K.R. MANGALAM UNIVERSITY
THE COMPLETE WORLD OF EDUCATION

SCHOOL OF BASIC AND APPLIED SCIENCES

Bachelor of Science (Hons) Chemistry

B.Sc. (Hons.) Chemistry

Programme Code: 10

2020-23

Approved in the 23rd Meeting of Academic Council Held on 23 June 2020

Academic Council
Member Secretary
K.R. Mangalam University

Registrar
K.R. Mangalam University
Sohna Road, Gurugram, (Haryana)

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1. Introduction

The K.R. Mangalam Group has made a name for itself in the field of education. Over a period of time, the various educational entities of the group have converged into a fully functional corporate academy. Resources at KRM have been continuously upgraded to optimize opportunities for the students. Our students are groomed in a truly inter-disciplinary environment wherein they develop integrative skills through interaction with students from engineering, management, journalism and media study streams.

The K.R. Mangalam story goes back to the chain of schools that offered an alternative option of world-class education, pitching itself against the established elite schools, which had enjoyed a position of monopoly till then. Having blazed a new trail in school education, the focus of the group was aimed at higher education. With the mushrooming of institutions of Higher Education in the National Capital Region, the university considered it very important that students take informed decisions and pursue career objectives in an institution, where the concept of education has evolved as a natural process.

K.R. Mangalam University was founded in the year 2013 by Mangalam Edu Gate, a company incorporated under Section 25 of the Companies Act, 1956.

K. R. Mangalam University is unique because of its

i. Enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.
ii. Protective and nurturing environment for teaching, research, creativity, scholarship, social and economic justice.

Objectives

i. To impart undergraduate, post-graduate and Doctoral education in identified areas of higher education.
ii. To undertake research programmes with industrial interface.
iii. To integrate its growth with the global needs and expectations of the major stake holders through teaching, research, exchange & collaborative programmes with foreign, Indian Universities/Institutions and MNCs.
iv. To act as a nodal center for transfer of technology to the industry.
v. To provide job oriented professional education to the pecia student community with particular focus on Haryana.

2. About School

The school imparts out both teaching and research through its various science disciplines viz Mathematics, Chemistry and Physics.

School of Basic and Applied Sciences imparts students technical knowledge, enhances their skill and ability, motivating them to think creatively, helping them to act independently and take decisions accordingly in all their scientific pursuits and other endeavors. It strives to empower its students and faculty members to contribute to the development of society and Nation.

The faculty is in constant touch with various experts in the relevant field and is willing to experiment with latest ideas in teaching and research.

The school comprises of Discipline of Chemistry, Physics and Mathematics.

VISION

School of Basic and Applied Sciences intends for continuum growth as centre of advanced learning, research, and innovation by disseminating analytical and scientific knowledge in the areas of basic and applied sciences by promoting interdisciplinary research and scientific acumen.

MISSION

M1: Enable students to be scientists/ academicians /entrepreneurs by accomplishing fundamental and advanced research in diverse areas of basic and applied sciences.

M2: Build strong associations with academic organizations/industries for knowledge creation, advancement, and application of scientific fervor.

M3: Create conducive environment for lifelong learning.

M4: Empower students to be socially responsible and ethically strong individuals through value-based science education.

3. Programmes offered by the school

School offers undergraduate B.Sc. (Hons) Programmes and postgraduate M.Sc. Programmes. All these programmes are designed to impart scientific knowledge to the students and will provide theoretical as well as practical training in their respective fields.

3.1 B. Sc. (Hons.) Chemistry

This course aims to impart basic and applied knowledge in various branches in Chemistry with a view to produce good academics, researchers and professionals in the field.

Eligibility Criteria:- The student should have passed the 10+2 examination conducted by the Central Board of Secondary Education or equivalent examination from a recognized Board in Science stream with an aggregate of 50% or more.

Course Outline:- Inorganic chemistry / Organic chemistry / Physical chemistry / Analytical methods in chemical sciences / Environmental chemistry / Biochemistry / Green Chemistry.

Career Options:- Opportunities exist in chemical industry, pharmacy, education and forensics.

Programme scheme: - For Programme scheme see Annexure A.

3.2 B.Sc. (Hons.) Physics

Physics, as a stream of study, helps in understanding fundamentals and develop curiosity in understanding various physical aspects of universe. This course aims to impart basic and applied knowledge in physics with a view to produce good academicians, researchers and professionals in varied fields.

Eligibility Criteria: - The student should have passed the 10+2 examination conducted by the Central Board of Secondary Education or equivalent examination from a recognized Board in Science stream with an aggregate of 50% or more.

Course Outline: - Mathematical Physics / Mechanics / Electricity & Magnetism/Waves & Optics / Thermal Physics / Digital Systems & Applications/Elements of Modern Physics/Analog Systems & Applications/Quantum Mechanics & Applications / Electromagnetic Theory / Statistical Mechanics/ Solid State physics / Elementary Nuclear Physics/ Elementary Particle Physics/Applied Optics.

Career Options: - Opportunities exist in academics, research laboratories and administration besides all the opportunities applicable to any other graduate like UPSC examination's, defense services and other govt. jobs.

Programme scheme: - For Programme scheme see Annexure B.

3.3 B.Sc. (Hons.) Mathematics

Mathematics is a universal part of human culture. This course aims to impart basic and applied knowledge in Mathematics with a view to produce good Mathematicians and researchers. A degree in mathematics provides you with a broad range of skills in problem solving, logical reasoning and flexible thinking.

Eligibility Criteria: - The student should have passed the 10+2 examination conducted by the Central Board of Secondary Education or equivalent examination from a recognized Board with an aggregate of 50% or more with Mathematics as a main subject.

Course Outline: - Calculus / Vector Calculus / Business Mathematics / Differential Equations / Solid Geometry / Computer Programming / Modern Algebra / Numerical Analysis / Linear Algebra / Real Analysis / Complex Analysis / Probability and Statistics / Operational research / Mechanics.

Career Options: - Mathematicians work in business, finance, industry, government offices, management, education and science.

Programme scheme: - For Programme scheme see Annexure C.

4. Programme Duration

The minimum period required for the B.Sc. (Hons.) Programme offered by the University shall extend over a period of three Academic Years.

The maximum period for the completion of the B.Sc. (Hons) Programme offered by the University shall be five years.

The minimum period required for the M.Sc. Programme offered by the University shall extend over a period of two Academic Years.

The maximum period for the completion of the M.Sc. Programme offered by the University shall be four years.

5. Class Timings

The classes will be held from Monday to Friday from 09:10 am to 04:10 pm.

6. Syllabi

The syllabi of all programme offered by SBAS are given in the following pages. These are arranged as: (a) common courses (b) degree specific courses, in numeric order of the last three digits of the course code.

For each course, the first line contains; Course Code and Credits (C) of the course. This is followed by the course objectives, syllabus (Unit I to IV), Text book and reference books.

6.1 Syllabi of Common Courses in all B.Sc. (Hons.) Programme

BSEL145A COMMUNICATION SKILLS (Credits 4)

Learning Outcomes

- Understand the basics of Grammar to improve written and oral communication skills.
- Understand the correct form of English with proficiency
- Improve student's personality and enhance their self-confidence.
- Improve professional communication.
- Enhance academic writing skills.

Course Content

UNIT I

Introduction to Communication: Importance of Communication Skills, Meaning, Forms & Types of Communication; Process of Communication; Principles of Effective Communication/7Cs, Barriers in Communication (Interpersonal, Intrapersonal and Organizational).

UNIT II

Academic Writing: Précis (Summary – Abstract – Synopsis – Paraphrase – Précis: Methods), Letter & Résumé (Letter Structure & Elements – Types of letter: Application & Cover - Acknowledgement – Recommendation – Appreciation – Acceptance – Apology – Complaint –Inquiry). Writing a proposal and synopsis. Structure of a research paper. Citations and plagiarism.

UNIT III

Technology-Enabled Communication: Using technology in communication tasks, E-mails, tools for constructing messages, Computer tools for gathering and collecting information; Different virtual medium of communication.

UNIT IV

Building Vocabulary: Word Formation (by adding suffixes and prefixes); Common Errors; Words Often Confused; One word substitution, Homonyms and Homophones; Antonyms &Synonyms, Phrasal Verbs, Idioms & Proverbs (25 each); Commonly used foreign words(15 in number);

UNIT V

Personality Development: Etiquettes& Manners; Attitude, Self-esteem & Self-reliance; Public Speaking; Work habits (punctuality, prioritizing work, bringing solution to problems), Body Language: Posture, Gesture, Eye Contact, Facial Expressions; Presentation Skills/ Techniques.

TEXT BOOK:

Kumar, Sanjay and Pushplata.*Communication Skills*.Oxford University Press, 2015.

REFERENCE BOOKS / SITES:

1. Mitra, Barun K. *Personality Development and Soft Skills*. Oxford University Press, 2012.
2. Tickoo, M.L., A. E.Subramanian and P.R.Subramaniam.*Intermediate Grammar, Usage and Composition.* Orient Blackswan, 1976.
3. Bhaskar, W.W.S., AND Prabhu, NS., " English Through Reading", Publisher: MacMillan,1978
4. Business Correspondence and Report Writing" -Sharma, R.C. and Mohan K. Publisher: Tata McGraw Hill1994
5. Communications in Tourism & Hospitality- Lynn Van Der Wagen, Publisher: HospitalityPress
6. Business Communication-K.K.Sinha
7. Essentials of Business Communication By Marey Ellen Guffey, Publisher: ThompsonPress
8. How to win Friends and Influence People By Dale Carnegie, Publisher: Pocket Books
9. Basic Business Communication By Lesikar&Flatley, Publisher Tata McGraw Hills
10. Body Language By Allan Pease, Publisher SheldonPress

BP001OC DIET & NUTRITION (Credits 6)

COURSE OVERVIEW:

These courses are designed for the allied health science and life science students to serve the society through its understanding or meant for personal interest to improve your health through mindful eating and diet modification. Helping others to understand how nutrition diet and activity levels play well in their health, wellness and longevity. In short, you will learn how important a dieticians and nutritionist can be in helping people to lead long, healthy lives.

COURSE OUTCOMES:

- Students learn about the nutritional properties of food, nutrition across the life span, and diseases caused by inadequate nutrition.
- Students get all information about the good and bad Diet.
- Students learn to promote health and nutrition and to act professionally and ethically in the role of a dietitian.

After the completion of this course students will be able to work in the following role:

- Dietitian
- Nutritionist
- Weight loss consultants
- Workplace health adviser
- Community health adviser

SYLLABUS:

UNIT-I An introductions to nutrition: 5 hrs

(1) Basic concepts about Food nutrition, health and fade diet.

(2) Role of diet in the maintenance of good health.

UNIT-II How food processing affects nutrition – nutrients and nutritive processes and concepts of calorie: 10 hrs

(1) Nutrients in food and food supplying them

(2) **Carbohydrates in nutritions** — Elementary principles.

(3) **Protein and amino acid** — their functions and requirements elementary principles, quality of food protein, animal vs vegetable protein — elementary principles.

(4) **Fats and oil in nutrition** — elementary principles.

(5) **Essential vitamins and minerals** — Source, functions and requirements, elementary principles.

(6) **Water and fluid balance** — water, hydration, dehydration and alcohol

UNIT-III Nutrition in everyday meal: 5 hrs

(1) Daily food pattern.

(2) Basic food groups and study of different foods: cereal, pulses, legumes, roots and tubers, leafy and other vegetables, meal, fish, egg and milk and milk products, fats & oils, sugar and jaggery.

(3) Balance diet for different age groups and occupations.

UNIT-IV How Diet Affects Health 5 hrs

Why people neglect a healthy diet, dietary targets, obesity, cutting down on sugar, heart disease, cutting down on saturated fat and salt, Junk foods, Food Adulterant diabetes and food allergies and intolerances.

UNIT-V Weight management and slimming therapies 5 hrs

Weight management – dietary/therapeutic/behavioral and other approaches e.g. drugs, surgery etc, weight imbalance, Holistic approach to weight management.

SHPS135A YOUTH PSYCHOLOGY (Credits 6)

COURSE LEARNING OUTCOMES

- To help students understand the notion of youth, youth across cultures, youth identity,
- Significant concerns among the youth
- To inculcate sensitivity to issues related to youth with special emphasis on gender
- Stereotypes/discrimination and risky behavior
- To develop an understanding of ways of empowering the youth

Course content

UNIT I

Introduction: Defining Youth (Transition to Adulthood); Youth across Cultures; Formulation of Youth Identity (Erikson and Marcia's Work on Identity), Gender Identity, Gender Roles, Sexual Orientation

UNIT II

Youth Development: Influence of Globalization on Youth; Body Image concerns among youth; Peer Pressure and Bullying

UNIT III

Issues and Challenges for Today's Youth: Gender Stereotypes and Gender Discrimination Impacting Youth, Substance (Alcohol) Use among Youth, Juvenile Delinquency, Risky Sexual Behaviour

UNIT IV

Developing Youth: Women Empowerment in the Indian Context, Encouraging Non-Gender Stereotyped Attitudes; Building Resources (Optimism; Resilience)

Suggested Readings

1. Baron, R.A., Byrne, D. & Bhardwaj, G. (2010). Social Psychology (12th Ed).New Delhi: Pearson.
2. Berk, L. (2013). Child Development. New York: Pearson.
3. Brannon, L. (2017). Gender: Psychological Perspectives (7th edition). New Delhi Routledge.
4. Brown, B.B., & Larson, R.W. (2002). The Kaleidoscope Of Adolescence: Experiences of the World's Youth at the beginning of the 21stCentury. In Brown, B. B., R. Larson, & T. S. Saraswathi. (Eds)., The World's Youth: Adolescence in Eight Regions of The Globe (pp. 1-19).
5. Cambridge: Cambridge University Press. Carson, RC, Butcher, J. N, Mineka, S., & Hooley, J. (2007). Abnormal Psychology. Delhi:
6. Pearson Education. Cash, T.F., & Smolak, L. (2011) (Eds). Body Image: A Handbook of Science, Practice, and Prevention. Chapters 9 & 10 (pp. 76-92). New York: The Guilford Press.
7. Ghosh, B. (2011). Cultural changes and challenges in the era of globalization: The case of India. Journal of Developing Societies, 27(2), 153-175.
8. Snyder, C.R., Lopez, S.J. & Pedrotti, J. (2011). Positive Psychology: The Scientific and Practical Explorations of Human Strengths. New Delhi: Sage
9. Arnett, J.J. (2013). Adolescence and Emerging Adulthood (5th Ed). Delhi: Pearson.
10. Bansal, P. (2012). Youth in Contemporary India: Images of Identity and Social Change. New Delhi: Springer.
11. Baumgardner, SR & Crothers, MK (2009). Positive Psychology. Delhi: Pearson.

12. Carr, A. (2004). Positive Psychology: The Science of Happiness and Human Strength. New York: Brunner- Routledge.
13. Connidis, I. A. & Barnett, A.E. (2010). Family Ties and Aging. London: Sage.
14. Helgeson, V.S. (2018). Psychology of Gender (5th Edition). New Delhi: Routledge.
15. Shaffer, D.R. & Kipp, K. (2010). Developmental Psychology: Childhood and Adolescence. California: Wadsworth.
16. Tomé G., Matos M., Simões C., Diniz J.A., & Camacho I. (2012). How can peer group influence the behavior of adolescents: Explanatory model? Global Journal of Health Science, 4(2), 26-35. Online resource:

SEED523A EDUCATION FOR SUSTAINBALE DEVELOPMENT (Credits 6)

Course Overview

Sustainability denotes one of the main future challenges of societies and the global community. Issues of sustainability range from energy and natural resources to biodiversity loss and global climate change. Properly dealing with these issues will be crucial to future societal and economic development. This course provides the theoretical background for the discussion and analysis of sustainability issues. Students will recognize specific sustainability issues, such as sustainable energy, as part of a more complex challenge of developing sustainable societies and systems, and against the background of the general meaning and implications of the conception of sustainability.

The course focuses on four main aspects: (i) the meaning of sustainability and definitions of the concept in politics and sciences, (ii) the systemic dimension of sustainability, (iii) the global and political aspects of sustainability, and (iv) the ethical dimension of sustainability. The main emphasis is on an integrated understanding of sustainability issues. The course analyzes how sustainability issues are interrelated with each other, how they are part of an overall challenge of developing a sustainability future, and how they are related to natural, societal, economic, technological, and political systems on the local and global scale. The course discusses particularly crucial conditions of and systemic interrelations between those systems. For this, the course refers to existing research fields which have addressed some specific interrelations and conditions: to Ecological Economics, which analyzes the interrelations and mutual dynamics of economic, political, and natural systems, and to Industrial Ecology, which analyzes specific aspects of the interrelation between technological-economic systems and the environment – particularly energy and material flows between those systems. Another focus is on sustainable system design and relevant parameters of system optimization - with the particular example of energy systems. The course also discusses the ethical dimension of sustainability. Sustainability is an inherently normative concept. It is considered to be something one should strive for, something that is good.

The course discusses possible justifications of this norm, its ethical implications for individuals and societies, and its relation to other established norms such as individual freedom or

efficiency. Finally, the course analyzes the political and particularly global dimension of sustainability. It discusses political developments in different regions and trends in global markets. Students of this course will develop an encompassing understanding of the challenges of sustainability and sustainability issues. The course will enable students to not only know and react to current market situations and existing rules but also to recognize future trends and market opportunities on the national and international level. Many sustainability fields such as sustainable energy are highly dynamic and global ones.

The course provides students with the intellectual means to identify and judge the main drivers and complex systemic interrelations of specific sustainability fields. The course enables students to become successful leaders in their field.

Objectives

The students will be able to:

- Develop an encompassing understanding of sustainability issues
- Develop the ability for systemic and diagnostic thinking
- Examine the inter relation of sustainability issues with each other.
- Understand the embedment of sustainability issues in environmental, societal, and economic systems.
- Do basic systemic analyses, such as material and energy flow analyses
- Comprehend the political and global aspects relevant to specific sustainability issues.
- Interpret the normative dimension of sustainability and its implications for dealing with specific sustainability issues,
- Perform integrated ethical analyses for specific issues or projects.
- Develop critical and proactive thinking for the successful sustainable successful leaders.

Unit- 1: Sustainable Development

- Concept of Sustainable Development
- Principles of Sustainable Development
- Perspectives of Sustainable Development
- Values within the Sustainable Paradigm
- Sustainable Development Goals and Plans

Unit- 2: Sustainability Issues

- Agriculture, food security and self-reliance, permaculture, sustainable agriculture, Sustainable fisheries, and urban horticulture
- Air, water, soil and noise pollution, sustainable forest management, sustainable city
- Biodiversity, biodiversity conservation & management, conservation biology, biosecurity, endangered species, invasive species, biosphere, biome and ecosystem services
- Changing consumption patterns, sustainable business, sustainable fashion, sustainable industries, sustainable landscape architecture, sustainable packaging, sustainable procurement, sustainable tourism and sustainable transport
- Climate Change, global warming, depletion of ozone layer
- Deforestation, fragile ecosystem development and forest and wildlife protection
- Environmental disasters, global energy policies & resources and green movements
- Water Scarcity, water harvesting and water conservation
- Gender equity and equality
- Human settlement, new urbanism, eco-cities, sustainable urban infrastructure, sustainable urban drainage systems, sustainable community, sustainable communities plan, sustainability reporting, sustainable design, sustainable living
- Indigenous people, economic values, religious values, and societal values
- Population growth, population control, birth control, family planning, unintended pregnancy, zero population growth
- Poverty, unemployment, and schemes undertaken by government.
- Protecting and promoting human health
- Solid and hazardous wastes and sewage, waste management and its steps

Unit- 3: World systems towards sustainability

- Rio Declaration on Environment and Development
- International reports and agreements
- United Nations Conference on the Human Environment (Stockholm 1972)
- Brundtlandt Commission Report, 1983
- Our Common Future, 1987
- Earth Summit (1992)
- Agenda 21 (1992)
- Convention on Biological Diversity (1992)
- ICPD Programme of Action (1994)
- Earth Charter
- Millennium Declaration (2000)
- Millennium Ecosystem Assessment (2005)

Unit- 4: Education for Sustainable Development

- ESD Pedagogies
- Importance of ESD Pedagogies
- Sustainable Development Goals and steps to achieve them through education
- ESD and Five Pillars of Education from the Delors Report: Learning: The Treasure Within: learning to know, learning to do, learning to live together, learning to be, and learning to transform oneself and society.
- ESD and the Millennium Development Goals
- Contribution of Sustainable Development to Education

Practicum

1. Engage students in a Project on one of the above-mentioned topics.
2. Take the students to your local community to spread awareness about Sustainable Development Goals through some activities like Nukkad Natak, Story-telling sessions at schools, Puppetry etc.
3. Involve students into group discussions and encourage them to share their ideas for achieving Sustainable Development Goals.

SUGGESTED READINGS:

1. Stevenson, R. (2013). International handbook of research on environmental education. New York: Routledge.
2. Öhman, J., & Frykman, S. (2008). Values and democracy in education for sustainable development. Malmö [Sweden]: Liber.
3. Moser, S., & Dilling, L. (2007). Creating a climate for change. Cambridge: Cambridge University Press.
4. Earth Charter. 2000. http://www.earthcharterinaction.org/content/pages/Read-the-Charter.htmlICLEI. Local Governments for Sustainability. http://www.iclei.org/ (Accessed 22 June 2011.)
5. UNESCO. 2006. Education for Sustainable Development Toolkit. Learning & Training Tools No1. http://unesdoc.unesco.org/images/0015/001524/152453eo.pdfAlso available online in html at http://www.esdtoolkit.orgRio Declaration. 1992. http://www.unep.org/Documents.Multilingual/Default.asp?documentid=78&articleid=1163
6. United Nations Department of Economic and Social Affairs. 2009. Division on Sustainable Development. Sustainable Development Topics http://www.un.org/esa/dsd/susdevtopics/sdt_index.shtmlUNESCO. 2005.
7. UNESCO & Sustainable Development. http://unesdoc.unesco.org/images/0013/001393/139369e.pdf (English)http://unesdoc.unesco.org/images/0013/001393/139369f.pdf (French
8. Rosenberg, E. 2009. Teacher Education Workbook for Environment and Sustainability Education. Rhodes University Environmental Education and Sustainability Unit, Grahamstown. Distributed through Share-Net Howick.

9. UNESCO. 2005. Contributing to a More Sustainable Future: Quality Education, Life Skills and Education for Sustainable Development. Paris: UNESCO. http://unesdoc.unesco.org/images/0014/001410/141019e.pdf
10. UNESCO. 2006. Storytelling. Teaching and Learning for a Sustainable Future, version 4. http://www.unesco.org/education/tlsf/mods/theme_d/mod21.htmlUNESCO. 2010. ESD Lens: A Policy and Practice Review Tool. Learning & Training Tools, No. 2. http://unesdoc.unesco.org/images/0019/001908/190898e.pd
11. Delors, J. et al. 1996. Learning: The Treasure Within. Paris: UNESCO. http://www.unesco.org/delors/
12. United Nations. 1992. Rio Declaration.http://www.unep.org/Documents.Multilingual/Default.asp?documentid=78&articleid=1163UN General Assembly. 2010. Draft Resolution, Keeping the promise: united to achieve the Millennium Development Goals. Document A/65/L.1. http://www.un.org/en/mdg/summit2010/pdf/mdg%20outcome%20document.pdf

IIIT131A RECENT GLOBAL DEVELOPMENTS IN MEASUREMENT SCIENCE (Credits 6)

Overview, Objective and Expected Outcome:

Measurements are all pervasive, ice in science, engineering, technology, health, trade, commerce, and even social development. The course will start with a discussion on historical aspects covering ancient Indian wisdom as found in classics like Manu Smiriti, Artha Shastra, Indus Valley Civilisation, Iron Pillar Ayurveda and the Egyptian Pyramids.

Industrial revolution in Europe led to the applications of science and technology in production of goods, and services as well as in trade. This needed a common measurement system, which has been a key element in the advancement of Science and Technology in general including space science in modern times. Units of length had many definitions in different historical epochs in India and abroad. For length, the unit ‘foot’, based on the length of the foot of the Ruler had served for sometimes in UK. The French scientists introduced meter, and related it to the diameter of the earth.

Fast industrialisation in Europe led to the creation of a formal organisation, the Metre Convention also known as the Treaty of the Metre with 17 nations as its member on 20 May 1875. The Treaty also led to the establishment of the International Bureau of Weights and Measures (BIPM) at Paris. In the first phase the BIPM used to prepare standards of meter and kilogram of platinum-iridium alloys, which are not affected too much by atmospheric contamination. Gradually the additional standards were adopted to meet the growing requirements. Attempts were continuously made to replace the artefact standards by linking definitions of base units to the fundamental constants like the velocity of light. Also, gradually, units of time(second), temperature (Kelvin), electric current (Ampere), amount of substance (Mole), and luminous intensity Candela, were added.

These seven units are termed as the Base Units. We have large number of derived units like velocity (length/time), force and power etc. Since 20 May 2019, all base units are now defined in terms of the fundamental constants. For example, the Metre (length) is defined in terms of velocity of light. Each country establishes a National Metrology Institute or NMI. The CSIR-National Physical Laboratory is the NMI of India. All measurements made in any country should be traceable to the NMI of that country. The NMI ensures the traceability too all measurements to the international standards. At present, there are Regional Networks for Asia Pacific, Europe, Americas and they continuously work together to improve quality of measurements through inter-laboratory comparisons.

Modern era is characterised by distributed manufacturing. Any major equipment like a motor car has thousands of components, These may be manufactured in different countries but can be assembled without difficulty as they all conform to the same standards.

Metrology had a strong impact on international trade. Sometimes ago the World Trade Organisation (WTO) had emphasised that there are barriers to free trade as the standards in all trading countries are not identical. Voluntary inter comparisons and quality standards were set up in all members of the Metre Convention. This enabled Mutual Recognition Arrangements, which greatly facilitated trade. Some important examples will be discussed. The environmental challenges faced by whole humanity finally boil down to measurements of pollutants, which are accepted globally.

SJBJ161A GENDER AND MEDIA STUDIES (Credits 6)

Overview:

Through this course learners will explore the historical development of media forms over time spanning oral, written and electronic forms. It will introduce the learners the study of gender, media and society within their social, political and cultural contexts.

The course will give a perspective to the learners about different sexes and their social roles. The course will give an overview of representation of gender and society in media which may reinforce or subvert social roles and ideologies of the societies. How media is identifying and addressing the issues in different forms of media vehicles.

Objective and Expected Outcome:

Students will be able to demonstrate their knowledge of key developments and debates in the representation of gender in various media forms. Main objective is to sensitize the learners about gender issues in media and society. The course will highlight the power of media in portraying gender issues. To make them understand various policies and guidelines with reference to gender and society by various national and International organization and governments they will be inculcated the habit of using media on daily basis.

At the end of the session, students will be able to clearly think and express their views on range of gender and social issues highlighted and not so highlighted in media. They will demonstrate the sense of gender equality and empowerment of weaker sections of the society. The course will set a path to create gender sensitive individuals who respect and understand the other genders. They will be able to understand the role of media in eliminating the prejudices, attitudes, norms and practices that sustain gender-based discrimination, marginalization and inequality. Learners will recognize the role of media in creating a gender-neutral society by breaking stereotypes through success stories in written and audio-visual media and more specifically through cinema.

This course will create a better understanding amongst learners about social issues related to gender equality and disparity. After completing the course, students will be able to understand the role of media in creating a better society.

Suggested Readings:

1. Byerly, C. M. (2011). Global Report on the Status of Women in the News Media, Washington DC: International Women's Media Foundation.
2. The Book of Woman, Osho, Penguin India
3. Gender Trouble, Judith Butler, Routledge Publishing
4. Gender and Media, Rosalind Gill, Rawat Publications
5. Media, gender, and identity, David Gauntlett, Routledge Publishing
6. Gender and Media: Representing, Producing, Consuming
7. Tonny Krijnen, Sofie Van Bauwel, Routledge

HMCT119A INTRODUCTION OF HOSPITALITY INDUSTRY (Credits 6)

Unit 1

Introduction to Hospitality Industry & organizational & Organizational Structure of Hotel

Unit 2

Classification of Hotels & Distribution Channel

Unit 3

Introduction to Front Office Division & Front Office Services

Unit 4

Front Office Communication & Other Attributes & Front Office and Guest Safety and Security

Resource Material

1. Tourism: Principles and Practice (3rd Edition) - Chris Cooper, Stephen Wanhill, John Fletcher, David Gilbert and Alan Fyall.
2. Hotel Management : Education and Environment Perspective - Yogendra. K Sharma.
3. Introduction to Hospitality Management & Tourism: Verma, M P &, Bhatnagar Mamta

BSDM301A DISASTER MANAGEMENT (Credits 3)

Course Objective: The objective of the course is to create awareness about various types of disasters and to educate the learners about basic disaster management strategies. The course examines disaster profile of our country and illustrates the role played by various governmental and non- governmental organizations in its effective management. It also acquaints learners with the existing legal frame work for disaster management.

Learning Outcome: The course will -

- Provide students an exposure to disasters, their significance and types.
- Ensure that the students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- Provide the students a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I Introduction to Disasters: Concept and definitions- Disaster, Hazard, vulnerability, resilience, risks.

Different Types of Disaster: Causes, effects and practical examples for all disasters.

- Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc
- Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism etc.

UNIT- II Disaster Preparedness and Response Preparedness

- Disaster Preparedness: Concept and Nature
- Disaster Preparedness Plan
- Prediction, Early Warnings and Safety Measures of Disaster.
- Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies.
- Role of IT in Disaster Preparedness
- Role of Engineers on Disaster Management.
- Relief and Recovery
- Medical Health Response to Different Disasters

UNIT III Rehabilitation, Reconstruction and Recovery

- Reconstruction and Rehabilitation as a Means of Development.
- Damage Assessment
- Post Disaster effects and Remedial Measures.
- Creation of Long-term Job Opportunities and Livelihood Options,
- Disaster Resistant House Construction

- Sanitation and Hygiene
- Education and Awareness,
- Dealing with Victims' Psychology,
- Long-term Counter Disaster Planning
- Role of Educational Institute.

UNIT IV Disaster Management in India

- **Disaster Management Act, 2005:**
  Disaster management framework in India before and after Disaster Management Act, 2005, National Level Nodal Agencies, National Disaster Management Authority

- **Liability for Mass Disaster**
  - Statutory liability
  - Contractual liability
  - Tortious liability
  - Criminal liability
  - Measure of damages
- **Epidemics Diseases Act, 1897: Main provisions, loopholes.**
- **Project Work**: The project/ field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived based on the geographic location and hazard profile of the region where the institute is located.

Reference Books:

1. Government of India, Department of Environment, Management of Hazardous Substances Control
2. Act and Structure and Functions of Authority Created Thereunder.
3. Indian Chemical Manufacturers' Association & Loss Prevention Society of India, Proceedings of the National Seminar on Safety in Road Transportation of Hazardous Materials: (1986).
4. Author Title Publication Dr. Mrinalini Pandey Disaster Management Wiley India Pvt. Ltd.
5. Tushar Bhattacharya Disaster Science and Management McGraw Hill Education (India) Pvt. Ltd.
6. Jagbir Singh Disaster Management: Future Challenges and Opportunities K W Publishers Pvt. Ltd.
7. J. P. Singhal Disaster Management Laxmi Publications.
8. Shailesh Shukla, Shamna Hussain Biodiversity, Environment and Disaster Management Unique Publications
9. C. K. Rajan, Navale Pandharinath Earth and Atmospheric Disaster Management: Nature and Manmade B S Publication

10. Indian law Institute (Upendra Baxi and Thomas Paul (ed.), Mass Disasters and Multinational Liability: The Bhopal Case (1986)
11. Indian Law Institute, Upendra Baxi (ed.), Environment Protection Act: An Agenda for Implementation (1987)
12. Asian Regional Exchange for Prof. Baxi., Nothing to Lose But our Lives: Empowerment to Oppose
13. Industrial Hazards in a Transnational world (1989)
14. Gurudip Singh, Environmental Law: International and National Perspectives (1995), Lawman (India) Pvt. Ltd.
15. Leela Krishnan, P, The Environmental Law in India, Chapters VIII, IX and X (1999), Butterworths, New Delhi.

6.2 Syllabi of Courses specific to B.Sc. (Hons.)Chemistry

SEMESTER- I

Syllabi of Courses specific to B.Sc. (Hons.) Chemistry

BSCH101A Inorganic Chemistry-I (Credits 4)

On completion of this course, the students will be able to understand:

Learning objective:

- Atomic theory and its evolution.
- Learning scientific theory of atoms, concept of wave function.
- Elements in periodic table; physical and chemical characteristics, periodicity.
- To predict the atomic structure, chemical bonding, and molecular geometry based on accepted models.
- To understand atomic theory of matter, composition of atom.
- Identity of given element, relative size, charges of proton, neutron and electrons, and their assembly to form different atoms.
- Defining isotopes, isobar and isotone.
- Physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and position in periodic table.
- Characterize bonding between atoms, molecules, interaction and energetics (ii) hybridization and shapes of atomic, molecular orbitals, bond parameters, bond-distances and energies.
- Valence bond theory incorporating concepts of hybridization predicting geometry of molecules.
- Importance of hydrogen bonding, metallic bonding.

Learning outcomes:

The objective of the course is to discuss the structure of atom on the basis of different theories like Bohr's atomic theory, Planck's quantum theory, de – Broglie equation and Heisenberg's uncertainty principle. Students could learn about the orbits and orbitals, complete information of electrons such as their size, shape and orientation. It will provide knowledge about the elements present in a particular sequence in the periodic table based on their electronic configuration. This course teaches the students how bonds are formed between two atoms using different theories (MO and VBT).

After learning these theories, they will get to know about superiority of MO theory for formation of bonds in the molecules and their paramagnetic behavior. Based on the concept of hybridization, students will be able to predict the shape of molecules, their bond angle. Students will learn how to to calculate the lattice energy of ionic compounds using Born – Lande equation and Born - Haber cycle.

UNIT I

Atomic Structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de' Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and $\psi 2$. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

UNIT II

Periodicity of Elements

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

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

(b)Atomic radii (van'der Waals)

(c)Ionic and crystal radii.

(d)Covalent radii (octahedral and tetrahedral)

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

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

(g)Electronegativity, Pauling, Mullikan, Allred Rachow scales, electronegativity and bond order, partial charge, hybridization, group electronegativity. Sanderson electron density ratio.

UNIT III

Chemical Bonding

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

(i)Covalent bond: Lewis structure, Valence Shell Electron Pair Repulsion Theory (VSEPR), Shapes of simple molecules and ions containing lone-and bond-pairs of electrons multiple bonding, sigma and pi-bond approach, Valence Bond theory, (Heitler-London approach). Hybridization containing s, p and s, p, d atomic orbitals, shapes of hybrid orbitals, Bents rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of simple homonuclear and heteronuclear diatomic molecules, MO diagrams of simple tri and tetra-atomic molecules, e.g., N2, O2, C2, B2, F2, CO, NO, and their ions; HCl, BeF2, CO2, HCHO, (idea of s-p mixing and orbital interaction to be given). Covalent character in ionic compounds, polarizing power and polarizability. Fajan rules, polarization. Ionic character in covalent compounds: Bond moment and dipole moment. ionic character from dipole moment and electronegativities**.**

UNIT IV

Metallic bonding and Weak chemical forces

(ii)Metallic Bond: Qualitative idea of free electron model, Semiconductors, Insulators.

(iii)Weak Chemical Forces: van'der Waals, ion-dipole, dipole-dipole, induced dipole dipole-induced dipole interactions, Lenard-Jones 6-12 formula, hydrogen bond, effects of hydrogen bonding on melting and boiling points, solubility, dissolution.

Recommended Books/References:

1.Lee, J. D. Concise Inorganic Chemistry, Wiley, 5th Edn.

2.Douglas, B.E., McDaniel, D.H., Alexander J.J., Concepts & Models of Inorganic Chemistry, (Third Edition) John Wiley & Sons,1999.

3.Atkins, P. W. and DePaula, J. Physical Chemistry, Tenth Edition, Oxford University Press, 2014.

4.Rodger, G. E. Inorganic and Solid State Chemistry, Cengage Learning, 2002.

BSCH151A Inorganic Chemistry-I Practicals (Credits-2)

(A)Titrimetric Analysis

(i)Calibration and use of apparatus.

(ii)Preparation of solutions of different Molarity/Normality of titrants.

(iii)Use of primary and secondary standard solutions.

(B)Acid-Base Titrations

(i)Estimation of carbonate and hydroxide present together in mixture.

(ii)Estimation of carbonate and bicarbonate present together in a mixture.

(iii)Estimation of free alkali present in different soaps/detergents

(C)Oxidation-Reduction Titrimetry

(i)Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution.

(ii)Estimation of oxalic acid and sodium oxalate in a given mixture.

(iii)Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Recommended Books/References:

1.Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.

2.Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012.

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH103A ORGANIC CHEMISTRY-I (Credits 4)

Overview:

The course deals with classification, nomenclature and stereochemistry of organic compounds. Students will appreciate the concept of geometric and optical isomerism and acquire knowledge about the methods of synthesis and reactions of alkanes, alkenes, alkynes, cycloalkanes and aromatic hydrocarbons.

This course provides the hands-on experience of how these reaction mechanisms occur and we can relate these reactions with daily life experiences. Combustion of organic compounds such as fuel is a perfect example to notice this type of reaction. This course will enlighten the thoughts of the students regarding the mechanisms of reactions and structure of hydrocarbons.

Objective and Expected Outcome:

On completion of this course, the students will be able to understand:

- Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.
- Stereochemistry of organic molecules – conformation and configuration, asymmetric molecules and nomenclature.
- Aromatic compounds and aromaticity, mechanism of aromatic reactions.
- Understanding hybridization and geometry of atoms, 3-D structure of organic molecules, identifying chiral centers.
- Reactivity, stability of organic molecules, structure, stereochemistry.
- Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways.
- Mechanism of organic reactions (effect of nucleophile/leaving group, solvent), substitution *vs*. elimination.
- Critically analyze and relate the nature in terms of reactions.

UNIT I

Basics of Organic Chemistry

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and relative stabilities of reaction intermediates (Carbocations, Carbanions, Free radicals and Carbenes).

Organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

UNIT II

Stereochemistry

Concept of asymmetry, Fischer Projection, Newmann and Sawhorse projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with

C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixtures, Relative and absolute configuration: D/L and R/S designations.

UNIT III

Chemistry of Aliphatic Hydrocarbons

Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Free radical substitutions: Halogenation - relative reactivity and selectivity.

Carbon-Carbon pi-bonds

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration- demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2- and 1, 4- addition reactions in conjugated dienes and, Diels- Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions.

Cycloalkanes and Conformational Analysis

Cycloalkanes and stability, Baeyer strain theory, Conformation analysis, Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms.

UNIT IV

Aromatic Hydrocarbons

Aromaticity: Huckel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of substituent groups.

Recommended Books/References:

1. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, 6th Edn., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Pine S. H. Organic Chemistry, Fifth Edition, McGraw Hill, (2007)
3. F. A. Carey, Organic Chemistry, Seventh Edition, Tata McGraw Hill (2008).
4. J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd Ed., (2012), Oxford Universitiy Press.
5. F. A. Carey, R. J. Sundberg, Advanced Organic Chemistry, Part A: Structure and mechanism, Kluwer Academic Publisher, (2000).

BSCH153A ORGANIC CHEMISTRY-I PRACTICALS (Credits 2)

Overview:

This course inculcates the thought process of basic understanding of simple phenomena of boiling point, melting point, distillation, sublimation, purification of organic compounds.

Objective and Expected Outcome:

- Checking the calibration of the thermometer.
- Purification of organic compounds by crystallization using the following solvents:
- a. Water b. Alcohol c. Alcohol-Water
- Determination of the melting points of given organic compounds and unknown organic compounds (using Kjeldahl method and electrically heated melting point apparatus).
- Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.
- Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)
- Chromatography
- Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
- Separation of a mixture of two sugars by ascending paper chromatography
- Separation of a mixture of *o*-and *p*-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC).

Recommended Books/Reference:

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009) 2.Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

ABILITY ENHANCEMENT COURSE-I

BSCH125A ENVIRONMENTAL STUDIES (Credits 3)

Overview:

Everything that surrounds and affects living organisms is environment. Environment includes all those things on which we are directly or indirectly dependent for our survival, whether it is living or biotic components like animals, plants or non-living or abiotic components like soil, air and water etc. It belongs to all, influences all and is important to all.

Environmental Protection Act (1986) defined "Environment as the sum total of water, air and land, their interrelationship among themselves and with the human beings, other living organisms and materials." Environmental studies are important since it deals with the most mundane problems of life like hygienic living conditions, safe and clean drinking water, fresh air, healthy food and sustainable development.

The syllabus for Environmental Studies includes conventional class room teaching as well as field work. In this course the teacher simply acts as a catalyst to infer what the student observes or discovers in his/her own environment. Involvement of students in project work is one of the most effective learning tools for environmental issues. This syllabus is beyond the scope of text book teaching and also the realm of real learning by observing the surroundings. The content of this course provides an overview of introduction to environment, concept of an ecosystem, various renewable and non-renewable resources, how are various biodiversity occur and different means to conserve these. This course also includes various types of pollution and environmental policies & practices related with environs. Finally, it also highlights the relationship of human population with environment.

The course further integrates to project work such as visit to an area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds, and study of simple ecosystems. These studies are as imperative as it forms a unique synergistic tool for comprehensive learning process. This will help students to recognize and appreciate how the technological advancement at global level, exponential growth of human population and their unlimited demands has put the environment at stake and has contaminated the environment worldwide.

Objective and Expected Outcome:

The main objective of the course is to create consciousness among the students with the idea about healthy and safe environment. This course is aimed to explain students that the rapid industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels. These changes need the discussion, concern and recognition at national and international level with respect to formulate protection acts and sustainable developments policies. It can be possible only if every citizen of the nation is environmentally educated and gets involved into this matter at the grass root level to mitigate pollution.

After studying the course, the learners will be able to comprehend and become responsive regarding environmental issues. They will acquire the techniques to protect our mother earth, as without a clean, healthy, aesthetically beautiful, safe and secure environment no specie can survive and sustain. This is the only inheritance which every genera of specie passes to their future generation.

UNIT I

Introduction of Environmental Studies: Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

Natural Resources: Renewable and Non-renewable Resources

Land resources: land use change; Land degradation, soil erosion and desertification.

Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity, and tribal populations.

Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).

Energy resources: Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

UNIT II

Ecosystems: Definition and Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession.

Case studies of the following ecosystems:

a) Forest ecosystem

b) Grassland ecosystem

c) Desert ecosystem

d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biological Diversity: Levels of biological diversity; genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots ; India as a mega-biodiversity nation; Endangered and endemic species of India; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity; Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

UNIT III

Environmental Pollution: Types, causes, effects and controls; Air, water, soil and noise pollution. Nuclear hazards and human health risks; Solid waste management: Control measures of urban and industrial waste; Pollution case studies.

Environmental Policies and practices: Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.

Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. International agreements: Montreal & Koyoto protocol and convention on biological diversity. Nature reserves, tribal population and rights, human wild life conflicts in Indian context.

UNIT IV

Human Communities and the Environment: Human population growth: Impacts on environment, human health and welfare; Resettlement and rehabilitation of project affected persons; case studies; Disaster management: floods, earthquake, cyclones and landslides; Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan; Environmental ethics: Role of Indian and other religions and cultures in environmental conservation; Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Field work:

Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.

Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.

Study of common plants, insects, birds and basic principles of identification.

Study of simple ecosystems-pond, river, Delhi Ridge, etc.

TEXTBOOKS:

1. Erach Bharucha, Textbook of Environmental Studies, Universities Press (P) Ltd., Hyderabad, India.
2. Anubha Kaushik and C. P. Kaushik, Environmental Studies, New Age International Publishers (P) Ltd. New Delhi.

REFERENCE BOOKS:

1. A.K. De, Environmental Chemistry, New Age International Publishers (P) Ltd. New Delhi.
2. P. H. Raven, D. M. Hassenzahl & L. R. Berg, Environment, John Wiley & Sons, New Delhi.
3. J. S. Singh, S. P. Singh and S. R. Gupta, Ecology, Environmental Science and Conservation, S. Chand Publication, New Delhi.

BSCH137A HERBAL TECHNOLOGY (Credits2)

Overview:

Herbal technology, are going to be the most influential elements that are fundamental for success and welfare for the people of nations. Nutraceutical are food or part of the food that grant medical or health benefits together with the prevention or cure of the disease. Herbal drugs represent a major contribute to all the formally recognized systems of health in India. The course deals with understanding of Indian traditional plants and their active constituents responsible for pharmacological activity.

Learning outcomes:

On completion of this course the students will be able to;

- Develop their understanding on Herbal Technology
- Define and describe the principle of cultivation of herbal products.
- List the major herbs, their botanical name and chemical constituents.
- Evaluate the drug adulteration through the biological testing
- Formulate the value added processing / storage / quality control for the better use of herbal medicine
- Develop the skills for cultivation of plants and their value added processing / storage / quality control

Unit I

Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine); Cultivation - harvesting - processing - storage of herbs and herbal products.

Unit II

Value added plant products: Herbs and herbal products recognized in India; Major herbs used as herbal medicines, nutraceuticals, cosmeticals and biopesticides, their Botanical names, plant parts used, major chemical constituents.

Unit III

Pharmacognosy - Systematic position, botany of the plant part used and active principles of the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, *Catharanthus roseus*, *Withania somnifera*, *Centella asiatica*, *Achyranthes aspera*, Kalmegh, Giloe (Tinospora), Saravar. Herbal foods, future of pharmacognosy.

Unit IV

Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds). Plant gene banks, Cultivation of Plants and their value added processing / storage / quality control for use in herbal formulations. Introductory knowledge of Tissue culture and Micro propagation. of some medicinal plants (*Withania somnifera*, neem and tulsi),

Suggested Readings

1. Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. (2013). Current scenario of Herbal Technology worldwide: An overview. *Int J Pharm Sci Res*; 4(11): 4105-17.
2. Arber, Agnes. (1999). Herbal Plants and Drugs. Mangal Deep Publications, Jaipur.
3. Varzakas, T., Zakynthinos, G, and Francis Verpoort, F. (2016). Plant Food Residues as a Source of Nutraceuticals and Functional Foods. Foods 5 : 88.
4. Aburjai, T. and Natsheh, F.M. (2003). Plants Used in Cosmetics. Phytotherapy Research 17 :987-1000.
5. Patri, F. and Silano, V. (2002). Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.
6. AYUSH (www.indianmedicine.nic.in). *About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy*. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
7. Evans, W.C. (2009): Trease and Evans PHARMACOGNOSY. 16th Edition, SAUNDERS / Elsevier.
8. Sivarajan, V.V. and India, B. (1994). Ayurvedic Drugs and Their Plant Sources.. *Oxford*

   & *IBH Publishing Company*, 1994 - Herbs - 570 pages.
9. Miller, L. and Miller, B. (2017). Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. *Motilal Banarsidass,*; *Fourth edition* .
10. Kokate, C.K. (2003). Practical Pharmacognosy. Vallabh Prakashan, Pune.

BSCH132A FERMENTATION SCIENCE AND TECHNOLOGY (Credits 2)

Overview:

Fermentation Science and Technology is a multidisciplinary field focusing on the science of fermented foods and beverages. The curriculum focuses on the science of the processes and methods involved with using microorganisms in the commercial production of fermented products.

Objective and Expected Outcome:

After completing this course the learner will be able to;

- Employ the process for maintenance and preservation of microorganisms
- Analyze the various aspects of the fermentation technology and apply for Fermentative production
- Demonstrate proficiency in the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover

Unit I

Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.

Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.

Unit II

Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture. Fermentative production of vinegar, alcohol (ethanol, wine, beer), acids (citric acid and gluconic acid), amino acids (lysine and glutamic acid) and antibiotics (penicillin and streptomycin).

Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.

Suggested readings

1. Waites M.J. (2008). Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK.
2. Prescott S.C., Dunn C.G., Reed G. (1982). Prescott & Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA.
3. Reed G. (2004). Prescott & Dunn's industrial microbiology, 4th Edition, AVI Pub. Co., USA.
4. JR Casida L.E. (2015). Industrial Microbiology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi, India.
5. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001) Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.
6. Pelczar M.J., Chan E.C.S. and Krieg N.R. (2003) Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

SEMESTER II

BSCH102A PHYSICAL CHEMISTRY-I (Credits 4)

Overview:

Physical chemistry blends the principles of physics and chemistry to study the physical characteristics, or properties, of molecules. By understanding these properties, you learn more about the way in which molecules are put together, as well as how the actual structure of a chemical is impacted by these properties. Well, they can be made, or synthesized, by a chemical reaction.

Within the field of physical chemistry, we can investigate how molecules or atoms combine to form particular molecules. We can also learn about the different properties of matter, such as why a compound burns or about its ability to convert from a liquid to solid substance. Undoubtedly, this field is very important in the world of science, especially as it paves the way for the discovery of new theories.

Objective and Expected Outcome:

On completion of this course, the students will be able to understand:

- Familiarization with various states of matter.
- Physical properties of each state of matter and laws related to describe the states.
- Calculation of lattice parameters.
- Electrolytes and electrolytic dissociation, salt hydrolysis and acid-base equilibria.
- Understanding Kinetic model of gas and its properties.
- Maxwell distribution, mean-free path, kinetic energies.
- Behavior of real gases, its deviation from ideal behavior, equation of state, isotherm, and law of corresponding states.
- Liquid state and its physical properties related to temperature and pressure variation.
- Properties of liquid as solvent for various household and commercial use.
- Solids, lattice parameters – its calculation, application of symmetry, solid characteristics of simple salts.
- Ionic equilibria – electrolyte, ionization, dissociation.
- Salt hydrolysis (acid-base hydrolysis) and its application in chemistry.

Learning outcomes

Unit I

deal with the different gaseous states and also familiarize with various states of matter. Physical properties of each state of matter and laws related to describe the states of matter present in nature. Calculation of lattice parameters in helps to understand the structure of solids and particle nature. Electrolytes and electrolytic dissociation, salt hydrolysis and acid-base equilibria helps in studying the reactions occurring in day to day life. Kinetic model of gas helps in understanding the properties of ideal and real gases. Maxwell distribution, mean-free path, kinetic energies turn into estimating the molecular size of gaseous molecules and also make s clear the behavior of real gases, its deviation from ideal behavior, equation of state, isotherm, and law of corresponding states.

Liquid state and its physical properties related to temperature and pressure variation helps in understanding the structure of liquids and properties of liquid as solvent for various household and commercial use. While studying solids, lattice parameters – its calculation makes clear the application of symmetry structures and solid characteristics of simple salts.Ionic equilibria – electrolyte, ionization, dissociation relates solids, liquids and gaseous states to each other.

UNIT I

Gaseous state

Behavior of real gases: Deviations from ideal gas behavior, compressibility factor, and its variation with pressure for different gases. Causes of deviation from ideal behavior. van der Waals equation of state, its derivation and application in explaining real gas behaviour; van der Waals equation expressed in virial form, Boyle temperature. Isotherms of real gases and their comparison

with van der Waals isotherms, continuity of states, critical state, critical and van der Waals constants, law of corresponding states.

UNIT II

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Liquid state

Structure and physical properties of liquids; vapour pressure, surface tension, viscosity, and their dependence on temperature, Effect of addition of various solutes on surface tension, cleansing action of detergents. Structure of water.

UNIT III
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 tri-protic acids.

Salt hydrolysis, hydrolysis constants, degree of hydrolysis and pH for different salts. Buffer solutions; Henderson equation, buffer capacity, buffer range, buffer action, applications of buffers in analytical chemistry, Solubility and solubility product.

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.

Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolytes.

UNIT IV
Solid state: (10 classes of 60 minutes duration each)

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray

diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Various types of defects in crystals, Glasses and liquid crystals.

Recommended Text books/references:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 8th Ed., Oxford University Press (2006).
2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
4. Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP 2009).
5. 5 G. M. Barrow, Tata McGraw Hill (Fifth Edition) (2007)

BSCH152A PHYSICAL CHEMISTRY-I PRACTICALS (Credits 2)

Overview:

Experiments in Physical Chemistry aim to facilitate experimental work in the physical chemistry laboratory. The experiments are based on simple theoretical background and are useful to students to gain confidence in their ability to perform experiments and to appreciate the value of the experimental approach.

Objective and Expected Outcome:

The students explores the concept of i) surface tension and learn them through (a) drop number (b) drop weight method, ii) Viscosity measurements using Ostwald's viscometer, iii) pH metry etc.

Surface tension measurements.

a. Determine the surface tension by (i) drop number (ii) drop weight method.

b. Study the variation of surface tension of detergent solutions with concentration.

2. Viscosity measurements using Ostwald's viscometer.

a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.

b. Viscosity of sucrose solution with the concentration of solute.

3. pH metry

a. Effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.

b. Preparation of buffer solutions of different pH

i. Sodium acetate-acetic acid

ii. Ammonium chloride-ammonium hydroxide

c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.

d. Determination of dissociation constant of a weak acid.

Recommended textbooks/references:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).
4. Athawale V. D. amd Mathur P. Experimental Physical Chemistry,, New Age Intenational (2001)

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH104A Organic Chemistry-II (Credits 4)

After completion of the course, the learner shall be able to understand:

Learning objective:

- Familiarization about classes of organic compounds and their methods of preparation.
- Basic uses of reaction mechanisms.
- Name reactions, uses of various reagents and the mechanism of their action.
- Preparation and uses of various classes of organic compounds.
- Organometallic compounds and their uses.
- Organic chemistry reactions and reaction mechanisms.
- Use of reagents in various organic transformation reactions.

Learning Outcome

These classes of compounds find wide applications in industry as well as in day-to-day life. For instance, have you ever noticed that ordinary spirit used for polishing wooden furniture is chiefly a compound containing hydroxyl group, ethanol. The sugar we eat, the cotton used for fabrics, the paper we use for writing, are all made up of compounds containing –OH groups. Just think of life without paper; no note-books, books, newspapers, currency notes, cheques, certificates, etc. The magazines carrying beautiful photographs and interesting stories would disappear from our life. It would have been really a different world. The reactive nature of primary alkyl chlorides is sometimes exploited in medicinal chemistry and chemical biology. Halogens containing organic compounds are relatively rare in terrestrial plants and animals. The ocean is the largest known source for atmospheric methyl bromide and methyl iodide. Furthermore, the ocean is also estimated to supply 10-20% of atmospheric methyl chloride, with other significant contributions coming from biomass burning, salt marshes and wood-rotting fungi. Many subsequent chemical and biological processes produce poly-halogenated methane.

It is expected that students will learn about the synthesis, importance, and the reactions of alkyl halide and aryl halides, phenols, alcohols and ethers.

Through this course students will be able to perform acetylation and benzoylation of amines and phenols, oxidation of aldehydes and alcohols etc.

Chemistry of Halogenated Hydrocarbons

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and S I mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

Aryl halides: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; SNAr, Benzyne mechanism.

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

Organometallic compounds of Mg and Li and their use in synthesis.

Alcohols, Phenols, Ethers and Epoxides

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism.

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4

Carbonyl Compounds

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff- Kishner, LiAlH4, NaBH4, MPV, PDC and PGC);

Additional reactions of unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Carboxylic Acids and their Derivatives

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group - Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmannbromamide degradation and Curtius rearrangement.

Sulphur containing compounds

Preparation and reactions of thiols, thioethers and sulphonic acids.

Recommended Books/references:

1 Solomons, T.W G., Fryhle, B. Craig. Organic Chemistry, John Wiley & Sons, Inc (2009).

2 McMurry, J.E. Fundamentals of Organic Chemistry, Seventh edition Cengage Learning, 2013.

3 P Sykes, A Guide Book to Mechanism in Organic Chemistry, 6th Edition (1997), Orient Longman, New Delhi.

4 Morrison R. T. and Boyd R. N. Organic Chemistry, Sixth Edition Prentice Hall India, 2003.

BSCH154A Organic Chemistry-II Practicals (Credits 2)

(List of experiments given are suggestive. One experiment from each group to be demonstrated) 1.Identification of elements (N, S, and halogen) and Functional group tests for alcohols, phenols, carbonyl, carboxylic acid and amine group of compounds.

2. Organic preparations:

i. Acetylation of one of the following compounds: amines (aniline, o-, m-, p-toluidines and o-, m-, p-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method: (Using conventional method.and Using green chemistry approach)

ii. Benzolyation of one of the amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and one of the phenols (β-naphthol, resorcinol, p-cresol) by Schotten-Baumann reaction.

iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).

iv. Bromination (any one)

a. Acetanilide by conventional methods

b. Acetanilide using green approach (Bromate-bromide method)

v. Nitration: (any one)

a. Acetanilide/nitrobenzene by conventional method

b. Salicylic acid by green approach (using ceric ammonium nitrate).

vi. Selective reduction of meta dinitrobenzene to m-nitroaniline.

vii. Reduction of p-nitrobenzaldehyde by sodium borohydride.

viii. Hydrolysis of amides and esters.

ix. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.

x. S-Benzylisothiouronium salt of one each of water soluble/ insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).

xi. Aldol condensation with either conventional or green method.

xii. Benzil-Benzilic acid rearrangement.

Collected solid samples may be used for recrystallization, melting point and TLC.

Recommended Books/References:

1 Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)

2 Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012)

3 Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry:

Preparation and Quantitative Analysis, University Press (2000)

4 Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

ABILITY ENHANCEMENT COURESE-II

BSEL145A Communication Skills (Credits 4)

Learning Outcome

- The course will help the learners to focus on communication activities in functional and situational contexts as well as enhance the four language skills of reading, writing, listening and speaking through real-life and professional situations.
- It will build confidence among the students and encourage them to speak fluently.
- Through practical learning and delivery, the learners will be able to identify their areas of strengths and weaknesses and improvise their personality and soft skills.
- The learners will be able to strengthen and broaden their communication skills through various insightful ways.

UNIT I

Introduction to Communication: Meaning, Forms & Types of Communication; Process of Communication; Principles of Effective Communication/7Cs, Barriers in Communication.

Emily Dickinson:"A Bird Came Down the Walk"

UNIT II

Essentials of Grammar: Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb, Preposition, Conjunction, Interjection; Using tenses; Articles; Types of sentences; Reported Speech; Punctuation.

Robert Frost: "Stopping by Woods"

UNIT III

Building Vocabulary: Word Formation (by adding suffixes and prefixes); Common Errors; Words Often Confused; One word substitution, Homonyms and Homophones; Antonyms &Synonyms, Phrasal Verbs, Idioms & Proverbs (25 each); Commonly used foreign words(15 in number); O'Henry: The Gift of Magi

UNIT IV

Personality Development: Etiquette & Manners; Leadership; Inter & intra personal skills; Attitude, Self-esteem & Self-reliance; Public Speaking; Body Language: Posture, Gesture, Eye Contact, Facial Expressions; Presentation Skills/ Techniques.

Rabindranath Tagore: "My Prayer to Thee"

Suggested Readings

Kumar, Sanjay and Pushplata. Communication Skills. Oxford University Press, 2015.
Mitra, Barun K. Personality Development and Soft Skills. Oxford University Press, 2012.

SKILL ENHANCEMENT COURSE-III

BSCH132A Fermentation Science and Technology (Credits 2)

Learning outcomes:
After completing this course the learner will be able to;
•Employ the process for maintenance and preservation of microorganisms
•Analyze the various aspects of the fermentation technology and apply for Fermentative production
•Demonstrate proficiency in the experimental techniques for microbial production of enzymes: amylase and protease, bio product recovers

Unit I

Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.
Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.

Unit II

Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture. Fermentative production of vinegar, alcohol (ethanol, wine, beer), acids (citric acid and gluconic acid), amino acids (lysine and glutamic acid) and antibiotics (penicillin and streptomycin).
Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.

Suggested readings

1. Waites M.J. (2008). Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK.
2. Prescott S.C., Dunn C.G., Reed G. (1982). Prescott & Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA.
3. Reed G. (2004). Prescott & Dunn's industrial microbiology, 4th Edition, AVI Pub. Co., USA.
4. JR Casida L.E. (2015). Industrial Microbiology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi, India.
5. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001) Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.
6. Pelczar M.J., Chan E.C.S. and Krieg N.R. (2003) Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

SKILL ENHANCEMENT COURSE-IV

BSCH134A Intellectual property right (IPR) and business skills for chemists (Credits 2)

Learning Outcomes

- Introduction to Intellectual Property is understood by historical perspective, different types of IP, importance of protecting IP. The understanding of Copyrights helps to obtain, Patents. Understanding of Trade Marks as Collective marks, certification marks, service marks, Trade names, etc. helps in promoting innovation.

- The rules for registration, prevention of illegal exploitation are important to Indian perspective of business. International design registration reveals Trade Secrets with the scope of Protection and risks involved in legal aspects of Trade Secret Protection.

- The study of different International agreements as Word Trade Organization (WTO), Paris Convention helps in understanding various laws in India Licensing and technology transfer. The application of Chemistry in Industry makes clear the current challenges and opportunities for the chemistry-using industries, its role in India and global economies and Financial aspects of business with case studies for better knowledge.

UNIT I

Introduction to Intellectual Property:
Historical Perspective, Different Types of IP, Importance of protecting IP.
Copyrights
Introduction, How to obtain, Differences from Patents.
Trademarks
Introduction, How to obtain, Different types of marks – Collective marks, certification marks, service marks, Trade names, etc. Differences from Designs.
Patents Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge, Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India.

UNIT II

Geographical Indications
Definition, rules for registration, prevention of illegal exploitation, importance to India.
Industrial Designs
Definition, How to obtain, features, International design registration.
Layout design of integrated circuits
Circuit Boards, Integrated Chips, Importance for electronic industry.
Trade Secrets

Introduction, Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade Secret Protection.

UNIT III

Different International agreements

(a) Word Trade Organization (WTO):

(i) General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement (ii) General Agreement on Trade related Services (GATS) (iii) Madrid Protocol (iv) Berne Convention (v) Budapest Treaty

(b) Paris Convention

WIPO and TRIPS, IPR and Plant Breeders Rights, IPR and Biodiversity

IP Infringement issue and enforcement – Role of Judiciary, Role of law enforcement agencies – Police, Customs etc. Economic Value of Intellectual Property – Intangible assets and their valuation, Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

UNIT IV

Business Basics

Key business concepts: Business plans, market need, project management and routes to market.

Chemistry in Industry

Current challenges and opportunities for the chemistry-using industries, role of chemistry in India and global economies.

Financial aspects

Financial aspects of business with case studies.

Recommended Books/References:

1. Acharya, N.K. Textbook on intellectual property rights, Asia Law House (2001).
2. Guru, M. & Rao, M.B. Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).
3. Ganguli, P. Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw- Hill (2001).
4. Miller, A.R. & Davis, M.H. Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
5. Watal, J. Intellectual property rights in the WTO and developing countries, Oxford University Press, New Delhi.

Semester - III

BSCH201A Physical Chemistry-II (Credits-4)

After completion of the course, the learner shall be able to understand:

Learning objective:

- Laws of thermodynamics and concepts.
- Partial molar quantities and its attributes.
- Dilute solution and its properties.
- Understanding the concept of system, variables, heat, work, and laws of thermodynamics.
- Understanding the concept of heat of reactions and use of equations in calculations of bond energy, enthalpy, etc.
- Understanding the concept of entropy; reversible, irreversible processes. Calculation of entropy using 3nd law of thermodynamics.
- Understanding the application of thermodynamics: Joule Thompson effects, partial molar quantities.
- Understanding theories/thermodynamics of dilute solutions.

Learning outcomes

The topic of thermodynamics helps students in understanding the laws of thermodynamics and concepts. The concept of Partial molar quantities and its attributes relate properties to concentration. The knowledge of dilute solution and its properties helps students in understanding the concept of system, variables, heat, work, and laws of thermodynamics. The concept of heat of reactions and use of equations in calculations of bond energy, enthalpy, etc.enables students to make use of thermodynamics in day to day activities. The understanding of the concept of entropy; reversible, irreversible processes enables them to calculate entropy using 3rd law of thermodynamics. Joule Thompson effects, Gibbs-Helmholtz equation; Maxwell relations. makes a clear scenario of the daily routine appliances utilizing the concept of thermodynamics. Four colligative properties: (i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure explain the freezing of water, use of pressure cooker, removal of snow using solid carbondioxide.

UNIT I

Introduction to thermodynamics

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

UNIT II

Thermochemistry

Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations), pressure on enthalpy of reactions.

Second Law

Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

UNIT III

Third law of thermodynamics

Third Law of thermodynamics, residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions

Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

UNIT IV

Partial molar quantities

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Dilute solutions

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties: [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Recommended Books

1 Atkins P. and De Paula, J. Physical Chemistry Tenth Ed., OUP, 2014. 2 Castellan, G. W. Physical Chemistry 4th Ed., Narosa, 2004.

3 Engel, T. and Reid, P. Physical Chemistry 3rd Ed., Prentice Hall, 2012.

4 McQuarrie, D. A. and Simon, J. D. Molecular Thermodynamics Viva Books, 2004. 5 Roy, B. N. Fundamentals of Classical and Statistical Thermodynamics Wiley, 2001 6 Commonly Asked Questions in Thermodynamics. CRC Press, 2011.

7 Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill, 2010. 8 Metz, C.R. 2000 solved problems in chemistry, Schaum Series, 2006.

BSCH251A Physical Chemistry-II Practicals (Credits-2)

(A list of suggested experiments are given. However, more experiments can be added based on facilities available in the laboratories).

1. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.

2. Study the equilibrium of at least one of the following reactions by the distribution method: (i) I2 (aq) + I □ I3-(aq)

(ii) Cu2+(aq) + nNH3 → Cu(NH3)n

3. Study the kinetics of the following reactions.

a. Acid hydrolysis of methyl acetate with hydrochloric acid.

b. Saponification of ethyl acetate.

Adsorption

Verification of Freundlich and Langmuir isotherms for adsorption of acetic acid and selected organic dye(s) on activated charcoal.

(Use of calorimeter for calculation of heat of reactions may be demonstrated)

Recommended Books/References:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand, New Delhi, 2011.

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry, Eighth Edition, McGraw-Hill(2003).

3 Halpern, A. M. and McBane, G. C. Experimental Physical Chemistry, Third Edition, W, H. Freeman (2003).

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH203A Organic Chemistry-III (Credits-4)

After completion of the course, the learner shall be able to understand:

Learning objective:

- Nitrogen containing functional groups and their reactions.
- Familiarization with polynuclear hydrocarbons and their reactions.
- Heterocyclic compounds and their reactions.
- Alkaloids and Terpenes
- Understanding reactions and reaction mechanism of nitrogen containing functional groups.
- Understanding the reactions and mechanisms of diazonium compounds.
- Understanding the structure and their mechanism of reactions of selected polynuclear hydrocarbons.
- Understanding the structure, mechanism of reactions of selected heterocyclic compounds.
- Classification, structure, mechanism of reactions of few selected alkaloids and terpenes.

Learning Outcome

In this course student will learn about structure, stability, methods of synthesis and reactions of amine and their derivatives. The course will apprise students about the synthesis, reactions and mechanism of substitution reactions of five membered and six membered heterocycles like furan, pyrrole, pyridine, thiophene and indole etc. Modern theory of colors and chemistry of dyes like azo dyes, phthalein dyes etc. will also be discussed. After the course students will be able to know the chemistry of amines, polynuclear aromatic hydrocarbons and heterocyclic compounds which have been frequently found as a key structural unit in synthetic pharmaceuticals and agrochemicals. After the completion of course students will be able to perform qualitative analysis of organic compounds.

UNIT I

Nitrogen Containing Functional Groups

Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann- elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium salts: Preparation and synthetic applications.

UNIT II

Polynuclear Hydrocarbons

Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

UNIT III

Heterocyclic Compounds

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler- Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction Derivatives of furan: Furfural and furoic acid.

UNIT IV

Alkaloids

Natural occurrence, General structural features, Isolation and their physiological action Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Terpenes

Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and α-terpineol.

Recommended Text Books/references:

1.Morrison, R. T., Boyd, R. N., Bhatterjee, S.K., Organic Chemistry, 7th Edn., Pearson.

2 Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Welly & Sons (1976).

3 Solomons, T.W., Fryhle Craig, Organic Chemistry, John Wiley & Sons, Inc (2009).

4 McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

5 Kalsi, P. S. Organic reacations and their mechanisms, New Age Science (2010).

6 Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press Inc., New York (2001).

7 Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, Prajati Parakashan (2010).

8 Bansal R. K. Heterocyclic Chemistry: Syntheses, Reactions and Mechanisms, New Age, Third Edition (1999).

9.Clayden J., Greeves N., Warren S., Organic Chemistry, (2nd Ed)., (2012), Oxford University Press.

BSCH253A Organic Chemistry-III Practicals (Credits-2)

1. Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols, etc.

2. Identification of functional groups of simple organic compounds by IR spectroscopy and NMR spectroscopy (IR and NMR of simple organic compounds may be done wherever facilities are available, otherwise sample spectra may be provided for simple organic compounds like Ethanol, Aniline, Phenol, acetic acid, other simple aldehydes, carboxylic acid, etc., for identification of functional groups. References from standard spectroscopy books may also be taken for such purpose for enhancing students understanding and skill).

3. Preparation of methyl orange.

4. Extraction of caffeine from tea leaves.

5. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars using simple lab procedures.

Recommended Books/References:

1. Vogel, A.I. Quantitative Organic Analysis, Part 3, Pearson (2012).

2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)

3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)

4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

5. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH205A Analytical Techniques of Chemistry (Credits-4)

After completion of the course, the student shall be able to understand:

Learning objective:

- Familiarization with fundamentals of analytical chemistry.
- Basics of spectroscopic, thermal, electrochemical techniques
- Learning basics of separation techniques and its applications.
- Understanding analytical tools, statistical methods applied to analytical chemistry.
- Understanding principle of UV-Vis spectroscopy and its applications.
- 6. Understanding principles of thermo-gravimetric analysis and study of thermal decomposition of materials/characterization of materials.
- Understanding basics of electro-analytical techniques and its applications.
- 8. Understanding principles of separation technology and its use in advanced instrumentations.

Learning Outcome

Student will be able to analyse any unkown compound with spectroscopy, TGA, pHmetric titrations and through separation techniques. After getting results student can analyse the analytical data, its errors etc.

UNIT I

Qualitative and quantitative aspects of analysis:

Tools in analytical chemistry and their applications, Sampling, evaluation of analytical data, errors, accuracy and precision, statistical test of data; F, Q and t-test, rejection of data, and confidence intervals.

UNIT II

Spectroscopy:

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

Vibration spectroscopy: Basic principles of instrumentation, sampling techniques. Application of IR spectroscopy for characterization through interpretation of data, Effect and importance of isotope substitution. Introduction to Raman spectra

UV-Visible Spectrometry: Basic principles of instrumentation, principles of quantitative analysis using estimation of metal ions from aqueous solution, Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

UNIT III

Thermal analysis

Theory of thermogravimetry (TG and DTG), instrumentation, estimation of Ca and Mg from their mixture.

Electroanalytical methods

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. determination of pKa values.

UNIT IV

Separation techniques

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non- aqueous media.

Chromatography techniques: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis using LC, GLC, TLC and HPLC.

Recommended Books/Reference Books:

1 Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

2 Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing California, USA, 1988.

Christian, G.D, Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

4 Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.

5 Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Saunder College Publications, (1998).

6 Mikes, O. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood John Wiley 1979.

7 Ditts, R.V. Analytical Chemistry; Methods of separation, van Nostrand, 1974.

8 Khopkar, S. M., Basic Concepts of Analytical Chemistry, New Age (Second edition)1998 9.Skoog D.A., Holler F.J., Nieman T.A., Principles of instrumental analysis, 5th Edn., Brooks & Cole (1997).

BSCH255A Analytical Techniques of Chemistry Practicals (Credits-2)

(Recommended to carry out at least two experiments from each section)

I. Chromatography:

(i) Paper chromatographic separation of Fe3+, Al3+, and Cr3+.

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.

iii. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.

(iv) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions:

(i) To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry.

ii. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

iii. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

III. Analysis of soil:

(i) Determination of pH of soil.

(ii) Total soluble salt

(iii) Estimation of calcium, magnesium, phosphate, nitrate

IV. Ion exchange:

(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.

(ii) Separation of metal ions from their binary mixture.

(iii) Separation of amino acids from organic acids by ion exchange chromatography.

V. Spectrophotometry

(i). Determination of pKa values of indicator using spectrophotometry.

(ii) Structural characterization of compounds by infrared spectroscopy.

(iii) Determination of dissolved oxygen in water.

(iv) Determination of chemical oxygen demand (COD).

(v) Determination of Biological oxygen demand (BOD).

(vi) Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Recommended text books/references:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

2. Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.

3. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

4. Harris, D.C. Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.

5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.

6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Edition.

7. Mikes, O. & Chalmes, R.A. Laboratory Handbook of Chromatographic & Allied Methods, Elles Harwood Ltd. London.

8. Ditts, R.V. Analytical Chemistry: Methods of separation. Van Nostrand, New York, 1974.

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSDM301A Disaster Management (Credits 3)

COURSE OBJECTIVE: The objective of the course is to create awareness about various types of disasters and to educate the learners about basic disaster management strategies. The course examines disaster profile of our country and illustrates the role played by various governmental and non- governmental organizations in its effective management. It also acquaints learners with the existing legal frame work for disaster management.

LEARNING OUTCOME: The course will -

- Provide students an exposure to disasters, their significance and types.
- Ensure that the students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- Provide the students a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I Introduction to Disasters: Concept and definitions- Disaster, Hazard, vulnerability, resilience, risks.Different Types of Disaster: Causes, effects and practical examples for all disasters.

 Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc

 Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism etc.

UNIT- II Disaster Preparedness and Response Preparedness

Disaster Preparedness: Concept and Nature

 Disaster Preparedness Plan

 Prediction, Early Warnings and Safety Measures of Disaster.

 Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies.

 Role of IT in Disaster Preparedness

 Role of Engineers on Disaster Management.

 Relief and Recovery

 Medical Health Response to Different Disasters

UNIT III Rehabilitation, Reconstruction and Recovery

 Reconstruction and Rehabilitation as a Means of Development.

 Damage Assessment

 Post Disaster effects and Remedial Measures.

 Creation of Long-term Job Opportunities and Livelihood Options,

 Disaster Resistant House Construction

- Sanitation and Hygiene
- Education and Awareness,
- Dealing with Victims' Psychology,
- Long-term Counter Disaster Planning
- Role of Educational Institute.

UNIT IV Disaster Management in India

- Disaster Management Act, 2005:

Disaster management framework in India before and after Disaster Management Act, 2005, National Level Nodal Agencies, National Disaster Management Authority

- Liability for Mass Disaster

- Statutory liability
- Contractual liability
- Tortious liability
- Criminal liability
- Measure of damages

- Epidemics Diseases Act, 1897: Main provisions, loopholes.

- Project Work: The project/ field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived based on the geographic location and hazard profile of the region where the institute is located.

Reference Books:

•Government of India, Department of Environment, Management of Hazardous Substances Control

•Act and Structure and Functions of Authority Created Thereunder.

•Indian Chemical Manufacturers' Association & Loss Prevention Society of India, Proceedings of the National Seminar on Safety in Road Transportation of Hazardous Materials: (1986).

•Author Title Publication Dr. Mrinalini Pandey Disaster Management Wiley India Pvt. Ltd.

•Tushar Bhattacharya Disaster Science and Management McGraw Hill Education (India) Pvt. Ltd.

•Jagbir Singh Disaster Management: Future Challenges and Opportunities K W Publishers Pvt. Ltd.

•J. P. Singhal Disaster Management Laxmi Publications.

•Shailesh Shukla, Shamna Hussain Biodiversity, Environment and Disaster Management Unique Publications

•C. K. Rajan, Navale Pandharinath Earth and Atmospheric Disaster Management: Nature and Manmade B S Publication

•Indian law Institute (Upendra Baxi and Thomas Paul (ed.), Mass Disasters and Multinational Liability: The Bhopal Case (1986)

•Indian Law Institute, Upendra Baxi (ed.), Environment Protection Act: An Agenda for Implementation (1987)

•Asian Regional Exchange for Prof. Baxi., Nothing to Lose But our Lives: Empowerment to Oppose

•Industrial Hazards in a Transnational world (1989)

•Gurudip Singh, Environmental Law: International and National Perspectives (1995), Lawman (India) Pvt. Ltd.

•Leela Krishnan, P, The Environmental Law in India, Chapters VIII, IX and X (1999), Butterworths, New Delhi.

Semester - IV

BSCH202A Physical Chemistry-III (Credits 4)

After completion the course, the learner shall be able to understand:

Learning objective:

- Phases, components, Gibbs phase rule, Phase diagrams and applications.
- Chemical kinetics: type of reactions, determination of rate, theories of reaction rate, steady state approximation.
- Adsorption isotherms.
- Understanding phases, components, Gibb's phase rule and its applications, construction of phase diagram of different systems, the application of phase diagram.
- Understanding the basics of chemical kinetics: determination of order, molecularity, and understanding theories of reaction rates, determination of rate of opposing/parallel/chain reactions with suitable examples, application of steady state kinetics, Steady-state approximation.
- Langmuir, Freundlich – adsorption isotherms, significance, multilayer adsorption – theory and significance.

Learning outcomes:

The students will be able to understand the concepts as Phases, components, Gibbs phase rule, Phase diagrams and applications. Gibbs-Duhem-Margules equation, CST, miscible pairs, steam distillation. Nernst distribution law gives a better insight on to study of phase systems. The chemical kinetics explains the type of reactions, determination of rate, theories of reaction rate, steady state approximation. Understanding the basics of chemical kineticsenables students to determine order, molecularity of a reaction. Understanding theories of reaction rates such as determination of rate of opposing/parallel/chain reactions with suitable examples and application of steady state kinetics gives a better insight of the various chemical processes going on in nature. Steady-state approximation, Langmuir, Freundlich – adsorption isotherms, signifies the adsorption process and various alloys formation. Michaelis- Menten mechanism enables students to understand enzymes used a s catalyst.

UNIT I

Phase Equilibria

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent.

and incongruent melting points, solid solutions. Three component systems, water-chloroform-acetic acid system, triangular plots. Binary solutions: Gibbs-Duhem-Margules equation, its derivation, and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

UNIT II

Chemical Kinetics

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated rate laws for first, second and fractional order reactions, pseudounimolecular reactions, determination of the order, kinetics of complex reactions (limited to first order): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

UNIT III

Catalysis

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis- Menten mechanism, acid-base catalysis.

UNIT IV

Surface chemistry

Physical adsorption, chemisorption, adsorption isotherms (Freundlich, Temkin, Derivation of Langumuir adsorption isotherms, surface area determination), BET theory of multilayer adsorption (no derivation), Adsorption in solution.

Recommended books:

1. Atkins P. W. and De Paula J., Physical Chemistry, (tenth edition) Oxford University Press, 2014. 2 Castellan, G. W. Physical Chemistry, 4th Ed., Narosa , 2004.

3 McQuarrie, D. A. & Simon, J. D., Molecular Thermodynamics, Viva Books, 2004. 4 Engel, T. & Reid, P. Physical Chemistry Third Edition, Prentice-Hall,2012.

5 Zundhal, S.S. Chemistry concepts and applications Cengage India, 2011 6 Ball, D. W. Physical Chemistry Cengage India, 2012.

7 Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP, 2009. 8.Levine, I. N. Physical Chemistry 6th Ed., Tata McGraw-Hill, 2011.

9. Metz, C. R. Physical Chemistry 2nd Ed., Tata McGraw-Hill, 2009.

BSCH252A Physical Chemistry-III Practicals (Credits 2)

Conductometry

1 Determination of cell constant

2 Equivalent conductance, degree of dissociation and dissociation constant of a weak acid. 3.Conductometric titrations of: Strong acid Vs. strong base (ii) Weak acid vs. strong base, (iii) Mixture of strong acid and (iv)weak acid vs. strong base, Strong acid vs. weak base.

Potentiometry

Potentiometric titrations of: (i) Strong acid vs. strong base (ii) Weak acid vs. strong base

(iii) Dibasic acid vs. strong base (iv) Potassium dichromate vs. Mohr's salt.

Recommend books/References:

1 Khosla, B. D.; Garg, V. C. and Gulati, A. Senior Practical Physical Chemistry, R. Chand New Delhi, 2011.

2 Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry Eighth Edition; McGraw-Hill: New York, 2003.

3 Halpern, A. M. and McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York, 2003.

(List of experiments and references are suggestive. However, more experiments can be added/list of experiments can be revised as per available facilities).

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH206A Inorganic Chemistry-II (Credits 4)

After completion of the course, the learner shall be able to understand:

Learning objective:

- Oxidation-Reductions and their use in metallurgy.
- Chemistry of s and p-block elements.
- Chemistry of noble gases.
- Inorganic polymers and their use.
- Understanding redox reactions in hydrometallurgy processes.
- Structure, bonding of s and p block materials and their oxides/compounds.
- Understanding chemistry of boron compounds and their structures.
- Chemistry of noble gases and their compounds; application of VSEPR theory in explaining structure and bonding.
- Understanding chemistry of inorganic polymers, their structures and uses.

Learning outcome:

After studying the course, students learn about the oxidation and reduction reactions, role of standard electrode potential for inorganic preparation and the methods used for the purification of metals. They will learn some basic concepts of inorganic chemistry like inert pair effect, allotropy, catenation etc. After through understanding the complete course, students will be able to explain about the chemistry of some elements like Boron, Carbon, Silicon, Phosphorous, Sulphur and Halogens. The course will provide the explanation about the occurrence of noble gases, preparation and properties of some noble gases compounds. The students also get an idea about different types of inorganic polymers and how they are differ from organic polymers.

UNIT I

Oxidation-Reduction and general principle of metallurgy

Redox equations, Standard Electrode Potential and its application to inorganic reactions. Occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon or carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel- de Boer process and Mond's process, Zone refining.

UNIT II

Chemistry of s and p Block Elements

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

Structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Per-oxo acids of Sulphur inter-halogen compounds, poly-halide ions, pseudo-halogens, properties of halogens.

UNIT III

Noble Gases

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF2, XeF4 and XeF6; Bonding in noble gas compounds (Valence bond and MO treatment for XeF2), Shapes of noble gas compounds (VSEPR theory).

UNIT IV

Inorganic Polymers

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Recommended books/references:

1 Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.

2 Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994.

3 Greenwood, N.N., Earnshaw. Chemistry of the Elements, Butterworth-Heinemann. 1997. 4 Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999.

5 Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002. 6 Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry Fourth Ed., Pearson, 2010

7 Atkins, P. W and Shriver D. N. Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

BSCH254A Inorganic Chemistry-II Practicals (Credits 2)

(A) Iodo / Iodimetric Titrations

(i) Estimation of Cu(II) and K2Cr2O7 using sodium thiosulphate solution (Iodimetrically).

(ii) Estimation of (i) arsenite and (ii) antimony iodimetrically

(iii) Estimation of available chlorine in bleaching powder iodometrically.

(B) Inorganic preparations

(i) Cuprous Chloride, Cu2Cl2

(ii) Preparation of Aluminium potassium sulphate (Potash alum) or Chrome alum.

Recommended books/references:

Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition Pearson, 2009.

(The above list of experiments are suggestive. Faculty/academic bodies may incorporate revision/may incorporate text and reference books as per need).

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH208A Introduction to Quantum Chemistry (Credits 4)

After completion the course, the learner shall be able to understand:

Learning objective:

- Learning the basics of radiation and distribution of energy.
- Understanding the Schrodinger equation in polar coordinates.
- Gain knowledge about simple harmonic osciallator model.
- Learn about processes as Rigid rotator model.
- Learn about general characteristics of Valence bond and molecular orbital approaches.
- Understanding the concept of hydrogen atom and hydrogen-like ions.
- Gain insight about determine the specific reaction rate of the hydrolysis of organic compounds. Knowledge about LCAO-MO and VB treatments of H2.
- Acquire knowledge about the degeneracies.

Learning outcomes

Learning the basics of radiation and distribution of energy will enable the students to understand the Schrodinger equation in polar coordinates. This course will enable students to gain knowledge about simple harmonic osciallator model and learn about processes as Rigid rotator model. Learning about general characteristics of Valence bond and molecular orbital approaches.makes a better understanding of the concept of hydrogen atom and hydrogen-like ions. The students will gain insight about determining the specific reaction rate of the hydrolysis of organic compounds, knowledge about LCAO-MO and VB treatments of H2. The course will enable to acquire knowledge about the degeneracies.

UNIT I

Introduction to black-body radiation and distribution of energy, photo-electic effect, concept of quantization, wave particle duality (de-Broglie's hypothesis), The uncertainty principle, The wave function: wave function and its interpretation, conditions of normalization and Orthogonality and its significance. Basic idea about operators, eigen function and values.

UNIT II

Schrodinger equation and application to free-particle and particle in a box, boundary conditions, wave functions and energies, degeneracy, hydrogen atom, Schrodinger equation in polar coordinates, radial and angular parts of the hydrogenic orbitals, degeneracies, spherical harmonics, representations of hydrogenic orbitals. (15 classes of 60 minutes durations)

UNIT III

Quantitative treatment of simple harmonic osciallator model, setting up of Schodinger equation and discussion of solution of wave functions. Rigid rotator model and discussion of application of Schrodinger equation. idea about transformation to spherical polar coordinate, discussion on solution, (15 classes of 60 minutes durations)

UNIT IV

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Valence bond and molecular orbital approaches, LCAO-MO treatment of H2, H +; bonding and anti-bonding orbitals, Comparison of LCAO-MO and VB treatments of H2 (only wavefunctions, detailed solution not required) and their limitations.

Recommended books/References:

1. Laideler K. J. and Meiser J. M. Physical Chemistry Third Edition (International)1999

2. Levine I. N., Physical Chemistry, Fourth Edition), McGraw-Hill (International), 1995.

3. McQuarrie D. A. and Simon J. D. Physical Chemistry- A Molecular Approach, University

Science Books, 1998.

4. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).

5. House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004).

BSCH256A Introduction to Quantum Chemistry Practicals (Credits 2)

(i)The students may be demonstrated hyperchem lab activities – building a molecular model (leveling of atoms, editing individual atoms, changing bond order, centrering, rotation of atoms), Selection of calculation method (e.g.force field calculation, ab-initio set up), displaying calculated properties, (instructor may demonstrate Computer programs that calculate the energy of various conformations of molecules and predict the lowest energy, to learn how to construct or draw representations of molecules using a molecular modeling program called HyperChem (HyperCube, Inc.), to perform geometry optimizations (energy minimizations) to determine the lowest energy conformations of molecules).

(Depending upon the availability of infrastructure facilities, instructor can demonstrate the students use of hyperchem software, Gaussian software – geometry optimization). They can be allowed for academic visit to computational labs to gain knowledge and a report may be considered for viva voce/examination). Open source softwares may be used for lab demonstration and students may prepare a report along with viva-voce shall constitute practical examination. Instructor may encourage the students to gain hand-on experience in using open-source softwares (for perfoming various calculation as mentioned) in lab computers, periodic evaluation of which can also be accepted as conducting lab practical examination. Basic idea is to encourage the students to get knowledge without keeping any rigid practical syllabus framework).

(Examples of the computational work that can be done: Compare the optimized C-C bond lengths in ethane, ethene, ethyne and benzene. Visualize the molecular orbitals of the ethane σ bonds and ethene, ethyne, benzene and pyridine π bonds.

ii. (a) Perform a conformational analysis of butane. (b) Determine the enthalpy of isomerization of

cis and trans 2-butene.

iii. Visualize the electron density and electrostatic potential maps for LiH, HF, N2, NO and CO and comment. Relate to the dipole moments. Animate the vibrations of these molecules.

(Software: ChemSketch, ArgusLab (www.planaria-software.com), TINKER 6.2 (dasher.wustl.edu/ffe), WebLab Viewer, Hyperchem, or any similar software.

(ii). Determination of indicator constant - colorimetry.

(iii). Verification of Beer's Law - Determination of concentration of solution by colorimetry.

Suggested books/reference books:

1.Essentials of computational chemistry – Theories and models, C. J. Crammer, Wiley, 2nd Edn., 2.Principle and applications of quantum chemistry, V.K.Gupta, Elsevier, 2016.

3.Practicals in physical chemistry – a modern approach, P.S.Sindhu, Macmillan,

4. Experiments in Physical Chemistry, J.M.Wilson, R.J.Newcomb, A.R.Denaro, 2nd Edn., Elsevier.

5. A.R. Leach, Molecular Modelling Principles and Application, Longman, 2001.

6. J.M. Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.

7. Gupta, S.P. QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

SEMESTER-V

BSCH301A Inorganic Chemistry-III (Credits 4)

After completion of the course, the learner shall be able to understand:

Learning objective:

- Coordination compounds – its nomenclature, theories, d-orbital splitting in complexes, chelate.
- Transition metals, its stability, color, oxidation states and complexes.
- Lanthanides, Actinides – separation, color, spectra and magnetic behavior
- Bioinorganic chemistry – metal ions in biological system, its toxicity; hemoglobin.
- Understanding the nomenclature of coordination compounds/complexes, Molecular orbital theory, d-orbital splitting in tetrahedral, octahedral, square planar complexes, chelate effects.
- Understanding the transition metals stability in reactions, origin of colour and magnetic properties.
- Understanding the separation of Lanthanoids and Actinoids, its color, spectra and magnetic behavior.
- Understanding the bioinorganic chemistry of metals in biological systems.
- Hemoglobin and its importance in biological systems.

Learning outcomes: Various topics covered in the coordination complexes acquaint the students with their chemistry, stability, nomenclature and bonding. After studying the coordination chemistry, students will get information about different theories of coordination complexes like valence bond theory, crystal field theory and molecular orbital theory. The course provides the complete information about transition elements and inner transition elements like their electronic configuration, oxidation state, their magnetic and coloring properties. Students will be able to understand typical roles and chemistry of the elements, in particular the metal ions which are essential for living systems and rationalize the role of specific metal ions in metalloenzymes for catalyzing energetically and stereo- and enantio-selectively difficult reactions.

UNIT I

Coordination Chemistry

Werner's theory, EAN rule, piano-stool compounds, valence bond theory (inner and outer orbital complexes), Crystal field theory, d-orbital splitting, , weak and strong fields, pairing energies, factors affecting the magnitude of (Δ).

Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar complexes, d orbital splitting in trigonal bipyramidal, square pyramidal and cubic ligand field environments, CFSE, Variation of lattice energies, enthalpies of hydration and crystal radii variations in halides of first and second row transition metal

series, Qualitative aspect of Ligand field theory, MO diagrams of representative coronation complexes, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with the coordination number 4 and 6, Chelate effect,

UNIT II

Transition Elements

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

UNIT III

Lanthanoids and Actinides

Electronic configuration, oxidation states, color, spectra and magnetic behavior, lanthanide contraction, separation of lanthanides (ion-exchange method only).

UNIT IV

Bioinorganic Chemistry

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), toxicity, chelating agents in medicine. Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.

Recommended text books/References:

Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.

Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.

Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry Wiley-VCH, 1999

Basolo, F, and Pearson, R.C. Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967. Greenwood, N.N. & Earnshaw A. Chemistry of the Elements, Butterworth-Heinemann, 1997.

BSCH351A Inorganic Chemistry-III Practicals (Credits 2)

1. Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given on understanding of the chemistry of different reactions. Following radicals may be analyzed:

Carbonate, nitrate, nitrite, sulphide, sulphate, sulphite, acetate, fluoride, chloride, bromide, iodide, borate, oxalate, phosphate, ammonium, potassium, lead, copper, cadmium, bismuth, tin, iron, aluminum, chromium, zinc, manganese, cobalt, nickel, barium strontium, calcium, magnesium. Mixtures containing one interfering anion, or insoluble component (BaSO4, SrSO4, PbSO4, CaF2 or Al2O3) or combination of anions e.g. CO32-and SO32-, NO2- and NO3-,Cl- and Br-, Cl- and I-, Br- and I-, NO3- and Br-, NO3- and I-. Spot analysis/tests should be done whenever possible.

2. Controlled synthesis of two copper oxalate hydrate complexes: kinetic vs thermodynamic factors.

3. Preparation of acetylacetanato complexes of Cu2+/Fe3+. (Also find the λmax of the prepared complex using instrument).

4. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Recommended text books/references:

1. Vogel's Qualitative Inorganic Analysis, Revised by G. Svehla. Pearson Education, 2002.

2. Marr & Rockett Practical Inorganic Chemistry. John Wiley & Sons 1972.

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH303A Molecular Spectroscopy & Photochemistry (Credits 4)

Learning outcomes:

- The students will be able to learn electromagnetic radiation with molecules and various types of spectra. Born- Oppenheimer approximation.
- Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution will enable them to understand the spectrum of atoms and molecules.
- Vibrational spectroscopy diatomic vibrating rotator, P, Q, R branches enables t.

- Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet o study spectrogram of a molecule and identify its structure.
- The phenomenon as fluorescence and phosphorescence dissociation and predissociation, Photophysical and photochemical processes enables the students to give a better understanding of light and illuminations. Quantum yield. Jablonski diagrams, Franck-Condon principle, law of photochemical equivalence, quantum efficiency, low and high quantum efficiency enables tudents to understand the kinetics of photochemical reactions in relation to electronic spectra and photochemistry.

Unit-I

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Unit-II

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation.

Unit-III

Photophysical and photochemical processes: laws of photochemistry, quantum yield. Jablonski diagrams: Franck-Condon principle, Law of photochemical equivalence, quantum efficiency, low and high quantum efficiency. kinetics of photochemical reactions ($H_2 + Br_2 = HBr$, $2HI = H_2 + I_2$), energy transfer in photochemical reactions (photosensitization and quenching), fluorescence, phosphorescence, chemiluminescence, Discussion of Electronic spectra and photochemistry (Lambert-Beer law and its applications).

Recommended books/References:

1. Laideler K. J. and Meiser J. M. Physical Chemistry Third Edition (International)1999

2. Levine I. N., Physical Chemistry, Fourth Edition), McGraw-Hill (International), 1995.

3. McQuarrie D. A. and Simon J. D. Physical Chemistry- A Molecular Approach, University Science Books, 1998

4. Rohatgi-Mukherjee K. K. Fundamentals of Photochemistry, New age (revised second edition).

5. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).

BSCH353A Molecular Spectroscopy & Photochemistry Practicals (Credits 2)

(i). Determination of indicator constant - colorimetry. (instructor may vary indicators available in the lab).

(ii). Verification of Beer's Law - Determination of concentration of solution by colorimetry. (Instructor may explain the principle of using colorimeter, its handling drawing standard calibration curve, and its application in finding unknown concentration of dyes, concentration of metal solutions (e.g.Ni, Cu using appropriate reagent) from standard calibration curve.

Suggested books/reference books:

1. Practicals in physical chemistry – a modern approach, P.S.Sindhu, Macmillan,

2. Experiments in Physical Chemistry, J.M.Wilson, R.J.Newcomb, A.R.Denaro, 2nd Edn., Elsevier.

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

Semester VI

BSCH311A BIOMOLECULES (Credits-4)

Learning Objectives:

This core course aims to introduce the learner to the fascinating chemistry of some biomolecules,i.e., amino acids, peptides, proteins, carbohydrates, lipids andnucleic acidsthat work within biological systems. It aims to build the concept of metabolism by the study of chemistry and energetics of biological system.

Learning Outcomes:

On completion of this course, the students will be able to:

•Understand and demonstrate how structure of biomolecules determines their reactivity and biological functions.

•Gain insight into concepts of heredity through the study of genetic code, replication, transcription and translation.

•Demonstrate understanding of metabolic pathways, their inter-relationship, regulation and energy production from biochemical processes.

Unit I

Nucleic Acids: Structure of components of nucleic acids: Bases, Sugars, Nucleosides and Nucleotides. Nomenclature of nucleosides and nucleotides, structure of polynucleotides (DNA and RNA), concept of DNA duplex formation and its characterization. Biological roles of DNA and RNA. Concept of heredity:Genetic Code, Replication, Transcription and Translation.

Unit II

Amino Acids, Peptides and Proteins: Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structure-end group analysis. Synthesis of peptides using N-protecting, C-protecting and C- activating groups, Solid-phase synthesis; primary, secondary and tertiary structures of proteins, Denaturation of proteins.

Enzymes: Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking chymotrypsin as an example), factors affecting enzyme action, coenzymes and cofactors (NAD,FAD), specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance.

Unit III

Carbohydrates and lipids: Occurrence, classification and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projection and conformational structures; Interconversion of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides – Structure elucidation of maltose, lactose and sucrose. Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

Introduction to oils and fats: common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

Unit IV

Concept of Energy in Biosystems: Introduction to metabolism (catabolism, anabolism). ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change. Agents for

transfer of electrons in biological redox systems: NAD+, FAD. Outline of catabolic pathways of carbohydrate-glycolysis, fermentation, Krebs cycle. Caloric value of food, standard caloric content of food types.

Reference Books:

1. Berg, J.M.; Tymoczko, J.L.; Stryer, L. (2006),Biochemistry. W.H. Freeman and Co.

2. Nelson, D.L.; Cox, M.M.; Lehninger, A.L.(2009),Principles of Biochemistry. W.H. Freeman and Co.

3. Murray, R.K., Granner, D.K., Mayes, P.A.; Rodwell, V.W.(2009),Harper's Illustrated Biochemistry.Lange Medical Books/McGraw-Hill.

4. Brown,T.A. (2018) Biochemistry, (First Indian addition 2018) Viva Books.

BSCH361A BIOMOLECULES LABS (Credits-2)

LIST OF EXPERIMENTS

1. Estimation of glucose by Fehling's solution.
2. Study of the titration curve of glycine.
3. Estimation of proteins by Lowry's method.
4. Study of the action of salivary amylase on starch under optimum conditions.
5. Effect of temperature on the action of salivary amylase.
6. Isolation and estimation of DNA using cauliflower/onion.
7. Saponification value of the given oil.
8. Determination of Iodine number of the given oil.

References books:

1. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.

2. Kumar, A.; Garg, S.; Garg, N. (2012), Biochemical Tests: Principles and Protocols.Viva Books.

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH302A Chemistry of Materials (Credits-4)

After completion of the course, the learner shall be able to understand:

Learning objective:

- Crystalline solids – parameters, symmetry.
- Silica based materials in applications.
- Technological importance of ionic liquids, preparation of materials– using sol-gel technique.
- Nano-structured materials, self-assembled structure.
- Composites and its applications
- Understanding basic parameters of crystalline solids, symmetry and crystal structures.
- Mesoporous/microporous silica based materials, functionalized hybrid materials and its applications.
- Preparation of inorganic solids, host-guest chemistry, ionic liquids and its significance.
- Understanding self-assembled structures, nano-structured materials, carbon nanotubes, applications.
- Understanding composites and their industrial applications.

Learning outcomes:

After complete study of the course, students will understand basic crystallographic and crystal chemical concepts such as unit cells, Bravais lattices, fractional coordinates, Miller indices, close packing, phase diagrams etc. and how to apply them in rationalizing simple inorganic crystal structure types. The different types of defect in crystalline solids are responsible for the electrical conductivity, thermal conductivity and their coloration properties. The course will provide the complete information about the silica based materials and their related functionalized mesoporous materials. They should be familiar with synthesis of crystalline materials via solid state reaction and understand the reaction dynamics of sol-gel and hydrothermal reaction processes and the use of such procedures to synthesize functional nanomaterials and thin films. The course will provide a basic understanding of the composite materials, the role of matrix in composites and use of fibre-reinforced composites in structural applications

UNIT I

Basics of crystalline solids

Crystalline solids, crystal systems, Bravais lattices, coordination number, packing factors – cubic, hexagonal, diamond structures, lattice planes, Miller indices, interplanar distances, directions, types of bonding , lattice energy, Madelung constants, Born Haber cycle, cohesive energy, Symmetry elements, operations , translational symmetries - point groups, space groups, equivalent positions, close packed structures, voids, crystal structures, Pauling rules, defects in crystals, polymorphism, twinning.

UNIT II

Silica based materials

Introduction to Zeolites, metallosilicates, silicalites and related microporous materials, Mesoporous silica, metal oxides and related functionalized mesoporous materials: Covalent organic frameworks, Organic-Inorganic hybrid materials, periodic mesoporous organo silica, metal organic frameworks: H2 /CO2 gas storage and catalytic applications

UNIT III

Inorganic solids/ionic liquids of technological importance

Preparation of inorganic solids: Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydro-thermal method, Ion-exchange and Intercalation methods. Introduction to Solid electrolytes, inorganic liquid crystals. Ionic liquids, forces responsible for ionic liquids, synthesis and application of imidazolium and phosphonium based ionic liquids. Host-guest chemistry (elementary ideas).

Nanomaterials: (8 classes of 60 minutes duration each)

Overview of nanostructures and nano-materials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nano-architecture-one dimensional control. Carbon nanotubes and inorganic nanowires.

UNIT IV

Composite materials

Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites.

Recommend books/References:

1. Atkins P, Overton T., Rourke J. Weller M. and Armstrong F Shriver and Atkins. Inorganic Chemistry Oxford University Press, Fifth Edition, 2012.

3. Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry. John Wiley,1974.

4. Poole, C.P. & Owens, F.J. Introduction to Nanotechnology John Wiley 2003.

5. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning, 2002.

BSCH352A Chemistry of Materials Practicals (Credits-2)

(The list of experiments is suggestive. However, faculties/academic bodies may add more experiments/references or incorporate suitable revisions based on infrastructure facilities available).

1. Preparation of urea-formaldehyde resin

2. Preparations of novalac resin/resol resin

3. Synthesis of materials/porous materials (Sol-gel, hydrothermal, microwave). (Similarly other materials synthesis can be designed).

4. Preparation of silver nano material. (Similarly other nano materials of other metals synthesis can be designed).

5. Analysis of XRD pattern of crystals.

6. Interpretation of FTIR, NMR and UV-Vis data of given material.

7. Estimation of particle size from the BET, SEM techniques.

8. Density measurement of ionic liquids

9. Determining dynamic viscosities of given ionic liquids

10. Determination of hydration number IR spectra.

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH358A Research Project (Credits-6)

Guidelines:

1. Students will be divided among faculty members of the Department for the supervision of the research work.

2. In the first week of Semester V, each faculty member will assign a suitable research topic to the students from the selected topics in the areas of chemical sciences.

3. The student will work on the assigned research topic during semesters V and VI in regular consultation with his/her assigned teacher.

4. The student will write a dissertation based on the research work carried out during Semesters V and VI and prepare two copies to be submitted to the office of the Head of the Department duly signed by the student and the supervisor in the sixth week of VI semester or a date decided by the HOD of the department.

5. Before preparing power point presentation and submission of dissertation, each student has to deliver a seminar talk on his/ her research project work on a date fixed by HOD, necessary suggestions has to be incorporated in the final draft of dissertation.

6. The student will make a power point presentation based on the work carried out and mentioned in the dissertation to the board of examiners appointed by the University.

DISCIPLINE SPECIFIC COURSE-I

BSCH305A Medicinal Chemistry (Credits-4)

After completion of the course, the learner can be able to understand:

- The basics of medicinal chemistry, biophysical properties
- Biological activity parameters
- Drug metabolism
- Biophysical and chemical properties of enzymes, hormones, vitamins
- Concept of rational drug design

UNIT I

Bio-physicochemical properties

Acidity/Basicity, Solubility, Ionization, Hydrophobic properties, Hydrophilic properties, Lipinski Rule, Drug-like properties, Understanding of the biological activity parameters such as Ki, Kd, LD50, EC50, IC50, CC50, ADMET properties

UNIT II

Structural properties

Isosterism, Bioisosterism, Nonclassical isosteres, Understanding of the 3D-structure along with bond length, bond angle and dihydral angle, Concept of Configuration and Conformation with

examples, Concept of stereochemistry in terms of biological response with examples, Stereoselective receptors or enzymes such as muscarinic receptor, Stereochemically pure drug and recemates, Examples such as catecholamines, etc.

UNIT III

Drug target understanding

Metabolism, Drug metabolism, Anti-metabolite, Enzyme inhibitor, Agonist, Antagonist, Examples.

Medicinal Chemistry of Therapeutic Agent

Structure, Chemistry, Mode of action and adverse effect of the representative therapeutic agents such as Anti-infective agent, Antimalarials, Antibacterial, Antiviral, Anticancer, CNS acting drugs, Adrenergic Agents, Cholinergic Drugs, Diuretics, Cardivascular, local anesthetic agent, Analgesic Agents, Histamine and Antihistamine agents

UNIT IV

Steroids, Prostaglandins, Enzyme, Hormone and Vitamins

Biophysico-chemical properties, Steroid Hormone Receptors, Chemical Contraceptive agents, COX-2 inhibitors, Prostaglandins for Ophthalmic use, pharmaceutically important enzyme products such as Pancreatin, Trypsin, Insulin. Classification of vitamins with examples.

Concept of rational drug design

Structure activity relationship, Drug-receptor understanding, Molecular modeling, Structure based drug design. QSAR.

Recommended books/References:

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical ...by Charles Owens Wilson, John H. Block, Ole Gisvold, John Marlowe Beale

2. Foye's Principles of Medicinal Chemistry by David A. Williams, Thomas L. Lemke, William O. Foye (2008), Kluwer publication.

3. Remington: The Science and Practice of Pharmacy Vol 1, Ed. 19 by Joseph Price Remington, Alfonso R. Gennaro. (1995), MACK Publishing.

4. Burgers Medicinal Chemistry by Manfred E. Wolff, Alfred Burger

5. Burgers Medicinal Chemistry and Drug Discovery by Abraham D. J., Lewis F. L., Burger A., vol.5, 6th Edn., 2003, Hoboken N.J.Wiley,

6. The Organic Chemistry of Drug Design and Drug Action by Silverman R. B., 2nd Edn., Academic Press. 2012.

7. Exploring QSAR: Fundamental and applications in Chemistry and Biology by Hansch C. and Leo, A American Chemical Society (1995)

8. Patrick, G. Medicinal Chemistry, Oxford.University Press (2000)

BSCH355A Medicinal Chemistry Practicals (Credits-2)

Practical wok suggested:

1. Purification Techniques of Solvents by Fractional Distillation and Vacuum Distillation 2.Thin Layer Chromatography Technique and Purification of commercially available drugs/Synthesized Compounds by Column Chromatography.

3. Preparation of Acid/Basic Salts of Drugs and Evaluation of their Physicochemical Properties.(Benzilic Acid & Sodium Benzoate)

4. Synthesis & Purification of following Compounds using:

(i)Precipitation or Recrystallization. (ii)Synthesis of Benzimidazole. (iii)Synthesis of Anthranilic Acid. (iv)Synthesis of Sulphanilamide.

(v)Synthesis of benzoic acid from benzyl alcohol. (vi)Synthesis of 1,4 – dihydropyridine.

5. Computational modeling of drug design/use of softwares may be demonstrated to students.

Suggsted books/references:

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J. D. Barnes,

M. J. K Thomas, 6th Edition, Pearson’s Education Ltd.

2. Advanced Practical Medicinal Chemistry, Ashutosh Kar, New Age International Ltd. (2004). 3.Vogel‟s Textbook of Practical Organic Chemistry, B. S. Furniss, A. J. Hannaford , P.W.G.

Smith, A. R Tatchell, 5th edition (2008), Pearson's Education Ltd

(The list of experiments and books are purly suggestive; University/institute may incorporate further changes in number of experiments and books/refererences (updated version from time to time) based on course design and available infrastructure facilities).

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH307A Heterocyclic Chemistry (Credits-4)

UNIT I

Heterocyclic Chemistry

Three-membered rings with one heteroatom: Chemistry of oxiranes, aziridines and episulphides - synthetic approaches and reactivities.

UNIT II

Three-membered heterocycles with two heteroatoms: oxaziranes, diaziridines and diazirines - synthetic approaches and reactivities.

UNIT III

Four-membered heterocycles: oxitanes, azatidanes and thietanes - synthetic approaches and reactivities. natural products: synthesis of Peniciline and cephalosporine.

UNIT IV

Five-membered aromatic heterocycles:

1. With one heteroatom: furans, pyrroles and thiophenes - general synthetic approaches, properties and reactivities.

2. With two heteroatoms: oxazoles, isoxazoles, imidazoles, thiazoles, pyrazoles and isothiazoles - general synthetic approaches and reactivities.

3. With three and four heteroatoms: triazoles and tetrazoles - synthetic approaches, properties and reactivity.

Condensed five-membered Heterocycles: Benzofuran, indoles and benzothiazoles - general synthetic approaches, with greater emphasis on the chemistry of Indoles.

Recommended Books/references:

1. Heterocyclic Chemistry, J.A. Joule, K. Mills, Wiley, 2010.

2. The Essence of heterocyclic Chemistry, A. R. Parikh, H. Parikh, R. Khunt, New Age Int. Publication,

3. Principles of Modern Heterocyclic Chemistry, L. A. Paquette, W. A. Benjamin, New York, 1968.

4. Heterocyclic Chemistry, J.A. Joule and G. F. Smith, van Nostrand, London, 1978.

5. Comprehensive Heterocyclic Chemistry. The structure, reactions, synthesis and use of Heterocyclic compounds, (Ed. A.R. Katritzky and C. W. Rees),. Vol 1-8, Pergamon Press, 1984.

6. Handbook of Heterocyclic Chemistry, A. R. Katritzky, Pergamon Press, 1985.

7. Van der plas, H. C. Ring transformations of Heterocycles, Vols 1 and 2, Academic Press, 1974.

BSCH357A Heterocyclic Chemistry Practicals (Credits-2)

List of suggested laboratory experiments

1. Identification of hetero atoms (S, N, X) in given organic compounds in lab.

2. Identification/separation of simple organic compounds containing hetero atoms using column chromatorgapy/TLC) in lab.

3. Spectroscopic identification of simple organic compounds (spectra may be provided to the students and teachers may help the students to identify the compounds using spectra). Melting point/boiling point of the compounds may be checked for its purity.

4. Teacher may guide the students for preparation of : Indigo (using aldol condensation reaction of 2-nitrobenzaldehyde with acetone in basic condition);

(Depending upon laboratory facilities, more preparation of heterocyclic group of compounds may be incorporated by teacher).

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

DISCIPLINE SPECIFIC ELECTIVE COURSE-II

BSCH309A Advanced Materials Chemistry (Credits-4)

Learning outcomes:

The course will ebnable the students to understand the crystal structure of solids, fundamental of lattices, unit cell, atomic coordinates, Bravais lattices, crystal direction and planes, types of close packing, packing efficiency, radius ratios; few important crystal structures. Synthesis of Inorganic solids enables to synthesise crystals in solid state, solution phase and vapor phase by the processes as precipitation, hydrothermal, sol-gel, surfactant based synthesis. Growth of single crystals can be done using Bottom-up vs. Top-down methods. The students will be able to synthesize nanowires and nanotubes by CVD and MOCVD method along with understanding of Magnetic properties of nanoparticles; superparamagnetism, ferromagnetism in antiferromagnetic nanoparticles and single domain to multidomain transition. magnetic nanoparticles as MRI contrast agents. The syllabus enables students to develop biodegradable polymers, conducting polymers, fibers and rubber.

UNIT I

Crystal structure of solids

Fundamental of lattices, unit cell, atomic coordinates, Bravais lattices, crystal direction and planes, types of close packing, packing efficiency, radius ratios; few important crystal structures.

Synthesis of Inorganic solids; solid state, solution phase and vapor phase synthesis; precipitation, hydrothermal, sol-gel, surfactant based synthesis. Growth of single crystals.

Crystal structure determination by X-ray diffraction, d-spacing formula, symmetrically absent reflections, Multiplicities, Scattering of X-rays by an atom and a crystal. Single crystal and powder diffraction. Electron and neutron diffraction. Concept of reciprocal lattice. Electron microscopy techniques.

UNIT II

Nanomaterial fundamentals

Synthesis: Bottom-up vs. Top-down Methods. Solution phase synthetic methods. Role of surfactant in shape and size control of nanomaterials. Synthesis of nanowires and nanotubes by CVD and MOCVD method.

UNIT III

Nanomaterials Characterization: XRD of nanomaterials, Electron microscopy (SEM, TEM, HRTEM and EDX) of nanomaterials, Scanning probe microscopy.

Nanomaterial properties and applications: Magnetic properties of nanoparticles; superparamagnetism, ferromagnetism in antiferromagnetic nanoparticles and single domain to multidomain transition. magnetic nanoparticles as MRI contrast agents.

UNIT IV

Frontier areas of polymer science and technology

Conducting polymers: basic principles of conducting polymers, delocalized electronic states of conjugated polymers, polyanilines, polyacetylenes, polythiophene, applications of conducting polymers.

Biodegradable polymers: Definition classification of natural biodegradable polymers, cellulose, cellulose acetate, cellophane, soy protein, corn, zein protein, wheat gluten protein, synthetic biodegradable polymers, polyhydroxy alkanoates, polycarpolactone, poly(vinyl alcohol), polyacetic acid, application of biodegradable and biomedical polymers, contact lens, dental polymers, artificial heart, kidney, skin, and blood cells.

Fibers: natural fibers, cotton, wool, silk, rayon, artificial fibers, polyamides, acrylic acid, PVC, PVA.

Rubber: Compounding and elastomeric properties, vulcanization, reinforcement.

Recommended books/References:

1. Zhen Guo and Li Tan, Fundamentals and Applications of Nanomaterials.2009, Artech House, London Publication.

2. Physical methods for chemistry: R. S. Drago, 1992, Saunders college publication.

3. Polymer science, V. R. Gowariker, N. V.Viswanathan, J. Sreedhar, New Age International (P) Ltd., 2015.

4. P. J. Flory, Principle of polymer chemistry, Cornell University Press.

5. Polymer Science and technology, Plastics, Rubber and composites, P. Ghosh, Tata McGraw Hill.

6. V. Gowriker, N. V. Viswanathan, J. Sreedhar, Polymer Science, New Age Int.Publication, 2019.

BSCH359A Advanced Materials Chemistry Practicals (Credits-2)

List of suggested Laboratory Experiment.

(The list of experiments are suggestive. However, faculties/academic bodies may add more experiments/references or incorporate suitable revisions based on infrastructure facilities available).

1. Preparation of gold and silver nano-particles.

2. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein

3. Determination of composition of dolomite (by complexometric titration).

4. Analysis of XRD pattern of few selected crystals like $NaNO_3$, $CaCl_2$, etc.; Indexing of a given powder diffraction pattern of a cubic crystalline system.

5. Interpretation of FTIR, NMR and UV-Vis data of given material.

6. Estimation of particle size from the BET, SEM techniques.

Recommended books/Reference Book:

1.Fahlman, B.D. Materials Chemistry, Springer, 2004.

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSCH321A Organometallic and Bioinorganic Chemistry (Credits-4)

Learning Objective:

- To understand the variable oxidation state of some transition elements
- To study the preparation and properties of Cr, Mn, Fe and Co.
- To describe the basics of organometallic compounds
- The synthesis and general properties of mono and binuclear carbonyl organometallic compounds
- Structural features of Metal alkyl compounds.
- Preparation, structure and properties of ferrocene
- Role of metal ions present in biological system
- Role of Ca^{2+} ions blood clotting

Learning outcomes:

The students should be familiar with variable oxidation state of transition elements like Cr, Fe, Co and Ni. They will get information about various common compounds of transitions

elements which are used in laboratory on daily basis. The students will develop the ability to understand basics of organometallic compounds, concepts of hepaticity, EAN rule and back pi bonding. They will learn about Ziegler – Natta catalyst which is an example of metal alkyl compound and also used as catalyst on large scale in various inorganic preparations. They will get the knowledge of Synergic effect that have wide application in chemistry especially metathesis, catalysis and infra-red analysis. The bioinorganic chemistry explain the importance of the role and chemistry of metal ions in human life. The course give the competence to predict and understand the function of Mg2+ and Ca2+ ions in daily basis life.

UNIT I

Chemistry of 3d metals: Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

UNIT II

Organometallic Compounds

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. pi-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

UNIT III

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects

(VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies). Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.

UNIT IV

Bioinorganic chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

Recommended books/reference books

1. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.

2. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry Wiley-VCH, 1999

3. Basolo, F, and Pearson, R.C. Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.

4. Greenwood, N.N. & Earnshaw A. Chemistry of the Elements, Butterworth-Heinemann, 1997

BSCH371A Organometallic and Bioinorganic Chemistry Practicals (Credits-2)

List of Laboratory experiments

(Necessary infrastructure may be developed and adequate precaution should be maintained to conduct such experiments; instructor may demonstate the experiment to students)

1. Rection of metal with halide – preparation of Grignard reagent. (only demonstration purpose)

2. Grignard preparation of dye (malachite green (using methylbenoate)/crystal violet (using diethylcarbonate) (starting material as p-bromo N, N-dimethyl aniline) (only demonstration purpose)

3. Preparation of various Schiff base-metal complexes and their identification using spectroscopy.

4. Preparation of any two of the following complexes and measurement of their conductivity measurement:

a. tetraamminecarbonatocobalt (III) nitrate

b. tetraamminecopper (II) sulphate

c. potassium trioxalatoferrate (III) trihydrate

Recommended books/reference books

1. Synthesis of organometallic compounds: A practical guide, S. Komiya, Wiley.

2. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.

3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall,

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

GENERIC ELECTIVE COURSES

Generic elective courses are both theory and practical based. Both Honours and Pass students can choose the course as outlined in the pattern of modeled credit distribution. Some of the courses are based largely on practical. These courses shall have the following credit pattern.

BSMA151A Basics of Mathematics-I (Credits-4)

Fundamentals of mathematics: (10 classes of 60 minutes duration each)

Mathematical functions, polynomial expressions, logarithms, exponential function, units of a measurement, inter-conversion of units, constants and variables, equation of a straight line, plotting graphs, data representation, pi-charts, histogram.

Uncertainty in experimental techniques: Displaying uncertainties and measurements in chemistry, decimal places, significant figures, combining quantities.

Uncertainties in measurement: types of uncertainties, combining uncertainties. Use of statistical tools, Data reduction and the propagation of errors, binomial, Poisson and Gaussian distributions, Graphical and numerical data reduction. Numerical curve fitting: the method of least squares (regression).

Algebraic operations on real scalar variables, Roots of quadratic equations analytically and iteratively, Numerical methods of finding roots (Newton-Raphson, binary –bisection).

Mathematical series: (10 classes of 60 minutes duration each)

Power series, Maclaurin, Taylor series, convergence (e.g. pressure virial equation of state, colligative properties). Pythagoras theorem in three dimensions. Trigonometric functions, identities.

Differential calculus: (10 classes of 60 minutes duration each)

The tangent line and the derivative of a function, numerical differentiation, differentials of higher order derivatives, discontinuities, stationary points, maximum-minimum problems, inflexion points, limiting values of functions: L'Hopital's rule, combining limits.

Calculus of several variables: Functions, change of variables, total differential, chain rule, partial differentiation, Euler's theorem, exact and inexact differentials (applications tin the domains of thermodynamics, surface chemistry), line/surface-integrals.

Integral calculus: (10 classes of 60 minutes duration each)

Integration, odd-even functions, indefinite integrals, standard integrals, methods of integration (by parts, substitution, partial fractions and others. Examples from kinetics, thermodynamics, nuclear chemistry and surface chemistry, numerical integration (Trapezoidal and Simpson rules, e.g. entropy/enthalpy change from heat capacity data), probability distributions and mean values. Tri- gonometric functions (applications in chemistry need to be emphasized throughout)

Recommended Books/References:

1 Chemical Maths Book, E. Steriner, Oxford University Press (1996).

2 Maths for Chemists, Vols 1 and 2 M. C. R. Cockett and G. Dogget, Royal Society of Chemistry, Cambridge (2003).

(The above course structure, number of classes and recommended books/references are suggestive. Faculty/academic bodies may incorporate revision as per need).

BSMA153A Basics of Mathematics-I Practicals (Credits-2)

(PRACTICALS/COMPUTATIONAL TOOL WORKS NEED TO BE DESIGNED BY FACUTLIES BASED ON THE AVAILABLE FACILITIES)

BSCH233A Life Science/Biology-I (Credits-4)

Cell and Cellular Processes: (14 classes of 60 minutes)

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components

Cell Organelles

Mitochondria: Structure, marker enzymes, composition; mitochondrial biogenesis; Semiautonomous organelle; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA

Chloroplast: Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA ER, Golgi body & Lysosomes: Structures and roles. Signal peptide hypothesis, N-linked glycosylation, Role of golgi in O-linked glycosylation. Cell secretion, Lysosome formation.

Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis.

Nucleus (10 classes of 60 minutes duration each)

Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome

The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall

Cell Cycle: (6 classes of 60 minutes duration each)

Role of Cell division; Overview of Cell cycle; Molecular controls; Meiosis Interphase, Mitosis and Meiosis.

Instrumentation techniques: (10 classes 60 minutes duration each)

Principles of microscopy; Light Microscope; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Introduction to Electron microscopy (EM)- Scanning EM and sample analysis with examples.

Recommended books/References:

1. Campbell, N.A. and Reece, J. B. Biology (Eighth edition) Pearson Benjamin Cummings, San Francisco, (2008).

2. Raven, P.H et al Biology, Seventh edition Tata McGraw Hill, New Delhi (2006).

3 Sheeler, P and Bianchi, D.E. Cell and Molecular Biology (Third edition) John Wiley (2006)

(The above course structure, number of classes and recommended books/references are suggestive. Faculty/academic bodies may incorporate revision as per need).

BSCH273A Life Science/Biology-I Practicals (Credits-2)

Tutorials/practical for Biology (preferably any six from the following list)

1. Study of prokaryotic cells (bacteria), viruses, eukaryotic cells using microscope.

2. Study of the photomicrographs of cell organelles

3. To study the structure of plant cell through temporary mounts.

4. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.

5. Preparation of temporary mounts of striated muscle fiber

6. To prepare temporary stained preparation of mitochondria from striated muscle cells/ cheek epithelial cells using vital stain Janus green.

7. To prepare temporary stained squash from root tips of Allium cepa and to study the various stages of mitosis.

8. Study the effect of temperature, organic solvent on semi permeable membrane.

9. Demonstration of dialysis of starch and simple sugar.

10. Study of plasmolysis and deplasmolysis on Rhoeo leaf.

11. Measure the cell size (either length or breadth/diameter) by micrometry.

12. Study the structure of nuclear pore complex by photograph (from Gerald Karp)

(Note: A candidate has to perform at least eight experiments in the lab. Any suitable experiment may be added.)

BSPH121A Basics of Physics-I (Credits-4)

Mathematical Physics: (8 classes of 60 minutes duration each)

Scalar and vector products, polar and axial vectors, triple and quadruple products.

Vector calculus:

Scalar and vector fields, differentiation of a vector, gradient, divergence, curl and O operations and their meaning, idea of line, surface and volume integrals, Gauss and Stokes' theorem.

Classical Mechanics: (18 classes of 60 minutes duration each)

Particle dynamics: Newton's laws of motion, conservation of linear momentum, center of mass, conservative forces, work energy theorem, particle collision.

Rotational kinematics and dynamics: Rotational motion, forces and pseudo forces, torque and angular momentum, kinetic energy of rotation, rigid body rotation dynamics, moment of inertia, conservation of angular momentum, comparison of linear and angular momentum, motion of a top. Oscillations: Linearity and superposition principle, free oscillation with one and two degrees of freedom, simple pendulum, combination of two simple harmonic motions. Lissajous figures, free and damped vibrations, forced vibrations and resonance, Q factor; wave equation, travelling and standing waves, superposition of waves, phase and group velocity.

Wave optics: (14 classes of 60 minutes duration each)

Interference, division of amplitudes, Young's double split, Fresnel's biprism, interference in thin films and wedged shaped films. Fresnel diffraction: Diffraction at a single slit and a circular aperture, diffraction at a double split, plane transmission grating, resolving power of a telescope and a microscope, resolving and dispersive power of a plane diffraction grating. Polarization: Polarization by reflection and refraction, Brewster's law, double refraction, nicol

prism, quarter and half-wave plates, Production and analysis of circularly and elliptically polarized light.

Recommended Text books/references:

1. Spiegel, M. R. Vector Analysis Schaum Outline Series. McGraw-Hill (1974)

2. Beiser, A. Concepts of Modern Physics McGraw-Hill (2002).

3. Resnick, R., Halliday, D. and Krane, K. S. Physics I and II Fifth Ed. John Wiley (2004)

4. Serway, R. A. & Jewett, J. W. Physics for Scientists and Engineers Sixth Ed.

(The above course structure, number of classes and recommended books/references are suggestive. Faculty/academic bodies may incorporate revision as per need).

BSPH161A Basics of Physics-I Practicals (Credits-2)

(Recommended that physics practical to be carried out from mechanics and optics as per availability of facilities with minimum 3 experiments from each group)

Group-A: Mechanics

1. Determination of spring constant of a spring by (i) static, and (ii) dynamic methods.

2. Study of damped harmonic oscillator- Q factor.

3. Determination of temperature coefficient of resistance using platinum resistance thermometer.

4. Study of thermal couple calibration and inversion temperature.

5. LCR study of resonance Q-factor.

6. Kator's pendulum- Bar pendulum.

Group-B:Optics

7. Determination of wavelength of light by Fresnel's biprism.

8. Determination of wavelength of sodium light by Newton's arrangement.

9. Determination of refractive index of tint glass using a spectrometer.

10. Determination of dispersive power of a glass prism using Cauchy's constant. Also determine the resolving power of a prism.

11. Determination of wavelength of sodium light using a plane transmission grating and resolving power of a diffraction grating.

12. Determination of specific rotation of cane sugar solution using a polarimeter.

BSMA152A Basics of Mathematics-II (Credits-4)

Differential equations: (8 classes of 60 minutes duration each)

Solving differential equations with separable variables, series solution, numerical solutions of differential equations those appear in Newtonian mechanism, harmonic oscillator, Linear differential equations with constant coefficients.

Partial differential equations: separation of variables. (10 classes of 60 minutes duration each)

Multiple integrals. Change variables. Vector derivative operators. Multiple integrals involving other coordinate systems (spherical polar). Maximum and minimum of functions of several variables. Stationary points, complex numbers, complex plane, Euler's formula and polar form of complex numbers, complex conjugates, modulus of a complex number.

Operators: (6 classes of 60 minutes duration each)

Operator algebra, linear and Hermitian operators, eigenfunctions and eigenvalues, commutators of operators.

Vectors and coordinate systems: (6 classes of 60 minutes duration each)

Unit vectors (application in solid state), addition and subtraction of vectors, multiplication of vectors. Vector calculus. Vectors and coordinate systems in three dimensions (Cartesian, spherical polar and their inter-conversion), Jacobian.

Determinants and Matrices: (10 classes of 60 minutes each)

Determinant, Matrix algebra, Simultaneous equations: method of substitution and elimination, consistency and independence. Homogeneous linear equations. Simultaneous equations with more than two unknowns, Cramer's rule, matrix inversion, orthogonal and unitary matrices, diagonalization of a matrix.

Recommended Books/references:

McQuarrie D. A. Mathematics for Physical Chemistry Opening Doors, University Science Books (2008).

(The above course structure/number of classes are suggestive. Faculty/academic bodies may incorporate revision/may incorporate text and reference books as per need).

BSMA154A Basics of Mathematics-II Practicals (Credits-2)

(Suitable Laboratory Practicals may be designed by the faculty of Mathematics/Chemistry based on above course modules and available facilities)

BSPH122A Basics of Physics-II (Credits-4)

Electrostatics and magnetism: (15 classes of 60 minutes duration each)

Electric field, potential due to a charge distribution and due to a dipole, electrical potential energy, flux, Gauss's law, electric field in a dielectric, polarization, energy stored in an electric field. Magnetic field due to a current-carrying conductor, Biot Savart law, magnetic force on a current, Lorentz force, electromagnetic induction, Lenz's law, magnetic properties of matter, para- dia- and ferromagnetism, spinning of a magnetic dipole in an external magnetic field. Modification of Ampere's law, equation of continuity and displacement current, Maxwell's equations, wave equation and its plane wave solution, nature of electromagnetic waves, tranversality and polarization, propagation of electromagnetic plane waves in dielectric media.

Electronics: (15 classes of 60 minutes duration each)

Half-wave, full-wave and bridge rectifiers, ripple factor, rectification efficiency, filters (series in inductor, shunt capacitator, LC and π sections), voltage regulations, load regulation, Zener diode as voltage regulator. Characteristic curves of bipolar transistors, static and dynamic load line, biasing (fixed and self) of transistor circuit, thermal instability of bias, the black box idea of CE, CB and CC transistor circuits as two-port network, small signal active output, hybrid model of a CE transistor circuit, analysis of a small signal amplifier: its voltage and current gains, negative and positive feedback. Barkhausen's criterion for self-sustaining oscillations, LC and phase shift oscillators.

Digital electronics: (10 classes of 60 minutes duration each)

Number systems (binary, BCD, octal and hexadecimal), 1's and 2's complements. Logic gates, AND, OR, NAND, NOR, XOR and NXOR. Boolean algebra (Boolean laws and simple expressions), binary adders, half adder, half subtractor, full adder and full subtractor.

Recommended Text books/References:

1. Griffiths, D. J. Introduction to Electromagnetism 3rd Ed. Prentice-Hall (1999).

2. Malvino, A.P. & Leach, D. P. Digital Principles and Applications, Tata McGraw- Hill (2008).

3. Ryder, J. D. Electronic Fundamentals and Applications: Integrated and Discrete Systems. 5th Ed. Prentice-Hall, Inc. (2007).

4. Floyd, T. L. & Buchla, D. M. Electronics Fundamentals: Circuits, Devices and Applications

(8th Ed.) Prentice-Hall (2009).

(The above course structure/number of classes are suggestive. Faculty/academic bodies may incorporate revision/may incorporate text and reference books as per need).

BSPH162A Basics of Physics-II Practicals (Credits-2)

1. Ballistic Galvanometer: resistance, current sensitivity, charge sensitivity, and critical damping resistance of the galvanometer.

2. Determination of high resistance by leakage method.

3. Determination of mutual inductance by Ballistic Galvanometer.

4. Operations and measurements by Cathode Ray Oscilloscope (CRO). Calibration of DC and AC voltages, frequency and phase measurements of a signal.

5. Study of transistor characteristics (CB, CE, CC configurations).

6. Study of power supply (rectification factor, voltage and load regulation for C, L, CL and π filters).

7. Study of basic RC coupled amplifier (frequency response and band width).

8. Self-inductance measurement by Owen's bridge.

9. Measurement of magnetic field by search coil.

10. To verify experimentally OR, NAD, NOT, NOR, NAND gates.

(The above lists of experiments are suggestive. Faculty/academic bodies may incorporate revision in the list of experiments depending upon experimental facilities available/may incorporate text and reference books as per need).

BSCH234A	**Life Science/ Biology II**	**L**	**T**	**P**	**C**
		3	1	0	**4**

LIFE SCIENCE/BIOLOGY-II

Course description: The students will be introduced to the principles of normal biological function in the human body. Basic human physiology will be outlined and correlated with histological structures. The course also provides students with a basic understanding of human endocrine glands, neuro-endocrine glands and their structure, function and signaling pathways. Students will also study the influence of biological rhythm on hormone secretion. Learning outcomes: Course Outcome After the completion of the course, the student will be able to Cognitive Level

C.O.1. Explain the principles of normal biological function in human body. Understand
C.O.2. Compare histological structures with their function Analyze
C.O.3. Discuss how animals maintain an internal homeostatic state in response to changes in their external environment. Understand
C.O. 4. Describe the endocrine system and the basic properties of hormones. Understand
C.O. 5. Gain insight into the molecular mechanism of hormone action and its regulation. Understand
C.O.6. List the endocrine disorders and critically analyze their own and their family`s health issues.

UNIT I (11 hrs)

Nutritional physiology: Structure and digestive system: General introduction, types of nutrition, mechanical and chemical changes of food in the alimentary canal, balanced diet, nutritional disorders-PEM, vitamin and mineral deficiency, hormonal control of digestion Circulatory physiology: Structure of heart, Blood composition and functions of blood plasma and formed elements, blood groups, mechanism of blood clotting, intrinsic and extrinsic pathways, disorders of blood clotting, anticoagulants, heartbeat, conducting system and pacemaker, pulse and blood pressure, clinical significance, control of cardiac activity, common cardiovascular diseases-arteriosclerosis, atheroslecrosis, myocardial infarction, electrocardiogram, angiogram, angioplasty, Lymph and lymphatic system.

UNIT II (11 hrs)

Respiratory physiology: Structure of lungs. Gas exchange, respiratory pigments-structure of haemoglobin, transport of oxygen-Oxyhaemoglobin curve, Bohn effect, transport of CO2carbonic acid, carbamino haemoglobin, bicarbonate and chloride shift, carbon monoxide poisoning, bronchitis, asthma, physiological effects of smoking, fibrosis

Unit III

Renal Physiology: Structure of kidney. Nephron-structure, urine formation, counter current multiplier system, the role of the kidney in osmoregulation, renal disorders-nephritis, haematurea, renal calculi, acidosis, and alkalosis-, fibrosis, Dialysis and kidney transplantation

UNIT IV (10 hrs)

Muscle Physiology: Brief account of types of muscles, fast and slow twitch muscles, red and white muscles, the ultrastructure of striated muscle fibre, muscle proteins, simple muscle twitch, summation, tetanus, tonus, ALL or None Law, fatigue, oxygen belt, rigor mortis, physiological and biochemical events in muscle contraction.

REFERENCES Physiology

1. Best and Taylor. (1990). Physiological basis of Medical Practice. Wilkins Co.
2. Eckert, R. and D. Randell. (1987). Animal Physiology, CBS Publishers and Distributors N. Delhi.
3. Ganong, W.F. (2003), Review of Medical Physiology, McGraw Hill, New Delhi. 4. Guyton, A.C. (1981). Textbook of Medical Physiology, W.B. Saunders Co.
5. Hoar, W.S.(1975). General and Comparative Physiology, Prentice-Hall. 65
6. Mac. Eleroy, W.D. (1971). Cell Physiology and Biochemistry. Prentice-Hall of India Ltd.
7. Nagabhushanan, R., Kaobarkar M.S. and Sarojini, R. (1983). A textbook of animal physiology, Oxford IBH Publishing Co., New Delhi.

BSCH274A	Life Science/ Biology II Practicals	L	T	P	C
		0	0	4	**2**

LIFE SCIENCE/BIOLOGY-II PRACTICALS

1. Preparation of temporary mounts: Blood film.
2. Demonstration of haemoglobin using Sahli‘s haemoglobinometer.
3. Examination of permanent histological sections of mammalian, stomach, lung, kidney, thyroid, pancreas, testis, ovary.
4. Determination of ABO Blood group.
5. Recording of blood pressure using a Sphygmomanometer in resting condition. 6. Study of the permanent slides of all the endocrine glands
7. Estimation of plasma level of any hormone using ELISA
8. Chromatographic separation of steroid hormones using paper chromatography
9. Survey based project on any prevalent endocrine disorder

7.1 Annexure-A

B.Sc. (H) Chem.			Year 2020-2023 (Scheme of Studies)								SBAS			
YEAR	**ODD SEMESTER**							**EVEN SEMESTER**						
	S.No	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**	**S.No**	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
FIRST	1	BSCH101A	INORGANIC CHEMISTRY-I	4	0	0	4	1	BSCH102A	PHYSICAL CHEMISTRY-I	3	1	0	4
	2	BSDM3A	DISASTER MANAGEMENT	3	0	0	3	2	BSCH152A	PHYSICAL CHEMISTRY-I PRACTICALS	0	0	4	2
	3	BSCH125A	ENVIRONMENTAL STUDIES	3	0	0	3	3	BSCH106A		3	1	0	4
	4	BSCH103A	ORGANIC CHEMISTRY-I	3	1	0	4	4	BSCH156A	INORGANIC CHEMISTRY-I PRACTICALS	0	0	4	2
	5	BSCH153A	ORGANIC CHEMISTRY-I PRACTICALS	0	0	4	2	5	BSCH108A	ORGANIC CHEMISTRY-II	3	1	0	4
	6	BSCH109A	HERBAL TECHNOLOGY	2	0	0	2	6	BSCH158A	ORGANIC CHEMISTRY-II PRACTICALS	0	0	4	2
	7	BSCH111A	FERMENTATION SCIENCE AND TECHNOLOGY	2	0	0	2		BSCH110A	INTELLECTUAL PROPERTY RIGHT (IPR) AND BUSINESS SKILLS FOR CHEMISTS	2	0	0	2
	8		GENERIC ELECTIVE- I	4	2	0	6			GENERIC ELECTIVE -II	4	2	0	6
	9		ONLINE COURSE - I (IIT Bombay spoken tutorial: Introduction to computer)	2	0	0	2							
	TOTAL						**28**		**TOTAL**					**26**
SECOND	1	BSCH201A	PHYSICAL CHEMISTRY-II	3	1	0	4	1	BSCH202A	PHYSICAL CHEMISTRY-III	3	1	0	4
	2	BSCH251A	PHYSICAL CHEMISTRY-II PRACTICALS	0	0	4	2	2	BSCH252A	PHYSICAL CHEMISTRY-III PRACTICALS	0	0	4	2
	3	BSCH203A	ORGANIC CHEMISTRY-III	3	1	0	4	3	BSCH206A	INORGANIC CHEMISTRY-II	3	1	0	4
	4	BSCH253A	ORGANIC CHEMISTRY-III PRACTICALS	0	0	4	2	4	BSCH254A	INORGANIC CHEMISTRY-II PRACTICALS	0	0	4	2
	5	BSCH205A	ANALYTICAL TECHNIQUES OF CHEMISTRY	3	1	0	4	5	BSCH208A	INTRODUCTION TO QUANTUM CHEMISTRY	3	1	0	4
	6	BSCH255A	ANALYTICAL TECHNIQUES OF CHEMISTRY PRACTICALS	0	0	4	2	6	BSCH256A	INTRODUCTION TO QUANTUM CHEMISTRY PRACTICALS	0	0	4	2
	7		GENERIC ELECTIVE- III	3	1	0	4	7		GENERIC ELECTIVE- IV	3	1	0	4
	8		GENERIC ELECTIVE -III PRACTICALS	0	0	4	2	8		GENERIC ELECTIVE -IV PRACTICALS	0	0	4	2
	TOTAL						**24**	**TOTAL**						**24**

THIRD	1	BSCH301A	INORGANIC CHEMISTRY-III	3	1	0	4		1	BSCH311A	BIOMOLECULES	4	0	0	4
	2	BSCH351A	INORGANIC CHEMISTRY-III PRACTICALS	0	0	4	2		2	BSCH361A	BIOMOLECULES LAB	0	0	4	2
	3	BSCH303A	MOLECULAR SPECTROSCOPY AND PHOTOCHEMISTRY	3	1	0	4		3	BSCH302A	CHEMISTRY OF MATERIALS	3	1	0	4
	4	BSCH353A	MOLECULAR SPECTROSCOPY AND PHOTOCHEMISTRY PRACTICALS	0	0	4	2		4	BSCH352A	CHEMISTRY OF MATERIALS PRACTICALS	0	0	4	2
	5		DISCIPLINE ELECTIVE –I	3	1	0	4		5		DISCIPLINE ELECTIVE -III	3	1	0	4
	6		DISCIPLINE ELECTIVE -I PRACTICALS	0	0	4	2		6		DISCIPLINE ELECTIVE -III PRACTICALS	0	0	4	2
	7		DISCIPLINE ELECTIVE -II	3	1	4	4		7		DISCIPLINE ELECTIVE -IV	3	1	4	4
	8		DISCIPLINE ELECTIVE -II PRACTICALS	0	0	4	2		8		DISCIPLINE ELECTIVE -IV PRACTICALS	0	0	4	2
									9	BSCH358A	RESEARCH PROJECT	0	0	2	6
	TOTAL						**24**		**TOTAL**						**30**

	DISCIPLINE ELECTIVE-I								**DISCIPLINE ELECTIVE-III**						
	BSCH305A	MEDICINAL CHEMISTRY	3	1	0	**4**		BSCH304A	ENVIRONMENTAL CHEMISTRY	3	1	0	**4**
	BSCH355A	MEDICINAL CHEMISTRY PRACTICALS	0	0	4	**2**		BSCH354A	ENVIRONMENTAL CHEMISTRY PRACTICALS	0	0	4	**2**
	BSCH307A	HETREOCYCLIC CHEMISTRY	3	1	0	**4**		BSCH306A	ORGANIC SPECTROSCOPY	3	1	0	**4**
	BSCH357A	HETREOCYCLIC CHEMISTRY PRACTICALS	0	0	4	**2**		BSCH356A	ORGANIC SPECTROSCOPY PRACTICALS	0	0	4	**2**
	DISCIPLINE ELECTIVE-II								**DISCIPLINE ELECTIVE-IV**						
	BSCH309A	ADVANCE MATERIAL CHEMISTRY	3	1	0	**4**		BSCH308A	INTRODUCTION OF NANOCHEMISTRY AND APPLICATIONS	3	1	0	**4**
	BSCH359A	ADVANCE MATERIAL CHEMISTRY PRACTICALS	0	0	4	**2**		BSCH368A	INTRODUCTION OF NANOCHEMISTRY AND APPLICATIONS PRACTICALS	0	0	4	**2**
	BSCH321A	ORGANOMETALLIC AND BIOINORGANIC CHEMISTRY	3	1	0	**4**		BSCH310A	GREEN PROCESSES OF CHEMISTRY	3	1	0	**4**
	BSCH371A	ORGANOMETALLIC AND BIOINORGANIC CHEMISTRY PRACTICALS	0	0	4	**2**		BSCH360A	GREEN PROCESSES OF CHEMISTRY PRACTICALS	0	0	4	**2**
								BSCH332A	POLYMER CHEMISTRY	3	1	0	**4**
								BSCH372A	POLYMER CHEMISTRY PRACTICALS	0	0	4	**2**
	Total Credits: 156														
	Student can choose two non-credit courses (2 hours per week), one in odd semester and one in even semester during the entire duration of Programme from the pool of courses provided by the university.														
	Generic Electives (I& II)														
	BSMA281A	BASICS OF MATHEMATICS-I	3	1	0	**4**		BSPH222A	BASICS OF PHYSICS-II	3	1	0	**4**
	BSMA283A	BASICS OF MATHEMATICS-I PRACTICALS	0	0	4	2		BSPH262A	BASICS OF PHYSICS-II PRACTICALS	0	0	4	2
	BSPH221A	BASICS OF PHYSICS-I	3	1	0	**4**		BSCH233A	LIFE SCIENCE/BIOLOGY-I	3	1	0	**4**
	BSPH261A	BASICS OF PHYSICS-I PRACTICALS	0	0	4	2		BSCH273A	LIFE SCIENCE/BIOLOGY-I PRACTICALS	0	0	4	2
	BSMA282A	BASICS OF MATHEMATICS-II	3	1	0	**4**		BSCH234A	LIFE SCIENCE/BIOLOGY-II	3	1	0	**4**
	BSMA284A	BASICS OF MATHEMATICS-II PRACTICALS	0	0	4	2		BSCH274A	LIFE SCIENCE/BIOLOGY-II PRACTICALS	0	0	4	2

7.4 Annexure-D

B.Sc.(H) Programme	Year 2020-2023 (Scheme of Studies)	SBAS

YEAR	ODD SEMESTER								EVEN SEMESTER						
	S. No.	COURSE CODE	COURSE TITLE	L	T	P	C		S.No	COURSE CODE	COURSE TITLE	L	T	P	C
FIRST	1	BSEL145A	COMMUNICATION SKILLS	4	0	0	4		1		CHEMISTRY ELECTIVE	3	1	0	4
	2	BSDM301A	DISASTER MANAGEMENT	3	0	0	3		2		CHEMISTRY ELECTIVE LAB	0	0	4	2
	3	BSCH125A	ENVIRONMENTAL STUDIES	3	0	0	3		3		PHYSICS ELECTIVE	4	0	0	4
	4	BSCH103A	ORGANIC CHEMISTRY-I	3	1	0	4		4		PHYSICS ELECTIVE LAB	0	0	4	2
	5	BSCH153A	ORGANIC CHEMISTRY-I PRACTICALS	0	0	4	2		5	BSMA124A	ORDINARY DIFFERENTIAL EQUATIONS	4	0	0	4
	6		GENERIC ELECTIVE- I	4	2	0	6		6	BSMA174A	ORDINARY DIFFERENTIAL EQUATIONS LAB	0	0	4	2
	7		ONLINE COURSE - I (IIT Bombay spoken tutorial: Introduction to computer)	2	0	0	2		7	BSCH110A	INTELLECTUAL PROPERTY RIGHT (IPR) AND BUSINESS SKILLS FOR CHEMISTS	2	0	0	2
									8		GENERIC ELECTIVE -II	4	2	0	6
	TOTAL						24				TOTAL				26

CHEMISTRY ELECTIVE					
BSCH102A	PHYSICAL CHEMISTRY-I	3	1	0	4
BSCH152A	PHYSICAL CHEMISTRY-I PRACTICALS	0	0	4	2
BSCH106A	INORGANIC CHEMISTRY-I	3	1	0	4
BSCH156A	INORGANIC CHEMISTRY-I PRACTICALS	0	0	4	2
PHYSICS ELCTIVE					
BSPH102A	ELECTRICITY AND MAGNETISM	4	0	0	4
BSPH152A	ELECTRICITY AND MAGNETISM LAB	0	0	4	2
BSPH103A	MECHANICS	4	0	0	4
BSPH153A	MECHANICS LAB	0	0	4	2