, Cycle, Connected and Disconnected graphs, Components, Euler graphs, Operation on graphs Complement of Graph, Partition, Decomposition.

Unit-IV: Graph Theory -2 **12 hrs**

Hamiltonian paths, Circuits, Planar graphs, Kuratowskiís graphs, Different representation of planar graphs, Geometric dual, Trees and some properties of trees, Rootedand binary tree, Spanning tree and fundamental circuits. Matrix representation, Incidence matrix, Cutset matrix, Circuit matrix, Adjacency matrix.

Suggested Text Books and References:

1. Elements of Discrete Mathematics 3rdedition by C.L. Liu, Tata Macgraw Hill Publishers (2008).
2. Discrete Mathematical Structures with Applications to Computer Science by J.P. Trembley and R. Manohar, TataMagrawHill Publishers
3. Kenneth H. Rosen, Discrete Mathematics and its Application, Fifth edition, Tata McGraw-Hill Publishing company PVT. Ltd., New Delhi, 2003.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MTS112	**CO1**	3	3	2	2	3				3	3
	CO2	3	2	3	2	2				2	3
	CO3	3	3	2	3	3				3	2
	CO4	3	3	3	2	2				3	3

Course Code	Fuzzy Mathematics	Type	L	T	P	C	Hrs/Week
B21MTS113		SC	3	0	0	3	4

Course objectives:

This course aims to provide for the student to:

1. Study the fuzzy sets, basic operation on fuzzy sets and inverse fuzzy operations.
2. Study fuzzy subsets and its properties.
3. Read and analyze the concept of fuzzy rings.

Course Outcomes:

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

1. Analyse the concept of fuzzy set and fuzzy logic using fuzzy operations.
2. Apply the concept of fuzzy sum, fuzzy product and Cartesian product on real world problems.
3. Analyse the concept of algebra of fuzzy relations and logic connectives.
4. Analyse the concept of fuzzy invariant subgroups and fuzzy subrings.

Course Contents:

Unit-I: 12 hrs

Introduction- Fuzzy Subsets-Lattices and Boolean Algebras- L fuzzy sets-operations on fuzzy – level sets – properties of fuzzy subsets.

Unit-II: 12 hrs

Algebraic product and sum of two fuzzy subsets-properties satisfied by Addition and product-cartesian product of fuzzy subsets.

Unit-III: 12 hrs

Introduction- Algebra of fuzzy relations-logic-connectives.

Unit-IV: 12 hrs

Some more connectives-Introduction-fuzzy subgroup-homomorphic image and Preimage of subgroupoid. Fuzzy invariant subgroups-fuzzy subrings.

Suggested Text Books and References:

1. S. Nanda and N. R. Das Fuzzy Mathematical concepts, Narosa Publishing House, New Delhi, 2010.
2. M.Ganesh, Introduction to Fuzzy Sets & Fuzzy Logic, Prentice Hall of India Pvt. Ltd., 2006.
3. J.N. Mordeson and P.S. Nair, Fuzzy Mathematics.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MTS113	**CO1**	3	3	2	2					2	3
	CO2	3	2	2	3					3	2
	CO3	3	2	3	2					3	2
	CO4	3	3	3	2					3	3

Course Code	Constitution of India and Professional Ethics	Type	L	T	P	C	Hrs/Week
B21LSM101		MC	0	0	0	0	2

Course objectives:

This course aims to provide for the student:

1. To impart knowledge on Constitution of India.
2. To facilitate the understanding of Fundamental Rights, Duties and other Rights which is been given by our law.
3. To facilitate the understanding of Constitution perspective and make them face the world as a bonafide citizen.
4. To attain knowledge about ethics and also know about professional ethics.
5. Explore ethical standards followed by different companies.

Course Outcomes:

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

1. Explain the Indian constitutional provisions and fololow them.
2. Demonstrate the fundamental rights and human rights.
3. Explain the duties and more importantly practice them in a right way.
4. Adopt the habit of raising their voice against a unconstitutionality of any laws and upon any legal discrimination as we have session of debates on Constitutional validity.

Course Contents:

Unit-I: Constitution of India

Making of Indian Constitution, features of Indian Constitution Preamble to the Constitution of India, Fundamental Rights under Part III; Rights to Equality, Right to Freedom, Right against Exploitation, Rights to Freedom of Religion, Cultural and Educational Rights, Constitutional Remedies. Fundamental Duties of the Citizen, Significance and Characteristics. Elements of National Significance; National Flag, National Anthem, National Emblem.

Unit-II: Legislature and Executive

Organs of the Government; Legislature, Executive and Judiciary. Union and state Executives:

president, Vice Preisdent, Prime Minister, Cabinet, Governor, Council of Ministers, Electoral process, Election Commission.

Unit-III: Judiciary

Supreme Court of Indian, High Court, Right to Information Act 2005, Consumer Protection-Consumer Rights- Caveat Emptor and Caveat Venditor.

Unit-IV: Professional Ethics

Definition Scope and need of Ethics for professional, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees. Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companies in India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence.

Suggested Text Books and References:

1. M.V. Pylee, An introduction to Constitution of India.
2. M. Govindarajan, S. Natarajan, V.S. Senthil Kumar, Engineering Ethics.
3. D.D. Basu, Introduction to constitution of India.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MTS103	**CO1**						2				
	CO2						3				
	CO3						3				
	CO4						3				

Course Code	Mathematics Practicals-I	Type	L	T	P	C	Hrs/Week
B21MT0102		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the student to:

1. Practical introduction to understand the concepts of matrix and its applications in various fields.
2. Acquire skill in solving problems on partial derivatives using *Python*.
3. Gain proficiency in using *Python* to solve the problems of differential calculus.

Course Outcomes:

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

1. Demonstrate the use of *Python* to understand concepts in matrix theory.
2. Be familiar with the built-in functions to find derivatives of any order in differential calculus.
3. Acquire problem solving skills on partial derivatives.
4. Exhibit the use of *Python* to understand and interpret the concepts of reduction formula.

Course Contents:

List of Programmes

1. Introduction to Python: Basic syntax, variable types, basic operators, numbers, strings, lists, tuples, functions and input/output statements.
2. Some simple programs to understand the relational, conditional and logical operators.
   i) Compare two numbers (less than, greater than) using if statement
   ii) Sum of natural numbers using while loop
   iii) Finding the factors of a number using for loop.
   iv) To check the given number is prime or not (use if... else statement).
   v) Find the factorial of a number (use if...if...else). vi) Simple programs to illustrate logical operators (and, or, not)
3. Python commands to reduce given matrix to echelon form and normal form with examples.
4. Python program/command to establish the consistency or otherwise and solving system of linear equations.
5. Python command to find the nth derivatives.
6. Python program to find nth derivative with and without Leibnitz rule.
7. Obtaining partial derivative of some standard functions
8. Verification of Euler's theorem, its extension and Jacobean.
9. Python program for reduction formula with or without limits.
10. Plotting 2D and 3D graphs.

Suggested Text Books and References:

1. Farukh Khalilov and Tayyip oral, Math coding Python, 5th Edition, USA-2020.
2. Joakim Sundnes, Introduction to Scientific programming with Python, 2nd Edition, Springer 2010.
3. Allen Downey and Jeffrey Elkner, Learning with Python, 5th Edition, Springer, 2015.
4. Eric Matthes, A Hands-On, Project-Based Introduction to Programming- Python Crash Course, 2nd Edition:
5. Al Sweigart, Automate The Boring Stuff With Python: Practical Programming For Total Beginners, 2nd Edition.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0102	**CO1**	3	2	2		1				3	3
	CO2	3	2	2		1				3	3
	CO3	2	2	2		1				3	2
	CO4	3	2	2		1				2	3

Course Code	Physics Practicals-I	Type	L	T	P	C	Hrs/Week
B21PH0102		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the student to:

1. Develop the ability to apply knowledge of Physics and engineering in calculating the elastic properties of materials.
2. Equip with the ability to use the techniques, modern engineering tools necessary for material testing.
3. Impart the knowledge of using the techniques, skills for testing of fluid properties.
4. Equip with knowledge of professional and ethical responsibility in the areas of material testing.

Course Outcomes:

On successful completion of this course; the student will be able to:

1. Compute the values of moment of inertia, mass and density and elastic properties of a given material through experiment.
2. Compute the liquid properties like surface tension and viscosity of the given liquid through experiment.
3. Calculate acceleration due to gravity through experiment.
4. Apply the knowledge of professional and ethical responsibility in the areas of material testing.

Course Contents:

Any EIGHT of the following experiments:

1. Determination of the acceleration due to gravity using Bar pendulum (graphical method).
2. Determination of moment of inertia, mass of Fly wheel
3. Determination of surface tension of water and kerosene by Drop weight method.
4. Determination of surface tension and angle of contact of mercury by Quincke's method
5. Determination of Young's modulus by single cantilever method.
6. Determination of young's modulus, the rigidity modulus, bulk modulus, and Poisson's ratio using Searle's double bar.
7. Determination of the rigidity modulus by Torsional pendulum
8. Determination of the Young's modulus by stretching method.
9. Determination of terminal velocity of small ball falling through viscous fluid and its coefficient of viscosity.
10. Verification of perpendicular axis theorem using Torsion pendulum.

Text books:

1. B Saraf etc, - Physics through experiments, Vikas Publications,2013.
2. D P Khandelwal –A Laboratory Manual of Physics for Undergraduate Classes, Vikas Publications First ed, 1985.
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London, 1923.
4. An Advanced Course in Practical Physics, D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002.
5. C.L. Arora, BSc Practical Physics, S Chand & Co, New Delhi, Revised Edition, 2007.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0102	CO1	3	2	2		1				3	3
	CO2	3	2	2		1				3	3
	CO3	2	2	2		1				2	3
	CO4	3	2	2		1				3	2

Course Code	Chemistry Practicals-I	Type	L	T	P	C	Hrs/Week
B21CH0102		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students to:

1. Basic knowledge of handling hazardous chemicals and safety precautions while performing experiments.
2. Hands on training about conduction of experiments independently.
3. Prepare the required solutions, using molarity and normality equations.
4. Apply suitable formule to obtain results, based on the results draw conclusions.

Course Outcomes:

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

1. Acquire the skill of handling glasswares, chemicals and instuments used in the laboratory.
2. Prepare the standard solutions and use the same for the estimation of requied from the given solution.
3. Build analytical skills such as recording the reading, interpretation of the date and drawing conclusions.
4. Estimate the amount of chlorine present in bleaching powder and COD in waste water.

Course Contents:

List of experiments:

1. Calibration of: (i) Pipette (ii) Burette (iii) Volumetric flask
2. Estimation of Carbonate and Bicarbonate in a given mixture using standard hydrochloric acid.
3. Estimation of potassium permanganate by using standard solution of oxalic acid present in the solution.
4. Determination of the percentage of available chlorine in the given sample of bleaching powder.
5. Estimation of ferrous and ferric iron in a given mixture using standard potassium dichromate solution
6. Estimation of COD of given waste water sample.
7. Estimation of total hardness of water.
8. Estimation of ammonium chloride using standard sodium hydroxide and standard hydrochloric acid solutions (back titration).
9. Determination of the density using specific gravity bottle and viscosity of a liquid using Ostwald's viscometer.
10. Determination of the density using specific gravity bottle and surface tension of a liquid using stalagmometer.
11. Effect surfactants on the surface Tension of water (Stock solution)

Suggested Text Books and References:

1. B.D. Khosla, V. C. Garg, A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New Delhi, 2011.
2. S.W. Rajbhoj and T. K. Chondhekar, Systematic Experimental Physical Chemistry, Anjali Publication, 2nd Edition, 2000.
3. Sunita Rattan, Experiments in Applied Chemistry, S.K. Kataria & Sons, 2nd edition 2008.
4. B.D. Khosla, V.C. Garg and A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New Delhi, 2011.
5. C.W. Garland, J.W. Nibler and D. P. Shoemaker, Experiments in Physical Chemistry, 1997.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0102	**CO1**	2			3		2	2	2	2	2

	CO2	3	2		3		2	1	3	3	3
	CO3	3	3	3	3			2	2	3	2
	CO4	3	3	2	2		2	2	3	3	2

SECOND SEMESTER

Course Code	Language – II: Kannada-II	Type	L	T	P	C	Hrs/Week
B21AHK201		FC	1	1	0	2	3

Course Objectives:

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ JgÀqÀ£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ¯ÉÃR£ÀUÀ¼ÀÄ ºÁUÀÄ ¥ÀæªÁ¸À PÀxÀ£À ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß ªÀÄÆr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀé «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¯ÉÃR£ÀUÀ¼ÀÄ ºÁUÀÄ ¥ÀæªÁ¸À PÀxÀ£À ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£ÀºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. ¸ÁªÀiÁfPÀ CjªÀÅ ªÀÄÆr¸ÀÄvÀÛzÉ
4. GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÉAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.

Course Contents:

Unit-I: ªÀÄzsÀåPÁ°Ã£À PÁªÀå

7 hrs

1. ZÀAzÀæªÀÄw «¯Á¥À - gÁWÀªÁAPÀ
2. ºÀUÉUÀ¼À£ÀÄ »ArzÀ£ÀÄ ªÀÄ£ÀzÉÆ¼ÀUÉ - PÀÄªÀiÁgÀªÁå¸À
3. UÉÆÃgÀPÀë ¥Àæ¸ÀAUÀ - ZÁªÀÄgÀ¸À

Unit-II: ªÀÄzsÀªÀ¯Á£Á PÁªÀå
6 hrs

1. wæ¥À¢UÀ¼ÀÄ - ¸ÀªÀðdÕÕ
2. V½AiÀÄÄ ¥ÀAdgÀzÉÆ½®è - ¥ÀÄgÀAzÀgÀ zÁ¸ÀgÀÄ
3. PÀgÉzÀÄ PÉÆlÖ£ÀÄ ±Á¥ÀªÀ£ÀÄ - PÀ£ÀPÀzÁ¸ÀgÀÄ

Unit-III: ¯ÉÃR£ÀUÀ¼ÀÄ **7 hrs**

1. DvÀä²æÃUÁV ¤gÀAPÀÄ±ÀªÀÄwUÀ¼ÁV - PÀÄªÉA¥ÀÄ
2. ªÀiÁ£À«ÃAiÀÄvÉ CAvÁgÀ¯Áè - zÉÃªÀ£ÀÆgÀÄ ªÀÄºÁzÉÃªÀ
3. ¨sÀÆvÁ¬Ä ªÀÄÄ¤zÁ¼ÀÄ - ªÀÄÄgÁj §¯Áè¼À

Unit-IV: ¥ÀæªÁ¸À PÀxÀ£À

6 hrs

£À£ÉÆß¼ÀV£À ºÁqÀÄ PÀÆå¨Á - f.J£ï. ªÉÆÃºÀ£ï

¥ÀgÁªÀÄ±Àð£À UÀæAxÀUÀ¼ÀÄ :

1. ªÀÄÄUÀ½ gÀA.²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
3. ºÀA¥À £ÁUÀgÁdAiÀÄå, ¸ÁAUÀvÀå PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
4. PÁ¼ÉÃUËqÀ £ÁUÀªÁgÀ, wæ¥À¢, gÀUÀ¼É ªÀÄvÀÄÛ eÁ£À¥ÀzÀ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
5. ¸ÀA. ¨É£ÀUÀ¯ï gÁªÀÄ gÁªï ªÀÄvÀÄÛ ¥Á£ÀåA ¸ÀÄAzÀgÀ ±Á¹ÛçÃ, ¥ÀÄgÁt £ÁªÀÄ ZÀÆqÁªÀÄtÂ, ¥ÀæPÁ±ÀPÀgÀÄ ¥Àæ¸ÁgÁAUÀ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ. 2010
6. ¸ÀA. §¸ÀªÀgÁdÄ J¯ï. ¸ÀªÀðdÕ£À ªÀZÀ£ÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2012
7. ªÀÄgÀÄ¼À¹zÀÝ¥Àà PÉ, µÀlà¢ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
8. ¸ÀA. ¸ÉÃvÀÄgÁªÀÄ gÁªï C.gÁ., ²æÃ ®Qëöä£±À£À eÉÊ«Ä¤ ¨sÁgÀvÀ(ªÀÄÆ®-vÁvÀàAiÀÄð-¸ÀavÀæ), ¥ÀæPÁ±ÀPÀgÀÄ PÁªÀÄzsÉÃ£ÀÄ ¥ÀÄ¸ÀÛPÀ ¨sÀªÀ£À, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
9. ¸ÀA. f.J¸ï.¨sÀmï., PÀÄªÀiÁgÀªÁå¸À£À PÀuÁðl ¨sÁgÀvÀ PÀxÁªÀÄAdj ¥ÀæªÉÃ±À, ¥ÀæPÁ±ÀPÀgÀÄ CPÀëgÀ ¥ÀæPÁ±À£À, ºÉUÉÆÎÃqÀÄ, ¸ÁUÀgÀ. 2006
10. QÃvÀð£ÁxÀ PÀÄvÀðPÉÆÃn, PÀ£ÀßqÀ ¸Á»vÀå ¸ÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉÆÃn ªÉÄªÉÆÃjAiÀÄ¯ï læ¸ïÖ, zsÁgÀªÁqÀ. 2009
11. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
12. ²ªÀgÀÄzÀæ¥Àà f.J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 201

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHK201	CO1					2	3				
	CO2					2	3				
	CO3						3				
	CO4							3	2		

Course Code	Language-II: Hindi-II	Type	L	T	P	C	Hrs/Week
B21AHH201		FC	1	1	0	2	3

Course Objectives:

This course aims to provide for the students to:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना |
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना |
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना |
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना |

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

1. सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है |
2. साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है |
3. समाज में अंतर्निहित पद्दतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है |
4. साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है |

Course Contents:

इकाई – 1: कविता: प्राचीन एवं आधुनिक **7 hrs**

कबीर के दोहे

कविता –जलियाँवाला बाग में बसंत- सुभद्राकुमारी चौहान

कविता – सुभाष की मृत्यु पर - धर्मवीर भारती

इकाई – 2: कविता: प्राचीन एवं आधुनिक **7 hrs**

तुलसीदस के पद

कविता – पाषाणी – नागार्जुन

कविता –चलना हमारा काम है।- शिवमंगल सिंह सुमन

इकाई – 3: कविता: प्राचीन एवं आधुनिक **6 hrs**

मीराबाई के पद

कविता – मेरे सपने बहुत नहीं हैं- गिरिराज कुमार माथुर

कविता – अभी न होगा मेरा अंत – निराला

इकाई – 4: **6 hrs**

अनुवाद : शब्द एवं अनुच्छेद (हिन्दी से अंग्रेज़ी)

सूचना: प्रत्येक इकाई 25 अंक के लिए निर्धारित है |

Text book

1. हिन्दी पाठ्य पुस्तक – रेवा विश्वविद्यालय |

References

1. सुबोध व्यवहारिक हिन्दी – डॉ. कुलदीप गुप्त
2. अभिनव व्यवहारिक हिन्दी – डॉ.परमानन्द गुप्त

3. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
4. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
5. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
6. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
7. संक्षेपण एवं पल्लवन

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHH201	**CO1**					2	3	2			
	CO2					2	2	3			
	CO3					3	3	3			
	CO4					3	2	3			

Course Code	Language-II: Additional English-II	Type	L	T	P	C	Hrs/Week
B21AHA201		FC	1	1	0	2	3

Course Objectives:

This course aims to provide for the students:

1. To assess ecological and environmental concerns through literature.
2. To identify the inequal structures of power in society.
3. To compare and relate the position of men and women in society.
4. To interpret the representation of society in popular culture.

Course Outcomes:

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

1. Demonstrate a thorough understanding of sensitive and critical ecological and environmental issues.
2. Analyze the rigid structure of center and margin in our society.
3. Criticize the subordinate position of women in society.
4. Justify the depiction of society in popular culture.

Course Contents:

Unit – I: Ecology & Environment **7 Hrs**

Literature: Toru Dutt - Casuarina Tree**;** Gordon J.L. Ramen – Daffodils No More; C.V. Raman – Water – The Elixir of Life; **Language:** Degrees of Comparison

Unit – II: Voices from the Margin **6 Hrs**

Literature: Tadeusz Rozewicz – Pigtail**;** Jyoti Lanjewar – Mother**;** Harriet Jacobs – Excerpt from *Incidents in the Life of a Slave Girl***; Language:** Prefix and Suffix

Unit – III: Women & Society **7 Hrs**

Literature: Kamala Das – An Introduction**;** Rabindranath Tagore – The Exercise Book**;** Jamaica Kincaid – Girl**; Writing Skills:** Dialogue Writing

Unit – IV: Popular Culture **6 Hrs**

Literature: Rudyard Kipling – The Absent-minded Beggar; Sir Arthur Conan Doyle – The Adventure of Lion's Mane; Aldous Huxley – The Beauty Industry**; Writing Skills:** Story Writing

Reference Books:

1. Agrawal, K.A. *Toru Dutt the Pioneer Spirit of Indian English Poetry - A Critical Study*. Atlantic Publications, 2009.
2. Latham, Edward Connery (ed). *The Poetry of Robert Frost*. Holt Paperbacks, 2002.
3. Gale, Cengage Learning. *A Study Guide for Tomas Rivera's The Harvest*. Gale, Study Guides, 2017.
4. Basu, Tejan Kumar. *The Life and Times of C.V. Ram*an. PrabhatPrakashan, 2016.
5. Rozewicz, Tadeusz. *New Poems*. Archipelago, 2007.
6. Manohar, Murli. *Critical Essays on Dalit Literature*. Atlantic Publishers, 2013.
7. Hansda, SowvendraShekhar. *The Adivasi Will Not Dance: Stories*. Speaking Tiger Publishing Private Limited, 2017.
8. Jacobs, Harriet. *Incidents in the Life of a Slave Girl*. Createspace Independent Publication, 2014.
9. Das, Kamala. *Selected Poems*. Penguin Books India, 2014.
10. Tagore, Rabindranath. *Selected Short Stories of Rabindranath Tagore*. Maple Press, 2012.
11. Gale, Cengage Learning.*A Study Guide for Jamaica Kincaid's Girl*. Gale, Study Guides, 2017.
12. Kipling, Rudyard. *The Absent-Minded Beggar*. Hardpress Publishing, 2013.
13. Doyle, Arthur Conan. *The Hound of the Baskervilles*. General Press, 2017.
14. Dixson, Robert J. *Everyday Dialogues in English*. Prentice Hall India Pvt Ltd., 1988.
15. Turton, Nigel D. *ABC of Common Errors*. Mac Millan Publishers, 1995.
16. Samson, T. (ed.) *Innovate with English.* Cambridge University Press, 2010.
17. Kumar, E Suresh, J. Savitri and P Sreehari (ed). *Effective English*. Pearson Education, 2009.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHA201	**CO1**					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Code	Communicative English-II	Type	L	T	P	C	Hrs/Week
B21AHE201		FC	1	1	0	2	3

Course Objectives:

This course aims to provide for the students:

1. To build skills essential for corporate communication.
2. To enhance context specific language skills.
3. To discover the creative linguistic potential through language and literature.
4. To develop communication skills necessary for employability.

Course Outcomes:

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

1. Apply acquired skills to communicate effectively in a corporate scenario.
2. Demonstrate command over rhetoric of language.
3. Develop critical and creative thinking through assimilated language skills.
4. Utilize the communication skills learnt to match industry standards.

Course Contents:

UNIT –I: Language Acquisition

Remedial Grammar: Questions & Negatives; Questions Tags**; Writing Skills:** Email Writing**; Activities:** Group Discussions**; Literature:** Alphonse Daudet - The Last Lesson.

UNIT – II: Persuasive Skills

Remedial Grammar: Past Simple & Past Perfect; **Writing Skills:** Report Writing**; Activities:** Book & Movie Reviews; **Literature:** Lord Alfred Tennyson – Ulysses.

UNIT – III: Cognitive Skills

Remedial Grammar: Present & Past Passive; Conditionals; **Writing Skills:** Creative Writing**; Activities:** Role Plays**; Literature:** O. Henry – The Gift of the Magi.

UNIT – IV: Employability Skills

Remedial Grammar: Reported Speech; Idioms; **Writing Skills:** Cover Letter & CV; **Activities:** Exchanging Information**; Literature:** Saki – The Open Window.

Reference Books:

1. Bansal, R.K. and J.B. Harrison. *Spoken English*. Orient Blackswan, 2013.
2. Raman, Meenakshi and Sangeeta Sharma. *Technical Communication*. Oxford University Press, 2015.
3. Thorpe, Edgar and Showick Thorpe. *Objective English*. Pearson Education, 2013.
4. Dixson, Robert J. *Everyday Dialogues in English*. Prentice Hall India Pvt Ltd., 1988.
5. Turton, Nigel D. *ABC of Common Errors*. Mac Millan Publishers, 1995.
6. Samson, T. (ed.) *Innovate with English.* Cambridge University Press, 2010.
7. Kumar, E Suresh, J. Savitri and P Sreehari (ed). *Effective English*. Pearson Education, 2009.
8. Goodale, Malcolm. *Professional Presentation*. Cambridge University Press, 2013.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHE201	CO1					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Code	Mathematics-II	Type	L	T	P	C	Hrs/Week
B21MT0201		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to:

1. Make the students to learn fundamental concepts of groups.
2. Make the students to develop the knowledge of differential calculus in polar coordinates.
3. Solve differential equations.

Course Outcomes:

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

1. Explain the classification of finitely generated abelian groups and subgroups.
2. Understand the concept of normal groups and quotient groups.
3. Interpret and apply polar coordinates to solve the problems.
4. Identify and solve the linear differential equations.

Course Contents:

Unit-I: Group Theory-I **12 hrs**

Definition and examples of groups – Some general properties of Groups, subgroups, Group of permutations – Cyclic permutations – Even and odd permutations. Order of an element of a group – Subgroups – Cyclic groups problems and theorems. Cosets, Index of a group, Lagrange's theorem, consequences.

Unit-II: Group theory-II **12 hrs**

Normal Subgroups, Quotient groups – Homomorphism. – Kernel of homomorphism – Isomorphism - Automorphism – Fundamental theorem of homomorphism.

Unit-III: Differential Calculus **12 hrs**

Polar coordinates – angle between the radius vector and the tangent at a point on a curve– angle of intersection between two curves – Pedal equations– Derivative of arc length in Cartesian, Parametric and Polar form (without proof). Curvature of plane curves - formula for radius of curvature in Cartesian, parametric, polar and pedal forms, (Centre of curvature - evolutes. Singular points – Asymptotes –Envelopes- Illustrative examples only).

Unit-IV: **12 hrs**

Differential equations of first order and first degree- Exact differential equations, reducible to exact, (close to M and N)

Linear Differential equations: Definitions, complete solution, rules for finding complementary functions, inverse operator, rules for finding particular integral. Method of variation of parameter. Cauchy's and Legendre linear equation.

Text Books:

1. Vashista, A First Course in Modern Algebra, 11th ed.: Krishna PrakasanMandir, 1980.
2. Shanthi Narayan and P.K. Mittal, Differential Calculus, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
3. M.D. Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.

Reference Books:

1. I.N. Herstien – Topics in Algebra.
2. Joseph Gallian – Contemporary Abstract Algebra, Narosa Publishing House, New Delhi,

Fourth Edition.
3. J.B. Fraleigh – A first course in Abstract Algebra.
4. M.D. Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt.Ltd., 2013.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0201	**CO1**	3	2	2						3	2
	CO2	2	2	2						3	3
	CO3	3	2	2						3	3
	CO4	3	2	2						3	2

Course Code	Heat and Thermodynamics	Type	L	T	P	C	Hrs/Week
B21PH0201		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to:

1. Impart knowledge about basics of physics to solve problems involving mean velocity, probable velocity and van der Waals's equation.
2. Explain the relationship between the laws of radiation different laws of radiation and to explain thermal conductivity in solids.
3. Familiarize with fundamental laws of Thermodynamics.
4. Familiarize with the principles of Thermodynamics for practical applications.

Course Outcomes:

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

1. Apply the laws of Kinetic theory of gases and concept of Low Temperature Physics to analyse and explain the problems in thermodynamics.
2. Demonstrate the concepts of different laws to explain the nature of radiation emitted by various bodies.
3. Analyse the heat flow in different bodies by the concepts of thermal conductivity and thermodynamics.
4. Interpret scientific information of heat and thermodynamics.

Course Contents:

Unit-I **12 hrs**

Kinetic theory of gases: Basic assumptions of kinetic theory, Degrees of freedom, Principle of equipartition of energy based on kinetic theory of gases, U=3/2 RT-derivation, Relation between molar specific heats and degrees of freedom, Atomicity of mono, di and polyatomic gases. Maxwell's law of distribution of molecular velocity (no derivation)-its interpretation, deduction of most probable velocity, mean velocity and root mean square velocity, Derivation of expression for mean free path Andrew's isothermals, Vander walls equations-derivation -expression for critical constants, Numerical Problems.

Low Temperature Physics: Ideal and real gases, porous plug experiment and its theory, Joule Thomson expansion-expression for the temperature of inversion, inversion curve, Relation between temperature of inversion and critical temperature of gas, Numerical Problems.

Unit-II **12 hrs**

Radiation: Black body radiation and its spectral energy distribution, Kirchhoff's law, Stefan-Boltzmann's law, Wien's displacement law, Rayleigh-Jeans law Planck's quantum theory of radiation, Stefan's law, Derivation of Planck's law of radiation - Deduction of Rayleigh-Jeans' law and Wien's displacement law from Planck's radiation law, Induced absorption, spontaneous and stimulated emission of radiation, Einstein's coefficients under thermal equilibrium condition, Numerical Problems.

Thermal conductivity: Equation of flow of heat through a solid bar. Determination of the thermal conductivity of a bad conductor by Lee and Charlton method. Numerical Problems.

Unit-III **12 hrs**

Thermodynamics-I: Thermodynamic coordinates, concept of heat, work, and internal energy, The Zeroth law of Thermodynamics, Indicator diagrams, Isothermals and Adiabatic changes –Expression for work done, The relation between pressure, volume, and temperature in an adiabatic change, First law of Thermodynamics-mathematical formulation.

Second law of thermodynamics – Reversible and irreversible process, The Carnot engine – expression for efficiency, the Carnot's theorem-its proof. reversibility of Carnot's cycle, Refrigerators-principle of working and coefficient of performance, Second law of thermodynamics-Kelvin Planck's statement and Clausius statement, Qualitative discussion on petrol and diesel engine, Numerical Problems.

Unit-IV **12 hrs**

Thermodynamics-II: Thermodynamic scale of temperature and its identity with perfect gas scale, Clausius-Clapeyron first latent heat equation., The concept of Entropy, Entropy of ideal gas, Change of entropy in reversible and irreversible cycles. Principle of increase of entropy –Clausius inequality, Entropy and II law of Thermodynamics, Concept of absolute zero and the third law of thermodynamics, thermodynamic potentials – internal energy, Gibb's free energy, Helmholtz free energy and their significance, Maxwell's equations, Numerical Problems.

Reference Books:

1. Brijlal and Subramanyam, Heat and Thermodynamics 5th edition, S. Chand & Co, 2016.
2. J. B. Rajam. Heat and Thermodynamics for Degree Students, Edition, 9. Publisher, S. Chand & Co., 1981.
3. D.S. Mathur: Heat, S. Chand & Co,1995.
4. David Halliday. Robert Resnick, and Jearl Walker, Fundamentals of Physics, Sixth Edition, John Wiley & Sons, Inc. 2001.
5. Charles Kittel & others, Berkeley Physics -Vol. 2, 2nd edition McGraw-Hill Education (India) 2011.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0201	**CO1**	3	2	2	3					3	2
	CO2	2	2	2	2					3	3
	CO3	3	2	2	3					3	3
	CO4	3	2	2	2					3	2

Course Code	Chemistry-II	Type	L	T	P	C	Hrs/Week
B21CH0201		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to:

1. Understand various interactions in liquid mixtures and their effect on mixture properties.
2. Study the effect of temperature on the behavior of miscible and immiscible liquids.
3. Acquire the concept of fractional distillation, its principles and applications.
4. Fundamental concepts of chemical bonding, Ionic bonding, Covalent Bonding etc.
5. Brief the concepts of binary mixtures, laws of miscibility, fractional distillation etc.
6. Defie the concepts of vapour pressure, elevation of boiling points, cryoscopic constant, isotonic solutions, plasmolysis etc.

Course Outcomes:

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

1. Apply Fajans rules and determine the percentage covalent character of an ionic compound.
2. Categorise the oraganic cyclic compounds into aromatic, non-aromatic and anti-aromatic character.
3. Draw conclusions form the properties of the solute and solvents and their interactions.
4. Interpret the analytical data and solve problems related to basics of analytical chemistry.

Course Contents:

Unit – I: Chemical Bonding **12 hrs**

Ionic Bonding: Lattice energy and solvation energy. Born-Landé equation, Born-Haber cycle and its applications. Polarization, polarizing power and polarizability. Fajan's rules, percentage ionic character in covalent compounds, dipole moments. Ionic solids; structure of NaCl and CsCl.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. AXE method. Concept of resonance and resonating structures in various inorganic compounds (CO_3^{2-}, SO_3^{2-}, O_3, HN_3, CH_2N_2, N_2O).

MO Approach: Rules for the LCAO method. Molecular orbital diagram for He_2^+, Be_2, N_2, O_2, O_2^{2-}, O_2^+, CO and NO (bond order, stability and magnetic properties to be discussed).

Metallic bond: Band theory, electrical conductance of metals, semiconductors (n- and p-type), Insulators and Superconductors. **Hydrogen bonding:** Types and conditions. Hydrogen bonding in HF, H_2O, NH_3.

UNIT-II **12 hrs**

Aromaticity-Huckel's rule, aromatic, anti-aromatic and non-aromatic character. Aromaticity in benzenoids, (benzene, naphthalene, anthracene and phenanthrene) and non-benzenoid compounds (cyclopropenyl, cyclopentadienyl, cycloheptadienyl system).

Aromatic electrophilic substitution reactions – Arenium mechanism, reactivity and orientation effects in benzene substituents- electron donating groups (-CH_3, -Cl, and -OH groups) and electron withdrawing groups (-NO_2, and –SO_3H groups). Friedel-craft alkylation and acylation.

Aromatic nucleophilic substitution *via* benzyne intermediate, mechanism with evidences for the formation of benzyne by trapping with anthracene, Birch reduction.

Amines: Classification. Preparation of alkyl and aryl amines-reductive amination of carbonyl compounds, Gabriel phthalimide synthesis. Basicity of amines in aqueous solution: Inductive, resonance, steric and solvation effects on the basicity of amines. Reaction of amines as nucleophiles –Methylation, quaternary salts, Hoffmann elimination with mechanism. Distinguishing reactions

of 1^0, 2^0 and 3^0 amines. Diazotization and synthetic applications of diazonium salts. Sandmeyer's reaction. (conversion to chlorobenzene, bromobenzene and benzonitrile), hydrolysis, reduction (to phenyl hydrazine and aniline), coupling reactions to give azo dyes (*p*-hydroxy azobenzene and 1-phenylazo-2-naphthol).

UNIT-III **12 hrs**

Liquid mixtures: Classification, Raoult's law, Henry's law and its limitations.

Completely miscible liquids: Ideal and non- ideal solutions. Vapor pressure – composition diagrams for ideal and non-ideal solutions. Principle of distillation of binary miscible liquids**:** Konowaloff's rule, Azeotropic mixtures.

Partially miscible liquids: Critical solution temperature (CST) – types – phenol-water system, triethylamine-water system. Effect of addition of non-volatile solute on CST.

Immiscible liquids: Steam distillation.

Colligative Properties: Relation between relative lowering of vapour pressure and molar mass (to be derived). Determination of relative molar mass of solute by Ostwald-Walker's dynamic method. Elevation of boiling point and its relation to lowering of vapour pressure and molar mass (to be derived, problems to be worked out). Ebullioscopic constant of the solvent and its relation to the boiling point (only equation). Determination of molar mass of the solute by Walker-Lumsden method. Depression in freezing point and its relation to lowering of vapour pressure and molar mass (to be derived, problems to be worked out). Cryoscopic constant and its relation to the melting point (equation). Determination of molar mass of a non-volatile solute by Beckmann's method (problems to be worked out).

Semi permeable membrane – natural and artificial, preparation of copper ferrocyanide membrane by Morse-Frazer method. Definition of osmosis, osmotic pressure, determination of osmotic pressure by Berkley-Hartley's method. Determination of molar mass from osmotic pressure measurements (relation to be derived, problems to be worked out), isotonic solutions.

UNIT-IV **12 hrs**

Analytical Chemistry:

Principles of qualitative and quantitative analysis; acid-base, oxidation-reduction and complexometric titrations using EDTA; precipitation reactions; use of organic reagents in inorganic analysis.

Indicator – Definitions, types (acid-base, redox, adsorption indicators), examples for each type. Theory of indicators – Oswald's theory and Quinonoid theory – indicator constant – action of phenolphthalein and methyl orange in acid-base solutions – pH titration curves for strong acid vs strong base, weak acid vs strong base, weak base vs strong acid, choice of indicators in these types of titrations – colour change and pH range.

Statistical treatment of results of quantitative analysis: Classification of errors, accuracy, precision, minimization of errors (calibration of apparatus, running of blank determination, running parallel determination to be mentioned), significant figures and computation, mean and standard deviation (explanation with an example), distribution of random errors (explanation with the help of curve), reliability of results (F-test and t-test).

References:

1. R.L. Madan, Chemistry for Degree Students, S. Chand, 1st Edition, 2011.
2. A. Bahl, and B.S. Bahl, Advanced Organic Chemistry, S. Chand, 2010.
3. A. Bahl, and B.S. Bahl, Advanced Physical Chemistry, S. Chand, 2010.
4. J.N. Gurtu and A. Gurtu, Advanced Physical Chemistry, Pragati Prakashan, Vol I, 4th Edition, 2017.

5. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Vishal Publishing Co., 33rd Edition, 2020.
6. P.A. Sykes, Guide book to Mechanism in Organic Chemistry, Orient Longman, New Delhi, 1988.
7. R.T. Morrison and R.N. Boyd, Organic Chemistry, Pearson, 2010.
8. B.H. Mahan, University Chemistry, Narosa, 3rd Edition, 1998.
9. J.D. Lee, Concise Inorganic Chemistry, Oxford University Press, 3rd Edition, 2008.
10. F.A. Cotton, G. Wilkinson and P.L. Gaus, Basic Inorganic Chemistry, Wiley, 3rd ed, 1995.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0201	**CO1**	3	3	2	3			2	1	2	2
	CO2	3	3	3	2			1	2	2	3
	CO3	3	2	2	2			2	1	2	3
	CO4	3	2	1	2			2	3	3	3

Course Code	Physics of Clouds	Type	L	T	P	C	Hrs/Week
B21PHS211		SC	3	0	0	3	4

Course objectives:

This course aims to provide for the students:

1. To understand the composition, formation, classification of clouds based on atmospheric thermodynamics.
2. To understand the growth rate, evaporation of droplet by Bergeron process.
3. To understand the role of Collisions and Coalescences process in the droplet growth.
4. To understand the phenomenon of Cloud electrification, precipitation and seeding.

Course Outcomes:

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

1. Describe the process of formation of clouds.
2. Explain the nucleation and growth of cloud particles.
3. Compare different mechanisms of droplet growth.
4. Explain the electrical phenomenon related to lightening.

Course Contents:

Unit-I: Fundamental Concepts **12 hrs**

Clouds: Introduction, Definition, identification, classification, altitude and composition.

Atmospheric thermodynamics: Vapor pressure, Clauius-Clapeyron equation, saturation vapor pressure, ways for reaching saturation and mechanisms for cooling the air.

Fundamental concepts of Cloud: Liquid water content, parameters of macroscale cloud, cloud drop size distribution, actual drop size distribution.

Unit-II: **12 hrs**

Formation of Cloud droplets: General aspects, saturation vapor pressure over a curved droplet, saturation vapor pressure over a solution, combining the curvature and solute effect, atmospheric aerosols, cloud condensation nuclei.

Droplet Growth by Diffusion: growth of an individual droplet by diffusion of water vapor, growth rate in term of mass or radius, other questions needed to solve for growth rate, evaporation of droplet, Bergeron process.

Unit-III: **12 hrs**

Roplet growth by Collisions and Coalescences: Droplet terminal fall speed, growth due to collection smaller, uniform droplet, collision efficiency, growth equation in terms of radius, growth due to collision with smaller droplets of non-uniform size.

Growth of Ice Crystals: Formation of ice crystals, diffusional growth of ice crystals branching versus faceting, collision-coalescence versus the Bergeron process.

Unit-IV: **12 hrs**

Precipitation: Types of precipitation, rainfall rate and drop-size distribution. The Marshall-Palmer drop-size distribution.

Weather Modification: Examples of experiments, cloud seeding, methodology.

Cloud Electrification: Lightning, electrical properties of the fair-weather atmosphere, electrical properties of a thunderstorm, Benjamin Franklin's famous kite experiment, cloud-to-ground lightning, Intra-cloud lightning, other forms of lightning, thunder, lightning rods, lightning safety.

Suggested Text Books and References:

1. R. R. Rogers, A Short Course in Cloud Physics.
2. B. J. Mason, The Physics of Clouds.
2. H. R. Fletcher and Klett, Microphysics of Clouds and Precipitation.
3. Lectures on atmospheric thermodynamics.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PHS211	**CO1**	3	3	2	2	1				3	3
	CO2	3	3	2	1	1				3	3
	CO3	3	3	2	1	1				3	3
	CO4	3	3	2		1				3	3

Course Code	Renewable Energy Resource	Type	L	T	P	C	Hrs/Week
B21PHS212		SC	3	0	0	3	4

Course objectives:

This course aims to provide for the students:

1. To understand the various forms of conventional energy resources.
2. To learn the present energy scenario and the need for energy conservation
3. To outline division aspects and utilization of renewable energy sources for both domestics and industrial application.
4. To analyze the environmental aspects of renewable energy resources.

Course Outcomes:

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

1. Compare the prospects of solar, wind, and bio energy systems.
2. Discuss the latest developments of solar energy resources and its utilization.
3. Estimation of wind energy for energy generation.
4. Describe the applications of solar energy.

Course Contents:

Unit -1 **12 hrs**

Solar energy: Basic ideas- Origin, Spectral distribution of solar radiation, Attenuation of beam radiation, Basic earth solar angle and derived solar angle, GMT, LCT, LST, Day length, Estimation of average solar radiation, sunshine recorder. Numerical problems.

Unit -2 **12 hrs**

Solar collectors: Principle of conversion of solar energy into heat, classification of solar collectors, Flat plate and concentrating collectors, construction, Thermal efficiency and coating, Heat losses, Solar cell and its efficiency, PV Panels. Numerical problems.

Photothermal devices: Solar cooker, Solar dryer, solar hot water system - principles and working.

Unit -3 **12 hrs**

Photovoltaic systems: Solar lantern, water pumps and streetlights - principles and working.

Wind energy: Origin, estimation of energy obtainable from wind, velocity and power duration curves, energy, pattern factors. Theory of power - Momentum transfer, power coefficients, principle of wind turbine, power vs velocity characteristics of wind turbine generator, cut in speed and cut out speed. Numerical problems.

Unit -4 **12 hrs**

Wind driven machines: Characteristics of wind turbine; Types - Horizontal and vertical axis types, vertical axis darrieus rotor wind turbine, Horizontal axis propeller type - twin blade and three blades. Blade pitch control. Advantages and disadvantages of two blade and three blade systems. Numerical problems.

Suggested Text Books and References:

1. Rai G D, Non-Conventional Energy Sources, 4th Edn., Khanna Publishers (2009).
2. Aarwal M P, Solar Energy, S Chand, and Co. (1985).
3. Sukhatme S P, Nayak J K, Solar Energy, 3rd Edn., Tata McGraw-Hill (2008).
4. Boyle G, Renewable Energy, Power for a Sustainable Future, 2nd Edn., Oxford University Press (2004).
5. Jayakumar P, Resource Assessment Handbook, APCTT (2009).
6. Balfour J, Shaw M, and Jarosek S, Introduction to Photovoltaics, Jones and Bartlett Learning (2013).

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PHS212	**CO1**	3	3	2	3	2				2	1
	CO2	3	3	2	3	2				3	3
	CO3	3	3	1	3	2				3	2
	CO4	3	3	2	3	2				3	3

Course Code	Lasers and Fibre Optics	Type	L	T	P	C	Hrs/Week
B21PHS213		SC	3	0	0	3	4

Course objectives:

This course aims to provide for the students:

1. To develop knowledge about lasers and laser amplifiers used in Industry and research
2. To explain the basic laser radiation properties and switching mechanism
4. To demonstrate different technics of light modulation
5. To analyse and apply the knowledge of optoelectronic devices in research

Course Outcomes:

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

1. Get knowledge of principle, mechanism, and applications of LASERs.
2. Understand and demonstrate LASER -matter interaction and effects.
3. Illustrate non-linear optical properties and to gain knowledge of electro, acousto and magneto-optic effects.
4. Apply optics and physics of materials knowledge in demonstrating optoelectronic devices.

Course Contents:

Unit-I: **12 hrs**

Laser basics: Coherence properties of laser light, temporal coherence, monochromaticity, spatial coherence, directionality, line width, brightness, divergence, line shape broadening, focusing properties of laser radiation, laser modes - axial and transverse, mode selection, single mode operation, selection of laser emission line.

Laser oscillator: Pumping schemes, Gain - threshold conditions; Optical resonators.

Unit-II: **12 hrs**

Types of lasers: Construction and principles of working of Nd-YAG, CO2 and dye lasers and semiconductor lasers.

Laser diodes: Lasing conditions and gain in a semiconductor, selective amplification and coherence, Materials for laser diodes, quantum well lasers, surface emitting lasers, characterization, and modulation of lasers.

Unit-III: **12 hrs**

Fibre optics and dielectric wave guides: Wave Guide- Slab wave guide, Modes, V number, Modal material and waveguide dispersions, Numerical problems.

Optical fibre: Types, functions, light propagation, optical power, velocity of propagation, critical angle, acceptance angle, numerical aperture, mode of propagation. Numerical problems.

Unit-IV: **12 hrs**

Index profile: Single mode step-index optical fibre, multimode step-index fibre, graded index fibre; advantages and disadvantages. Numerical problems.

Energy losses in optical fibre: Bit rate, dispersion optical fibre communication, and optical bandwidth, Absorption, and scattering, optocoupler.

Suggested Text Books and References:

1. Wilson J, and Hawkes J, Optoelectronics: An Introduction, 3rd Edn., PrenticeHall (1998).
2. Singh J, Optoelectronics: An Introduction to Materials and Devices, McGraw-Hill (1996).
3. Bhattacharya P, Semiconductor Optoelectronic Devices, Prentice Hall International (1997).
4. Nambiar K R, Lasers: Principles, Types and Applications, New Age International Publisher (2004).
6. Tomasi W, Electronic Communication Systems, 5th Edn., Pearson Education (2008).
7. Roddy D, and Coolen J, Electronic Communication, 4th Edn., Pearson Education (2008).

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PHS213	**CO1**	3	3	2	2					2	3
	CO2	3	2	2	3					3	2
	CO3	3	2	3	2					3	2
	CO4	3	3	3	2					3	3

Course Code	Environmental Studies	Type	L	T	P	C	Hrs/Week
B21ASM201		MC	0	0	0	0	2

Course Objectives:

This course aims to provide for the students:

1. Discuss foster clear awareness and concern about economic, social, political and ecological interdependence in urban and rural area
2. Influence the new patterns of behaviors of individuals, groups and society as a whole towards the environment
3. List the knowledge values, attitudes, commitment and skills needed to protect and improve the environment
4. Elaborate the evaluation of the environmental measures and education programs.

Course Outcomes:

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

1. Adapt the environmental conditions and protect it
2. Estimate the role of individual, government and NGO in environmental protection.
3. Interpret the new renewable energy resources with high efficiency through active research.
4. Analyze the ecological imbalances and protect it.

Course Contents:

Unit-I **12 hrs**

Multidisciplinary Nature of Environmental Studies: Introduction to environment, objectives and guiding principles of environmental education, components of environment, structure of atmosphere, sustainable environment/development. Impact of technology on the environment in terms of modern agricultural practices and industrialization. Environmental Impact Assessment.

Environmental protection – Role of government-assignments of MOEF, functions of central and state boards, Institutions in environment and people in environment. Initiative and role of non-government organizations in India and world.

Self study: Need for public awareness on the environment, Gaia Hypothesis.

Unit-II **12 hrs**

Environmental pollution, Degradation & Waste management:

Environmental Pollution – Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Soil pollution, Automobile Pollution-Causes, Effects & control measures.

Self study: Case studies of London smog, Bhopal gas tragedy, marine pollutions and study of different waste water treatment processes.

Environmental Degradation – Introduction, Global warming and greenhouse effect, Acid rain-formation & effects, Ozone depletion in stratosphere and its effect.

Solid Waste Management – Municipal solid waste, Biomedical waste, Industrial solid waste and electronic waste (E-Waste).

Self study: Disaster management, early warning systems-bio indicators for Tsunami and other natural disasters.

Unit-III **12 hrs**

Energy & Natural resources:

Energy – Definition, classification of energy resources, electromagnetic radiation-features and applications, Conventional/Non-renewable sources – Fossil fuels based(Coal, petroleum & natural gas), nuclear energy, Non-conventional/renewable sources – Solar, wind,hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source of energy.

Self study: Remote sensing and its applications, Chernobyl (USSR) nuclear disaster and Fukushima (Japan) nuclear disaster.

Natural resources –water resource (Global water resource distribution, Water conservation methods, Water quality parameters, uses of water and its importance), Mineral resources (Types of minerals, Methods of mining & impacts of mining activities), Forest wealth (Importance's, Deforestation-Causes, effects and controlling measures)

Self study: Hydrology & modern methods adopted for mining activities.

Unit-IV **12 hrs**

Ecology and ecosystem:

Ecology-Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Characteristics of an Ecosystem-Ecosystem Resilience, Ecological succession and productivity, Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity. Biogeochemical cycles and its environmental significance – Carbon, nitrogen and phosphorus cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids.

Self study: Need for balanced ecosystem and restoration of degraded ecosystems.

Reference Books

1. R.J. Ranjit Daniels and J. Krishnaswamy, Environmental Studies, by (2017),
2. Wiley India Private Ltd., New Delhi, Co-authored &Customised by Dr. M. S. Reddy & Chandrashekar, REVA University.
3. "Environmental Studies", by R.J. Ranjit Daniels and JagadishKrishnaswamy, (2009), Wiley India Private Ltd., New Delhi.
4. "Environmental Studies" by Benny Joseph, Tata McGraw – Hill Publishing Company Limited.
5. Environmental Studies by Dr. S. M. Prakash, Elite Publishers Mangalore, 2007
6. Rajagopalan R. 2005, "Environmental Studies – from Crisis to cure", Oxford University Press.
7. Environmental Science by Arvind walia, Kalyani Publications, 2009.
8. Environmental Studies by AnilkumarDey and Arnab kumarDey.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21ASM201	**CO1**	1	2	1	1	1	2	3	1	1	1
	CO2	1	3	1	1	1	3	3	1	1	1
	CO3	2	3	2	1	3	3	3	1	1	1
	CO4	1	2	1	1	1	2	3	1	1	1

Course Code	Mathematics Practicals-II	Type	L	T	P	C	Hrs/Week
B21MT0202		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. Obtain skill in creating simple programs using *Scilab* and *Maxima*.
2. Acquire skill in tracing standard curves using *Maxima*.
3. Gain proficiency in using *Maxima* to solve problems on Differentiation and Euler's theorem and its extension.

Course Outcomes:

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

1. Acquire proficiency in using *Scilab* to find identity and inverse element of a group and in construction of Caley –Table.
2. Demonstrate the use of *Maxima* to understand and interpret the various types of functions from the algebraic and graphical points of view.
3. Sketch graphs of standard curves using *Maxima* to interpret tracing of curves.
4. Be familiar with the built-in functions to find derivatives of any order and solve application problems dealing with the concept of partial derivatives.

Course Contents:

List of Programmes

1. Verifying whether given operator is binary or not.
2. To find identity and inverse element of a group.
3. Verification of normality of a given subgroup.
4. Illustrating homomorphism and isomorphism of groups.
5. Examples for finding right and left coset and the index of a group.
6. Examples to verify Lagrange's theorem.
7. Plotting of standard Cartesian curves.
8. Plotting of standard Cartesian curves.
9. Plotting of standard polar curves.
10. Plotting of standard parametric curves.
11. Solution of second and higher order ordinary differential equations with constant coefficients.
12. Solution of second order ordinary differential equations with variable coefficients
    i) Method of variation of parameters
    ii) When the equation is exact

Suggested Text Books and References:

1. Farukh Khalilov and Tayyip oral, Math coding Python, 5th Edition, USA-2020.
2. Joakim Sundnes, Introduction to Scientific programming with Python, 2nd Edition, Springer 2010.
3. Allen Downey and Jeffrey Elkner, Learning with Python, 5th Edition, Springer, 2015.

4. Eric Matthes, A Hands-On, Project-Based Introduction to Programming- Python Crash Course, 2nd Edition:
5. Al Sweigart, Automate The Boring Stuff With Python: Practical Programming For Total Beginners, 2nd Edition.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0202	**CO1**	3	2	2				1	1	3	3
	CO2	3	2	2	1			1	1	3	3
	CO3	2	2	2	1			1	1	3	3
	CO4	3	2	2				1	1	3	3

Course Code	Physics Practicals-II	Type	L	T	P	C	Hrs/Week
B21PH0202		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. Impart knowledge about various laws of thermodynamics through experiments
2. Familiarise with the concepts of thermal conductivity through experiments
3. Familiarise with various experiments in thermodynamics and mechanics Lab
4. Enable to understand physical constant through experiments

Course Outcomes:

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

1. Verify various laws of thermodynamics through experiments
2. Analyse the concepts of thermal conductivity through experiments
3. Demonstrate the various experiments in thermodynamics and mechanics Lab
4. Determination of physical constant through experiments

Course Contents:

Any **Eight** of the Following Experiments

1. Determination of Specific heat of a liquid by cooling – graphical method.
2. Determination of thermal conductivity of a bad conductor by Lee-Charlton method.
3. Verification of Stefan – Boltzmann law by using Ohm's law.
4. Determination of boiling point of a liquid using platinum resistance thermometer.
5. Determination of moment of inertia of irregular body using Torsional pendulum.
6. Determination of rigidity modulus by the static torsion method.
7. Determination of the acceleration due to gravity using Spiral spring (graphical method).
8. Determination of wavelength of a given LASER by diffraction method.
9. Verification of Gaussian distribution law and calculation of standard deviation –Monte Carlo experiment.
10. Determination of speed of the transverse waves over the sonometer wire (Study of stationary wave on a stretched string).

Reference Books:

1. B Saraf etc., - Physics through experiments, Vikas Publications, 2013.
2. D P Khandelwal –A Laboratory Manual of Physics for Undergraduate Classes, Vikas Publications First ed (1985)
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London, 1923.
4. An Advanced Course in Practical Physics, D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002.
5. BSC, Practical Physics, CL Arora, S. Chand & Co, New Delhi, Revised Edition, 2007.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0202	**CO1**	3	2	2		1				3	3
	CO2	3	2	2	1	1				3	3
	CO3	2	2	2	2	2				3	3
	CO4	3	2	2		1				3	3

Course Code	Chemistry Practicals-II	Type	L	T	P	C	Hrs/Week
B21CH0202		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. Obtain skill of handling strong acids and reagents used for functional group anlysis.
2. Perform independently detection of elements, solubility of the compound, functional group analysis and preparation of suitable solid derivative.
3. Perform the distinguishing test between aldehyde and ketone using Schif's reagent.
4. Prepare some organic compounds and purification using recrystallization technique.

Course Outcomes:

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

1. Acquire knowledge of steps involved in organic functional group analysis.
2. Test for elements such as sulfur, nitrogen and halogens using sodium fusion extract.
3. Determine the physical constants of both compound and its derivative using melting point apparatus.
4. Setup organic reactions, isolation and purification of organic compounds.

Course Contents:

Part 1: Qualitative analysis of mono functional organic compounds through functional group analysis. Determination of physical constant. Preparation of suitable solid derivative of the following class.

1. Acids,
2. Alcohols,
3. Aldehydes,
4. Amide,
5. Amine,
6. Halogenated hydrocarbons,
7. Hydrocarbons,

8. Ketones,
9. Nitro compounds,
10. Phenols.

Part 2: Organic preparations: Recrystallisation and determination of melting point and its importance may be mentioned

1. Acetylation: Preparation of acetanilide from aniline
2. Oxidation: Preparation of benzoin acid from benzaldehyde
3. Nitration: Preparation of m-dinitrobenzene from benzene
4. Esterification: Preparation of methyl benzoate from benzoic acid.

References:

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Pandey, O.P., Bajpai D. N. & Giri S. *Practical Chemistry, Revised Edition*, (For BSc. I, II, III Year Students of All Indian Universities) S. Chand Company Pvt Limited, 2014.
4. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0202	**CO1**	2	2	3	2	1		2	2	1	3
	CO2	3	3	3	3	1		2	3	2	2
	CO3	3	2	2	3			2	2	3	2
	CO4	2	3	2	2	1		2	3	2	2

THIRD-SEMESTER

Course Code	Language – II: Kannada-III	Type	L	T	P	C	Hrs/Week
B21AHK301		FC	1	1	0	2	3

Course Objectives:

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÀÄÆgÀ£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è ºÉÆ¸ÀUÀ£ÀßqÀ ¸Á»vÀå ¥ÀæPÁgÀUÀ¼ÁzÀ £ÀªÉÇÃzÀAiÀÄ, £ÀªÀå PÁªÀå, ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß ªÀÄÆr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀé «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èèlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

ºÉÆ¸ÀUÀ£ÀßqÀ ¸Á»vÀå ¥ÀæPÁgÀUÀ¼ÁzÀ £ÀªÉÇÃzÀAiÀÄ, £ÀªÀå PÁªÀå, ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃl UÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£ÀºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. ¸ÁªÀiÁfPÀ CjªÀÅ ªÀÄÆr¸ÀÄvÀÛzÉ
4. GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÁAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.

Course Contents:

Unit I **£ÀªÉÇÃzÀAiÀÄ PÀ«vÉUÀ¼ÀÄ**
7 hrs

1. ¨É¼ÀUÀÄ zÀ.gÁ. ¨ÉÃAzÉæ
2. PÀ°Ì PÀÄªÉA¥ÀÄ
3. PÀ£Àßqï ¥ÀzÀUÉÆ¼ï f. ¦. gÁdgÀvÀßA

Unit II **£ÀªÉÇÃzÀAiÀÄ ºÁUÀÄ £ÀªÀå PÀ«vÉUÀ¼ÀÄ** 7 hrs

1. CªÀzsÀÆvÀ ¸ÀÄ.gÀA.JPÀÄÌAr
2. ªÀÄ£É¬ÄAzÀ ªÀÄ£ÉUÉ PÉ.J¸ï.£À
3. £À£Àß ºÀtvÉ f.J¸ï.J¸ï.

Unit III **¸ÀtÚ PÀxÉUÀ¼ÀÄ** 6 hrs

1. zÁ½ £ÀqÉzÁªÀ CuÁÚ ªÀÄgÉÃ±À £ÀÄUÀqÉÆÃtÂ
2. PÉÆ£ÉAiÀÄ VgÁQ ¤gÀAd£À
3. ªÀiÁ¤ÃlgÏ vÉÃd¹é

Unit IV £ÁlPÀ 6 hrs

1. «ÄÃrAiÀiÁ (¸ÀAUÀæºÀ) AiÀÄÄj¦rÃ¸ï C£ÀÄªÁzÀ.: PÉ. ªÀÄgÀÄ¼À ¹zÀÞ¥Àà

Suggested Text Books and References:

1. ªÀÄÄUÀ½ gÀA.²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
3. qÁ. CgÀ«AzÀ ªÀiÁ®UÀwÛ, ¸Á»vÀå ¸ÀA¸Àløw ªÀÄvÀÄÛ zÀ°vÀ ¥ÀæeÉÕ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÀßqÀ ¸Á»vÀå ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2014
4. qÁ. F.J¸ï. DªÀÄÆgÀ, PÀ£ÀßqÀ PÀxÀ£À ¸Á»vÀå : PÁzÀA§j, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
5. QÃvÀð£ÁxÀ PÀÄvÀðPÉÆÃn, PÀ£ÀßqÀ ¸Á»vÀå ¸ÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉÆÃn ªÉÄªÉÆÃjAiÀÄ¯ï læ¸ïÖ, zsÁgÀªÁqÀ. 2009
6. ¸ÀA. ©.J¸ï. PÉÃ±ÀªÀgÁªï. PÉÊ¯Á¸ÀA PÀ£ÀßqÀ £ÁlPÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ CAQvÀ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2005
7. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
8. DzsÀÄ¤PÀ PÀ£ÀßqÀ PÁªÀå ¨sÁUÀ-2, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2004
9. ²ªÀgÀÄzÀæ¥Àà f.J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHK301	**CO1**					2	3				
	CO2					2	3				
	CO3						3				
	CO4							3	2		

Course Code	Language – II: Hindi-III	Type	L	T	P	C	Hrs/Week
B21AHH301		FC	1	1	0	2	3

Course Objectives:

This course aims to provide for the students:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना।
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना।

3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना।
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना।

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

1. सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है।
2. साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है।
3. समाज में अंतर्निहित पद्धतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है।
4. साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है।

Course Contents:

इकाई – 1: नाटक **:** एक और द्रोणाचार्य – डॉ. शंकर शेष **7 hrs**

लेखक परिचय
प्रथम दृश्य
द्वितीय दृश्य

इकाई – 2: नाटक **:** एक और द्रोणाचार्य **7 hrs**

तृतीय दृश्य
चतुर्थ दृश्य

इका ई – 3: नाटक **:** एक और द्रोणाचार्य **6 hrs**

पंचम दृश्य
छठा दृश्य

इकाई – 4: **6 hrs**

अनुवाद : अंग्रेजी - हिन्दी-समाचार पत्र संबंध

सहन्दी -अंग्रेजी - समाचार पत्र संबंध

सूचना: प्रत्येक इकाई 25 अंक के लिए निर्धारित है।

Text book/s: पाठ्य पुस्तक

1. एक और द्रोणाचार्य – डॉ. शंकर शेष

References: सन्दर्भ ग्रन्थ

1. एक और द्रोणाचार्य – डॉ. शंकर शेष
2. मीडिया लेखन एवं जनसंचार – डॉ.संजीव कुमार
3. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
4. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
5. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
6. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
7. कार्यालय अनुवाद निदेशिका
8. मीडिया विमर्श – रामशरण जोशी
9. संस्कृति, जनसंचार और बाजार – नन्द भरद्वाज

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2

B21AHH301	**CO1**					2	3	2			
	CO2					2	2	3			
	CO3					3	3	3			
	CO4					3	2	3			

Course Code	**Language-II: Additional English-III**	**Type**	**L**	**T**	**P**	**C**	**Hrs/Week**
B21AHA301		FC	1	1	0	2	3

Course Objectives:

This course aims to provide for the students:

1. To outline the global and local concerns of gender and identity.
2. To identify the complexities of human emotions through literature.
3. To assess the struggles of human survival throughout history.
4. To compare and contrast between the various dimensions of childhood.

Course Outcomes:

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

1. Evaluate the pressing gender issues within our society.
2. Criticize human actions through a humane and tolerant approach.
3. Perceive the human conflicts with an empathetic perspective.
4. Disprove the assumption of a privileged childhood.

Course Contents:

UNIT-I: Gender & Identity **7 hrs**

Anne Sexton – Consorting with Angels; Eugene Field – The Doll's Wooing; Vijay Dan Detha – Double Life; Charlotte Perkins Gilman – The Yellow Wallpaper.

UNIT-II: Love & Romance **6 hrs**

Alfred Noyes – The Highway Man; William Shakespeare – Sonnet 116; Frank Richard Stockton – The Lady or the Tiger?; Oscar Wilde – The Nightingale and the Rose.

UNIT-III: War & Trauma **7 hrs**

Lord Alfred Tennyson – The Charge of the Light Brigade; Taufiq Rafat – The Medal; Guy de Maupassant – Two Friends; Sadaat Hasan Manto – Toba Tek Singh.

UNIT-IV: Children's Literature **6 hrs**

William Blake – The Chimney Sweeper; D.H. Lawrence – Discord in Childhood; Anna Sewell – *The Black Beauty* (Extract); Rudyard Kipling – *The Jungle Book* (Extract)

Reference Books:

1. Sexton, Anne. *The Complete Poems*. Houghton Mifflin, 1999.
2. Namjoshi, Suniti. *Feminist Fables*. Spinifex Press, 1998.
3. Vanita, Ruth &Saleem Kidwai (ed.) *Same Sex Love in India*. Penguin India, 2008.
4. Gilman, Charlotte Perkins. *The Yellow Wallpaper*. Rockland Press, 2017.
5. Gale, Cengage Learning. *A Study Guide for Alfred Noyes's "The Highwayman".* Gale, Study Guides, 2017. (Kindle Edition Available)
6. Shakespeare, William. *Poems and Sonnets of William Shakespeare*. Cosimo Classics, 2007.

7. Stockton, Frank Richard. *The Lady, or the Tiger?* Create space Independent Publications, 2017.
8. Wilde, Oscar. *The Collected Works of Oscar Wilde*. Wordsworth Editions Ltd., 1997.
9. Tennyson, Lord Alfred. *The Complete Works of Alfred Tennyson*. Forgotten Books, 2017.
10. Blake, William Erdman, David V. (ed.). The Complete Poetry and Prose (Newly revised ed.). Anchor Books, (1988).
11. Maupassant, Guy de. *Guy de Maupassant-The Complete Short Stories*. Projapati, 2015.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHA301	**CO1**					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Code	Mathematics-III	Type	L	T	P	C	Hrs/Week
B21MT0301		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to:

1. Apply and understand limit of a sequence.
2. Demonstrate the convergence or divergence of sequences and standard series.
3. Prove the tests for convergence: Comparison Test, Ratio Test, Cauchy's Root test, Raabe's Test, Alternating Series Test etc.
4. familiarize with vector calculus.
5. Formation and solving of a partial differential equation.

Course Outcomes:

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

1. Quote and understand the definition of a limit of a sequence or a function in its various forms
2. Demonstrate the convergence or divergence of the geometric and harmonic series and other standard series.
3. Interpret physically vector differentiation applied to both scalar and vector functions. Apply suitable method to solve partial differential equations and to solve non-linear partial differential equations.

Course Content:

Unit-I: 12 hrs

Sequences and Series-I: Sequence of real numbers – Bounded and unbounded sequences – Limit of a sequence – Sum, product and quotient of limits – Standard theorems on limits – Convergent, divergent and oscillatory sequences – Standard properties – Monotonic sequences and their properties – Cauchy's general principle of convergence.

Unit-II: 12 hrs

Sequences and Series-II: Infinite series of real numbers – Convergence and Divergence -Properties of convergence – Series of positive terms – Geometric series – p – series – Comparison tests – D' Alembert's ratio test – Raabe's test – Cauchy's root test – alternating series Leibnitz's test.

Unit-III: 12 hrs

Vector Calculus: Scalar field – gradient of a scalar field, geometrical meaning – directional derivative – Maximum directional derivative – Angle between two surfaces - vector field – divergence and curl of a vector field – solenoidal and irrotational fields – scalar and vector potentials – Laplacian of a scalar field – vector identities. Standard properties, Harmonic functions, Problems.

Unit-IV: 12 hrs

Partial differential Equations: Formation of a partial differential equations by elimination of arbitrary constants and functions – Solution of partial differential equations – Solution by Direct integration, Lagrange's linear equations of the form $Pp + Qq = R$, Standard types of first order non-linear partial differential equations – Charpit's method.

Text Books:

1) S. C. Malik and Savita Arora, Mathematical Analysis, 2nd ed. New Delhi, India: New Age international (P) Ltd., 1992.
2) Shanthi Narayan and P K Mittal, Differential Calculus, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
3) G K Ranganath, Text book of B.Sc., Mathematics, Revised ed. New Delhi, India: S Chand and Co., 2011
4) M D Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0301	CO1	3	3	3	3			1	3	3	3
	CO2	3	2	1	2			1	2	3	3
	CO3	3	2	2	2			1	2	3	3
	CO4	3	3	3	3			1	3	3	3

Course Code	Optics and Spectroscopy	Type	L	T	P	C	Hrs/Week
B21PH0301		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. To understand progressive and simple harmonic wave motions and the mathematical equations that govern them.
2. To understand superposition of simple harmonic wave motions and the phenomenon related to them.
3. To study the theory of light and the basic design principles of optical instruments.
4. To analyse and explain interference, diffraction and polarization of light.

Course Outcomes:

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

1. Explain the phenomenon related to simple harmonic motion waves.
2. Explain the laws of reflection and refraction based on Huygen's principle.
3. Describe the working of optical instruments based on different types of lens.
4. Differentiate between interference, diffraction and polarization.

Course Contents:

UNIT-I **12 hrs**

Interference: Concept of coherent sources. Interference by division of wave Front-Theory of Fresnel's biprism, Interference by division of amplitude-Thin films of uniform thickness, anti-reflective coatings, Newton's rings, Interference at a wedge, Michelson's interferometer-Measurement of λ and dλ. Numerical problems.

Diffraction: Fresnel and Fraunhofer diffraction, Explanation of rectilinear propagation of light. Theory of the zone plate, Comparison with a convex lens, Fresnel diffraction at a straight edge, Fraunhofer diffraction at a single slit.

Transmission grating - theory for the case of normal incidence, resolving power and dispersive power of plane grating. Numerical problems.

UNIT-II **12 hrs**

Polarization: Double refraction in uniaxial crystals, Huygen's theory, Positive and negative crystal, Principal refractive indices, Huygen's constructions of O and E wave fronts in a uniaxial crystal (i) optic axis in the plane of incidence and parallel to the crystal surface at normal incidence, (ii) optic axis in the plane of incidence and perpendicular to the crystal surface at normal incidence, Retarding plates, Production and analysis of linearly, Circularly, and elliptically polarized light, Optical activity, Fresnel's theory, Rotatory polarization. calculation of fringe width. Numerical problems.

UNIT-III **12 hrs**

Atomic Spectra: A qualitative account of Sommerfeld relativistic atom model. Excitation and Ionization potentials - Franck-Hertz experiment. Vector model of atom. Electron spin. Space quantization. Magnetic moment of an electron due to its orbital motion. Stern-Gerlach experiment. Spin-orbit interaction and the fine structure of spectral lines. Quantum number and selection rules. Pauli's exclusion principle. Electronic configuration of atoms. Valance electron. Numerical problems.

Zeeman effect: Normal and anomalous effects, Experimental details of normal Zeeman effect, explanation of normal Zeeman effect based on classical model, expression for the Zeeman shift. Numerical problems.

UNIT-IV **12 hrs**

Molecular spectra and The Raman effect: Rotation, vibration and electronic spectra of molecules, associated quantum numbers and selection rules, Theory of pure rotation spectra. Theory of rotational-vibrational spectra. Raman effect - Salient features, experimental setup to study Raman effect, Quantum Theory of Raman effect; Intensity and polarization of Raman lines; Applications. Fluorescence and phosphorescence. Numerical problems.

Lasers: Properties, Metastable state, Spontaneous emission, stimulated emission, population inversion. Three level lasers. The CO_2 laser, Semiconductor laser. Laser applications: medical, communications, and industrial applications. Numerical problems.

Suggested Text Books:

1. Bhattacharya A B, and Bhattacharya R, Undergraduate Physics, Vol. 2, New Central Book Agency (2008).
2. Subrahmanyam N, Brij Lal, and Avadhanulu. M N, A Textbook of Optics, 24th Revised Edn., S Chand and Company (2015).
3. Satya Prakash, Optics and Atomic Physics, 8th Revised Edn., Ratan Prakashan Mandir (1988).
4. Ashok Kumar, Khanna D R, and Gulati H.R, Fundamentals of Optics, 15th Edn., R Chand, Publishers (2011).

5. Murugeshan R, Kiruthiga Sivaprasath, Optics and Spectroscopy, 17th Revised Edn., S Chand and Company (2011).
6. Jenkins F A, and White H E, Optics, 3rd Edn., McGraw-Hill (1957).

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0301	**CO1**	3	3	3	3	1				3	3
	CO2	3	3	3	3					3	3
	CO3	3	2	2	2	1				3	2
	CO4	3	3	2	2					3	2

Course Code	Chemistry-III	Type	L	T	P	C	Hrs/Week
B21CH0301		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to:

1. Learn the structure and bonding in following compounds of Boron, Carbon, Nitrogen, Sulphur and halogens.
2. Understand the classification of the following topics Alkyl halides, aryl halides, alcohols, phenols, carbonyl comounds
3. Explore the fundamental knowledge about electrolytes, common ion effect, ionization constant and salt hydrolysis.
4. Develop the knowledge about various laws of thermodynamics, heat capacity, bond energy, carnot cycle etc.

Course Outcomes:

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

1. Illustrate the nature of bonding in metal carbonyls, boron, halogens and its properties, identify different functional groups.
2. Understand the nomenclature, different reactions and its mechanism of various named reactions.
3. Classify the electrolytes based on Debye Huckle theory and discussing about asymmetric effect and electrophoretic effect, etc.
4. Conclude the limitations and conclude the limitations and postulates of various thermodynamic laws, working of carnot cycle.

Course Contents:

Unit-I: **12 hrs**

Chemistry of Non-Metals:

Boron: Compounds of boron – diborane, BF_3, Borazole, and boric acid, preparation, structure and uses.

Carbon: Fullerenes – production, structure of C_{60} and $C_{70.}$ CNT, Fullerenes, molecular sieves.

Silicon: Structure of silica. Silicates – types and structure with one example for each type.
Nitrogen: Preparation, properties, structure and applications of hydrazine, hydroxyl amine.
Sulphur: Preparation, properties, structures and applications of thionyl chloride, sulphuryl chloride.
Halogens: Bleaching powder – preparation, properties and structure.
Pseudo halogens: Preparation, properties and structure of cyanogen and thiocyanogen.
Interhalogens: Preparation, properties and structure of ClF_3 and IF_7.
Lanthanides and Actinides: Electronic configuration, atomic and ionic sizes, lanthanide contraction and its consequences. Oxidation states, spectral and magnetic properties, comparison of oxidation states, complex formation and magnetic properties of d and f block elements. Ion exchange method for separation of Lanthanides.

Unit-II: 12 hrs

Alcohols: Definition and classification, oxidation reaction (CrO_3, Jones reagent, PCC) reduction reaction, glycols, glycerols, and thiols.
Phenols: Definition, classification with examples, acidity of phenols, effect of substituents on acidity of phenols. Mechanism of Reimer-Tiemann reaction and Kolbe reaction. Industrial applications of phenols (as drug).
Carboxylic acids: Definition, Classification with examples. Homologation of carboxylic acid - Arndt-Eistert reaction.
Carbonyl Compounds: Distinguish between aldehydes and ketones – oxidation ($K_2Cr_2O_7$) and reduction (H_2Pt, $LiAlH_4$) method. Mechanism of aldol condensation (Ex: acetaldehyde), Perkins reaction, Cannizzaro reaction, Michael-addition reaction, Wittig reaction, Claisen condensation, Knoevenagel reaction.
Tautomerism and Enolates: Keto-Enol tautomerism. Acidity of alpha-hydrogen atoms in aldehydes, ketones and active methylene compounds (example diethyl malonate and ethyl acetoacetate). Preparation of (from acetic acid) and synthetic applications of diethyl malonate. Preparation of - butanoic acid, Adipic acid, cinnamic acid and butanone. Preparation and applications of ethyl acetoacetate.

Ethers: Williamson ether synthesis, reactions – cleavage and auto-oxidation, estimation of number of methoxy groups by Ziesel's method. Cyclic and crown ethers.

Unit-III: 12 hrs

Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).
Salt hydrolysis - calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson-Hasselbalch equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.
Solubility and solubility product of sparingly soluble salts –applications of solubility product principle. Qualitative treatment of acid –base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

Unit-IV: 12 hrs

Basic Thermodynamics: Definition of thermodynamic terms: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work. Zeroth Law of thermodynamics, First law of thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law – Joule – Thomson coefficient for ideal gas and real gas:

and inversion temperature. Temperature dependence of enthalpy, Kirchhoff's equation. Bond energies and applications of bond energies.

Second Law of Thermodynamics: Limitations of First Law of Thermodynamics – need for II Law of thermodynamics, spontaneous, non-spontaneous and equilibrium processes , different ways of stating II Law, heat engine (example) Carnot cycle, efficiency of Carnot cycle(derivation), concept of entropy – definition and physical significances of entropy – criteria of spontaneity in terms of entropy change, statements of II law in terms of entropy (numerical problems to be worked out on entropy and efficiency of Carnot engine).

Suggested Text Books:

1. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, S. Chand, 2010.
2. A. Bahl and B.S. Bahl, Advanced Physical Chemistry, S. Chand, 2010.
3. J.N. Gurtu and Aayushi Gurtu, Undergraduate Physical Chemistry, Vol I, Vol II and Vol III Pragati Prakashan.
4. Puri, Sharma and Kalia, Principles of Inorganic Chemistry, Milestone Publications & Distributors, 33rdEdition, 2018.
5. S.P. Banerjee, Advanced Inorganic Chemistry, Books and Allied (p) Ltd, 2ndEdition, 2017.
6. N.N. Greenwood and A. Earnshaw, Chemistry of the Elements, Pergamon Press, 2ndEdition, 1989.
7. P.A. Sykes, Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0301	**CO1**	1	2	1	1				1	2	2
	CO2	2	2	1	1				1	2	2
	CO3	1	2	1	2				1	1	1
	CO4	2	1	1	2				1	1	2

Course Code	Heterocyclic Chemistry & Chemistry of Natural Products	Type	L	T	P	C	Hrs/Week
B21CHS311		SC	3	0	0	3	3

Course Objectives:

This course aims to provide for the students to:

1. Explain the fundamental concept of structure, bonding and properties in heterocyclic compound.
2. Discuss the structural elucidation of certain organic compounds.
3. Illustrate the chemical route synthesis of some biomolecules (carbohydrates) and natural product.
4. Explain the basic concept of amino acids, types of amino acids and peptides.

Course Outcomes:

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

1. Analyze the different types, reactivity and aromatic character of heterocyclic compounds
2. Predict the structure and chemical route synthesis of some organic compounds.
3. Classify the different types of aminoacids and their synthesis.
4. Discuss the topics include chemical strategy used to elucidate natural product pathways.

Course Contents:

UNIT-I **12 hrs**

Heterocyclic Compounds: Introduction, Nomenclature and classifications, five membered ring compounds with single hetero atom (Ex: pyrrole, furan and thiophene), aromatic character and preparation from 1, 4-di carbonyl compounds, Paul Knorr synthesis. Properties: Acidic character of pyrrole –electrophilic substitution at 2, 5 positions, (nitration, sulphonation and halogenation). Diels-Alder reactions of furan. Pyridine: Structure, basicity, aromaticity-comparison with pyrrole, preparation and properties, reactivity towards nucleophilic substitution reaction.

UNIT-II **12 hrs**

Terpenoids: Occurrence, classification and isoprene rule. Structural elucidation and synthesis of citral. Structures of limonene, menthol, α-terpineol, camphor, β carotene and their uses.

Alkaloids: Introduction, classification and general characteristics. Structural elucidation and synthesis of nicotine. Structures and uses of ephedrine, caffeine, cocaine, atropine, quinine and morphine.

Steroids: Introduction, classification, synthesis of cholesterol.

UNIT-III **12 hrs**

Carbohydrates: Introduction, Definition, classification based on composition with examples-reducing and non-reducing sugars.

Monosaccharides

Structural elucidation of glucose in detail – evidence for cyclic structure of glucose (aldehyde test and mutarotation) determination of ring size (methylation, hydrolysis and oxidation reactions) pyranose structures (Haworth and chair conformational formulae) Fischer and Haworth structures of fructose and galactose.

Conversion reactions – 1. Kiliani's synthesis 2. Wohl's degradation.

Disaccharides: Glycosidic bond, structural formulae of maltose and lactose (Haworth structure).

Nucleic Acids

Purine and pyrimidine bases. Structure of nucleosides and nucleotides. Methods of formation of internucleotide bonds (DCC, phosphotriester approach). Biological importance of DNA and RNAs. Protein-nucleic acid interaction chromatin and viral nuclear capsid.

UNIT-IV **12 hrs**

Amino acids and proteins:

Introduction, classification- Natural and un-natural amino acids, examples.

Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.

Reference Books:

1. R.K. Bansal, Heterocyclic Chemistry, Tata Mcgraw Hill Publications.
2. M.K. Jain, A Text book of Organic Chemistry, S. Chand & Company.
3. Bhal and Bhal, A Text book of Organic Chemistry, S. Chand & Company.
4. P.L. Soni, A Text book of Organic Chemistry, S. Chand & Company.
5. R.K. Bansal, Laboratory Manual of Organic Chemistry, New Age Publications.
6. Jayaraman, Laboratory Manual of Organic Chemistry, S. Chand & Company.

7. A. Goel, Chemistry of Natural products, Publishing House, Meerut.
8. K.K. Sharma, Organic Chemistry, Shobhanlal & Nagan Company.
9. Ashuthosh Kar, Medicinal Chemistry, Tata Mcgraw Hill Publications.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CHS311	**CO1**	1	1	1	2				1	1	1
	CO2	1	1	2	3				1	1	1
	CO3	1	1	1	2				2	1	3
	CO4	1	1	2	2				2	1	2

Course Code	Polymer Chemistry	Type	L	T	P	C	Hrs/Week
B21CHS312		SC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. To realize the importance of monomer concept in polymers.
2. Enhance the knowledge foundation concepts of synthesis of various polymeric compounds.
3. Expertize basic concepts in Biopolymers and their fundamental importance.
4. Understand reaction kinetics, theory and relevant applications of the polymers.

Course Outcomes:

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

1. Assimilate the appreciate the foundation knowledge of polymer concepts, importance of polymers and molecular weight of the polymeric compounds.
2. Design and apply the knowledge of synthesis, applications of polymeric compounds.
3. Realization of polymerization foundation in various processes.
4. Increase knowledge on biopolymer, synthesis and application.

Course Contents:

UNIT-I: Introduction to polymer Science 12 hrs

History of macromolecular science. Concept of macromolecules. Degree of polymerization, Concept of molecular mass, polydispersity, number average and weight average, viscosity average molecular weight, molecular weight distribution in linear polymers (step growth and chain polymers), Nomenclature of polymers. Basic concepts in polymer science. Different ways in classification of polymers depending on – The origin (natural, Semisynthetic, synthetic etc.), The structure (linear, branched, network, hyperbranched, dendrimer.), The type of atom in the main chain (homochain, hetercohain).

The formation (condensation, addition). Homopolymers, copolymers. The behaviour on application of heat and pressure (thermoplastic andThermosetting). The form and application (plastics, fiber. elastomers and resin). Stereochemistry of polymers, Introduction to two types of polymerization Reactions viz. condensation and addition polymerization (without detailed mechanism and derivations), Monomer structure and polymerizability.

Concept of functionality. Writing the structure of the polymer formed for a given monomer and its classification. Raw materials for monomers with specific example viz. acrylonitrile, vinyl, chloride, methyl methacrylate, isoprene, styrene, hexamethylene diamine and adipic acid, caprolactum, ethylene glycol and their Polymerization reactions.

UNIT-II **12 hrs**

Inorganic polymers: Definition – examples, general properties, comparison with organic polymers, **Silicones:** Definition, nomenclature, preparation (linear, cross- linked and cyclic). Factors affecting the nature of silicon polymers, properties (chemical and thermal stabilities, chemical properties) uses of silicon polymers, silicon fluids/oils – uses, silicon elastomers – rubbers, silicon resins (preparation and uses). Synthesis, structural aspects and applications of siloxanes. Borazines, phosphazenes, and polysulphates.

UNIT-III: Kinetics and Mechanism of Chain Polymerization Processes: **12 hrs**

Chain reaction (Addition) polymerization, Free radical addition polymerization mechanism of vinyl polymerization, generation of free radicals, initiation, propagation, termination, chain transfer inhibition of retardation, configuration of monomer units in vinyl polymer chains.

Kinetics of free radical addition polymerization – experimental determination of rate constants, derivations for rate expressions and expressions for kinetic chain length and hence degree of polymerization. Thermodynamics of free radical polymerization, effect of temp and pressure, enthalpies, entropies, free energies, activation energies polymerization. Ionic and coordination chain (addition) polymerization common features of two types of ionic polymerization, Mechanism of cationic polymerization, expressions for overall rate of polymerization and the number average degree of polymerization. Mechanism of anionic, polymerization, expressions for overall rate of polymerization and the average degree of polymerization.

UNIT-IV **12 hrs**

Biopolymer Interactions

Synthesis of Biopolymers, Forces involved in biopolymer interaction. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interaction. Multiple equilibria and various types of binding processes in biological system. Hydrogen ion titration curve. Thermodynamics of biopolymers. Vant's Hoff's law of osmotic pressure, Theory of osmotic pressure and semipermiability. Behaviour of cells and molecular weight determination from osmotic pressure measurements. Significance of osmosis in biology. Problem solving.

TRANSPORT OF IONS: Ion transport through cell membrane, irreversible thermodynamic treatment of membranetransport.

BIOSENSORS: Definition, types, sensors for environmental, medical, food safety and biosecurity applications.

Reference Books:

1. F.W. Billmeyer, Jr. Textbook of polymer science, Wiley- Interscience, N.Y. 1971.
2. R. Seymour, Introduction to polymer chemistry, Wiley –Interscience, 1981.
3. D.D. Deshpande, Physical chemistry of Macromolecules, Vishal publications,1985.
4. P.J. Flory, Principles of polymer chemistry, Singer, 2015.
5. V.R. Gowarikar, Polymer Science, Publisher: John Wiley and Sons Ltd, 2012.
6. G. Odian, Principles of polymerization, Wiley – Interscience, 1981.
7. G. Odian, Principles of polymerization, Wiley – Interscience, 1981.
8. K.J. Saunders, Organic polymer chemistry, Chapman and Hall, London,1973.
9. R.B. Seymour, G. S. Kirshenbaum, High performance polymers, their origin and development, Elservie, 2012.
10. P.W. Morgen, Condensation polymers by interfacial and solution methods, Interscience publishers, 2010.
11. T.L. Richardson, Industrial plastics: Theory applications, Chapman and Hall, London,2000.
12. R.W. Lenz, Organic chemistry of synthetic high polymers, Interscience publisher, 2004.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CHS312	**CO1**	2	1	1						1	1
	CO2	2	1	1	1	1				1	1
	CO3	2	1	1	1	1				1	1
	CO4	2	1	1	1	1			1	1	1

Course Code	Solid State Chemistry	Type	L	T	P	C	Hrs/Week
B21CHS313		SC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to:

1. Explain basic concept of electronic structure, electrical and magnetic behaviors in solids.
2. Disuses the topic related defect, superconductivity, etc., in solids.
3. Prediction of crystal structure in solids and understanding the basic concept of X-ray diffraction theory, etc.,
4. Analyze the structure of solids using neutron diffraction and electron diffraction methods.

Course Outcomes:

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

1. Analyze the fundamental concepts of nature of bonding and electronic structure in solids.
2. Predict the electrical and magnetic behavior in the solid.
3. Discussion related to the defects in solid and understanding the principle and theory of superconductivity.
4. Identify the crystal structures and defects in solids using various instrumental techniques.

Course Objectives:

UNIT-I **12 hrs**

Electronic structure of solids: Bonding in solids: Ionic, covalent, metallic and molecular solids. Free electron theory, Fermi sphere, Fermi-Dirac statistics, Ohm's law, limitations of the free electron theory. Electrons in a weak periodic potential (Independent electron model), energy levels in extended, repeat and reduced zone schemes.

Electrical and Magnetic Properties of Solids: Metals: calculation of density of states, origin of resistivity, weak paramagnetism. Semiconductors: Intrinsic and extrinsic- p and n-types, Hall effect, Junctions and their applications- metal-metal, metal-semiconductor, semiconductor-semiconductor types and transistors.

Insulators- dielectric properties, piezo and inverse piezoelectric effects, ferroelectricity, ferroelectric transitions in $BaTiO_3$, ionic conductivity applications of band theory to TiO and NiO: Limitations of the Independent electron model, modeling electron correlation.

UNIT-II **12 hrs**

Dynamics of Atoms in a Solid: Dispersion curves of an elastic structureless medium, Longitudinal and Transverse modes, Optical and Acoustic modes of a crystal, total vibrational energy of a crystal. Case study of calcite.

Defects in Solids: Point defects, Line defects and Plane defects, Stacking faults and grain boundaries.

Superconductivity: Superconductivity, Meisner effect, Type I and type II superconductors, Features of superconductors, Frolich diagram, Cooper pairs, Theory of low temperature superconductivity, Junctions using superconductors.

UNIT-III **12 hrs**

Geometric Crystallography: Symmetry elements, Bravais lattices, Screw axes and glide planes, point groups, and space groups and nomenclature. Law of Interfacial angle (Euler's construction).

Diffraction theory and Single crystal X-ray diffraction: X-rays, Bragg's law, assignment of lines, diffraction pattern of a primitive cubic lattice, space group extinctions, Scaterring factor and structure factor, intensities from atomic positions for BCC and FCC lattices; Ewald's sphere of reflection, Reciprocal Lattice concept, Electron density function, Fourier synthesis, Fourier transform of the structure factor, Phase problem and Patterson synthesis.

UNIT-IV **12 hrs**

Experimental Methods:

Rotation, Oscillation, Weissenberg and Precession methods. Debye-Scherrer method (Powder method), Determination of lattice parameters from these methods.

Electron diffraction: Experimental technique, Wierl equation, Radial-Distribution method**.**

Neutron diffraction: Principle and Theory, advantages and uses.

Reference Books:

1. L.V. Azaroff, Introduction to Solids, McGraw Hill Book Co., New York, 1960.
2. N.W. Ashcroft and N. D. Mermin, Solid State Physics, Holt Saunders International Ltd., New York, 1976.
3. G.M. Barrow, Physical Chemistry, McGraw Hill (2nd ISE), 1966.
4. M.M. Woolfson, An Introduction to X-ray Crystallography, Cambridge University Press-Vikas Publishing House, New Delhi, 1980.
5. H.V. Kheer, Principles of the Solid State, Wiley Eastern Ltd., New Delhi, 1993.
6. W. Cochran, Edward Arnold, Dynamics of Atoms in Crystals, London, 1973.
7. P.M.A. Sherwood, Vibrational Spectroscopy of Solids, University Press, Cambridge, 1972.
8. C.N.R. Rao and K.J. Rao, Phase Transitions, Cambridge University Press
9. G.H. Stout and L.H. Jenson, X-ray Structure determination: A practical guide, Macmillan Publishing Co. Inc and Collier Macmillan Publishers.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CHS313	**CO1**	3	2	3	3				1	1	1
	CO2	3	2	2	3				1	1	1
	CO3	3	3	2	2				2	2	1
	CO4	2	2	1	2				1	2	1

Course Code	NCC	Type	L	T	P	C	Hrs/Week
		OE	3	0	0	3	3

Course Objectives:

This course aims to provide for the students:

To develop character, discipline, comradeship, secular outlook and to create a pool of trained, organized and motivated youth with various leadership qualities.

Course Outcomes:

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

1. Develop qualities of character, discipline, leadership, secular outlook, spirit of national integrity and the ideals of selfless service among the youth to make them useful citizen.
2. Create a human resource of organized, trained, and motivated youth by imparting different drills and shall exhibit field experience.
3. Demonstrate the qualities of a, ethical leader and communicate effective as a team member.
4. Participate as a citizen of the country during disasters for the protection of the weaker sections and carry out social service.

Course Contents:

UNIT-I: National Integration and Awareness **9 hrs**

Introduction on Organization, Indian History & Culture, Religion & customs of India, Unity, Integrity & Diversity, National integration and its importance, Social movement, Famous leaders in India and Its Neighbors.

UNIT-II: Protocols in drill **9 hrs**

General and words of commands, Attention stand, saluting at the halt, getting on parade, falling out and dismissing, Marching length of place and time of marching in quick time and halt, slow march and halt, Turning at the march and wheeling, Guard of honor, Formation of Squad and Squad drill, Basic organization of Armed Forces, Badges and Ranks, Organization of the Navy, NHQ, commands and fleets, Organization of IAF, ranks and cadres.

UNIT-III: Personality Development **9 hrs**

Motivation, Discipline and Unity of a good citizen, Leadership Traits, Personality and Characters development, Values and Code of Ethics, Perception, Communication, Importance of Group and teamwork, importance of time and its management, tools for time management.

UNIT-IV: Disaster management & Community Development **9 hrs**

Types of Emergencies/ National disasters, Protection, Essential Services & their materials, setting up relief camp during disaster management, Weaker section of society and their needs, social service & their needs, Family planning, Cancer, causes and prevention, NGOs and its contribution in society

Text Books:

1. Cadet's Hand book.
2. NCC OTA Precise.
3. Radhakrishnan Pillai, Chanakya's 7 Secrets of Leadership, JAICO Publishing House, New Delhi, 2014.
4. Prakash Iyer, The Habit of winning - Stories to Inspire, Motivate and Unleash the Winner Within, CloudTrail India, New Delhi, 2nd Edition, 2020.
5. Bipin Chandra, India's Struggle for Independence: 1857-1947, Penguin Random House, India, 2016.
6. A.K. Shrivastava, Disaster management, Scientific Publishers, 2021.
7. Mukesh Kumar, Famous Indian leaders: Biography, e-book, 2016.
8. Kuttan Mahadevan, The great leaders of India, Emerald Publishers, India, 2016.

Course Code	Classical Optimization	Type	L	T	P	C	Hrs/Week
B21ASO301		OE	3	0	0	3	3

Course Objectives:

This course aims to provide for the students:

1. Make the students to know about the optimization techniques.
2. Make the students to know about unconstrained minimization techniques.
3. Make the students to know about unconstrained minimization techniques to solve non-linear programming problems.
4. Make the students to know about constrained minimization techniques.

Course Outcomes:

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

1. Able to implement optimization techniques.
2. Able to implement unconstrained minimization techniques.
3. Able to solve non-linear programming problems by unconstrained minimization techniques.
4. Able to solve non-linear programming problems by constrained minimization techniques.

Course Contents:

UNIT-I: **9 hrs**

Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints.

UNIT-II: **9 hrs**

Unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques.

UNIT-III: **9 hrs**

Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods.

UNIT-IV: **9 hrs**

Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering problems. Formulation and solution of structural optimization problems by different techniques.

Text Books:

(i) "Operations Research" by J.K. Sharma
(ii) "Operations Research" by S.D. Sharma

Reference Books:

1. Spunt, "Optimum Structural Design"- Prentice Hall
2. S.S. Rao, "Optimization – Theory and Practice"- Wiley Eastern Ltd.
3. Uri Krisch, "Optimum Structural Design"- McGraw Hill
4. Richard Bronson, "Operation Research"- Schaum's Outline Series
5. Bhavikatti S.S.- "Structural optimization using sequential linear programming"- Vikas publishing house.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21ASO301	CO1	3	3	2	2					2	3
	CO2	3	2	2	3					3	2

	CO3	3	2	3	2					3	2
	CO4	3	3	3	2					3	3

Course Code	**Physics in Everyday Life**	**Type**	**L**	**T**	**P**	**C**	**Hrs/Week**
B21ASO303		OE	3	0	0	3	3

Course Objectives:

This course aims to provide for the students:

1. To have a clear understanding of the working and principles of home appliances
2. To understand phenomena of light and its application
3. To know the formation of clouds and cyclic process.
4. To implement and understand properties of smart materials for their application in various places.

Course Outcomes:

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

1. To have a clear understanding of the working and principles of home appliances.
2. To understand phenomena of light and its application.
3. To know the formation of clouds and cyclic process.
4. To implement and understand properties of smart materials for their application in various places.

Course Contents:

UNIT-I: Gadgets in Daily Life **9 hrs**

Principle of levers, Frictional force, Electric bulb, fan, and motor, Washing Machine, Kitchen Electronics; Microwave, Dishwasher, Induction Stoves, Basics of Smartphones, Smart Refrigerators, Smart alarms, Smart floor, Smart locks, batteries, working principle of Microphone and Loudspeaker, Radio and Radio waves, AM and FM, Basics of Digital Cameras.

UNIT-II: Applications of Electromagnetic Waves **9 hrs**

Introduction to Electromagnetic waves and applications, Scattering of light in atmosphere, LASER and application, Hologram and 3D pictures, Optical fibers and communication system, RADAR & navigation and its applications, Display systems: CRT, LCD, LED and Photodiode, Mobile communication.

UNIT-III: Atmosphere **9 hrs**

Clouds: Introduction, Atmospheric thermodynamics, Vapor pressure, Formation of Cloud droplets, Lightning, electrical properties of the fair, weather atmosphere, electrical properties of a thunderstorm, Benjamin Franklin's famous kite experiment, cloud-to-ground lightning, Intra-cloud lightning, other forms of lightning, thunder, lightning rods, lightning safety.

UNIT-IV: Advanced Materials **9 hrs**

Superconductors, Semiconducting materials, physical principles of optical materials; Polaroids and goggles, dielectrics, piezoelectric, ferroelectric, pyroelectric, magnetic materials and their applications, Motion Sensors, Thermal Sensors and Image Sensors, and Water Level Sensors.

Recommended Books:

1. Louis A. Bloomfield, How Things Work: The Physics of Everyday Life, 6th Edition, Wiley 2016.

2. DK, How to Be Good at Science, Technology, and Engineering, DK Publishing, 2018.
3. DK, How Things Work Encyclopedia, DK Publishing, 2009.
4. DK, How Technology Works: The Facts Visually Explained, DK Publishing, 2019.
5. Thomas L Floyd "Electronic Devices" 10th Edition Pearson Education Asia 2018.
6. Jordan Frith, "Smartphones as Locative Media ", Wiley 2014.
7. M. I. Skolnik, Introduction to Radar Systems, Tata McGraw Hill 2006.
8. R. R. Rogers, A Short Course in Cloud Physics, 3rd Edition, 1889, Reprint 1996.
9. Dennis C Brewer, " Home Automation", Que Publishing 2013.
10. T. Pratt, C. Bostian and J. Allnutt, Satellite Communications, John Wiley and Sons, Second Edition., 2003.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21ASO303	**CO1**	3	3	3	3					3	3
	CO2	3	3	3	3					3	2
	CO3	3	2	2	2					3	3
	CO4	3	3	2	2					3	2

Course Code	Water Technology	Type	L	T	P	C	Hrs/Week
B21ASO304		OE	3	0	0	3	3

Course Objectives:

This course aims to provide for the students:

1. Determine the basic concepts of water pollution, various water analysis methods like COD, BOD, TOC, hardness and properties of water.
2. Analyze the estimation of dissolved oxygen, alkalinity, acidity and chlorides in water, Water treatment for domestic purpose.
3. Enhance knowledge one Ion-exchange processes, and lime soda process.
4. Conclude the biological relevance of pH and pKa of functional groups in biopolymers, proteins and nucleic acids.

Course Outcomes:

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

1. Differentiate between the Organic pollutants and Inorganic pollutants
2. Acquired the knowledge about acid-base reactions and alkalinity/acidity to solve problems associated with water/wastewater treatment and natural water quality.
3. Explain the hardness of water and their internal and external treatment.
4. Analyze properties of water and buffers, pH value of various bio-entities

Course Objectives:

UNIT-I **9 hrs**

Introduction, Sources, Water pollutants classification: Organic pollutants –Pesticides, insecticides, detergents. Inorganic pollutants, Sediments, Radioactive materials and Thermal pollutants. Drinking water supplies, Trace elements in water. COD, BOD, TOC-definitions. Monitoring techniques and methods: Determination of pH, conductance, dissolved oxygen by Winkler's method, nitrate/nitrite by diazo coupling, chloride by Mohrs and Volhard's method, and fluoride by Alizarin Visual method, Water contamination with cyanide, sulfide, sulphate, phosphate and total hardness. Analysis of Arsenic by Atomic absorption spectroscopy (AAS), cadmium and mercury by dithizone method,

chromium by diphenyl carbazide method, lead by polarographic method. Water pollution control and management.

UNIT-II **9 hrs**

Determination of Hardness of water and its Units, Disadvantages of hard water, Estimation of hardness by EDTA method, Numerical problems on hardness, Estimation of dissolved oxygen, Alkalinity, acidity and chlorides in water, Water treatment for domestic purpose (Chlorination, Bleaching powder, ionization)

Industrial Use of water: For steam generation, troubles of Boilers: Scale & Sludge, Priming and Foaming, Caustic Embrittlement and Boiler Corrosion.

UNIT-III **9 hrs**

Treatment of Boiler Feed water: Internal Treatment: Colloidal, Phosphate, Carbonate, Calgon and sodium aluminate treatment.

External Treatment: Ion-Exchange and Permutit processes, Lime soda process.

Demineralization of brackish water: Reverse Osmosis and Electro dialysis Determination of turbidity of wastewater, Total solids, volatile solids and fixed solids of wastewater, nitrogen, Phosporous from waste water.

UNIT-IV **9 hrs**

Properties of water: Ionic product of water and its measurements. Importance of water in biological system with special reference to the maintenance of the native structure of biological molecules. Types of bonding in biological molecules. Biological relevance of pH and pKa of functional groups in biopolymers, proteins and nucleic acids. Buffers, pH value of various bio-entities, buffer action, buffer capacity and their importance in biological systems. Isoelectric points for amino acids. Titration of proteins and preparation of buffer.

Karl-Fischer titrations: Stoichiometry of the reaction, preparation of the reagent, titration method, standardization of the reagent using water-in-methanol, determination of water in samples, interference and their elimination, application to quantitative analysis of some organic compounds-alcohols, carboxylic acids, acid anhydrides and carbonyl compounds.

References:

1. Jain and Jain, D. Rai, A Text Book of Engineering Chemistry, Himalaya Publications, New Delhi, 2012.
2. K.B. Chandra Sekhar, U.N. Das and S. Mishra, Engineering Chemistry, SCITECH Publications India Pvt Limited, 2012.
3. A. Srivastava and N.N. Janhavi, Concepts of Engineering Chemistry, Himalaya Publications, 2014.
4. C.P. Murthy, C.V. Agarwal and A. Naidu, Text Book of Engineering Chemistry, Dhanapathirai Publications, 2012.
5. C.V. Agarwal and C. P. Andranaidu, Chemistry of Engineering Materials, Dhanapathirai Publications, 2013.
6. Shashichawla, Text Book of Engineering Chemistry, Dhanapathirai Publications. 2012.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21ASO304	**CO1**	2	1	1	1	1			2	1	1
	CO2	2	1	1	1	1			2	1	1
	CO3	2	1	1	1	1			2	1	1
	CO4	2	1	1	1	1			2	1	1

Course Code	Skill Development Program	Type	L	T	P	C	Hrs/Week
B21SGM301		SC	0	0	0	0	2

Note: Skill development training courses will be organised by the **Department of Chemistry**. The students have to undergo Skill development training conducted by the **Department of Chemistry**.

Course Code	Mathematics Practicals-III	Type	L	T	P	C	Hrs/Week
B21MT0302		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students to:

1. Acquire skill in solving problems on differential calculus using *Python*.
2. Acquire proficiency in using *Python* to solve the concept of sequence and series of real numbers.
3. Obtain skill in creating programs on vector calculus using *Python*.
4. Obtain skill in creating programs on solving partial differential equations.

Course Outcomes:

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

1. Demonstrate the use of *Python* to understand and interpret the core concepts in sequences and series.
2. Demonstrate the use of *Python* to apply ratio test, root test and Raabe's test to test the convergence of a series.
3. Exhibit proficiency in using *Python* to vector derivatives
4. Obtain the proficiency in using python to solve partial differential equations.

Course Contents:

List of programs:

1. Illustration of convergent, divergent and oscillatory sequence.
2. Illustration of convergent, divergent and oscillatory series.
3. Using Cauchy's criterion to determine the convergence of a sequence.
4. To find the sum of the series.
5. To demonstrate the physical interpretation of gradient, divergence curl and laplacian.
6. Using cyclic notations to derive some more vector identities
7. Solutions to the problems on solenoidal and irrotational vecotrs.
8. Solutions to the problems on different types of Partial differential equations.
9. Solving second order linear partial differential equations in two variables with constant coefficient.
10. Solving some more second order linear partial differential equations in two variables with constant coefficient.

Text Books:

1. Farukh Khalilov and Tayyip oral, Math coding Python, 5th Edition, USA-2020.
2. Joakim Sundnes, Introduction to Scientific programming with Python, 2nd Edition, Springer 2010.
3. Allen Downey and Jeffrey Elkner, Learning with Python, 5th Edition, Springer, 2015.
4. Eric Matthes, A Hands-On, Project-Based Introduction to Programming- Python Crash Course, 2nd Edition:

5. Al Sweigart, Automate The Boring Stuff With Python: Practical Programming For Total Beginners, 2nd Edition.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0302	**CO1**	3	2	2	1	1	1		1	3	2
	CO2	3	2	2	1	1			1	3	3
	CO3	3	2	2	1	1			1	3	2
	CO4	3	2	2	1			1	1	2	2

Course Code	Physics Practicals-III	Type	L	T	P	C	Hrs/Week
B21PH0302		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. To visualise simple harmonic wave motions and verify the theories that govern them.
2. To visualise interference, diffraction and polarization of light.
3. To use different optical phenomenon in different applications.
4. To visualize different spectal lines.

Course Outcomes:

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

1. Explain the phenomenon related to simple harmonic motion waves.
2. Determine the thickness of thin objects, radius of curvature of a plano-convex lens by interference and diffraction.
3. Analyse observed optical phenomenon in nature.
4. Estimate the refractive index of glass.

Course Contents:

Any **Eight** of the Following Experiments:

1. Determination of radius of curvature of a Plano - convex lens (Newton's rings).
2. Determination of diameter of a thin wire (Air wedge).
3. Determination of grating constant and wavelength (minimum deviation method).
4. Determination of diameter of a wire (Diffraction at a straight wire).
5. Determination of Cauchy's constants using spectrometer.
6. Determination of unknown concentration of sugar solution by graphical method using a polarimeter.
7. Determination of refractive indices of quartz crystal using spectrometer and sodium light.
8. Determination of attenuation coefficient in an optical fiber.
9. Determination of velocity of sound in a liquid by ultrasonic interferometer.
10. Determination of resolving power of plane transmission grating using spectrometer.

Text books:

1. Thiruvadigal, J. D., Ponnusamy, S. Sudha. D. and Krishnamohan M., “Physics for Technologists”, Vibrant Publication, Chennai, 2013

2. R. K. Shukla and Anchal Srivastava, “Practical Physics”, 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G. L. Souires, “Practical Physics:”, 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, “An Advanced Course in Practical Physics”, 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. D. Chattopadhyay, P.C. Rakshit B. Saha, An Advanced Course in Practical Physics, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002.
4. CL Arora, BSc Practical Physics, S. Chand & Co, New Delhi, Revised Edition, 2007.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0302	**CO1**	3	3	3	3					3	1
	CO2	3	3	2	1					2	2
	CO3	3	3	2	2					2	1
	CO4	3	3	3	1					3	3

Course Code	Chemistry Practicals-III	Type	L	T	P	C	Hrs/Week
B21CH0302		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. This course is intended to provide basic skills in qualitative analysis at the semi-micro scale.
2. It also emphasizes the importance of organized and systematic approach in carrying out experiments.
3. It also helps in developing analytical reasoning, critical thinking, questioning etc.

Course Outcomes:

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

1. Identify the indivisual anions and cat ions in a compound.
2. Apply the knowledge in determining the strength of analyte.
3. Interprete the involvement of intermediate ions while estimating particular group.
4. Solve the reactions involved related to intermediates and product formation during analysis

Course Contents:

Part 1: Systematic semi-micro qualitative analysis of inorganic salt mixture containing two cations and two anions (Minimum 10 mixtures to be analysed).

Anions: HCO_3^-, CO_3^{2-}, SO_3^-, Cl^-, Br^-, NO_3^-, BO_3^{3-}, SO_4^{2-} and PO_4^{3-}

Cations: Pb^{2+}, Bi^{3+}, Cd^{2+}, Al^{3+}, Fe^{3+}, Fe^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, K^+, Na^+ and NH_4^+.

Note:

1. Mixture requiring elimination of phosphate and borate should not be given
2. Combination like Cl^- and Br^-, NO^{3-} and Br^- shall be avoided.
3. Salts that yield double decomposition shall be avoided (like $CaSO_4$, $BaSO_4$, $FeSO_4$).
4. The combination of two cations in the mixture should to different groups. However, combination like Mg^{2+} and NH_4^+ and Na^+ and NH_4^+ can be given.

Part-2: Inorganic preparation

a. Preparation of Chloropentaminecobalt (III) chloride
b. Preparation of Cuprammoniumsulphate
c. Preparation of Ferric alum
d. Preparation of ferrous oxalate
e. Preparation of Prussian blue (ferri ferrocyanide)

Reference Books: Practicals

1. J. Mendham, A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
2. Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education, 2002.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0302	**CO1**	1	2	1	1	1	1	1	1	2	1
	CO2	2	2	1	1	1	2	1	2	2	2
	CO3	1	2	1	2	2	2	1	1	1	1
	CO4	2	1	2	2	1	2	2	2	1	2

FOURTH – SEMESTER

Course Code	Language-II: Kannada-IV	Type	L	T	P	C	Hrs/Week
B21AHK401		FC	1	1	0	2	3

Course Objectives:

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ £Á®Ì£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è ºÉÆ¸ÀUÀ£ÀßqÀ ¸Á»vÀå ¥ÀæPÁgÀUÀ¼ÁzÀ £ÀªÀå, ¹ÛçÃªÁ¢ ºÁUÀÄ £ÀªÉÇåÃvÀÛgÀ PÁªÀå, ««zsÀ ¯ÉÃR£ÀUÀ¼ÀÄ ºÁUÀÄ PÁzÀA§j ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß ªÀÄÄr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀé «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èèlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

ºÉÆ¸ÀUÀ£ÀßqÀ ¸Á»vÀå ¥ÀæPÁgÀUÀ¼ÁzÀ £ÀªÀå-£ÀªÉÇåÃvÀÛgÀ PÁªÀå, ««zsÀ ¯ÉÃR£ÀUÀ¼ÀÄ ºÁUÀÄ PÁzÀA§j ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃl UÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£ÀºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀĤPÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. ¸ÁªÀiÁfPÀ CjªÀÅ ªÀÄÄr¸ÀÄvÀÛzÉ.
4. GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÉAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.

Course Contents:

Unit I **£ÀªÀå-¹ÛçÃªÁ¢ PÀ«vÉUÀ¼ÀÄ** 7 hrs

1. §Ä¢ÞªÀAvÀjUÉ PÀ£À¸ÀÄ ©zÀÝgÉ J.PÉ.gÁªÀÄ£ÀÄd£ï
2. PÀÄjUÀ¼ÀÄ ¸Ágï PÀÄjUÀ¼ÀÄ ¤¸Ágï CºÀªÀÄzï
3. CPÀÌ ºÉÃ½zÀÄ ¸À. GµÁ

Unit II **zÀ°vÀ-§AqÁAiÀÄ** 7 hrs

1. £À£Àß PÀªÀ£ÀUÀ¼À°è ºÀÄqÀÄPÀ¢gÀÄ £À£Àß ZÀA¥Á
2. zÀ°vÀgÀÄ §gÀÄªÀgÀÄ zÁj©r ¹zÀÞ°AUÀAiÀÄ
3. PÀlÖqÀzÀ PÉ®¸ÀUÁgÀgÀÄ JZï J¸ï ²ª À¥ÀæPÁ±À

Unit III **¯ÉÃR£ÀUÀ¼ÀÄ** 6 hrs

1. ºÀ¹gÀÄ ºÉÆ¸ÀPÀÄªÀ UÀtÂUÀ¼ÀÄ AiÀÄ®è¥Àà gÉrØ

2. eÁUÀwÃPÀgÀtzÀ »£ÉÃß¯ÉAiÀÄ°è UÀA¢üÃfAiÀÄ ¥Àæ¸ÀÄÛvÀvÉ ¹. £ÁUÀtÚ
3. ZÁªÁðPÀgÀÄ: MAzÀÄ n¥ÀàtÂ ¦ J£ï gÀAUÀ£ï

Unit IV **PÁzÀA§j** 6 hrs

1. ¸ÀA¸ÁÌgÀ (DAiÀÄÝ§sÁUÀ) AiÀÄÄ.Dgï. C£ÀAvÀªÀÄÆwð

¥ÀgÁªÀÄ±Àð£À UÀæAxÀUÀ¼ÀÄ :

1. ªÀÄÄUÀ½ gÀA.²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
3. ºÀA¥À £ÁUÀgÁdAiÀÄå, ¸ÁAUÀvÀå PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
4. gÀAeÁ£ï zÀUÁð, ±ÀgÀtgÀ ¸ÀªÀÄUÀæ PÁæAw, ¥ÀæPÁ±ÀPÀgÀÄ. ¯ÉÆÃ»AiÀiÁ ¥ÀæPÁ±À£À, §¼Áîj. 2015
5. ªÀ¹µÀ×., gÀvÁßPÀgÀªÀtÂðAiÀÄ ¨sÀgÀvÉÃ±À ªÉÊ¨sÀªÀ, ¥ÀæPÁ±ÀPÀgÀÄ ZÉÃvÀ£À §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 1999
6. qÁ. CgÀ«AzÀ ªÀiÁ®UÀwÛ, ¸Á»vÀå ¸ÀA¸Àløw ªÀÄvÀÄÛ zÀ°vÀ ¥ÀæeÉÕ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÀßqÀ ¸Á»vÀå ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2014
7. qÁ. F.J¸ï. DªÀÄÆgÀ, PÀ£ÀßqÀ PÀxÀ£À ¸Á»vÀå : PÁzÀA§j, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
8. QÃvÀð£ÁxÀ PÀÄvÀðPÉÆÃn, PÀ£ÀßqÀ ¸Á»vÀå ¸ÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉÆÃn ªÉÄªÉÆÃjAiÀÄ¯ï læ¸ïÖ, zsÁgÀªÁqÀ. 2009
9. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
10. ¸ÀA. qÁ! ¹. Dgï. ZÀAzÀæ±ÉÃRgï, ªÀÄÄAzÁ¼ÀÄvÀ£ÀzÀ ®PÀëtUÀ¼À£ÀÄß ¨É¼É¹PÉÆ¼ÀÄîªÀÅzÀÄ ºÉÃUÉ?, ¥ÀæPÁ±ÀPÀgÀÄ £ÀªÀPÀ£ÁðlPÀ ¥À©èPÉÃµÀ£îì ¥ÉæöÊªÉmï °«ÄmÉqï. 2010
11. DzsÀÄ¤PÀ PÀ£ÀßqÀ PÁªÀå ¨sÁUÀ-2, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2004
12. ²ªÀgÀÄzÀæ¥Àà f.J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHK401	**CO1**					2	3				
	CO2					2	3				
	CO3						3				
	CO4							3	2		

Course Code	Language – II: Hindi-IV	Type	L	T	P	C	Hrs/Week
B21AHH401		FC	1	1	0	2	3

Course Objectives:

This course aims to provide for the students:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना।
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना।
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना।
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना।

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

1. सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है।
2. साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है।
3. समाज में अंतर्निहित पद्दतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है।
4. साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है।

Course Contents:

इकाई – 1: खंड काव्य – नहुष – मैथिलीशरण गुप्त **7 hrs**

कवि परिचय
काव्य पररचय
शची सर्ग
नहुष सर्ग

इकाई – 2: खंड काव्य – नहुष – मैथिलीशरण गुप्त **7 hrs**

उर्वशी सर्ग
स्वर्गभोग सर्ग

इका ई – 3: खंड काव्य – नहुष – मैथिलीशरण गुप्त **6 hrs**

सन्देश सर्ग
मंत्रणा सर्ग
पतन सर्ग

इकाई – 4: सिनिमा रिव्यू **6 hrs**

सूपर 30, मिशन मंगल, थप्पड़, आर्टिकल 15

सूचना: प्रत्येक इकाई 25 अंक के लिए निर्धारित है।

Text book/s: पाठ्य पुस्तक:

1. **खंड-काव्य – नहुष – मैथिलीशरण गुप्त**

References: सन्दर्भ ग्रन्थ

1. रस – छंद – अलंकर - कृष्णदेव शर्मा & सुरेश अग्रवाल
2. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
3. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
4. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
5. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
6. मीडिया विमर्श – रामशरण जोशी

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2

	COs										
B21AHH401	**CO1**					2	3	2			
	CO2					2	2	3			
	CO3					3	3	3			
	CO4					3	2	3			

Course Code	**Language-II: Additional English-IV**	**Type**	**L**	**T**	**P**	**C**	**Hrs/Week**
B21AHA401		FC	1	1	0	2	3

Course Objectives:

This course aims to provide for the students:

1. To infer the myths from the contemporary perspective.
2. To outline the idea of family represented in literature.
3. To interpret horror and suspense as a genre of literature.
4. To assess the impact of education in building a society.

Course Outcomes:

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

1. Examine the relevance of myths and mythology.
2. Demonstrate family values and ethics essential to live in the society.
3. Analyze horror and suspense as a significant genre of literature.
4. Evaluate the applicability of academic contribution in building a society.

Course Contents:

UNIT – I: Myths & Mythology **6 hrs**

John W. May – Narcissus; W.B. Yeats – The Second Coming; Devdutt Pattanaik - *Shikhandi and the Other Stories They Don't Tell you* (Extracts).

UNIT – II: Family & Relationships **6 hrs**

Nissim Ezekiel – Night of the Scorpion; Langston Hughes – Mother to Son; Kate Chopin – The Story of an Hour; Henrik Ibsen – *A Doll's House* (Extract).

UNIT – III: Horror & Suspense **7 hrs**

Edgar Allan Poe – The Raven; Bram Stoker – A Dream of Red Hands; Satyajit Ray – Adventures of Feluda (Extract).

UNIT – IV: Education **7 hrs**

The Dalai Lama – The Paradox of Our Times; Kamala Wijeratne – To a student; Sudha Murthy – In Sahyadri Hills, a Lesson in Humility; Frigyes Karinthy – *Refund.*

Reference Books:

1. Finneran, Richard J. *The Collected Works of W.B. Yeats*(Volume I: The Poems: Revised Second Edition). Simon & Schuster, 1996.
2. Pattanaik, Devdutt. *Shikhandi: Ánd Other 'Queer' Tales They Don't Tell You*. Penguin Books, 2014.
3. Karve, Irawati. *Yuganta: The End of an Epoch*. Orient Blackswan, 2007.
4. Ezekiel, Nissim. *Collected Poems* (With A New Introduction By John Thieme). OUP, 2005.

5. Hughes, Langston. *The Collected Poems of Langston Hughes*. Vintage, 1995.
6. Chopin, Kate. *The Awakening and Selected Stories of Kate Chopin*. Simon & Schuster, 2004.
7. Ibsen, Henrik. *A Doll's House*. Maple Press, 2011.
8. Poe, Edgar Allan. *The Complete Poetry of Edgar Allan Poe*. Penguin USA, 2008.
9. Stoker, Bram. *Dracula*. Fingerprint Publishing, 2013.
10. Ray, Satyajit. *The Complete Adventures of Feluda* (Vol. 2). Penguin Books Ltd., 2015.
11. Lama, Dalai. *Freedom In Exile: The Autobiography of the Dalai Lama of Tibet*. Little, Brown Book Group, 1998.
12. Murthy, Sudha. *Wise and Otherwise: A Salute to Life*. Penguin India, 2006.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21AHA401	**CO1**					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Code	Mathematics –IV	Type	L	T	P	C	Hrs/Week
B21MT0401		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. Get familiar with the theories on rings, integral domains and fields.
2. Introduce the basic concepts of abstract algebra.
3. To understand the concepts of solid geometry and its applications in various fields.
4. Demonstrate an understanding of and be able to use Green's Theorem for the plane, Stokes Theorem, and Gauss' divergence Theorem to simplify and solve appropriate integrals.

Course Outcomes:

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

1. Explain the fundamental concepts of abstract algebra such as rings, fields and their role in modern mathematics and applied contexts.
2. Apply the concepts of solid geometry and to solve problems of various fields.
3. Compute double integrals and be familiar with change of order of integration.
4. Apply Green's Theorem, Divergence Theorem and Stoke's Theorem.

Course Contents:

Unit-I: - Ring theory **12 hrs**

Rings – Subrings, Examples – Integral Domains – Division rings – The ring of quaternions- Fields--Subfields with examples- Homomorphism of Rings – Definition and elementary properties, Maximal and Prime ideals.

Unit-II: Analytical geometry in 3-D **12 hrs**

(Recapitulation of three-dimensional geometry - Different forms of equations of straight line and plane). Angle between two planes - Line of intersection of two planes - Plane coaxial with given

planes - Planes bisecting the angle between two planes - Angle between a line and a plane - Coplanarity of two lines - shortest distance between two lines. Equation of the sphere in general and standard forms - equation of a sphere with given ends of a diameter. Tangent plane to a sphere, orthogonallity of spheres. Standard equations of right circular cone and right circular cylinder.

Unit-III: Multiple integrals **12 hrs**

Definition of a line integral and basic properties – Examples on evaluation of line integrals –Double integrals- Change of order of integration –change of variables (polar coordinates, area enclosed by plane curves, evaluation of triple integrals and volume of solids.

Unit-IV: Vector Integration **12 hrs**

Integration of vectors- line integral (circulation, work done)-Surface integral (flux), Green's theorem (with proof) - Direct consequences of the theorem. The Divergence theorem (without proof) and problems (verification and evaluation). The Stokes' theorem (without proof) and problems (verification and evaluation) - Direct consequences of the theorem.

Text Books:

1. Shanthi Narayan, Analytical Solid Geometry. New Delhi: S. Chand and Co. Pvt. Ltd., 2004.
2. D E Bournesand and P C Kendall, Vector Analysis, ELBS, 1996
3. M. D. Raisinghania, Vector Calculus, S Chand Co. Pvt. Ltd., 2013

Reference Books:

1. I N Herstien – Topics in Algebra
2. John B Fraleigh, A First course in Abstract Algebra, 3rd ed.: Narosa Publishing House., 1990.
3. R. Balakrishan and N. Ramabadran, A Textbook of Modern Algebra, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0401	CO1	3	3	2	3	2				3	3
	CO2	3	3	2	3	2				3	3
	CO3	3	3	2	3	2				3	2
	CO4	3	2	1	2	2				3	3

Course Code	Electricity and Electromagnetism	Type	L	T	P	C	Hrs/Week
B21PH0401		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. Describe how static electricity is produced and list examples where its effects are observed.
2. Describe how magnetism is produced and list examples where its effects are observed.
3. Identify the connection between electricity and magnetism.
4. Develop understanding the concepts in electricity and magnetism.

Course Outcomes:

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

1. Calculate the force on a charged particle.

2. Explain the method of measuring voltage and frequency using CRO.
3. Explain the response of LR, CR and LCR circuits frequencies.
4. Explain Anderson's bridge, thermocouple and self-inductance of solenoid.

Course Contents:

UNIT-I **12 hrs**

Thermoelectricity: The Thermocouple, Seebeck, Peltier, and Thomson effects, Thermodynamic theory of thermoelectric effect, Neutral temperature, Temperature of inversion, The law of intermediate metals, and the law of intermediate temperatures. Numerical problems.

Network Theorems: Mesh analysis circuits using KVL and KCL, Statement and proof of Thevenin's theorem, Norton's theorem, and Superposition theorem, Applications to DC circuits. Numerical problems.

UNIT-II **12 hrs**

Electromagnetism: Scalar and Vector fields, The gradient of a scalar field, The divergence and curl of a vector field, The physical significance of gradient, divergence, and curl, Statement and theorems of Gauss and Stokes, Numerical problems.

Electromagnetic theory: Equation of continuity, Maxwell's modification of Ampere circuital law; Displacement current, Setting up of Maxwell's field equations. Maxwell's field equations in free space, Poynting vector (definition). Wave equation for the field vectors in free space and in isotropic dielectric. Energy density of electromagnetic wave and Poynting Theorem (Proof). Plane monochromatic electromagnetic waves - Transverse nature. Helmholtz equation. Characteristic impedance of free space. Hertz's experiment. Numerical problems.

UNIT-III **12 hrs**

CRO: Construction and working. Measurement of voltage, frequency, and phase using a CRO, Measurement of various electrical parameters using Multimeter.

Alternating current: Average, Peak, and RMS values. Response of LR, and CR circuits to sinusoidal voltages (discussion using the `j' symbols). Series Resonance and parallel resonance- half-power frequencies, band - width and Q- factor. Power in electrical circuits- power factor. Maximum power transfer theorem for ac circuits (statement and proof). Numerical problems.

UNIT-IV **12 hrs**

Applications of ac circuits:

i) **AC bridges** - Anderson's bridge, Maxwell's bridge, de Sauty bridge, Numerical problems.

ii) **Frequency filters** - High-pass and low-pass filters with LC, LR, and CR combinations. Expression for cut-off frequency, Band pass filters. Numerical problems including designing the filters.

References

1. Tewari K K, Electricity and Magnetism, Revised Edn., S Chand and Company, 2007.
2. Vasudeva D N, Fundamentals of Magnetism and Electricity, 9th edn, S.Chand, and Company, 2013.
3. Laud B B, Electrodynamics, Revised 2nd Edn., New Age International, 2005.
4. David J Griffiths, Introduction to Electrodynamics, 4th Edn., Prentice Hall of India, 2017.
5. Hayt W H, and Buck J A, Engineering Electromagnetism, 8th Edn., Tata McGraw Hill, 2017.
6. Mehta V K, Principles of Electronics, S Chand, and Co., 2005.
7. Brij Lal, and Subrahmanyam N, A Textbook of Electricity and Magnetism, 19th Edn., Ratan Prakashan Mandir, 2016.
8. Bhattacharya A B, and Bhattacharya R, Undergraduate Physics Vol. 2, New Central Book Agency, 2008.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0401	**CO1**	3	2	1	1					3	2
	CO2	3	2	3	2					3	2
	CO3	3	3	3	3					3	3
	CO4	3	2	2	2					3	2

Course Code	Chemistry –IV	Type	L	T	P	C	Hrs/Week
B21CH0401		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students study the:

1. The importance of acid-base concept, HSBA rule in compound formation, non-aqueous solvent and noble gas chemistry
2. The fundamental concepts of organic chemistry synthesis of various functional organic compounds
3. Illustrate the Vital concepts thermodynamics and its principles and its importance.
4. Correlate the reaction kinetics and foundation theory and relevant applications.

Course Outcomes:

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

1. Apply the knowledge of noble gases, compounds of N, S and pseudo halogens in explaining, interpreting structures and their reactivities of noble gases and organometallic compounds.
2. Analyze the bonding stability organic compounds and their applications.
3. Recognize the typical named organic reactions and explain their mechanisms through various steps.
4. Correlate the importance of adsorption and catalysis reactions of chemical compounds in industries e.g. Hydrogenation, dehydrogenation.

Course Contents:

UNIT-I **12 hrs**

Noble Gases: Preparation, separation of Noble gases-Dewar'smethod. Preparation, Structure and properties of compounds of Xenon and Krypton (XeF_2, XeO_3, KrF_2, KrO_3), Clathrates (explanation with suitable examples, essential conditions for the formation and uses).

Organometallic Compounds: Definition with example, Organo magnesium and organolithium compounds: preparation and synthetic applications. Metal carbonyls: Definition, classification with examples, nature of M-CO bonding in carbonyls. nitrosyls and metallocenes.

Bioinorganic Chemistry: Essentials and trace elements of life; basic reactions in the biological systems and the role of metal ions, especially Fe^{2+}, Fe^{3+}, Cu^{2+} and Zn^{2+}; structure and function of hemoglobin and myoglobin and carbonic anhydrase.

Non-aqueous solvents: classification of solvents, Liquid ammonia-reasons for the solvent properties, typical reactions- solubility of alkali metals; acid-base, precipitation, Ionization of weak acids, advantages and disadvantages.

UNIT-II **12 hrs**

Stereochemistry – Introduction, Stereo isomerism; Optical isomerism; Symmetry and chirality; Absolute and relative configuration. D and L. Enantiomers and diastereomers; Racemic mixture, racemisation and resolution. Threo and erythro; CIP Rules: R/S and E-Z system of nomenclature. Optical isomerism in compounds with stereocenters (lactic acid and tartaric acid) and without any stereocenters (allenes, biphenyls); atropisomerism. conformation of acyclic systems (substituted ethane/n-propane/n-butane) and cyclic systems (mono- and di-substituted cyclohexanes).

Pericyclic and photochemical reactions:

Pericyclic reactions: Introduction. Classification of pericyclic reactions, electro cyclic reactions-con rotation and dis rotation. Electro cyclic closure and opening in 4n and 4n+2 π systems.

Organic Photochemistry: Introduction, types of photochemical reactions-laws of photochemistry, photo dissociation - isomerization- cyclisation- dimerization and oxetane formation. Norrish-I and II reactions. Barton reaction- photo Fries rearrangement, Paterno Buchi reaction.

UNIT-III **12 hrs**

Free Energy: Helmholtz and Gibb's free energy – their definitions and their relationship, Gibb's – Helmholtz equation at constant pressure and volume, thermodynamic criteria of equilibrium and spontaneity, Claussius – Clappeyron equation, integrated form of Claussius – Clappeyron equation (to be assumed) and its applications (enthalpy of vapourization, boiling point and freezing point at different temperatures), Van't Hoff's reaction isotherms and isochore equations.

Adsorption: Introduction, principle involved. Sorption, absorption and adsorption (statement, differences and examples) physical and chemical adsorption – definition and differences. Adsorption of gases on solids – factors which influence, **t**ypes of adsorption, factors affecting adsorption. Free energy change in adsorption, Adsorption isotherms –Freundlich's isotherm and Langmuir's adsorption. Equation of Langmuir's adsorption isotherm, BET equation (derivation not required) applications.

Catalysis-types, general characteristics, homogeneous and heterogeneous catalysis. Theories of catalysis, intermediate compound formation theory and adsorption theory. Enzyme catalysis –lock and key mechanism with example. Michaelis-Menton enzyme catalytic equation, Industrial applications of enzymes and catalysts.

UNIT-IV **12 hrs**

Chemical Kinetics: Rate of reaction, rate equation, factors influencing the rate of a reaction. Order of a reaction, integrated rate expression for zero order, first order, second and third order reaction. Half-life period of a reaction. Methods of determination of order of reaction, effect of temperature on the rate of reaction – Arrhenius equation. Theories of reaction rate – Simple collision theory for unimolecular and bimolecular collision (hard sphere model). Transition state theory of bimolecular reactions.

Electrochemistry: Electrolytic conduction, factors affecting electrolytic conduction, specific, conductance, molar conductance, equivalent conductance and relation among them, their variation with concentration. Arrhenius theory of ionization, Ostwald's Dilution Law. Debye- Hückel – Onsager's equation for strong electrolytes (elementary treatment only) Transport number, definition and determination by Hittorfs methods, (numerical included), Kohlarausch's Law, calculation of molar ionic conductance and effect of viscosity temperature & pressure on it. Applications of Kohlarausch's Law: Calculation of conductance of weak electrolytes at infinite dilution, determination of degree of dissociation, determination of K_a of acids and determination of solubility product of sparingly soluble salts.

Reference Books:

1. D.W. Ball, Physical Chemistry, Thomson Press, India, 2007.
2. G.W. Castellan, Physical Chemistry, 4th Ed. Narosa, 2004.
3. B.S. Bahl, A. Bhal, G. D. Tuli, Essentials of Physical Chemsitry, S. Chand & Company Edition 2006.
4. Gurudeep Raj, Advanced Physical Chemistry, Goel Publication
5. M.K. Jain, A Text book of Organic Chemistry, S. Chand & Company.
6. A. Bhal and B.S. Bhal, A Text book of Organic Chemistry, Chand & Company.
7. P.L. Soni, A Text book of Organic Chemistry, S. Chand & Company.
8. Puri, Sharma and Kalia, Principles of Inorganic Chemistry, Shobhanlal Nagin Chand Co.
9. Gurudeep Raj, A Text book of Inorganic Chemistry.
10. J.D. Lee, Concise Inorganic Chemistry, B-Block Well Science Ltd.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ Cos	PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0401	CO1	1	2	1	1	1	1	1	1	2	1
	CO2	2	2	1	1	1	2	1	1	2	2
	CO3	1	2	1	2	1	2	1	1	1	1
	CO4	2	1	1	2	1	1	2	1	1	2

Course Code	Complex Analysis	Type	L	T	P	C	Hrs/Week
B21MTS411		SC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to learn the complex analysis and applications of line integrals, Cauchy's in equality and Residue theorem.

Course Outcomes:

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

1. Analyze the conjugate and modulus of a complex number.
2. Apply the concepts of Cauchy-Riemann equations in Cartesian and polar forms to solve the problems.
3. Apply Cauchy integral theorem and its consequences to solve the problems.
4. Analyze the power series expansion of an analytic function.

Course Contents:

UNIT-I: Complex Analysis – 1 **12 hrs**

Recapitulation of Complex numbers, the complex plane, conjugate, and modulus of a complex number. Polar form, Euler's formula. Hyperbolic functions -simple problems.

UNIT-II: Complex Analysis – 2 **12 hrs**

Functions of complex variables: Limit, continuity, and differentiability-Simple problems. Analytic functions, Cauchy-Reimann equations in Cartesian and polar forms. Sufficient conditions for analyticity (in Cartesian form). Properties- Harmonic and orthogonal system and problems. Construction of analytic function, given real and imaginary parts.

UNIT-III: Complex analysis – 3 **12 hrs**

The complex line integral: Examples and properties (definitions of the concepts like neighborhood of a point, closed contour, etc. at appropriate places should be mentioned). Cauchy's integral theorem (with proof) and its consequences. Cauchy's integral formulae for the function and derivatives (with

proof). Applications to the evaluation of simple line integrals. Cauchy's inequality, Liouville's Theorem-Fundamental theorem of algebra.

UNIT-IV: Complex analysis – 4 **12 hrs**

Power series expansion of an analytic function, Taylor's and Laurent's series (without proof). Singularity poles, residues, formula for the residue at a pole and Cauchy's Residue theorem (with proof) problems.

References

1. S. Shanthinarayan, Complex Analysis, S Chand Co. Pvt. Ltd., 2012.
2. R.V. Churchil & J W Brown, Complex Variables and Applications, 5th ed. TMH 1989.
3. L.V. Ahlfors, Complex Analysis, 3rd ed.: Mc Graw Hill, 1979.
4. A.R. Vashista, Complex Analysis, Krishna Prakashana Mandir, 2012.
5. Richard R Goldberg, Methods of Real Analysis, Indian ed. New Delhi, India: O&IBH Publishing Co. 1970.
6. G K Ranganath, Text book of B.Sc. Mathematics, Revised ed. New Delhi, India: S Chand Company Ltd., 2011.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MTS411	**CO1**	3	3	2	2					2	3
	CO2	3	2	2	3					3	2
	CO3	3	2	3	2					3	2
	CO4	3	3	3	2					3	3

Course Code	Operations Research	Type	L	T	P	C	Hrs/Week
B21MTS412		SC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to:

1. Make the students to know about the history of operations research.
2. Make the students to learn about operations research models.
3. Make the students to formulate linear programming model.
4. Illustrate about the application areas of linear programming.

Course Outcomes:

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

1. Explain the classification of operations research models.
2. Demonstrate different methods for solving operations research models.
3. Gain knowledge on linear programming model formulation, applications and limitations.
4. Master on the applications of linear programming.

Course Contents:

UNIT-I: Operations Research Introduction **12 hrs**

History-Features of operations research approach-Operations research approach to problem solving-Models and modeling in operations research-Classification based on structure-Classification based on function-Classification based on time – Classification based on degree of certainty-Classification based on method of solution or quantification.

UNIT-II: Operations Research Models **12 hrs**

Advantages of model building-Methods for solving operations research models-Methodology of operations research-Advantages of operations research study-Opportunities and shortcomings of the operations research approach-Features of operations research solution-Applications of operations research-Operations research models in practice-Computer software for operations research.

UNIT-III: Linear Programming **12 hrs**

General structure of an LP model-Assumptions of an LP model-Advantages of using LP-Limitations of LP-Application areas of LP-General mathematical model of LPP-LPP model formulation.

UNIT-IV: Applications of Linear Programming **12 hrs**

LP model on production- LP model on Marketing- LP model on Finance- LP model on Agriculture-LP model on Transportation-LP model on personnel.

References

1. Operations Research by J.K. Sharma
2. Operations Research by S.D. Sharma
3. Operations Research by Sreenivasa Reddy M
4. Operations Research an Introduction by Hamdya.Taha
5. Linear Programming Methods and Applications by Saul I. Gass
6. A First Course in Optimization Theory by Rangarajan K Sundaram

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MTS412	**CO1**	3	3	2	2					2	3
	CO2	3	2	2	3					3	2
	CO3	3	2	3	2					3	2
	CO4	3	3	3	2					3	3

Course Code	Topology	Type	L	T	P	C	Hrs/Week
B21MTS413		SC	3	0	0	3	4

Course Objectives:

The aim of the course is to provide for the students an introduction to theory of metric and topological spaces with emphasis on those topics that are important to further studies. The course focuses on Homotopy, Homology theories and Topological groups and Lie groups.

Course Outcomes:

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

1. Analyse different axioms of Topology.
2. Learn Homotopy Theory.
3. Analyse fundamental groups of S1 and Sn.
4. Analyse Topological groups and Lie groups.

Course Contents:

UNIT-I: **12 hrs**

General Topology: Introduction, metric topology, separation axioms, compactness, Connectedness, product topology, introduction to manifolds, sub manifolds.

UNIT-II: **12 hrs**

Homotopy Theory. Covering spaces, homotopy maps, homotopy equivalence, Contractible spaces, deformation retraction.

UNIT-III: **12 hrs**

Fundamental Groups: Universal cover and lifting problem for covering maps, Fundamental groups of S1 and Sn. Introduction to Homology Theory.

UNIT-IV: **12 hrs**

Topological Groups: Introduction, integration on locally compact spaces, Haar Measure, Character groups, group action. Lie groups and lie algebras: Basic theory, linear groups.

References

1. C.O. Christenson and W.L. Voxman. Aspects of Topology.
2. J.R. Munkres. General Topology.
3. I.M. Singer and J.A. Thorpe. Lecture Notes in Elementary Topology and Geometry.
4. K. Chandrasekharan. A Course on Topological Groups.
5. W. Fulton and J. Harris. Representation Theory.
6. F.W. Warner. Foundations of Differentiable Manifolds and Lie Groups.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MTS413	**CO1**	3	3	2	2					2	3
	CO2	3	2	2	3					3	2
	CO3	3	2	3	2					3	2
	CO4	3	3	3	2					3	3

Course Code	Soft Skill Training	Type	L	T	P	C	Hrs/Week
B21PTM401		SC	0	0	0	0	2

Note: Soft Skill Training courses are organised by the **Placement and Training Centre**. The students have to undergo Soft Skill Courses conducted by the said Centre.

Course Code	Skill Development Program	Type	L	T	P	C	Hrs/Week
B21SGM401		MC	0	0	0	0	2

Note: Skill development training courses will be organised by the **Department of Chemistry**. The students have to undergo skill development training conducted by the **Department of Chemistry**.

Course Code	Mathematics Practicals-IV	Type	L	T	P	C	Hrs/Week
B21MT0402		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. Theories on rings, integral domains and fields using *Python*.
2. Basic concepts of abstract algebra through *Python.*

Course Outcomes:

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

1. Exhibit proficiency in using *Python* to study abstract algebra.
2. Obtain knowledge in abstract algebra and calculus.
3. Demonstrate the use of *Python* to understand and interpret the core concepts in integral calculus.
4. Demonstrate the use of *Python* to understand and interpret the core concepts in vector integration.

Course Contents:

List of programms:

1. Examples on different types of rings.
2. Examples on integral domains and fields.
3. Examples on subrings, ideals and subrings which are not ideals.
4. Homomorphism and isomorphism of rings- illustrative examples.
5. Python program to find equation and plot sphere, cone, cylinder.
6. Evaluation of the line integral with constant limits.
7. Evaluation of the double integral with constant limits.
8. Evaluation of the triple integral with constant limits.
9. Evaluation of the line integral with variable limits.
10. Evaluation of the double integral with variable limits.
11. Evaluation of the triple integral with variable limits.
12. Green's theorem.

Text Books:

1. Farukh Khalilov and Tayyip oral, Math coding Python, 5th Edition, USA-2020.
2. Joakim Sundnes, Introduction to Scientific programming with Python, 2nd Edition, Springer 2010.
3. Allen Downey and Jeffrey Elkner, Learning with Python, 5th Edition, Springer, 2015.
4. Eric Matthes, A Hands-On, Project-Based Introduction to Programming- Python Crash Course, 2nd Edition:
5. Al Sweigart, Automate The Boring Stuff With Python: Practical Programming For Total Beginners, 2nd Edition.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0402	**CO1**	3	2	2	2				1	3	2
	CO2	3	2	2	2				1	3	3
	CO3	3	2	2	2				1	3	2
	CO4	3	2	2	2				1	2	2

Course Code	Physics Practicals-IV	Type	L	T	P	C	Hrs/Week
B21PH0402		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students to:

1. Develop experimental skills and study practical applications of electricity and magnetism
2. Create and describe series and parallel LCR circuits
3. Study and analyse application of Ballistic galvanometer and CRO
4. Describe the properties of magnetism by plotting B-H Curve.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

1. Draw frequency response of circuits containing R, L and C components;
2. Verify the laws combination of capacitors
3. Design low pass and high pass filters for different frequency and quality factor.
4. Draw magnetic hysteresis and find coercive field and hysteresis loss

Course Contents:

Any **Eight** of the Following Experiments:

1. Determination of the self-inductance of the coil (Anderson's bridge)
2. Verification of laws of combination of capacitances (de-Sauty bridge).
3. To identify the components using Black box experiment.
4. B-H using Helmholtz double coil galvanometer and potentiometer.
5. Determination of C, Q-factor, and resonance frequency by LCR series circuit.
6. Voltage triangle - Measurement of phase difference
7. Determination of the cut-off frequency by Low and High pass filters.
8. Determination of L, Q-factor, and resonance frequency by LCR parallel circuit.
9. To verify the magnetic field at the center and at the edges by Solenoid experiment.
10. Determination of voltage and frequency using CRO.

Textbooks:

1. Thiruvadigal, J. D., Ponnusamy, S. Sudha. D. and Krishnamohan M., "Physics for Technologists", Vibrant Publication, Chennai, 2013
2. R. K. Shukla and Anchal Srivastava, "Practical Physics", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G. L. Souires, "Practical Physics:", 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. An Advanced Course in Practical Physics, D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002.
4. BSC, Practical Physics, CL Arora, S. Chand & Co, New Delhi, Revised Edition, 2007.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0402	**CO1**	3	2	1	1			1	3	3	2
	CO2	3	2	3	2				2	3	2
	CO3	3	3	3	3			2	3	3	3
	CO4	3	2	2	2			2	2	3	2

Course Code	Chemistry Practicals-IV	Type	L	T	P	C	Hrs/Week
B21CH0402		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students to:

1. Develop knowledge on different analytical instrumentation techniques for the estimation of analyte.
2. Apply the laboratory skills in quantitative techniques.
3. Understand the importance electrodes in physical related experiments.
4. Compare the involvement various physical properties in experiments.

Course Outcomes:

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

1. Analyse the importance of instruments while conducting lab experiments.
2. Demonstrate the experimental skills in labs.
3. Operate and interprete experimental data.
4. Identify the causes for unexpected results and to the reach better results.

Course Contents:

List of Experiments:

1. Hydrolysis of methyl Acetate or Ethyl Acetate at Constant temperature.
2. Potentiometric titration of FAS vs $K_2Cr_2O_7$.
3. Conductometric titration of strong acid v/s strong base and acid mixtures v/s strong base.
4. Colorimeteric estimation of Cu^{2+} ion using NH_4OH as complexing agent.
5. Determination of percentage composition of sodium chloride solution by determining the miscibility temperature of phenol - water system.
6. pH titration of strong acid against strong base (by observing change in pH).
7. Determination of molecular weight of a polymer material by viscosity measurements (celluloseacetate/methyl acrylate).
8. Colorimetric estimation of Fe^{3+} ion using ammonium thiocyanate as complexing agent.
9. Determination of partition coefficient of acetic acid between n-butanol and water.
10. Verification of freundlich adsorption isotherm of acetic acid on charcoal.
11. Determination of chloride content of water by argentometry.

Reference Books for Practicles

1. B.D. Khosla, V.C. Garg and A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New Delhi, 2011.
2. S.W. Rajbhoj and T.K. Chondhekar, Systematic Experimental Physical Chemistry, Anjali Publication, Second Edition, 2000.
3. Sunita Rattan, Experiments in Applied Chemistry, S.K. Kataria & Sons, Second edition, 2008.
4. B.D. Khosla, V.C. Garg, and A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New Delhi, 2011.
5. C.W. Garland, J.W. Nibler and D.P. Shoemaker, Experiments in Physical Chemistry.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2

B21CH0402	**CO1**	1	2	1	1			1	1	2	1
	CO2	2	2	1	1			1	1	2	2
	CO3	1	2	1	2			1	1	1	1
	CO4	2	1	1	2			2	1	1	2

FIFTH-SEMESTER

Course Code	Mathematics-V	Type	L	T	P	C	Hrs/Week
B21MT0501		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. Understand the concepts in vector spaces and Linear Transformations.
2. Gain problems solving skills in solving vector spaces and linear transformations.
3. To provide students with an introduction to the field of numerical analysis.
4. The course aims to develop and apply problem solving skills through the introduction of numerical methods

Course Outcomes:

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

1. Understand concepts of vector space, subspace of a vector space, linear span, linear dependence, linear independence, dimension, basis and formally prove standard results related to these concepts.
2. Be familiar with Linear transformations and their corresponding matrices and understand the Rank and nullity concepts
3. Use information and communication technology to discuss problems relevant to Numerical Analysis.
4. Demonstrate the ability to study the solution of a differential equation and develop a practical interpretation of the numerical results.

Course Contents:

UNIT-I: Vector space-I **12 hrs**

Vector Spaces – Definition – Examples – Vector subspaces – Criterion for a subset to be a subspace – Algebra of Subspaces – Linear Combination– Linear Span – Linear dependence and linear Independence of vectors – Theorems on linear dependence and linear independence – Basis of a vector space – Dimension of a vector space – Some properties – Quotient spaces–Homomorphism of vector spaces– first kind of Isomorphism of vector spaces.

UNIT-II: Vector space-II **12 hrs**

Linear transformation – Linear maps as matrices – Change of basis and effect of associated matrices – Kernel and image of a linear transformation – Rank and nullity theorem.

UNIT-III: Numerical Methods-I **12 hrs**

Numerical solutions of Algebraic and transcendental equations – Bisection method – The method of false position – Newton – Raphson method. Numerical solutions of first order differential equations Picard's method– Euler's method – Euler's modified method – Runge -Kutta fourth order method.

UNIT-IV: Numerical Methods-II **12 hrs**

Forward and backward differences – shift operator – Interpolation – Newton – Gregory forward and backward interpolation formulae –Divided difference, Newton's general interpolation formula, Lagrange's and Inverse Lagrange's interpolation formula.

Numerical differentiation: direct formulae and problems.

Numerical Integration: General quadrature formula – Trapezoidal Rule –Simpson's 1/3 rule – Simpson's 3/8 th rule, Weddle's rule.

Text Books:

1. G K Ranganath, Text book of B.Sc. Mathematics, Revised ed. New Delhi, India: S Chand and Company Ltd., 2011.
2. S S Sastry, Introductory methods of Numerical Analysis, 3rd ed. New Delhi, India: Prentice Hall of India, 1999.
3. Francis Scheid, Schaum's Outline of Numerical Analysis, Revised ed.: Mc. Graw Hill., 2006.

Reference Book(s):

1. M K Jain, S R K Iyengar, and R K Jain, Numerical Methods for Scientific and Engineering Computation, 4th Ed. New Delhi, India: New Age International, 2003.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0501	**CO1**	3	3	3	2	3				3	2
	CO2	3	3	3	3	3				3	3
	CO3	3	3	2	3	2				3	2
	CO4	3	3	2	3	3				3	3

Course Code	Quantum Mechanics and Nuclear Physics	Type	L	T	P	C	Hrs/Week
B21PH0501		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. To have a clear understanding of the principles of quantum mechanics.
2. To know the application of Schrodinger wave equations and quantum concepts
3. Introduce students to the fundamental principles and concepts governing nuclear physics and working knowledge of their application to real-life problems.
4. Provide students with opportunities to develop basic knowledge and understanding of radioactivity decay.

Course Outcomes:

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

1. Understand the mathematical representations of particle properties of waves and analysis used in quantum mechanics.
2. Apply Schrodinger wave equation for one dimensional problem like particle in a box.
3. Explain radioactive decay using physics laws.
4. Apply basic knowledge of radio decay to solve nuclear physics related problems and decay systems in nuclear elements.

Course Contents:

UNIT-I: Theory of Relativity and Wave-Particle Dualism 12 hrs

Special theory of relativity: Postulates of the special theory of relativity; Lorentz Transformations – Length Contraction, Time Dilation, Velocity Addition Theorem; Variation of mass with velocity; Mass – Energy equivalence; Relativistic momentum and kinetic energy, Quantum Theory of Light, Photoelectric Effect, The Compton Effect (qualitative); Wave-Particle Duality of light, De-Broglie waves, Wave-Particle Duality of matter, de Broglie Wave Velocity, Wave packet, Phase and group velocities, Relations between phase, group and particle velocities, Wave function, Born's Interpretation of wave function, Probability density, Davison- Germer's experiment, The Uncertainty principle and its applications, Numerical problems.

UNIT-II: Schrödinger's Equation and its Application **12 hrs**

Introduction, Schrödinger's Equation: Time dependent and Time independent wave equations, Conditions for Physical Acceptability of Wave Functions, normalization of wave function, Quantum Mechanical Operators, Expectation Values, Eigen values and Eigen functions, Particle in a one-dimensional box: energy quantization, wave functions, probability density, Numerical Problems.

UNIT-III: Nucleus and its Properties **12 hrs**

Constituents of nucleus and their intrinsic properties. The proton-neutron hypothesis. Quantitative facts about size, mass, charge, nuclear density, angular momentum, magnetic dipole moment, nuclear spin, parity, and binding energy. Average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/Z plot and nuclear stability. Nuclear forces, Yukawa's theory (qualitative), characteristics of nuclear forces, Numerical Problems.

UNIT-IV: Nuclear Models and Radioactivity **12 hrs**

Nuclear Models: Liquid drop model, Semi-empirical mass formula and significance of various terms, nuclear magic numbers and experimental evidence for nuclear magic numbers, basic assumption of shell model, explanation of magic numbers from nuclear shell model, Numerical Problems.

Radioactivity: Radioactivity, law of radioactive decay, half-life period and mean life. Successive disintegration, radioactive series, Alpha decay, Velocity, kinetic energy and Range of alpha-particle and their measurements, Geiger-Nuttal law, Nuclear potential barrier, Gamow's theory of alpha-decay (qualitative). Beta Decay, Pauli's neutrino hypothesis, neutrino and antineutrino, Gamma decay (qualitative), internal conversion, G.M. counter, inverse square law and absorption coefficient, Numerical Problems.

Books Recommended:

1. Concepts of modern physics, Arthur Beiser, 6thedition, TMH, New Delhi, 2008.
2. Modern Physics, R. Murugeshan, S. Chand & Co. XIth Revised edition, 2001.
3. Introduction to Quantum Mechanics, Ghatak, A, Macmillan India Ltd, 2000
4. Quantum Mechanics, Schiff, L. I., III Edition, McGraw Hill, 1968
5. Engineering Physics, S. P. Basavaraju, Subhas Publications, 2016
6. Nuclear Physics, 1st edition, S. N. Ghoshal, S. Chand and Co, 1994 (Reprint 2018).
7. Nuclear Physics, 2ndedition, Irving Kaplan, Narosa Publishing House, 1987 (Reprint 2002).
8. Introductory Nuclear Physics, K. S. Kranes, Wiley India, 2008.
9. Nuclear Physics, 5th edition, D. C. Tayal, Himalaya Publishing House, 2008.
10. Halliday D, Resnick R, and Walker J, Principles of Physics, 10th Edn., Wiley India Pvt. Ltd. (2013).

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0501	**CO1**	3	3	2	3	2				2	1
	CO2	3	3	2	3	2				3	3
	CO3	3	3	1	3	2				3	2
	CO4	3	3	2	3	2				3	3

Course Code	Chemistry –V	Type	L	T	P	C	Hrs/Week
B21CH0501		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. To impart basic knowledge about different Chromatographic techniques.
2. To explore polymers and understand the process of synthsis and using for different purposes.
3. To understand the mechanism of rearrangement and named reaction and their importanw.
4. To introduce the basic aspects of spectroscopies such as Molecular spectroscopy (rotational spectroscopy, vibrational spectroscopy, and Raman spectroscopy) and photochemistry.

Course Outcomes:

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

1. Understand the basic principles and different types of chromatographic techniques and evaluate R_f value.
2. Enhance the understanding of polymerization and their applications.
3. To synthesis and different rearrangement and named reactions
4. Illustrate the basic principles involved in different molecular spectroscopic techniques and give selection rules and brief the laws of photochemistry.

Course Contents:

UNIT-I **12 hrs**

Chromatography:

Introduction, classification of chromatographic techniques.

Paper Chromatography: introduction, Principles, R_f values, experimental procedures, choice of paper and solvent systems, developments of chromatogram - ascending, descending and radial., applications.

Thin layer Chromatography (TLC): Advantages. Principles, factors effecting Rf values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of the chromatogram. Detection of the spots, two-dimensional chromatography, Applications.

Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation technique.

Ion Exchange chromatography-separation of anions and cations,

HPLC: Basic principles, Instrumentation and applications.

UNIT-II **12 hrs**

Polymerisation: Classification, types, addition and condensation polymerisation Molecular weight of Polymers: Expression for Weight average and Number average (experimental determination is not required), Polydispersity.

Organic and Inorganic Polymers: Inorganic Polymers: structure and applications of silicones, phosphazenes, S-N compounds, S-P compounds, Differences between inorganic and organic polymers.

Organic Polymers: Preparation and applications of the following types of polymers

1. Plastics:
   i)thermosetting plastics (Phenol-formaldehyde)
   ii) thermo softening plastics (PVC).
2. Fibers: Acrylic, polyamide, polyester types: one example for each.
3. Rubber: Neoprene,
4. Fluoro Carbons: Teflon,
5. Polyaniline, Polythiophene and Orlan.

UNIT-III **12 hrs**

Organic Reaction Mechanism and Synthetic Applications:

Rearrangement reactions: Classification – inter molecular and intra molecular rearrangements-Mechanisms, evidences, migratory aptitude, inter or intra molecular of the following rearrangements: Hofmann, Curtius, Lossen, Beckmann rearrangements, Wolff rearrangement, Pinacol-pinacolone, Favorskii, Benzil-benzilic acid rearrangement, dienone-phenol rearrangement, Cope and Claisen (sigmatropic) rearrangement.

Named Reactions: Simmons-Smith reaction, Reimer-Tiemann reaction, Mannich reaction, Darzens reaction, Chichibabin reaction and McMurry reaction; Baeyer-Villeger reaction. Suzuki and Stille coupling reactions. Oxidation and reduction reactions in organic chemistry.

Reagents: $NaBH_4$, $LiAlH_4$, DDQ, DCC, SeO_2, MnO_2, Organocopper reagents in organic synthesis. Functional group inter-conversions and structural problems using chemical reactions.

UNIT-IV **12 hrs**

Molecular spectroscopy: The basis of absorption and emission of radiation by molecular species, the wave properties of the light, the quantum theory of light, quantum theory of matter, molecular energies and the types of molecular motion.

Rotational spectroscopy – Classical description of molecular rotation, quantum mechanics of molecular motion, rotational spectra, rotational energy levels (from Schrodinger equation), selection rules. determination of the bond length from rotational constants,

Vibrational spectroscopy – Quantum description of molecular vibrations, vibrational selection rules, harmonic and a harmonic vibration, vibration of polyatomic molecules.

Raman Spectroscopy – description of Raman scattering, Rayleigh scattering, Stokes and anti-Stokes's scattering, polarizability of the molecules, rotational Raman spectra, Comparision of Raman and IR.

Reference Books:

1. P. W. Atkins – Physical Chemistry, eighth Edition, New York, 2006,
2. P.W. Atkins, and J.D. Paula, Physical Chemistry for the Life Sciences, New York, 2011
3. P.J. Larkin, IR and Raman Spectroscopy, Principles and Spectral Interpretation, Elsevier, 2011.
4. S.M. Khopkar, Basic concepts of Analytical Chemistry. New Age International
5. Madan, Malik and Tuli, Selected Topics in Inorganic Chemistry, S. Chand & Company.
6. B.K. Sharma, Instrumental methods of Chemical analysis, Goel Publishing House.
7. Willard, Meritind and Dean, Analytical Chemistry, New Age Publications.
8. H.H. Willard, L.L. Merrite, K.A. Dean and F.A. Kettle, Instrumental methods of Chemical analysis CBS Publishers.
9. C.N. Banwell, Fundamentals of Molecular Spectroscopy.
10. W.A. Gullory, Introduction to Molecular Structure and Spectroscopy.
11. R Chang, Basic Principles of Spectroscopy.
12. M. Kundan and S.K. Jain, Physical Chemistry, S. Chand & Company.
13. K.K. Sharma and C.K. Sharma, Text book of Physical Chemistry, Vani Educational Books.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0501	**CO1**	2	1	1	1			1	2	1	2
	CO2	3	2	2	1			1	2	2	2
	CO3	2	1	1							2
	CO4	2	1	1	1			1	1	2	2

Course Code	Astronomy and Astro Physics	Type	L	T	P	C	Hrs/Week
B21PHS511		SC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. To provide basic knowledge to understand the stellar Physics.
2. To understand the formation of Milky Way.
3. To understand the solar system.
4. To understand the cosmology and big bang theory.

Course Outcomes:

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

1. Describe the aspects of stellar Physics.
2. Explain the formation of galaxy and origin of solar system.
3. Compare different solar systems.
4. Explain the aspects of cosmology.

Course Contents:

Unit-I: 12 hrs

Astronomical scales: Astronomical distance, mass, and time; scales; brightness, radiant flux and luminosity, measurement of astronomical quantities astronomical distances, stellar radii, masses of stars, stellar temperature. Basic concepts of positional astronomy - celestial sphere, geometry of a sphere, spherical triangle, astronomical coordinate systems, geographical coordinate systems, Univ. of horizon system, equatorial system, diurnal motion of the stars, conversion of coordinates. Measurement of time - sidereal time, apparent solar time, mean solar time, equation of time, calendar the Julian date and its importance in astronomical observation.

Unit-II: 12 hrs

Basic parameters of stars- determination of distance by parallax method; brightness, radiant flux and luminosity, apparent and absolute magnitude scale, distance modulus. Numerical problems.

Stars: Surface or effective temperature, and color of a star. Intrinsic temperature of a star. Expression for average temperature, core temperature and core pressure of a star based on the linear density model of a star. Numerical problems.

Unit-III: 12 hrs

Stellar characteristics: Spectral classification, Edward Charles Pickering classification (i.e., OBAFGKM), Harvard sequence, and Yerke's luminosity classification. Size (radius) of a star. Expression for radius using Stefan's-Boltzmann law. Spectral signature of elements presents in the stellar atmosphere. Mass luminosity relationship and expression for lifetime of a star. Color index HD classification and HR diagram. Main sequence stars and their general characteristics.

Unit-IV: 12 hrs

The stellar evolution. The evolutionary track of stars - Protostars, premain sequence stars, main sequence stars. Evolution of a star to white dwarf stage through red giant stage. Supernova explosion. Formation of a pulsar or neutron star and black hole (qualitative).

Cosmology: Basic assumptions and limitations of cosmology; Expansion of the Universe and its evidence; Hubble's Law: Big bang theory and thermal history of the universe. Size and age of the universe.

References

1. Carroll B W, and Ostlie D A, Modern Astrophysics, 2nd Edn., Addison-Wesley (2007).
2. Zeilik M, and Gregory S A, Introductory Astronomy and Astrophysics, 4th Edn., Saunders College Publishing (2009).
3. Shu F, The Physical Universe: An Introduction to Astronomy, 1st Edn., University Science Books (1982).
4. Karttunen H, Kroger P, Oja H, Poutanen M, and Donner K J, Fundamental Astronomy, 4th Edn., Springer (1987) Univ.
5. Krishnasamy K S, Astrophysics: A Modern Perspective, Reprint, New Age International (2006).
6. Basu B, An Introduction to Astrophysics, Second Printing, Prentice Hall of India (2001).
7. Bhatia V B, Textbook of Astronomy and Astrophysics with Elements of Cosmology, Alpha Science International (2001).

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PHS511	**CO1**	3	3	2	1	1				3	3
	CO2	3	3	2	1	1				3	3
	CO3	2	2	2	1	1				3	3
	CO4	3	2	2		1				3	3

Course Code	Nano Materials	Type	L	T	P	C	Hrs/Week
B21PHS512		SC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. To understand the fundamental concepts behind nanoscience and nanotechnology.
2. To familiarize with various processing techniques available for synthesis of nanostructure materials.
3. To acquire the knowledge of various nanomaterial characterization methods.
4. To get familiarized with the various analytical techniques.
5. To understand the properties of nanomaterials.

Course Outcomes:

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

1. Analyse the fundamental principles of nanotechnology and apply to different applications
2. Apply physics concepts to the nanoscale and non-continuum domain.
3. Demonstrate state-of-the-art nano-fabrication methods to prepare nano particles
4. Evaluate processing conditions to functional nanomaterials for current constraints, such as regulatory, ethical, political, social, and economical encountered when solving problems in living systems.

Course Contents:

UNIT I: **12 hrs**

Nanoscale systems: Length scales in physics. Nanostructures – 0D, 1D, 2D, and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size effects in nano systems, Quantum confinement: Applications of Schrodinger equation - Quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences.

UNIT–II: **12 hrs**

Synthesis of nanostructure materials: Top down and Bottom-up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electro deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth of quantum dots.

UNITS–III: **12 hrs**

Characterization: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy.

UNIT–IV: **12 hrs**

Nano materials and properties: Carbon nano tubes properties, Metal oxide properties (titanium oxide, zinc oxide), Metal nano particles (Gold and silver nano particles), Size dependent properties - Mechanical, physical, and chemical properties.

References

1. Poole Jr P C, Owens F J, Introduction to Nanotechnology, Wiley India, 2003.
2. Kulkarni S K, Nanotechnology: Principles and Practices, Capital Publishing Company, 2015.
3. Chattopadhyay K K, and Banerjee A N, Introduction to Nanoscience and Technology, PHI Learning, 2009.
4. Booker R, and Boysen E, Nanotechnology, John Wiley, and Sons, 2005.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PHS512	**CO1**	1	1	2	2	2				2	2
	CO2	2	1	2	2	2				2	2
	CO3	3	1	2	2	2				2	2
	CO4	3	1	2	3	3				2	2

Course Code	Optoelectronics	Type	L	T	P	C	Hrs/Week
B21PHS513		SC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. To provide knowledge about optical fibres and applications.
2. To explain the basic components integrated optics, ex: optoelectronic devices.
3. To demonstrate different tools and fundamental concepts in signal processing.
4. To understand the modelling of photonics crystals.

Course Outcomes:

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

1. To apply optics and physics of materials knowledge in demonstrating optoelectronic devices
2. To understand and demonstrate usage of different tools integrated optoelectronic devices
3. To demonstrate signal processing
4. To Explain the modelling and properties of photonic crystals.

Course Contents:

UNIT -I: **12 hrs**

Optical process in a semiconductor: Electron-hole pair formation and recombination, absorption in semiconductor direct and indirect band gap semiconductors, effect of electric field on absorption, Franz-Keldysh effect in semiconductors.

UNIT -II: **12 hrs**

Optoelectronic devices: Light Emitting Diodes - Materials for light emitting diodes, Principle of action of LED, expression for light power in terms of photon energy, homo structured LED, and Heterojunction LED. Types of LED structures- planar, dome type, surface emitter, edge emitter, super luminescent structure, Performance characteristics of LED - Optical output power-current characteristics, forward current voltage characteristics, Modulation bandwidth, power bandwidth product, Lifetime, Rise time/fall time, reliability, Internal quantum efficiency, advantages / disadvantages of using LED. Numerical problems.

UNIT -III: **12 hrs**

Organic optoelectronic devices: Organic light emitting diodes (OLED), The principle of OLED, characterization, structure, efficiency, multilayer OLED.

Photo detectors: Important parameters of photodetectors, Detector responsivity, spectral response range, response time, quantum efficiency, capacitance, noise characteristics, Absorption of radiation - absorption coefficient, mention of expression for photocurrent, long wavelength cut off, direct and indirect absorption.

UNIT -IV: **12 hrs**

Types of photodiodes - Junction photodiodes, pin diode, avalanche photodiodes, CCD photodetectors; Comparison of different detectors, Photomultiplier tubes, Phototransistors – characteristics, Photo conductive detectors- expression for photoconductive gain, Numerical problems.

Photovoltaic devices: Solar cell - IV characteristics, efficiency, material, Organic photovoltaic diodes (OPVD)|fundamental process, exciton absorption, exciton dissociation, charge transport, charge collection, characterization. Numerical problems.

Books for Reference:

1. Keiser G, Optical Fibre Communications, 3rd Edn., McGraw Hill, 2000.
2. Agarwal D C, Fibre Optic Communication, 2nd Edn., Wheeler Publications, 1996.
3. Katiyar S, Optical Communication, 1st Edn., S K Kataria and Sons, 2010.
4. Kasap S O, Optoelectronics and Photonics: Principles and Practices, 2nd Edn., Pearson, 2013.
5. Wilson J and Hawkes J F B, Optoelectronics: An Introduction, 3rd Edn., Prentice Hall, 1998.
6. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, 2nd Edn., Prentice Hall, 1997.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PHS513	**CO1**	1	2	2	2	2				2	2
	CO2	2	2	2	2	2				2	2
	CO3	1	2	2	2	2				2	2

	CO4	1	2	3	3	3				2	2

Course Code	MOOC/SWAYAM	Type	L	T	P	C	Hrs/Week
B21SGON01		SC	2	0	0	2	2

MOOC/ SWAYAM:

Globally, MOOC (Massive Open Online Course) platforms are gaining much popularity. Considering the popularity and relevance of MOOCs, Government of India has also launched an indigenous platform, SWAYAM. SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) is basically an integrated MOOCs platform for distance education that is aimed at offering all the courses from school level (Class IX) to post-graduation level. The platform has been developed collaboratively by MHRD (Ministry of Human Resource Development) and AICTE (All India Council for Technical Education) with the help of Microsoft and is capable of hosting 2,000 courses. There are many other international agencies, foreign universities offering OOC courses.

A student shall register and successfully complete any of the courses available on SWAYAM. Student shall inform the MOOC/SWAYAM coordinator of the school about the course to which he/she has enrolled. The minimum duration of the course shall be not less than 40 hours and of 4 credits. The student should submit the certificate issued by the SWAYAM to the MOOC/SWAYAM coordinator of the school, the grades obtained in the course shall be forwarded to concerned authority of the University.

Course Code	Skill Development Program	Type	L	T	P	C	Hrs/Week
B21SGM501		SC	0	0	0	0	2

Note: Skill development training courses will be organised by the **Department of Chemistry**. The students have to undergo skill development training conducted by the **Department of Chemistry**.

Course Code	Mathematics Practicals-V	Type	L	T	P	C	Hrs/Week
B21MT0502		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. To provide students with an introduction to the field of numerical analysis.
2. Aside from developing competency in the topics and emphases listed, the course aims to develop and apply problem solving skills through the introduction of numerical methods.

Course Outcomes:

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

1. Demonstrate the use of *Python* to understand to find whether vectors are dependent or independent.
2. Exhibit proficiency in using *Python* to basis and dimension of vector space.
3. Acquire proficiency in using *Python* to study Numerical differentiation.
4. Acquire proficiency in using *Python* to study Numerical integration.

Course Contents:

List of Programs:

1. i) Vector space, subspace – illustrative examples. ii) Expressing a vector as a linear combination of given set of vectors.
2. Examples on linear dependence and independence of vectors.
3. Basis and Dimension – illustrative examples.
4. Verifying whether a given transformation is linear.
5. Finding matrix of a linear transformation.
6. Problems on rank and nullity.
7. Programs on Interpolations with equal intervals.
8. Programs on Interpolations with unequal intervals.
9. Programs to find derivatives with equal intervals.
10. Programs to evaluate integrals using Simpson's $1/3^{rd}$ and $3/8^{th}$ rule.

Reference Books:

1. Farukh Khalilov and Tayyip oral, Math coding Python, 5th Edition, USA-2020.
2. Joakim Sundnes, Introduction to Scientific programming with Python, 2nd Edition, Springer 2010.
3. Allen Downey and Jeffrey Elkner, Learning with Python, 5th Edition, Springer, 2015.
4. Eric Matthes, A Hands-On, Project-Based Introduction to Programming- Python Crash Course, 2nd Edition:
5. Al Sweigart, Automate The Boring Stuff With Python: Practical Programming For Total Beginners, 2nd Edition.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0502	**CO1**	3	3	2	2					2	3
	CO2	3	2	2	3					3	2
	CO3	3	2	3	2					3	2
	CO4	3	3	3	2					3	3

Course Code	Physics Practicals-V	Type	L	T	P	C	Hrs/Week
B21PH0502		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. To make the students gain practical knowledge to co-relate with theoretical laws of quantum mechanics and nuclear physics.
2. To achieve perfectness in experimental skills and analyzing the experimental data that will bring more confidence and understanding of the concepts.
3. Design of circuits using new technology and latest components to study practical applications of advanced materials.
4. Study and analyze the applications of the Geiger-Muller (G. M.) counter.

Course Outcomes:

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

1. Determine the few physical constants through experiments.
2. Estimate the e/m value of an electron.

3. Demonstrate various experiments related to nuclear radiation counting and measuring half-life period of radioactive sources.
4. Verify various physics principle/theorems through experiments.

Course Contents:

List of Experiments:

1. Determination of Planck's constant using light emitting diodes (LEDs).
2. Determination of particle size using LASER diffraction halos method.
3. Determination of Rydberg constant of Hydrogen spectra using gas discharge tube.
4. Measuring the ionization potential of mercury gas.
5. Determination of e/m of an electron using a bar magnet (Thomson effect).
6. Verification of inverse square law for gamma-rays.
7. Measurement of half-life period of a radioactive source (K 40).
8. Measuring the absorption coefficient of gamma-rays.
9. Study the characteristics of GM-tube.
10. Determination of Planck's constant using color filters.

Textbooks:

1. Thiruvadigal, J. D., Ponnusamy, S. Sudha. D. and Krishnamohan M., "Physics for Technologists", Vibrant Publication, Chennai, 2013.
2. R. K. Shukla and Anchal Srivastava, "Practical Physics", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G. L. Souires, "Practical Physics:", 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. Advanced Practical Physics for Students – Workshop & Flint, Methuen & Co, London, 1923.
4. Practical Physics – S. L. Gupta & V. Kumar, Pragati Prakashan, 2002.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0502	**CO1**	3	3	3	2					2	3
	CO2	3	3	3	2					3	3
	CO3	2	2	1	3					3	2
	CO4	3	2	3	1					2	2

Course Code	Chemistry Practicals-V	Type	L	T	P	C	Hrs/Week
B21CH0502		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. Intended to impart analytical skills with an emphasis on application oriented quantitative analysis such as gravimetric and chromatographic separation.
2. Define and understand the concept of gravimetric analysis.
3. Able to use different instrument to validate the theoretical concepts with experimental results.

4. Expertise in using the conductometry, colorometry, Abbe's reflectometry and perform the experiments to measure the physical and chemical properties.

Course Outcomes:

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

1. Interpret different gravimetric analysis methods.
2. Acquire training in the quantitative analysis of metal ions and anions using gravimetric method.
3. Develop skills in handling the conductometry, colorometry, Abbe's reflectometry instruments.
4. Compute the result of analysis and to document its reliability.

Course Contents:

List of Experiments:

1. Gravimetric estimation of barium as barium sulphate.
2. Gravimetric estimation of copper as copper (I) thiocyanate.
3. Gravimetric estimation of nickel as nickel dimethylglyoximate.
4. Gravimetric estimation of zinc as zinc oxide.
5. Paper chromatographic separation of Fe^{3+} and Ni^{2+} ions.
6. Determination of solubility of sparingly soluble salt (like $BaSO_4$) by conductometric method.
7. Determination of Ka (dissociation constant of a weak acid) by conductometric method.
8. Determination of rate constant of saponification of ethyl acetate by conductivity measurements.
9. Determination of percentage composition of a given mixture containing two miscible liquids by Abbe's refractometer (Demo).
10. Colorimetric study of kinetics of oxidation of indigocarmine by chloramine-T.
11. Preparation of standard potassium dichromate solution and estimation of iron in the given sample of hematite by dichromate method.
12. Estimation of copper in bronze by iodometric method.

Reference Books

1. A.I. Vogel, A Textbook Quantitative analysis, ELBS.
2. B.K. Sharma, Instrumental methods of Chemical analysis, Goel Publishing House.
3. Gurudeep Raj, Advanced Practical Inorganic Chemistry, Goel Publishing House.
4. M.A. Malati, Experimental Inorganic/Physical Chemistry, Horward Series in Chemical science.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0502	**CO1**	1	2	2	1			2		3	1
	CO2	1	2	1	3			3		3	1
	CO3	1	2	2	2			2		3	1
	CO4	1	1	2	1			2	2	3	1

SIXTH – SEMESTER

Course Code	Mathematics-VI	Type	L	T	P	C	Hrs/Week
B21MT0601		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. Gain familiarity in fundamental theories on Fourier Series and Laplace Transforms.
2. Acquire problem solving skills on Fourier Series and Laplace Transforms.

Course Outcomes:

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

1. Evaluate improper integrals using beta and gamma functions.

2. Understand Laplace transforms of different types of functions.
3. Apply Laplace transform method to linear differential equations.
4. Express given function in terms of sines ad cosines.

Course Contents:

UNIT-I: **12 hrs**

Integral Calculus: Improper Integrals (definition only) – Gamma and Beta functions and results following the definitions – relation between Beta and gamma functions – Applications to evaluation of integrals – Duplication formula.

UNIT-II: **12 hrs**

Laplace Transforms: Definition and basic properties – Laplace transforms of e^{kt}, $\cos kt$ $\sin kt$, t^n, $\cosh kt$ and $\sinh kt$. Laplace transform of $e^{at}f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$, Laplace transform of derivatives, Laplace transforms of integrals (without proof) and problems. Laplace transform of periodic functions, unit-step function and Unit impulse functions and problems.

UNIT-III: **12 hrs**

Inverse Laplace transforms: Inverse Laplace transforms – problems. Convolution theorem (with proofs) problems (both evaluation and verification). Applications of Laplace transforms to solve simultaneous differential equations and linear order differential equations with constant coefficients.

UNIT-IV: **12 hrs**

Fourier series: Introduction – Periodic functions – Fourier series and Euler formulae (statement only) – Even and odd functions – Half range series – Change of interval. Complex form of Fourier series.

Text Books:

1. G K Ranganath, Text book of B.Sc., Mathematics, Revised ed. New Delhi, India: S Chand and Co., 2011.
2. Raisinghania M D., Laplace and Fourier Transforms. New Delhi, India: S. Chand and Co. Ltd., 1995.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 8th ed. New Delhi, India: Wiley India Pvt. Ltd., 2010.
2. Murray R, Spiegel L: Laplace Transforms (Schaum Series).
3. Raisinghania M.D., Laplace and Fourier Transforms. New Delhi, India: S. Chand and Co. Ltd., 1995.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0601	**CO1**	3	3	3	3			1	2	3	3
	CO2	3	3	3	3			1	2	3	3
	CO3	3	2	2	2			2	2	3	3
	CO4	3	2	2	2			2	2	3	3

Course Code	Solid State Physics	Type	L	T	P	C	Hrs/Week
B21PH0601		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. To know the basic concepts of electricity and superconductivity as well as their potential applications.
2. To explain the underlying physics, explore the internal behaviour, working principles, and properties of solid-state materials and devices.
3. Introduce students to the fundamental principles and concepts governing statistical physics, dielectrics, and liquid crystals.
4. Provide students with opportunities to develop basic knowledge and understanding of X-ray diffraction.

Course Outcomes:

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

1. Apply the basic knowledge of electricity and superconductivity to solve physics related problems.
2. Explain the working of semiconductor and optoelectronic devices like Zener diode, Solar cells, Photodiode, and LED.
3. Explain the fundamental principles and concepts governing statistical physics, dielectrics, and liquid crystals.
4. Apply basic knowledge of X-ray diffraction to study and analyze the materials.

Course Contents:

UNIT-I: Electricity and Superconductivity 12 hrs

Electrical properties of metals: Band theory of solids - review, Free electron theory of metals - classical theory and quantum theory. Expression for electrical conductivity - Ohm's law, Wiedemann-Franz law. Density of states, Expression for Fermi energy. Hall effect and magnetoresistance in metals. Expression for Hall coefficient in metals. Numerical problems.

Superconductivity: Experimental observation of superconductivity, critical temperature (Tc), Meissner effect, Influence of external agents on superconductivity; Critical magnetic field (Hc), Critical current (Ic) and Critical current density (Jc), BCS theory (qualitative), Types of superconductors; type-I and type-II superconductors, Applications of superconductivity. Introduction to high temperature superconductors, Numerical problems.

UNIT-II: Semiconductors and Devices 12 hrs

Semiconductors: Concept of bands in solids. Intrinsic and extrinsic semiconductors. Depletion region, drift velocity, expression for electron and hole concentration in intrinsic semiconductor under thermal equilibrium. Derivation of the expression for electrical conductivity of intrinsic semiconductors; electron and hole mobilities; Expression for the energy gap; Hall effect in semiconductors. Numerical problems.

Semiconductor devices: Diode current equation, I-V characteristics, Expression for ripple factor and efficiency. Filters - Zener breakdown and avalanche breakdown. Phenomenon of photoconductivity, photovoltaic cells, LED, Hartley oscillator, Numerical problems.

UNIT-III: Statistical Physics, Dielectrics and Liquid crystals 12 hrs

Statistical physics: Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac energy distribution formulae (derivation). A qualitative comparison of the three distribution formulae.

Dielectrics: Dielectric materials (Ferro, Piezo and pyro); their properties. Method of determining dielectric constant for solids.

Liquid crystals: Symmetry, structure, and classification of liquid crystals; polymorphism in thermotropic.

UNIT-IV: X-ray diffraction **12 hrs**

Bragg's law and the Bragg's spectrometer. A brief mention of the different types of crystals. Miller indices, structure of NaCl and KCl crystals. Continuous X-ray spectrum and its origin, Duane, and Hunt limit. Characteristic X-ray spectra and its origin. Mosley law and its significance. Compton effect, Experimental set-up and explanation of Compton effect, Expression for Compton shift, Compton wavelength, Verification of change in wavelength. Reason for non-observance of Compton effect in visible light. Numerical problems.

Books for Reference:

1. Sedha R S, A Textbook of Applied Electronics, 2nd Edn., S Chand Limited (2007).
2. Theraja B L, and Sedha R S, Principles of Electronic Devices and Circuits, 2nd Edn., S. Chand Limited (2008).
3. Mehta V K, Principles of Electronics, 2nd Edn., S Chand and Company (2005).
4. Leach D P, Malvino A P, and Saha G, Digital Principles and Applications, 8thEdn., McGraw Hill (1993).
5. Beiser A, Mahajan S, Rai Choudhary S, Concepts of Modern Physics, 6th Edn., McGraw Hill (2009).
6. Eisberg R M, Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles,2nd Edn., Wiley India (2006).
7. Blackmore J B, Solid State Physics, 2nd Edn., Cambridge University Press (1998).
8. Dekker A J, Solid State Physics, Macmillan (1971).
9. Kittel C, Introduction to Solid State Physics, 7th Edn., Wiley (2008).

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0601	**CO1**	3	3	2	3	2				2	1
	CO2	3	3	2	3	2				3	3
	CO3	3	3	1	3	2				3	2
	CO4	3	3	2	3	2				3	3

Course Code	Chemistry-VI	Type	L	T	P	C	Hrs/Week
B21CH0601		HC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students:

1. To give students a firm grounding in Co-ordination chemistry.
2. To impart knowledge about radioactivity and nuclear chemistry.
3. To introduce the photochemistry, important photochemical process in our lives and understand the different photochemical reactions. Also introduce the solidstate chemistry and importance X-ray diffraction to understand the crystalline materials structure.
4. To impart knowledge about different spectroscopic techniques.

Course Outcomes:

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

1. Understand the fundamentals of coordination chemistry, Isomerism and M-L bonding in transition metal complexes.

2. Acquire the knowledge about different nuclear energy resources, radioactivity and nuclear chemistry.
3. Appreciate the natural photochemical reactions, drive towars the usage of natural energy resource and to be analyse structure of crystalline solids with the help of XRD.
4. Analyse the different organic compounds using the UV-vis, IR aand NMR spectroscopy and to elucidate their structures.

Course Contents:

UNIT-I **12 hrs**

Coordination and Organometallic compounds:

Coordination compounds, ligands and their classification (mono, bi, tri, tetra, penta and hexa dentate ligands) and ambidentate ligands, coordination number, nomenclature of coordination compounds in detail. Theories of structure and bonding (Explanation for the formation of complexes by Werner's Theory in detail and its limitations). EAN rule, Valence bond theory postulates, low spin and high spin complexes with examples, limitations of VBT. Crystal field theory (octahedral, tetrahedral and square planar complexes). Crystal field splitting and crystal field stabilization energies, limitations of CFT. Magnetic properties of $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$. Spectral properties of $[Ti(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{3+}$, $[CoCl_4]^{2-}$.

Isomerism-Structural: ionization, linkage, hydrate and coordination isomerism with examples. Stereoisomerism-geometrical and optical isomerism (CN: 4 & 6) with examples.

Organometallic compounds– ligands, classification (hapticity). Synthesis and structure of $K[PtCl_3(\eta^2\text{-}C_2H_4)]$ and $[Fe(\eta^5\text{-}C_5H_5)_2]$.

UNIT-II **12 hrs**

Nuclear Chemistry: Introduction to Nuclear forces (brief explanation), nuclear stability-n/p ratio, Mass defect, Binding energy, Inner structure of nucleus- Liquid drop model, Nuclear fission-(definition with suitable examples), Calculation of energy release in nuclear fission, modes of release of fission energy (uncontrolled and controlled).

Plutonium as a fissionable material (Plutonium bomb), nuclear fusion and its advantages over nuclear fission reactions, hydrogen bomb, nuclear transmutation-artificial radioactivity. Detection and measurement of radioactivity – G. M. counter. Cyclotron, Nuclear reactor, Breeder reactor, Q values of nuclear reactions.

Uses of radio isotopes – tracer technique, agriculture, medicine, food preservation and carbon-14-dating (explanation). Separation of uranium isotopes – Laser irradiation method (atomic and molecular routes). Nuclear programme in India.

UNIT-III **12 hrs**

Laws of Photochemistry: Grotthus-Draper law, Stark-Einstein law, Differences between photophysical and photochemical processes with examples. Comparison of photochemical and thermal reactions. Quantum yield of photochemical combination of (1) H_2 - Cl_2 (2) H_2 - Br_2, (3) dissociation of HI (4) dimerisation of anthracene. Photochemistry: Primary and secondary processes in photochemical reactions. Photoelectric cells.

Basics of Crystallography: Classification of solids, CCP, HCP, Packing fraction, voids etc, Laws of crystallography – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements of crystals. Definition of unit cell & space lattice. Bravais lattices, crystal system. X-ray diffraction by crystals. Derivation of Bragg equation and its application in the determination of crystal structure of NaCl by rotating crystal method (Numericals).

UNIT-IV **12 hrs**

Spectroscopy of Organic compounds

UV-Visible spectroscopy: Introduction to spectroscopy, Absorptions laws, types of electronic transitions. Chromophores and auxochromes, blue shift and red shift. Conjugation and solvent effects. UV-visible spectra of some organic compounds (naphthalene, anthracene and beta-carotene).

IR spectroscopy: Introduction, principle, theory of molecular vibrations, number of fundamental vibrations, factors influencing vibrational frequencies. Stretching frequency of –OH (free and H-bonded), alkyl –C-H, -C=C-H, C=C, C-C, C=O and C-O groups (by taking suitable examples). IR spectra of some organic compounds.

NMR Spectroscopy: Basic principles, quantum approach- Magnetic nature of electron and nucleons, basic NMR equation. Equivalent and non-equivalent protons. Chemical shift. TMS as reference, Spectra of simple organic molecules ethanol, ethyl bromide, acetaldehyde, and toluene.

Qualitative Organic Analysis: Identification of functional groups by chemical tests; elementary UV, IR and ^{1}H NMR spectroscopic techniques as tools for structural elucidation.

Reference Books:

1. Puri, Sharma & Kalia Shobhanlal Nagin, Principles of Inorganic Chemistry, Chand Co.
2. Gurudeep Raj, A Textbook of Inorganic Chemistry.
3. J.D. Lee, Concise Inorganic Chemistry B-Block Well Science Ltd.
4. Sathya Prakash, A Textbook of Inorganic Chemistry
5. D.L. Pavia, G.M. Lampman, G.A. Kriz and J.R. Vyvyan, Introduction to Spectroscopy, Cingage Learning, 5th edition, 2015.
6. M.K. Jain, A Textbook of Organic Chemistry, S. Chand & Company.
7. Bhal & Bhal, A Textbook of Organic Chemistry, S. Chand & Company.
8. V.K. Ahluwalia & Renu Aggarwal, Organic Synthesis special techniques, Narosa publishing.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0601	**CO1**	2	2	2	1		1		1		1
	CO2	3	2	1	1				2	1	1
	CO3	2	1	2	2		1		2	2	1
	CO4	2	3	1	2		1	1	2	1	1

Course Code	Industrial Chemistry	Type	L	T	P	C	Hrs/Week
B21CHS611		SC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to:

1. Train students to demonstrate knowledge of energy sources and lubricates.
2. Emphasis knowledge on properties of glass, ceramics, cements, additives and refractories and applications
3. Expand fundamental understanding on surface coating, properties, and application
4. Aim to provide knowledge on fertilizers, cosmetics, perfumes, and pesticides.

Course Outcomes:

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

1. Demonstrate knowledge of energy sources, lubricates and determination.

2. Create knowledge on properties of glass, ceramics, cements, additives and refractories and applications
3. Explore surface coating, properties, and application
4. Acquire knowledge on fertilizers, cosmetics, perfumes, and pesticides.

Course Contents:

UNIT-I **12 hrs**

Fuel Chemistry: Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value, Bomb calorimetric estimation of calorific value.

Coal: Uses of coal (fuel and non-fuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas composition and uses.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

UNIT-II **12 hrs**

Glass: Properties, types, manufacture of soda glass. Composition and applications of borosilicate, metallic glass, optical glasses and polycarbonate glass, safety glass, fire and bullet proof glasses.

Ceramics: Raw materials and their roles, varieties of clay, production of ceramic ware, glazing, ceramic insulators.

Cement: Raw materials grades, manufacture of Portland cement.

Alloys: Classification of alloys, Ferrous and Non-Ferrous alloys, Specific properties of elements in alloys

Refractories: Classification, properties of refractories and its failures. Applications of refractories.

UNIT-III **12 hrs**

Surface Coatings: Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, modified oils, Pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, electrolytic and Metallic coatings (electroless), metal spraying and anodizing.

UNIT-1V **12 hrs**

Fertilizers: Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, Ammonium nitrate, Calcium ammonium nitrate, Ammonium phosphates; Polyphosphate, Super phosphate.

Cosmetics and Perfumes -A general study including preparation and uses of the following: Hair dye, hair spray, Shampoo, Sun-tan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams).

Pesticides: General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Reference Books:

1. O.P. Vermani and A.K. Narula, Industrial Chemistry, Galgotia Publications Pvt. Ltd., New Delhi, 2012.

2. E. Stocchi, Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK, 2002.
3. W.D. Kingery, H.K. Bowen, D.R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi, 2004.
4. J.A. Kent, Riegel s Handbook of Industrial Chemistry, CBS Publishers, New Delhi, 2006.
5. B.K. Sharma, Industrial Chemistry, Goel Publishing House, Meerut.2008.
6. Hakishan and V.K. Kapoor, Medicinal and Pharmaceutical Chemistry, VallabhPrakashan Pitampura, New Delhi, 2010.
7. R. Cremlyn, Pesticides, John Wiley, 2012.
8. B.K. Sharma, Industrial Chemistry, John Wiley, 2012.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CHS611	**CO1**	2	1	1						1	1
	CO2	2			1	1				1	1
	CO3	2			1	1				1	1
	CO4	2			1	1				1	1

Course Code	Chemistry of Bio Molecules	Type	L	T	P	C	Hrs/Week
B21CHS612		SC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to:

1. Understand the significance of biomolecules in various biological functions.
2. Develop the knowledge on various methods to synthesis amino acids form available starting materials.
3. Explain the stuctue and functions of various biomoleucles such as nucleic acids, enzymes and vitamins.
4. Discuss the role of aminoacids, proteins and peptides in living system.

Course Outcomes:

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

1. Classify the different type of biomolecules, explain their structure and functions.
2. Predict the role of biomolecules in various biochemical mechanisms.
3. Outline the significance of amino acids, enzymes, lipids, nucleic acids and carbohydrates.
4. Build the importance of essential and trace elements in the biological processes.

Course Contents:

UNIT-I: Introduction to Biomolecule. **12 hrs**

Carbohydrates:

Introduction and definition, Types of naturally occurring sugars. Deoxy sugars, amino sugars, branched chain sugars, methyl ethers and acid derivatives of sugars. Structure, degradation and biological functions of starch, cellulose and chitin.

Lipids:

Introduction, isolation and properties of lipids. Oils and fats: definitions and significances of hydrogenation, iodine value, saponification value and auto-oxidation of oils and fats. Phospholipids: lecithins, cephalins and phosphatidyl serine. Sphingolipids: sphingosine, sphingomyelin and cerebrocides.

UNIT-II: Drugs **12 hrs**

Chemotherapy and chemotherapeutic agents, definition of drugs, types of drugs, antipyretics, analgesics, anesthetics, sedatives, narcotics, antiseptics, antibacterials, antibiotics, antimalarials and sulpha drugs with examples. Synthesis of paracetamol, sulphanilamide, sulphaguanidine, Insectisides, Pesticides.

UNIT-III: Enzymes and Vitamins **12 hrs**

Enzymes

Characteristic features, classification (EC code number not required) active site, specificity, Fisher and Koshland models. Enzyme kinetics-factors affecting rate of enzymatic reactions, Michaels Menten equation (derivation not required). Competitive and non-competitive inhibition. Cofactors.

Vitamins

Definition, classification and deficiency manifestation of water soluble and fatsoluble vitamins. Coenzyme functions of B complex vitamins.

UNIT-IV: Amino acid, peptide and proteins **12 hrs**

Essential and non-essentialamino acids, amino acids buildingblocks of proteins, classification, structure and properties of amino acids, peptide bonds. Biologically important peptides, Protein-primary, secondary, tertiary andquaternary structures. Outline of variousbiological functions of proteins, Basictechniques in protein chemistry.

Reference Books:

1. J.D. Rawn, Biochemistry, Neil Pattuson publishers, North Carolina, USA, 1989.
2. I.L. Finar, Organic Chemistry, Vol I and Vol II, 6th edn. ELBS & Longman, London, 1975.
3. D. Chapman, Inroduction to Lipids, McGraw-Hill, 1969.
4. S.K. Ghosh, Advanced general Organic Chemistry, DK and Allied publishers (UBS), Calcutta, 1998.
5. E.S. West, W.R. Todd, H.S. Mason & J.T. Van Bugen, Text book o Biochemistry, 4th Edn. Amerind publishing co., New Delhi, 1974.
6. Ashuthosh Kar, Medicinal Chemistry, Tata Mcgraw Hill Publications.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CHS612	**CO1**	3	2	2	1		2		1	2	3
	CO2	3	2	2	2		1	1		2	3
	CO3	2	3	2	1				2	2	3
	CO4	2	3	2	2			1	1	3	3

Course Code	Electro-Analytical Chemistry	Type	L	T	P	C	Hrs/Week
B21CHS613		SC	3	0	0	3	4

Course Objectives:

This course aims to provide for the students to:

1. Explain the fundamental concept, principles and laws of electrochemistry,
2. Discuss related to the types of electrodes and study of electrode reactions pathway.
3. Classify the types of corrosion and its controls.
4. Describe the concept of electrochemical sensor, electrochemical energy storage and conversion devices.

Course Outcomes:

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

1. Analyze the basic concepts of electroanalytical techniques.
2. Classify the types of electrochemical reaction and its mechanism.
3. Apply the knowledge of corrosion science and its control essential for the commercially available materials.
4. Design the electrode with suitable materials for various application in the field of electrochemical sensors, electrochemical energy storage and conversion devices.

Course Contents:

UNIT-I **12 hrs**

Basic electro chemistry: Electrochemistry Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series.

Polarography: Definition, advantage of dropping mercury electrode, factors affecting on limiting current, Half wave potentials and significance, Ilkovic equations, Applications of Polarography

Amperometric Titrations: Basic principle involved in the Amperometry, Amperometric Titrations and applications, Advantages and disadvantages of Amperometric Titrations.

UNIT-II **12 hrs**

Electro analytical methods: Potentiometry, Conductometry, Colorimetry, cyclic voltammetry and pulse voltammetry.

Electrochemical sensors: Potentiometric Sensors and voltammetric sensors, Non-enzymatic Sensors for determination of-Amino Acids, Glucose, hydrogen peroxide and urea.

UNIT-III **12 hrs**

Electro Chemical Energy Storage and Conversion Devices:

Batteries: Definition, Types, primary batteries- dry cell, Secondary batteries- Lead acid, Ni-Cd, Lithium-Ion Batteries.

Super capacitors- Electrical double layer capacitor, pseudo capacitors and hybrid capacitors.

Fuels cells: Fuel cell working principle, classification of fuel cells-Hydrogen-Oxygen and Methanol-Oxygen, solid oxide fuel cell.

Photovoltaic Cells: Definition, synthesis of semiconductor grade silicon, doping of silicon, construction and working of PV cell.

UNIT-IV **12 hrs**

Corrosion: definition, Types of Corrosion: Dry Corrosion (Direct Chemical attack), Wet Corrosion. Electrochemical analysis- Equilibrium potential methods, Anodization potential methods. Tafel plots and Impedence –Charge transfer resistance. Corrosion Control.Pourbias diagram: Water-iron system, water-Aluminium

Electrplating: Theory of electroplating, factor affecting nature of eleectrodeposits. Electroplating of gold using acid, basic and netral cyanide baths. Electroless plating of copper

Reference Books:

1. Monk, Fundamentals of Electroanalytical Chemistry.
2. B.K. Sharma, Engineering Chemistry
3. Jayaprakash and Venugopal, Engineering Chemistry.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CHS613	**CO1**	1		1	1				1	3	1
	CO2	1	2	2	1					1	1
	CO3	1		2	1				3	2	1
	CO4	1		1	2				2	3	3

Course Code	Project	Type	L	T	P	C	Hrs/Week
B21SG0601		HC	0	0	4	4	8

Course Objectives:

To carry out the research under the guidance of R&D supervisor/Industry/R&D Institution and in the process learn the techniques of research.

Course Outcomes:

After successful completion of the course a student will be able to:

1. Familiarize with literature search.
2. Conduct the experiments related to research and formulate computational techniques.
3. Interpret the scientific data.
4. Write report and defend the research findings.

Course Contents:

Project:

This project will be based on preliminary research-oriented topics both in theory and experiment. The teachers who will act as supervisors for the projects will float projects and any one of them will be allocated to the student. The research projects floated should be completed in 7-8 weeks. After the completion of the project the student shall submit project report in the form of dissertation on a specified date by the school. The details of assessment of project are explained under the heading "Evaluation of Minor Project/Dissertation" in this handbook.

Course Code	Mathematics Practicals-VI	Type	L	T	P	C	Hrs/Week
B21MT0602		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students to:

1. Understand the concept of Laplace transform.
2. Familiarize with Inverse Laplace transforms.

Course Outcomes:

After successful completion of the course a student will be able to:

1. Problems on Laplace transform using *Python*.
2. Problems on inverse Laplace transforms using *Python*.
3. Acquire proficiency in using *Python* to evaluate improper integrals.
4. Acquire proficiency in using *Python* to study Fourier series

Course Contents:

1. Problems on gamma and beta functions.
2. Problems on duplication formula.
3. Problems on evaluation of improper integrals in applications.
4. Finding the Laplace transform.
5. Finding the inverse Laplace transform.
6. Problems on Convolution theorem
7. Laplace transform method of solving first order ordinary differential equations with constant coefficients.
8. Laplace transform method of solving second order ordinary differential equations with constant coefficients
9. To find full range trigonometric Fourier series of some simple functions with period 2π and 2L.
10. Finding the half-range sine and cosine series of simple functions and plotting them.

Text Books:

1. Farukh Khalilov and Tayyip oral, Math coding Python, 5th Edition, USA-2020.
2. Joakim Sundnes, Introduction to Scientific programming with Python, 2nd Edition, Springer 2010.
3. Allen Downey and Jeffrey Elkner, Learning with Python, 5th Edition, Springer, 2015.
4. Eric Matthes, A Hands-On, Project-Based Introduction to Programming- Python Crash Course, 2nd Edition:
5. Al Sweigart, Automate The Boring Stuff With Python: Practical Programming For Total Beginners, 2nd Edition.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21MT0602	**CO1**	3	3	2	2			1	2	2	3
	CO2	3	2	2	3			1	2	3	2
	CO3	3	2	3	2			2	2	3	2
	CO4	3	3	3	2			2	2	3	3

Course Code	Physics Practicals–VI	Type	L	T	P	C	Hrs/Week
B21PH0602		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. To make the students gain practical knowledge to co-relate with theoretical laws of solid-state physics.

2. To achieve perfectness in experimental skills and analyzing the experimental data that will bring more confidence and understanding of the concepts.
3. Design of circuits using new technology and the latest components to study practical applications of advanced solid-state materials and devices.
4. Study and determination of interplanar distances using X-ray photograph.

Course Outcomes:

After successful completion of the course a student will be able to:

1. Determine the electrical resistivity and energy gap of semiconducting materials.
2. Demonstrate various experiments related to solid-state electronics such as Solar cells, PN diodes, Photodiode and Hartley oscillator etc.
3. Estimate dielectric constant of a given material.
4. Determination of interplanar distances from X-ray photograph.

Prerequisites:

1. Measurement of resistivity of a semiconductor material using the Four probe method.
2. Determination of Energy gap of semiconductor by graphical method.
3. Determination of Fermi energy of metal (copper) by meter bridge method.
4. Study of I-V characteristics, fill factor & efficiency of a Solar cell.
5. Study of I-V Characteristics of Photodiode.
6. Determination of dielectric constant of a given solid.
7. Study the I-V characteristics and voltage regulator property of Zener diode.
8. Determination the value of Boltzmann constant using I-V characteristics of PN diode.
9. Study and analyze the wave form generated by Hartley Oscillator.
10. Determination of interplanar distances of NaCl using X-ray computerized photograph.

Text books:

1. Thiruvadigal, J. D., Ponnusamy, S.Sudha.D. and Krishnamohan M., "Physics for Technologists", Vibrant Publication, Chennai, 2013
2. R. K. Shukla and Anchal Srivastava, "Practical Physics", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G. L. Souires, "Practical Physics:", 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. Advanced Practical Physics for Students – Workshop & Flint, Methuen & Co, London, 1923.
4. Practical Physics – S. L. Gupta & V. Kumar, Pragati Prakashan, 2002.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21PH0602	**CO1**	3	3	3	2	2				2	3
	CO2	3	3	3	2	2				3	3
	CO3	2	2	1	3	2				3	3
	CO4	2	2	1	2	1				2	2

Course Code	Chemistry Practicals-VI	Type	L	T	P	C	Hrs/Week

B21CH0602		HC	0	0	1.5	1.5	3

Course Objectives:

This course aims to provide for the students:

1. To demonstrate the analysis of given ore, alloy, phenol and biomolecules by titrimetric methods.
2. Exposure to prepare various standard soltutions using molarity and normality calculations.
3. Allow independently for the separation of organic compounds with the knowledge of TLC using colum chromatographic technique.
4. Analyze the spectral data to obtain the structure of the organic compound.

Course Outcomes:

After successful completion of the course a student will be able to:

1. Apply the knowledge on preparation of standard solution, estimation and separation of organic comounds using column chromatographic technique.
2. Estimate the quantitative analysis of organic and in organic compounds by titrimetric method.
3. Acquire knowledge on various titrimetric and complexometric methods in estimation of ore and organic molecules.
4. Design basic research problems in the analysis of ore, alloy and organic molecules.

Course Contents:

1. Separation of p- and o- nitroaniline by TLC method and column chromatography. (Solvent extraction).
2. Estimation of glucose by Fehling solution method.
3. Estimation of ascorbic acid by iodometric method.
4. Determination of Iodine value of oils by chloromine-T.
5. Study of enzyme kinetics (by taking any one example)
6. Estimation of alpha amino acids by using Ninhydrin by colorimetric method.
7. Estimation of creatinine by Jaffe's method.
8. Separation of a-amino acids by paper chromatography.
9. Estimation of total reducing sugars by DNS (dinitrosalicylic acid) method.
10. Isolation of lactose and casein from milk and estimation of lactose by colorimetric method.
11. Estimation of inorganic phosphate by Fiske- Subbarow Method
12. Isolation of Castor oil from Castor seeds.
13. Preparation nanocellulose from sugar cane bagasse.

References for Practicals:

1. A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford and P.W.G. Smith, Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
2. F.G. Mann, and B.C. Saunders, Practical Organic Chemistry, Orient-Longman, 1960.
3. O.P. Pandey, D.N. Bajpai and S. Giri, Practical Chemistry, Revised Edition, S. Chand Company Pvt Limited, 2014.
4. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., Pearson, 2009.
5. G. Svehla, Vogel's Qualitative Inorganic Analysis, Pearson Education, 2002.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B21CH0602	**CO1**	3	3	3	3			2	2	3	2
	CO2	3	3	2	3			2	2	3	1
	CO3	3	3	2	3			2	2	3	2
	CO4	2	2	3	3			2	2	3	3

CAREER DEVELOPMENT AND PLACEMENT

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

1. Willingness to learn
2. Self motivation
3. Team work
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing skills
6. Analytical and Technical skills
7. Computer skills
8. Internet searching skills
9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of

Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improves their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Physics, Chemistry, and Mathematics is not only the knowledge in the subject, but also the skill to do the job proficiently, team spirit and a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The School of Applied sciences also has emphasised subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. The students during their day to day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students.

The University has also established University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification-based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has also signed MOU’s with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students’ exchange programs for higher learning and for conducting certification programs.