K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF BASIC

AND

APPLIED SCIENCES

B.Sc. (Hons.) Chemistry

B.Sc. (Hons.) Physics

B.Sc. (Hons.) Mathematics

2020-21

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.

3. Programmes offered by the School

School offers undergraduate B.Sc. Programme, 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.

3.4 B.Sc. Programme

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: - Chemistry, Physics, Mathematics, Environmental Studies, Communication skills, Introduction to Computers, Disaster Management

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.

4. Programme Duration

The minimum period required for the B.Sc. Program and 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. Program and B.Sc. (Hons) Programme offered by the University shall be five 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 courses for first year for all the programmes 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. Programme and B.Sc. (Hons.) Programme

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.

TEXT BOOKS:

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.

BSEL155A COMMUNICATION SKILLS (Credits 4)

Course Level Learning Outcomes

1. Understand the basics of Grammar to improve written and oral communication skills.
2. Understand the correct form of English with proficiency
3. Improve student's personality and enhance their self-confidence.
4. Improve professional communication.
5. 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)**

PROGRAMME 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.

PROGRAM 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

- Baron, R.A., Byrne, D. & Bhardwaj, G. (2010). Social Psychology (12th Ed).New Delhi: Pearson.
- Berk, L. (2013). Child Development. New York: Pearson.
- Brannon, L. (2017). Gender: Psychological Perspectives (7th edition). New Delhi Routledge.
- 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).
- Cambridge: Cambridge University Press. Carson, RC, Butcher, J. N, Mineka, S., & Hooley, J. (2007). Abnormal Psychology. Delhi:

- 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.
- Ghosh, B. (2011). Cultural changes and challenges in the era of globalization: The case of India. Journal of Developing Societies, 27(2), 153-175.
- Snyder, C.R., Lopez, S.J. & Pedrotti, J. (2011). Positive Psychology: The Scientific and Practical Explorations of Human Strengths. New Delhi: Sage
- Arnett, J.J. (2013). Adolescence and Emerging Adulthood (5th Ed). Delhi: Pearson.
- Bansal, P. (2012). Youth in Contemporary India: Images of Identity and Social Change. New Delhi: Springer.
- Baumgardner, SR & Crothers, MK (2009). Positive Psychology. Delhi: Pearson.
- Carr, A. (2004). Positive Psychology: The Science of Happiness and Human Strength. New York: Brunner- Routledge.
- Connidis, I. A. & Barnett, A.E. (2010). Family Ties and Aging. London: Sage.
- Helgeson, V.S. (2018). Psychology of Gender (5th Edition). New Delhi: Routledge.
- Shaffer, D.R. & Kipp, K. (2010). Developmental Psychology: Childhood and Adolescence. California: Wadsworth.
- 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 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 -

1. Provide students an exposure to disasters, their significance and types.
2. Ensure that the students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
3. Provide the students a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
4. 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.

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

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:

1. Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.
2. Stereochemistry of organic molecules – conformation and configuration, asymmetric molecules and nomenclature.
3. Aromatic compounds and aromaticity, mechanism of aromatic reactions.
4. Understanding hybridization and geometry of atoms, 3-D structure of organic molecules, identifying chiral centers.
5. Reactivity, stability of organic molecules, structure, stereochemistry.
6. Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways.
7. Mechanism of organic reactions (effect of nucleophile/leaving group, solvent), substitution *vs*. elimination.
8. 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 4)

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:

1. Checking the calibration of the thermometer.
2. Purification of organic compounds by crystallization using the following solvents:
3. a. Water b. Alcohol c. Alcohol-Water
4. Determination of the melting points of given organic compounds and unknown organic compounds (using Kjeldahl method and electrically heated melting point apparatus).
5. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.
6. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)
7. Chromatography
8. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
9. Separation of a mixture of two sugars by ascending paper chromatography
10. 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.)

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 4)

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.

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:

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

Learning outcomes

Unit I deals 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 4)

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 text books/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.)

BSCH106A INORGANIC CHEMISTRY-I (Credits 4)

Overview:

On completion of this course, the students will be able to understand: atomic theory and its evolution.

Objective and Expected Outcome:

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

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

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

1. *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.
2. Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
3. Atomic radii (van'der Waals)
4. Ionic and crystal radii.
5. Covalent radii (octahedral and tetrahedral)
6. Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
7. Electron gain enthalpy, trends of electron gain enthalpy.
8. 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.

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., N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, 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

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

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, 5^{th} Ed^{n}.

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)

Overview:

Experiments in Inorganic Chemistry aim to facilitate experimental work in the Inorganic chemistry laboratory. Experiments that have a simple theoretical background and useful to students to gain confidence in his ability to perform inorganic chemistry experiment and to appreciate the value of the experimental approach.

Objective and Expected Outcome:

The student explores the Titrimetric Analysis of primary and secondary standard solutions, Acid-Base Titration and Oxidation-Reduction Titrimetry.

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.

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

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.)

BSCH104A ORGANIC CHEMISTRY-II (Credits 4)

Overview:

The course deals with 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.

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.

Learning objective:

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

1. Familiarization about classes of organic compounds and their methods of preparation.
2. Basic uses of reaction mechanisms.
3. Name reactions, uses of various reagents and the mechanism of their action.

4. Preparation and uses of various classes of organic compounds.
5. Organometallic compounds and their uses.
6. Organic chemistry reactions and reaction mechanisms.
7. Use of reagents in various organic transformation reactions.

Chemistry of Halogenated Hydrocarbons

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – S_N1, S_N2 and S_N^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 $LiAlH_4$

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, $LiAlH_4$, $NaBH_4$, MPV, PDC and PGC);
Addition 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.

BSCH104A ORGANIC CHEMISTRY-II PRACTICALS (Credits 4)

Organic preparations:

1. 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)
2. 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.
3. Oxidation of ethanol/ isopropanol (Iodoform reaction).
4. Bromination (any one)
5. Acetanilide by conventional methods
6. Acetanilide using green approach (Bromate-bromide method)
7. Nitration: (any one)

a. Acetanilide/nitrobenzene by conventional method

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

8. Selective reduction of *meta* dinitrobenzene to *m*-nitroaniline.
9. Reduction of *p*-nitrobenzaldehyde by sodium borohydride.
10. Hydrolysis of amides and esters.
11. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
12. *S*-Benzylisothiouronium salt of one each of water soluble/ insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
13. Aldol condensation with either conventional or green method.
14. 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.)

BSCH134A INTELLECTUAL PROPERTY RIGHT (IPR) AND BUSINESS SKILLS FOR CHEMISTS (Credits 2)

Overview:

The course introduces the concept of Intellectual Property and how it can be protected. It helps in understanding patents, design rights and copyright and how to extract key information from chemistry patents, understanding Trade Secrets, Confidentiality Agreements and Ownership of IP and how IPR can be valued and traded including licensing, assignment, etc.

Objective and Expected Outcome:

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.

Trade Marks

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

6.4 Syllabi of Courses specific to B.Sc. (Hons.)Physics

SEMESTER-I

BSPH206A ANALOG SYSTEMS AND APPLICATIONS (Credits 4)

Course Objective

This course introduces the concept of semiconductor devices and their applications. It also emphasizes on understanding of amplifiers, oscillators, operational amplifier and their applications.

Course Learning Outcomes

At the end of this course, the following concepts will be learnt

- Characteristics and working of pn junction.
- Two terminal devices: Rectifier diodes, Zener diode, photodiode etc
- NPN and PNP transistors: Characteristics of different configurations, biasing, stabilization and their applications.
- CE and two stage RC coupled transistor amplifier using h-parameter model of the transistor.
- Designing of different types of oscillators and their stabilities.
- Ideal and practical op-amps: Characteristics and applications.
- In the laboratory course, the students will be able to study characteristics of various diodes and BJT. They will be able to design amplifiers, oscillators and DACs. Also different applications using Op-Amp will be designed.

Unit I

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity.PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Derivation for Barrier Potential, Barrier Width and Current for abrupt Junction. Equation of continuity, Current Flow Mechanism in Forward and Reverse Biased Diode.

Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter, (2) Zener Diode and Voltage Regulation. Principle, structure and characteristics of (1) LED, (2) Photodiode and (3) Solar Cell, Qualitative idea of Schottky diode and Tunnel diode.

Unit II

Bipolar Junction transistors: n-p-n and p-n-p Transistors. I-V characteristics of CB and CE Configurations. Active, Cutoff and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow.

Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network.h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.

Coupled Amplifier: Two stage RC-coupled amplifier and its frequency response.

Unit III

Feedback in Amplifiers: Positive and Negative Feedback. Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.

Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.

Unit IV

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.

Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Comparator and Zero crossing detector (8) Wein bridge oscillator.

Conversion: D/A Resistive networks (Weighted and R-2R Ladder). Accuracy and Resolution.

References for Theory:

Essential Readings :

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.

2. Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall

3. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India

4. Electronic Principles, A. Malvino, D.J. Bates, 7th Edition, 2018, Tata Mc-Graw Hill Education.

5. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson.

Additional Readings:

1. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI

2. Learning Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill OP-Amps

3. Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning

4. Microelectronic Devices & Circuits, David A.Bell, 5th Edn.,2015, Oxford University Press

5. Basic Electronics: Principles and Applications, C.Saha, A.Halder, D.Ganguli, 1st Edition, 2018, Cambridge University Press

BSPH256A ANALOG SYSTEMS AND APPLICATIONS LAB (Credits 2)

Course Objective

Session on the construction and use of specific analogue devices and experimental apparatuses used in the lab, including necessary precautions.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.

Course Learning Outcomes

Application to the specific experiments done in the lab.

At least 08 experiments from the following:

1. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
2. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
3. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
4. To study the various biasing configurations of BJT for normal class A operation.
5. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
6. To study the frequency response of voltage gain of a two stage RC-coupled transistor amplifier.
7. To design a Wien bridge oscillator for given frequency using an op-amp.
8. To design a phase shift oscillator of given specifications using BJT.
9. To design a digital to analog converter (DAC) of given specifications.
10. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
11. (a) To design inverting amplifier using Op-amp (741,351) & study its frequency response

(b) To design non-inverting amplifier using Op-amp (741,351) and study frequency response

12. (a) To add two dc voltages using Op-amp in inverting and non-inverting mode

(b) To study the zero-crossing detector and comparator.

13. To design a precision Differential amplifier of given I/O specification using Op-amp.
14. To investigate the use of an op-amp as an Integrator.
15. To investigate the use of an op-amp as a Differentiator.
16. To design a circuit to simulate the solution of simultaneous equation and 1st/2ndorder differential equation.

References for Laboratory Work:

1. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994, Mc-Graw Hill. OP-Amps

BSPH105A PHYSICS WORKSHOP SKILL (Credits 4)

Course Objective

The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode. This course enable students to understand working of various measuring devices and different type of errors student can encounter in the measurement process. This course also develops the mechanical skills of the students by direct exposure to different machines and tools by demonstration and experimental technique.

Course Learning Outcomes

After completing this course, student will be able to :

- Learning measuring devices like Vernier callipers, Screw gauge, travelling microscope and Sextant for measuring various length scales.
- Acquire skills in the usage of multimeters, soldering iron, oscilloscopes, power supplies and relays.
- Developing mechanical skill such as casting, foundry, machining, forming and welding and will become familiar with common machine tools like lathe, shaper, drilling, milling, surface machines and Cutting tools.
- Getting acquaintance with prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axle. Lever mechanism. Lifting of heavy weight using lever. braking systems, pulleys.

UNIT-I

Introduction: Measuring units. conversion to SI and CGS. Familiarization with meterscale, Vernier caliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc.

UNIT-II

Mechanical Skill: Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet.

UNIT-III

Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuitshaving discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay

UNIT-IV

Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears withmotor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.

Reference Books:

- A text book in Electrical Technology - B L Theraja – S. Chand and Company.
- Performance and design of AC machines – M.G. Say, ELBS Edn.
- Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
- Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN: 0750660732]
- New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]

SEMESTER-II

BSPH101A MATHEMATICAL PHYSICS-I (Credits 4)

Course Objective

The emphasis of course is to equip students with the mathematical and critical skills required in solving problems of interest to physicists. The course will also expose students to fundamental computational physics skills enabling them to solve a wide range of physics problems. The skills developed during course will prepare them not only for doing fundamental and applied research but also for a wide variety of careers.

Course Learning Outcomes

After completing this course, student will be able to

- Draw and interpret graphs of various functions.
- Solve first and second order differential equations and apply these to physics problems.
- Understand the concept of gradient of scalar field and divergence and curl of vector fields.
- Perform line, surface and volume integration and apply Green's, Stokes' and Gauss's Theorems to compute these integrals.
- Apply curvilinear coordinates to problems with spherical and cylindrical symmetries.
- Understand elementary probability theory and the properties of discrete and continuous distribution functions.
- In the laboratory course, the students will be able to design, code and test simple programs in C++ in the process of solving various problems.

UNIT-I

Calculus:

Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions, Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only).

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral.

UNIT-II

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

Vector Calculus: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

UNIT-III

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

UNIT-IV

Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Introduction to probability:

Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance. Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesi testing.

Dirac Delta function and its properties:

Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.

Reference Books:

- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
- An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
- Differential Equations, George F. Simmons, 2007, McGraw Hill.
- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
- Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book

- Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
- Mathematical Physics, Goswami, 1st edition, Cengage Learning
- Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
- Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
- Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press.
- Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.

BSPH151A MATHEMATICAL PHYSICS-I LAB (Credits 4)

Course Objective

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems
- The course will consist of lectures (both theory and practical) in the Lab
- Evaluation done not on the programming but on the basis of formulating the problem
- Aim at teaching students to construct the computational problem to be solved
- Students can use any one operating system Linux or Microsoft Windows

Course Leaning Outcomes

Topics	**Description with Applications**
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow- emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D & 2D)

	and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs:	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of pi (π)
Solution of Algebraic and Transcendental equations by Bisection, Newton Raphsonand Secant methods	Solution of linear and quadratic equation,
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions
Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method	Given Position with equidistant time data to calculate velocity and acceleration and vice versa. Find the area of B-H Hysteresis loop
Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods	First order differential equation . Radioactive decay . Current in RC, LC circuits with DC source . Newton's law of cooling . Classical equations of motion.

Referred Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
- Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Pub.
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rd Edn. , 2007, Cambridge University Press.
- A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
- Elementary Numerical Analysis, K.E. Atkinson, 3 r d E d n . , 2 0 0 7 , Wiley India Edition.
- Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
- An Introduction to computational Physics, T.Pang, 2nd Edn. , 2006,Cambridge Univ. Press
- Computational Physics, Darren Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.

BSPH103A **MECHANICS** **(Credits 4)**

Course Objective

This course reviews the concepts of mechanics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with Newton's Laws of Motion and ends with the Fictitious Forces and Special Theory of Relativity. Students will also appreciate the Collisions in CM Frame, Gravitation, Rotational Motion and Oscillations.

The students will be able to apply the concepts learnt to several real world problems.

Course Learning Outcomes

Upon completion of this course, students are expected to

- Understand laws of motion and their application to various dynamical situations.
- Learn the concept of inertial reference frames and Galilean transformations. Also, the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.
- Understand translational and rotational dynamics of a system of particles.
- Apply Kepler's laws to describe the motion of planets and satellite in circular orbit.
- Understand concept of Geosynchronous orbits
- Explain the phenomenon of simple harmonic motion.
- Understand special theory of relativity - special relativistic effects and their effects on the mass and energy of a moving object.
- In the laboratory course, the student shall perform experiments related to mechanics:
- compound pendulum, rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity), fluid dynamics, estimation of random errors in the observations etc.

UNIT-I

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable-mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by nonconservative forces. Law of conservation of Energy.

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

UNIT-II

Rotational Dynamics: Angular momentum of a particle and system of particles.Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire. (3 Lectures)

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

UNIT-III

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere.

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS)

Oscillations: SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

UNIT-IV

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

Special Theory of Relativity: Michelson-Morley Experiment and its outcome.Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum.

Reference Books:

- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Additional Books for Reference

- Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
- University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
- Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010,
- Cengage Learning
- Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

BSPH153A MECHANICS LAB (Credits 2)

Course Objective

Demonstration cum laboratory sessions on the construction and use of Vernier callipers, screw gauge and travelling microscope, and necessary precautions during their use.

Sessions and exercises on the least count errors, their propagation and recording in final result up to correct significant digits, linearization of data and the use of slope and intercept to determine unknown quantities.

Session on the writing of scientific laboratory reports, which may include theoretical and practical significance of the experiment performed, apparatus description, relevant theory, necessary precautions to be taken during the experiment, proper recording of observations, data analysis, estimation of the error and explanation of its sources, correct recording of the result of the experiment, and proper referencing of the material taken from other sources (books, websites, research papers, etc.)

Course Leaning Outcomes

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling
2. microscope.
3. To study the random error in observations.
4. To determine the height of a building using a Sextant.
5. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
6. To determine the Moment of Inertia of a Flywheel.
7. To determine g and velocity for a freely falling body using Digital Timing Technique
8. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's
9. method).
10. 8. To determine the Young's Modulus of a Wire by Optical Lever Method.
11. 9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
12. 10. To determine the elastic Constants of a wire by Searle's method.
13. 11. To determine the value of g using Bar Pendulum.
14. 12. To determine the value of g using Kater's Pendulum.

Reference Books:

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt.Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

BSPH102A ELECTRICITY AND MAGNETISM (Credits 4)

Course Objective

This course begins with elementary vector analysis, an essential mathematical tool for understanding static electric field and magnetic field. By the end of the course student should appreciate Maxwell's equations.

Course Learning Outcomes

At the end of this course, students will be able to

- Gain the concepts of vector analysis.
- Apply Gauss's law of electrostatics to solve a variety of problems.
- Articulate knowledge of electric current, resistance and capacitance in terms of electric field and electric potential.
- Calculate the magnetic forces that act on moving charges and the magnetic fields due to currents (Biot- Savart and Ampere laws)
- Gain brief idea of dia, para and ferro-magnetic materials
- Understand the concepts of induction and self-induction, to solve problems using Faraday's and Lenz's laws
- Have an introduction to Maxwell's equations.
- In the laboratory course the student will get an opportunity to verify network theorems and study different circuits such as RC circuit, LCR circuit. Also, different methods to measure low and high resistance, capacitance etc.

UNIT-I

Electric Field and Electric Potential

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry.

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole.

UNIT-II

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics.

UNIT-III

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

Magnetic Properties of Matter: Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis.

UNIT-IV

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits.

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR.

Reference Books:

- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

BSPH152A ELECTRICITY AND MAGNETISM LAB (Credits 2)

Course Objective

Dedicated demonstration cum laboratory sessions on the construction, functioning and uses of different electrical bridge circuits, and electrical devices like the ballistic galvanometer.

Sessions on the review of scientific laboratory report writing, and on experimental data analysis, least square fitting, and computer programme to find slope and intercept of straight line graphs of experimental data.

Course Leaning Outcomes

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Foster's Bridge.
5. To compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin and Norton theorems.
8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Anderson's bridge.
10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
13. Determine a high resistance by leakage method using Ballistic Galvanometer.
14. To determine self-inductance of a coil by Rayleigh's method.
15. To determine the mutual inductance of two coils by Absolute method.

Reference Books:

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.

BSPH106A ELECTRICAL CIRCUITS AND NETWORK SKILLS (Credits 4)

Course Objectives

To develop an understanding of basic principles of electricity and its household applications. To impart basic knowledge of solid state devices and their applications, understanding of electrical wiring and installation.

Course Leaning Outcomes

At the end of this course, students will be able to

- Demonstrate good comprehension of basic principles of electricity including ideas about voltage, current and resistance.
- Develop the capacity to analyze and evaluate schematics of power efficient electrical circuits while demonstrating insight into tracking of interconnections within elements while identifying current flow and voltage drop.
- Gain knowledge about generators, transformers and electric motors. The knowledge would include interfacing aspects and consumer defined control of speed and power.
- Acquire capacity to work theoretically and practically with solid-state devices.
- Delve into practical aspects related to electrical wiring like various types of conductors and cables, wiring-Star and delta connections, voltage drop and losses.
- Measure current, voltage, power in DC and AC circuits, acquire proficiency in fabrication of regulated power supply.
- Develop capacity to identify and suggest types and sizes of solid and stranded cables, conduit lengths, cable trays, splices, crimps, terminal blocks and solder.

UNIT-I

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. (4 Lectures) Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

UNIT-II

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources

UNIT-III

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)

UNIT-IV

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star anddelta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. **Reference Books:**

- A text book in Electrical Technology - B L Theraja - S Chand & Co.
- A text book of Electrical Technology - A K Theraja
- Performance and design of AC machines - M G Say ELBS Edn.

6.4 Syllabi of Courses specific to B.Sc. (Hons.) Mathematics

SEMESTER – I

BSMA121A CALCULUS (Credits 4)

Overview:

This is considered a first course in calculus, primarily for students intending to continue to advanced courses in calculus, and mathematics in general. Students conduct a detailed study of differential calculus and its applications, and are introduced to antiderivatives.

Course Learning Outcomes: This course will enable the students to:

i) Assimilate the notions of limit of a sequence and convergence of a series of real numbers.
ii) Calculate the limit and examine the continuity of a function at a point.
iii) Understand the consequences of various mean value theorems for differentiable functions.
iv) Sketch curves in Cartesian and polar coordinate systems.
v) Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Sequences and Integration: Real numbers, Sequences of real numbers, Convergence of sequences and series, Bounded and monotonic sequences; Definite integral as a limit of sum, Integration of irrational algebraic functions and transcendental functions, Reduction formulae, Definite integrals.

Limit and Continuity: $\epsilon - \delta$ definition of limit of a real valued function, Limit at infinity and infinite limits; Continuity of a real valued function, Properties of continuous functions, Intermediate value theorem, Geometrical interpretation of continuity, Types of discontinuity; Uniform continuity.

Differentiability: Differentiability of a real valued function, Geometrical interpretation of differentiability, Relation between differentiability and continuity, Differentiability and monotonicity, Chain rule of differentiation; Darboux's theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Geometrical interpretation of mean value theorems; Successive differentiation, Leibnitz's theorem.

Expansions of Functions: Maclaurin's and Taylor's theorems for expansion of a function in an infinite series, Taylor's theorem in finite form with Lagrange, Cauchy and Roche–Schlomilch forms of remainder; Maxima and minima.

Curvature, Asymptotes and Curve Tracing: Curvature; Asymptotes of general algebraic curves, Parallel asymptotes, Asymptotes parallel to axes; Symmetry, Concavity and convexity, Points of inflection, Tangents at origin, Multiple points, Position and nature of double points; Tracing of Cartesian, polar and parametric curves.

References:

1. Howard Anton, I. Bivens & Stephan Davis (2016). *Calculus* (10th edition). Wiley India.
2. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer-Verlag.
3. Wieslaw Krawcewicz & Bindhyachal Rai (2003). *Calculus with Maple Labs*. Narosa.
4. Gorakh Prasad (2016). *Differential Calculus* (19th edition). Pothishala Pvt. Ltd.
5. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). *Thomas*' *Calculus* (14th edition). Pearson Education.

BSMA171A CALCULUS LAB (Credits 2)

Overview:

The purpose of these labs is to help students talk and write in meaningful ways about mathematics. Specifically to describe quantities and changes in quantities clearly in terms of context, to make rigorous arguments about how such quantities are related, and to make connections between these features in the contexts and on graphs.

Modeling of the following problems using MATLAB / Mathematica / Maple etc.

List of Practical's

- Plotting the graphs of the functions $exp(ax+b), log(ax+b), 1/(ax+b), sin(ax+b), cos(ax+b)$, and to illustrate the effect of a and b on the graph.
- Plotting the graphs of the polynomial of degree 4 and 5.
- Calculate the limit and derivative of above function.
- Sketching parametric curves (eg. Trochoid, cycloid, hypocycloid).
- Obtaining surface of revolution of curves.
- Tracing of conics in Cartesian coordinates/polar coordinates.
- Sketching ellipsoid, hyperboloid of one and two sheets (using Cartesian co-ordinates)

BSMA123A ALGEBRA AND GEOMETRY (Credits 6)

Overview:

Algebra is designed to give students a foundation for all future mathematics courses. The fundamentals of algebraic problem-solving are explained. Students will explore the basic concepts of matrices, relation between the roots and coefficients of general polynomial equation in one variable, Nature of roots by inspection of change of sign of equations. Throughout the course the student learns how to apply the concepts in real-life situations.

This course will introduce to the analytic geometry with examples from real life and various sciences. In selecting such problems for our examples and exercises we highlighted this motivation by references to applications in the social, business, and life sciences. The course was prepared with three related objectives: concreteness, motivation and applicability.

Course Learning Outcomes: This course will enable the students to:

i) Understand the importance of roots of real and complex polynomials and learn various methods of obtaining roots.
ii) Familiarize with relations, equivalence relations and partitions.
iii) Employ De-Moivre's theorem in a number of applications to solve numerical problems.
iv) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.
v) Find eigenvalues and corresponding eigenvectors for a square matrix.
vi) Explain the properties of three dimensional shapes.

Theory of Equations and Complex Numbers: Elementary theorems on the roots of an equations including Cardan's method, The remainder and factor theorems, Synthetic division, Factored form of a polynomial, The Fundamental theorem of algebra, Relations between the roots and the coefficients of polynomial equations, Imaginary roots, Integral and rational roots; Polar representation of complex numbers, The n^{th} roots of unity, De-Moivre's theorem for integer and rational indices and its applications.

Relations and Basic Number Theory: Relations, Equivalence relations, Equivalence classes; Functions, Composition of functions, Inverse of a function; Finite, countable and uncountable sets; The division algorithm, Divisibility and the Euclidean algorithm, The fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences; Principles of mathematical induction and well ordering.

Row Echelon Form of Matrices and Applications: Systems of linear equations, Row reduction and echelon forms, Linear independence, The rank of a matrix and applications; Introduction to linear transformations, The matrix of a linear transformation, Matrix operations, Determinants, The inverse of a matrix, Characterizations of invertible matrices; Applications to Computer Graphics; Eigenvalues and eigenvectors, The characteristic equation and the Cayley-Hamilton theorem.

Planes, Straight Lines and Spheres: Planes-Distance of a point from a plane, Angle between two planes, pair of planes, Bisectors of angles between two planes; Straight lines- Equations of straight lines, Distance of a point from a straight line, Distance between two straight lines, Distance between a straight line and a plane; Spheres- Different forms, Intersection of two spheres, Orthogonal intersection, Tangents and normal, Radical plane, Radical line, Coaxial system of spheres, Pole, Polar and Conjugacy.

Locus, Surfaces, Curves and Conicoids: Space curves, Algebraic curves, Ruled surfaces, Some standard surfaces, Classification of quadric surfaces, Cone, Cylinder, Central conicoids, Tangent plane, Normal, Polar planes, and Polar lines.

References:

1. Titu Andreescu, & Dorin Andrica (2014). *Complex Numbers from A to...Z*. (2^{nd} edition). Birkhäuser.
2. Robert J. T. Bell (1994). *An Elementary Treatise on Coordinate Geometry of Three Dimensions*. Macmillan India Ltd.
3. D. Chatterjee (2009). *Analytical Geometry: Two and Three Dimensions*. Narosa Publishing House.
4. Leonard Eugene Dickson (2009). *First Course in the Theory of Equations*. The Project Gutenberg EBook (http://www.gutenberg.org/ebooks/29785)
5. Edgar G. Goodaire & Michael M. Parmenter (2015). *Discrete Mathematics with Graph Theory* (3^{rd} edition). Pearson Education Pvt. Ltd. India.
6. Bernard Kolman & David R. Hill (2003). *Introductory Linear Algebra with Applications* (7^{th} edition). Pearson Education Pvt. Ltd. India.
7. David C. Lay, Steven R. Lay & Judi J. McDonald (2016). *Linear Algebra and its Applications* (5^{th} edition). Pearson Education Pvt. Ltd. India.

BSMA122A MULTIVARIABLE CALCULUS (Credits 4)

Overview:

The goal of this chapter is to see that many quantitates in various scientific fields depend on more than one variable: the strength of the gravitational force between two bodies depend on their masses and their distance apart; the monthly mortgage payments depend on the amount borrowed, the interest rate, and the number of years to pay off. Then we will see many different ways of representing functions of several variables including algebraic formulas, graphs, contour diagrams, cross sections, and numerical tables.

Course Learning Outcomes: This course will enable the students to:

i) Learn conceptual variations while advancing from one variable to several variables in calculus.
ii) Apply multivariable calculus in optimization problems.
iii) Inter-relationship amongst the line integral, double and triple integral formulations.
iv) Applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.
v) Realize importance of Green, Gauss and Stokes' theorems in other branches of mathematics.

Partial Differentiation: Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Tangent planes, Chain rule, Directional derivatives, The gradient, Maximal and normal properties of the gradient, Tangent planes and normal lines.

Differentiation: Higher order partial derivatives, Total differential and differentiability, Jacobians, Change of variables, Euler's theorem for homogeneous functions, Taylor's theorem for functions of two variables and more variables, Envelopes and evolutes.

Extrema of Functions and Vector Field: Extrema of functions of two and more variables, Method of Lagrange multipliers, Constrained optimization problems, Definition of vector field, Divergence, curl, gradient and vector identities.

Double and Triple Integrals: Double integration over rectangular and nonrectangular regions, Double integrals in polar co-ordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals, Triple integration in cylindrical and spherical coordinates, Change of variables in double and triple integrals, Dirichlet integral.

Green's, Stokes' and Gauss Divergence Theorem: Line integrals, Applications of line integrals**:** Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral, Surface integrals, Stokes' theorem, The Gauss divergence theorem.

References:

1. Jerrold Marsden, Anthony J. Tromba & Alan Weinstein (2009). *Basic Multivariable Calculus*, Springer India Pvt. Limited.
2. James Stewart (2012). *Multivariable Calculus* (7^{th} edition). Brooks/Cole. Cengage.
3. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). *Calculus* (3^{rd} edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.

BSMA172A MULTIVARIABLE CALCULUS LAB (Credits 2)

Modelling of the following problems using MATLAB / Mathematica / Maple etc.

List of Practicals

- Evaluate the integration of the function
- Evaluate the double/ triple integral integration of the function
- Evaluate the area of closed curve
- Evaluate the arc length of curve
- Evaluate the Volume of closed curve
- Find the critical points and use Mathematica to graph the surface and determine the max/min/saddle nature of these points.
- Calculate the dot and cross product of vectors
- Calculate the Gradient of a vector, Divergence and Curl of vector

BSMA124A ORDINARY DIFFERENTIAL EQUATIONS (Credits 4)

Overview:

An ordinary differential equation (ODE) is an equation that involves some ordinary derivatives (as opposed to partial derivatives) of a function. Often, our goal is to solve an ODE, i.e., determine what function or functions satisfy the equation. In general, solving an ODE is more complicated than simple integration. ODEs of arbitrary order with constant coefficients are treated. It is shown how to obtain the general solution to a linear second-order ODE if a single solution to the related homogeneous ODE is available.

Course Learning Outcomes: The course will enable the students to:

i) Understand the genesis of ordinary differential equations.
ii) Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
iii) Know Picard's method of obtaining successive approximations of solutions of first order differential equations, passing through a given point in the plane and Power series method for higher order linear equations, especially in cases when there is no method available to solve such equations.
iv) Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.
v) Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day to day problems arising in physical, chemical and biological disciplines.

First Order Differential Equations: Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p. Clairaut's form and singular solutions. Picard's method of successive approximations and the statement of Picard's theorem for the existence and uniqueness of the solutions of the first order differential equations.

Second Order Linear Differential Equations: Statement of existence and uniqueness theorem for linear differential equations, General theory of linear differential equations of second order with variable coefficients, Solutions of homogeneous linear ordinary differential equations of second order with constant coefficients, Transformations of the equation by changing the dependent/independent variable, Method of

variation of parameters and method of undetermined coefficients, Reduction of order, Coupled linear differential equations with constant coefficients.

Higher Order Linear Differential Equations: Principle of superposition for a homogeneous linear differential equation, Linearly dependent and linearly independent solutions on an interval, Wronskian and its properties, Concept of a general solution of a linear differential equation, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler-Cauchy equation, Method of variation of parameters and method of undetermined coefficients, Inverse operator method.

Series Solutions of Differential Equations: Power series method, Legendre's equation, Legendre polynomials, Rodrigue's formula, Orthogonality of Legendre polynomials, Frobenius method, Bessel's equation, Bessel functions and their properties, Recurrence relations.

Applications: Orthogonal trajectories, Acceleration-velocity model, Minimum velocity of escape from Earth's gravitational field, Growth and decay models, Malthusian and logistic population models, Radioactive decay, Drug assimilation into the blood of a single cold pill; Free and forced mechanical oscillations of a spring suspended vertically carrying a mass at its lowest tip, Phenomena of resonance, LCR circuits, Lotka-Volterra population model.

References:

1. Belinda Barnes & Glenn Robert Fulford (2015). *Mathematical Modelling with Case Studies***:** *A Differential Equation Approach Using* Maple *and* MATLAB (2^{nd} edition). Chapman & Hall/CRC Press, Taylor & Francis.
2. H. I. Freedman (1980). *Deterministic Mathematical Models in Population Ecology*. Marcel Dekker Inc.
3. Erwin Kreyszig (2011). *Advanced Engineering Mathematics* (10^{th} edition). Wiley.
4. Daniel A. Murray (2003). *Introductory Course in Differential Equations*, Orient.
5. B. Rai, D. P. Choudhury & H. I. Freedman (2013). *A Course in Ordinary Differential Equations* (2^{nd} edition). Narosa.
6. Shepley L. Ross (2007). *Differential Equations* (3^{rd} edition), Wiley India.
7. George F. Simmons (2017). *Differential Equations with Applications and Historical Notes* (3^{rd} edition). CRC Press. Taylor & Francis.

SMA174A ORDINARY DIFFERENTIAL EQUATIONS LAB (Credits 2)

Modeling of the following problems using MATLAB / Mathematica / Maple etc.

List of Practicals

1. Plotting of second order solution family of differential equation.
2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Lake pollution model
6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model)
9. Basic Epidemic model of influenza
10. Basic Battle model

BSMA125A LaTeX and HTML (Credits 2)

Overview:

LaTeX is a pervasive markup language these days. But there are lots of problems in getting from a LaTeX source file to a final document — usually in either PostScript (PS) or Adobe's Portable Document Format (PDF) form — that can be sent to a printer, displayed on the Web, or e-mailed to other people.

LaTeX *per se* knows nothing about typefaces or graphics. It's merely a tool for arranging rectangular objects — the bounding boxes of characters or images — on pages. From the point of view of its layout engine, printed letter-forms (called glyphs in typesetting jargon) are merely reusable graphics to be arranged in rows (lines of type, from the user's point of view).

Course Learning Outcomes: After studying this course the student will be able to:

i) Create and typeset a LaTeX document.
ii) Typeset a mathematical document using LaTex.
iii) Learn about pictures and graphics in LaTex.
iv) Create beamer presentations.
v) Create web page using HTML.

Getting Started with LaTeX: Introduction to TeX and LaTeX, Typesetting a simple document, Adding basic information to a document, Environments, Footnotes, Sectioning and displayed material.

Mathematical Typesetting with LaTeX: Accents and symbols, Mathematical typesetting (elementary and advanced)**:** Subscript/ Superscript, Fractions, Roots, Ellipsis, Mathematical Symbols, Arrays, Delimiters, Multiline formulas, Spacing and changing style in math mode.

Graphics and Beamer Presentation in LaTeX: Graphics in LaTeX, Simple pictures using PSTricks, Plotting of functions, Beamer presentation.

HTML: HTML basics, Creating simple web pages, Images and links, Design of web pages.

References:

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
2. Lamport, Leslie (1994). *LaTeX*: *A Document Preparation System*, User's Guide and Reference Manual (2nd ed.). Pearson Education. Indian Reprint.

BSMA173A LaTeX and HTML LAB (Credits 2)

Practical / Lab work to be performed in Computer Lab

- Introduction to TeX and LaTeX, Typesetting a simple document, Adding basic information to a document, Environments, Footnotes, Sectioning and displayed material.
- Accents of symbols, Mathematical typesetting (elementary and advanced): Subscript/Superscript, Fractions, Roots, Ellipsis, Mathematical symbols, Arrays, Delimiters,
- Multiline formulas, Spacing and changing style in math mode.
- Graphics in LaTeX, Simple pictures using PSTricks, Plotting of functions.
- Beamer presentation
- HTML basics, Creating simple web pages
- Adding images and links, Design of web pages

B.Sc. (H) Chem.	Year 2020-2023 (Scheme of Studies) August 22, 2020													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	BSCH102A	PHYSICAL CHEMISTRY-I	3	1	0	4
	2	BSDM301A	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	INORGANIC CHEMISTRY-I	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							26

										TOTAL					
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	0	0	4	**2**

											PRACTICALS				
		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

B. Sc. (H) PHYSICS

SCHEME OF STUDIES (YEAR 2020 - 2023)

	ODD SEMESTER								EVEN SEMESTER							
	SN	COURSE CODE	COURSE TITLE	TEACHING SCHEDULE			C		SN	COURSE CODE	COURSE TITLE	TEACHING SCHEDULE			C
				L	T	P						L	T	P	
FIRST	1	BSEL145A	COMMUNICATION SKILLS	4	0	0	4		1	BSPH101A	MATHEMATICAL PHYSICS-I	4	0	0	4
	2	BSDM301A	DISASTER MANAGEMENT	3	0	0	3		2	BSPH151A	MATHEMATICAL PHYSICS-I LAB	0	0	4	2
	3	BSCH125A	ENVIRONMENTAL STUDIES	3	0	0	3		3	BSPH102A	ELECTRICITY AND MAGNETISM	4	0	0	4
	4		GENERIC ELECTIVE- I	4	2	0	6		4	BSPH152A	ELECTRICITY AND MAGNETISM LAB	0	0	4	2
		BSPH206A	ANALOG SYSTEMS AND APPLICATIONS	4	0	0	4			BSPH103A	MECHANICS	4	0	0	4
	5	BSPH256A	ANALOG SYSTEMS AND APPLICATIONS LAB	0	0	4	2		5	BSPH153A	MECHANICS LAB	0	0	4	2
	6	BSPH105A	PHYSICS WORKSHOP SKILL	2	2	0	4		6	BSPH106A	ELECTRICAL CIRCUITS AND NETWORK SKILLS	2	2	0	4
	7		ONLINE COURSE - I (IIT Bombay spoken tutorial: Introduction to computer)	2	0	0	2		7		GENERIC ELECTIVE -II	4	2	0	6
	TOTAL						**28**		**TOTAL**						**28**
SECOND	1	BSPH201A	MATHEMATICAL PHYSICS-II	4	0	0	4		1	BSPH202A	MATHEMATICAL PHYSICS-III	4	0	0	4
	2	BSPH251A	MATHEMATICAL PHYSICS-II LAB	0	0	4	2		2	BSPH252A	MATHEMATICAL PHYSICS-III LAB	0	0	4	2
	3	BSPH203A	THERMAL PHYSICS	4	0	0	4		3	BSPH204A	ELEMENTS OF MODERN PHYSICS	4	0	0	4
	4	BSPH253A	THERMAL PHYSICS LAB	0	0	4	2		4	BSPH254A	ELEMENTS OF MODERN PHYSICS LAB	0	0	4	2
	5	BSPH205A	DIGITAL SYSTEMS AND APPLICATIONS	4	0	0	4		5	BSPH104A	WAVES AND OPTICS	4	0	0	4
	6	BSPH255A	DIGITAL SYSTEMS AND APPLICATIONS LAB	0	0	4	2		6	BSPH154A	WAVES AND OPTICS LAB	0	0	4	2
	7		GENERAL ELECTIVE -III	4	0	4	6		7		GENERAL ELECTIVE -IV	4	0	4	6
	TOTAL						**24**		**TOTAL**						**24**
THIRD	1	BSPH301A	QUANTUM MECHANICS AND APPLICATIONS	4	0	0	4		1	BSPH302A	ELECTROMAGNETIC THEORY	4	0	0	4
	2	BSPH351A	QUANTUM MECHANICS AND APPLICATIONS LAB	0	0	4	2		2	BSPH352A	ELECTROMAGNETIC THEORY LAB	0	0	4	2
	3	BSPH303A	SOLID STATE PHYSICS	4	0	0	4		3	BSPH304A	STATISTICAL MECHANICS	4	0	0	4
	4	BSPH353A	SOLID STATE PHYSICS LAB	0	0	4	2		4	BSPH354A	STATISTICAL MECHANICS LAB	0	0	4	2
	5	BSPH305A	BASIC INSTRUMENTATION SKILLS	2	2		4		5	BSPH306A	APPLIED OPTICS	2	2	0	4
	6	BSPH307A	CLASSICAL DYNAMICS	5	1	0	6		6	BSPH308A	PHYSICS OF EARTH	5	1	0	6
	7	BSPH309A	NUCLEAR AND PARTICLE PHYSICS	5	1	0	6		7	BSPH356A	DISSERTATION	0	0	2	6

TOTAL						**28**			**TOTAL**						**28**
Electives (Choose any one from each group)															
GEC-I									**GEC-II**						
1	BSMA121A	CALCULUS	4	0	0			**1**	BSMA124A	ORDINARY DIFFERENTIAL EQUATIONS	4	0	0	4
	BSMA171A	CALCULUS LAB	0	0	4				BSMA174A	ORDINARY DIFFERENTIAL EQUATIONS LAB	0	0	4	2
2	BSCH141A	ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS	4	0	0			**2**	BSCH142A	CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL GROUP ORGANIC CHEMISTRY-I	4	0	0	4
	BSCH161A	ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS LAB	0	0	4				BSCH162A	CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL GROUP ORGANIC CHEMISTRY-I LAB	0	0	4	2
3	ANY OTHER FROM POOL OF UNIVERSITY							**3**	ANY OTHER FROM POOL OF UNIVERSITY					6	
GEC-III									**GEC-IV**						
1	BSMA215A	PROBABILITY AND STATISTICS	4	0	0			**1**	BSMA304A	LINEAR PROGRAMMING	4	0	0	4
	BSMA271A	PROBABILITY AND STATISTICS LAB	0	0	4				BSMA374A	LINEAR PROGRAMMING LAB	0	0	4	2
2	BSCH241A	SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II	4	0	0			**2**	BSCH242A	GREEN CHEMISTRY: DESIGNING CHEMISTRY FOR HUMAN HEALTH AND ENVIRONMENT	4	0	0	4
	BSCH267A	SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II LAB	0	0	4				BSCH268A	GREEN CHEMISTRY: DESIGNING CHEMISTRY FOR HUMAN HEALTH AND ENVIRONMENT LAB	0	0	4	2
3	ANY OTHER FROM POOL OF UNIVERSITY							**3**	ANY OTHER FROM POOL OF UNIVERSITY					6	
Total Credits [C] = 158															

Student can choose two noncredit 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.

Student can choose available MOOCs recommended by Dean Academics and approved by Vice Chancellor of K. R. Mangalam University, from the list of approved MOOCs by SWAYAM Board in each semester.

ODD SEMESTER								EVEN SEMESTER							
Y	**SN**	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**	**SN**	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
First	1	BSEL145A	COMMUNICATION SKILLS	4	0	0	4	1	BSMA122A	MULTIVARIABLE CALCULUS	4	0	0	4
	2	BSDM301A	DISASTER MANAGEMENT	3	0	0	3	2	BSMA124A	ORDINARY DIFFERENTIAL EQUATIONS	4	0	0	4
	3	BSCH125A	ENVIRONMENTAL STUDIES	3	0	0	3	3	BSMA126A	LATEX AND HTML	2	0	0	2
	4		GENERIC ELECTIVE- I	4	2	-	6	4		GENERIC ELECTIVE- II	4	2	-	6
	5	BSMA121A	CALCULUS	4	0	0	4	5	BSMA172A	MULTIVARIABLE CALCULUS LAB	0	0	4	2
	6	BSMA171A	CALCULUS LAB	0	0	4	2	6	BSMA174A	ORDINARY DIFFERENTIAL EQUATIONS LAB	0	0	4	2
	7	BSMA123A	ALGEBRA AND GEOMETRY	5	1	0	6	7	BSMA176A	LATEX AND HTML LAB	0	0	4	2
								8		ONLINE COURSE	2	0	0	2
	TOTAL						**28**	**TOTAL**						**24**
Second	1	BSMA211A	PARTIAL DIFFERENTIAL EQUATIONS AND CALCULUS OF VARIATIONS	4	0	0	4	1	BSMA212A	ADVANCED ALGEBRA	5	1	0	6
	2	BSMA213A	GROUP THEORY	5	1	0	6	2	BSMA214A	LINEAR ALGEBRA	5	1	0	6
	3	BSMA215A	PROBABILITY AND STATISTICS	4	0	0	4	3	BSMA216A	REAL ANALYSIS	5	1	0	6
	4		GENERIC ELECTIVE -III	-	-	-	6	4		GENERIC ELECTIVE- IV	-	-	-	6
	5	BSMA271A	PARTIAL DIFFERENTIAL EQUATIONS AND CALCULUS OF VARIATIONS LAB	0	0	4	2	5	BSMA226A	COMPUTER ALGEBRA SYSTEMS AND RELATED SOFTWARE	2	0	0	2
	6	BSMA273A	PROBABILITY AND STATISTICS LAB	0	0	4	2	6	BSMA272A	COMPUTER ALGEBRA SYSTEMS AND RELATED SOFTWARE LAB	0	0	4	2
	TOTAL						**24**	**TOTAL**						**28**
Third	1	BSMA301A	NUMERICAL ANALYSIS	4	0	0	4	1	BSMA302A	COMPLEX ANALYSIS	4	0	0	4
	2	BSMA303A	SET THEORY AND METRIC SPACES	5	1	0	6	2	BSMA304A	LINEAR PROGRAMMING	4	0	0	4
	3		DISCIPLINE SPECIFIC ELECTIVE- I	-	-	-	6	3		DISCIPLINE SPECIFIC ELECTIVE- III	-	-	-	6
	4		DISCIPLINE SPECIFIC ELECTIVE- II	-	-	-	6	4		DISCIPLINE SPECIFIC ELECTIVE- IV	-	-	-	6
	5	BSMA371A	NUMERICAL ANALYSIS LAB	0	0	4	2	5	BSMA372A	COMPLEX ANALYSIS LAB	0	0	4	2
								6	BSMA374A	LINEAR PROGRAMMING LAB	0	0	4	2
										VALUE ADDED COURSE	2	0	0	2
	TOTAL						**24**	**TOTAL**						**26**

Electives													
Discipline Specific Elective I and II (Choose any two)							**Discipline Specific Elective III and IV (Choose any two)**						
1	BSMA305A	TENSORS AND DIFFERENTIAL GEOMETRY	5	1	0	6	1	BSMA306A	ADVANCED MECHANICS	5	1	0	6
2	BSMA307A	MATHEMATICAL LOGIC	5	1	0	6	2	BSMA308A	WAVELETS AND APPLICATIONS	5	1	0	6
3	BSMA309A	INTEGRAL TRANSFORMS AND FOURIER ANALYSIS	5	1	0	6	3	BSMA310A	NUMBER THEORY	5	1	0	6
4	BSMA311A	INFORMATION THEORY AND CODING	5	1	0	6	4	BSMC671A	MATHEMATICAL FINANCE	5	1	0	6
5	BSMA313A	GRAPH THEORY	5	1	0	6	5	BSMA312A	CRYPTOGRAPHY	5	1	0	6
6	BSMA315A	SPECIAL THEORY AND RELATIVITY	5	1	0	6	6	BSCS113A	C++PROGRAMMING FOR MATHEMATICS	4	0	0	4
								BSCS167A	C++PROGRAMMING FOR MATHEMATICS	0	0	4	2
							7	BSMA314A	DISSERTATION ON ANY TOPIC OF MATHEMATICS	-	-	-	6
Total Credits [C]			**154**										
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 ELECTIVE (GE) COURSES OFFERED

SEM	S.No.	Course Code	Course Title	L	T	P	C
I	1	ETCS103A	PROGRAMMING FOR PROBLEM SOLVING	3	1	2	5
		ETCS566A	COMPUTER SCIENCE PROJECT -1 (PPS)	0	0	0	1
	2	BSCH141A	ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS	4	0	0	4
		BSCH161A	ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS LAB	0	0	4	2
	3	BSPH103A	MECHANICS	4	0	0	4
		BSPH153A	MECHANICS LAB	0	0	4	2
	4	SHES107A	INTRODUCTORY MICROECONOMICS	5	1	0	6
II	1	ETCS307A	DATABASE MANAGEMENT SYSTEMS	3	1	2	5
		ETCS567A	COMPUTER SCIENCE PROJECT -2 (DBMS)	0	0	0	1
	2	BSCH142A	CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL GROUP ORGANIC CHEMISTRY	4	0	0	4
		BSCH162A	CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL GROUP ORGANIC CHEMISTRY LAB	0	0	4	2
	3	BSPH102A	ELECTRICITY AND MAGNETISM	4	0	0	4
		BSPH152A	ELECTRICITY AND MAGNETISM LAB	0	0	4	2
	4	SHES110A	INTRODUCTORY MACROECONOMICS	5	1	0	6
III	1	ETCS304A	COMPUTER NETWORKS	3	1	2	5
		ETCS568A	COMPUTER SCIENCE PROJECT -3 (COMPUTER NETWORKS)	0	0	0	1
	2	BSCH241A	SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY	4	0	0	4
		BSCH267A	SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY LAB	0	0	4	2

	3	BSPH203A	THERMAL PHYSICS	4	0	0	4
		BSPH253A	THERMAL PHYSICS LAB	0	0	4	2
	4	SHES311A	INDIAN ECONOMY-I	5	1	0	6
IV	1	ECS220A	ANALYSIS AND DESIGN OF ALGORITHMS	3	1	2	5
		ETCS569A	COMPUTER SCIENCE PROJECT -4 (ANALYSIS AND DESIGN OF ALGO.)	0	0	0	1
	2	BSCH242A	GREEN CHEMISTRY: DESIGNING CHEMISTRY FOR HUMAN HEALTH AND ENVIRONMENT	4	0	0	4
		BSCH268A	GREEN CHEMISTRY: DESIGNING CHEMISTRY FOR HUMAN HEALTH AND ENVIRONMENT LAB	0	0	4	2
	3	BSPH204A	ELEMENTS OF MODERN PHYSICS	4	0	0	4
		BSPH254A	ELEMENTS OF MODERN PHYSICS LAB	0	0	4	2
	4	SHES312A	INDIAN ECONOMY-II	5	1	0	6

B.Sc.		**Year 2020-2023 (Scheme of Studies) August 22, 2020**					**SBAS**
YEAR	**ODD SEMESTER**						
	S. No.	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
FIRST	1	BSEL145A	COMMUNICATION SKILLS	4	0	0	4
	2	BSDM301A	DISASTER MANAGEMENT	3	0	0	3
	3	BSCH125A	ENVIRONMENTAL STUDIES	3	0	0	3
	4	BSCH103A	ORGANIC CHEMISTRY-I	3	1	0	4
	5	BSCH153A	ORGANIC CHEMISTRY-I PRACTICALS	0	0	4	2
	6		GENERIC ELECTIVE- I	4	2	0	6
	7		ONLINE COURSE - I (IIT Bombay spoken tutorial: Introduction to computer)	2	0	0	2
	TOTAL						**24**

	EVEN SEMESTER					
S. No	**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1		CHEMISTRY ELECTIVE	3	1	0	4
2		CHEMISTRY ELECTIVE LAB	0	0	4	2
3		PHYSICS ELECTIVE	4	0	0	4
4		PHYSICS ELECTIVE LAB	0	0	4	2
5	BSMA124A	ORDINARY DIFFERENTIAL EQUATIONS	4	0	0	4
6	BSMA174A	ORDINARY DIFFERENTIAL EQUATIONS LAB	0	0	4	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				**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