

JSS Academy of Higher Education & Research

(Deemed to be University)

Re-Accredited "A+" Grade by NAAC

Sri Shivarathreeshwara Nagara Mysuru - 570015, Karnataka

Faculty of Life Sciences

Syllabus

B.Sc. BIOCHEMISTRY
As Per National Education Policy 2020
Under the CBCS Pattern
Implementation Year 2021-22 onwards

BSc

Syllabus

B.Sc. Biochemistry As per NEP 2020

Under the CBCS Pattern



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B.Sc Biochemistry

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B.Sc. Biochemistry

Program Overview

| | |
|--------------------------------------|-------------------------------------------------------------------|
| Name of the Degree Program | : B.Sc., (Hons) |
| Discipline Core | : Biochemistry |
| Total Credits for the Program | : B.Sc., - 136 credits B.Sc., Hons. - 176credits |

Year of implementation : 2021-22

Program Objectives

The learning outcomes are designed to help learners understand the objectives of studying B.Sc., (Honors) Biochemistry that is, to analyze, appreciate, understand the basic concepts of biomolecular processes and chemical reactions occurring in the living system. This course is fundamental to tackle many of the health-related challenges facing society. Considering the rapid and far-reaching advances in biological sciences in 21st century, it is imperative to have curriculum incorporating these updated emerging concepts of Biochemistry. The current pattern is designed to impart concept-based learning with emphasis on hands-on training, skill development and research. It is particularly aimed at multi-faceted development of a student, the curriculum includes courses encompassing core courses, intra- and inter-discipline specific courses, skill, and ability enhancement courses to impart in-depth knowledge in Biochemistry complemented with varied subjects and skills. The course seeks to discover and nurture typical attributes of a competent science graduate such as spirit of inquiry, critical thinking, problem solving, analytical reasoning, aptitude to research/industry and entrepreneurial instincts.

The following are the objectives of the Program

- To provide better understanding of the principles and applications of life sciences
- To demonstrate technical competence in biological chemistry, clinical biochemistry, and enzymology
- To provide research-oriented learning through interdisciplinary approaches and to impart skills to handle high throughput biological lab equipment
- To train the students to excel in life science sectors through continuous training, skill development and entrepreneurship activities
- To create strong research foundation and inculcate quality research ideas through in house /external dissertation
- To make the students take up social responsibility to solve the real-time problems in the field addition to career development

Program Outcomes

The learning outcome-based curriculum is specific in terms of changes in cognitive and psychomotor behavior of students. Biochemistry Honors course is intended to provide a broad framework enabling students to acquire a skill set that helps them understand and appreciate the field of biochemistry. The structure or design of this framework shall ensure a high standard of the Honors degree in Biochemistry at national level. The programme specification is intended as a reference point for prospective students, current students, academic in delivering the programme and

realizing its objectives. Keeping in pace with the developmental trends in Biochemistry and allied areas, it is expected that the students undertaking Biochemistry (Honors) course become conversant with the essence of Biochemistry and exhibit certain levels of learning outcomes as proposed below.

Program Specific Outcomes:

By the end of the program the students will be able to develop competencies needed to be acquired by a candidate securing B.Sc., or B.Sc., (Hons.) degree in Biochemistry.

1. Enables students to understand and develop interest in Biochemistry and appreciation for chemical basis of biological processes.
2. Demonstrate the proficiency Inculcate the spirit of inquiry and value of systematic study of a discipline.
3. Demonstrate understanding of the related disciplines with a holistic knowledge generation in biological sciences.
4. Demonstrate in-depth understanding of chemical reaction mechanisms in biological processes.
5. Provides knowledge of historical developments of enzymes and their applications in research, diagnostics, and various industries.
6. Enables students to gain proficiency in basic laboratory techniques and be able to apply the scientific method to the processes of experimentation, hypothesis testing, data interpretation and logical conclusions.
7. Develops problem solving and analytical skills through case studies, research papers and hands-on-experience
8. Delivers the insights of biochemical mechanistic basis of physiological processes, metabolism under normal and pathological conditions importance and levels of metabolic regulations.
9. Offers effective communication with scientific reasoning and data analysis in both written and oral forms. They will be able to communicate effectively with well-designed posters and slides in talks aimed at scientific audiences as well as the public.
10. Bridges the knowledge and skill, to fulfill academic and industry requirements.
11. Gives competency to students in conducting independent, hypothesis-driven, biological research, project planning and management.
12. Nurtures skill sets to publish research findings, and awareness of IP rights, and scientific publication ethics and problems of plagiarism.
13. Prepares competent human resource with better knowledge, hands-on-experience, and scientific attitude, at national and global levels for careers in Research and Development, Academia and Pharma-, Biotech- and Agro-, and Food processing industries
14. Apply knowledge and skills of immunology, clinical biochemistry, cell signaling, proteomics, genomics, drug design and medicinal chemistry to test the models and aid in drug discovery.
15. Demonstrate communication skills, scientific writing, data collection and interpretation abilities in all the fields of life sciences and biomedical sciences.
16. Learning and practicing professional skills in handling biological samples and demonstrate the ability to identify ethical issues related to recombinant DNA technology, genetic engineering, animals handling, intellectual property rights, good laboratory practices, biosafety, and biohazards.
17. Fosters students towards scientific research and demonstrating innovative

thinking in addressing the current day and future challenges with respect to food, health, and environment.

18. Understanding and application of molecular biology techniques and principles in forensic science and clinical biochemistry.
19. Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises or CROs.

Eligibility:

Candidates who have passed the 10+2 Examination/Equivalent Examination with at least 40% marks with science as one of the subjects.

Pedagogy:

The general pedagogy to be followed for theory and practical are as under.

1. Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counselling, Remedial Coaching.
2. Field/Institution/Industrial visits, Hands on training, Case observations, Models/charts preparations, Problem solving mechanism, Demonstrations, Project presentations, Experiential documentation, and Innovative methods.
3. Active learning as per LSSSDC (NSDC) LFS/Q0509 guidelines, at skill training Level 3.

Assessment:

Weightage for assessments (in percentage)

| Type of Course | Formative Assessment / IA | Summative Assessment |
|----------------|---------------------------|----------------------|
| Theory | 30% | 70% |
| Practical | 30% | 70% |
| Projects | 30% | 70% |

| Curriculum Structure for the Undergraduate Degree Program B.Sc., (Hons) in Biochemistry | | | | | | |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Semester | Core Subjects (Credits) L T P | Discipline Specific/ Open Elective Subjects (Credits) L T P | Language L T P | Skill Enhancement Courses (SEC) / Ability Enhancement Compulsory Courses (AECC) L T P | Value Based/ Activity Based Courses L T P | Total Credits |
| I | DSC 01 – Chemical Foundation of Biochemistry (5) 3+0+2 DSC 02 - Fundamentals of Laboratory Techniques (5) 3+0+2 | OEC 01 - Principles of Biochemistry (3) 3+0+0 | L1 English (3) 3+0+0 L2 English/ Kannada/ French (3) 3+0+0 | SEC 01 - Digital Fluency (3) 3+0+0 | Value Based Course (VBC) 01 - Health & Wellness (2) 2+0+0 | 24 |
| II | DSC 03 - Bioorganic Chemistry (5) 3+0+2 DSC 04 - Analytical Biochemistry (5) 3+0+2 | OEC 02 - Tools and Techniques in Biochemistry (3) 3+0+0 | L1 English (3) 3+0+0 L2 English/ Kannada/ French (3) 3+0+0 | AECC 01 – Environmental Studies (3) 3+0+0 | Activity Based Course (ABC) 01 - Minor Project (RBPT) (2) 0+0+2 | 24 |
| Exit Option Certificate in Biochemistry 48 Credits | | | | | | |
| III | DSC 05 - Biochemistry of Macromolecules (5) 3+0+2 DSC 06 - Nutrition (5) 3+0+2 | OEC 03 - Biochemical Basis of Diseases (3) 3+0+0 | L1 English (3) 3+0+0 L2 English/ Kannada/ French (3) 3+0+0 | AECC 02 – Indian Constitution (2) 2+0+0 SEC 02 – Artificial Intelligence (2) 2+0+0 | - | 23 |
| IV | DSC 07 - Intermediary Metabolism (5) 3+0+2 DSC 08 - Clinical Biochemistry (5) 3+0+2 | OEC 04 – Diagnostic Biochemistry (3) 3+0+0 | L1 English (3) 3+0+0 L2 English/ Kannada/ French (3) 3+0+0 | SEC 03 – Cyber Security (2) 2+0+0 | Activity Based Course (ABC) 02 - Case Study/ Observership in Hospitals/ Internship in Industries (2) 0+0+2 | 23 |
| Exit Option Diploma in Biochemistry 94 Credits | | | | | | |

| Semester | Core Subjects (Credits) L T P | Discipline Specific/ Open Elective Subjects (Credits) L T P | Skill Enhancement (SEC) / Ability Enhancement Compulsory Courses (AECC) L T P | Value Based / Activity Based L T P | Total Credits |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------|
| V | DSC 09 - Human Anatomy and Physiology (5) 3+0+2 DSC 10 - Cell Biology (5) 3+0+2 DSC 11 - Immunology (4) 3+0+1 | DSE 01a - Membrane Biology (3) 3+0+0 (OR) DSE 01b -Bioenergetics (3) 3+0+0 | SEC 04 - Proteomics (3) 3+0+0 | Value Based Course (VBC) 02 - Ethics & Self Awareness (2) 2+0+0 | 22 |
| VI | DSC 12 - Biochemical Techniques (5) 3+0+2 DSC 13 - Enzymology (5) 3+0+2 DSC 14 - Fundamentals of Genetics (4) 3+0+1 | DSE 02a -Protein Chemistry and Technology (3) 3+0+0 (OR) DSE 02b -Metabolomics (3) 3+0+0 | SEC 05 - Professional / Societal Communication (3) 3+0+0 | - | 20 |
| Exit Option B.Sc., in Biochemistry 136 Credits | | | | | |
| VII | DSC 15 - Molecular Biology & Gene Regulation (5) 3+0+2 DSC 16 - Biophysical Techniques (5) 3+0+2 DSC 17 - Genetic Engineering (5) 3+0+2 | DSE 03a -Cell Culture & Animal Models (3) 3+0+0 (OR) DSE 03b -Biosafety and Bioethics (3) 3+0+0 & DSE 03c -Principles of Research Methodology (3) | - | - | 21 |
| VIII | DSC 18 - Plant Biochemistry (5) 3+0+2 DSC 19 - Medicinal Chemistry (5) 3+0+2 | DSE 04a -Stem Cell Biology & Regenerative Medicine (3) 3+0+0 (OR) DSE 04b Pharmacovigilance (3) 3+0+0 DSE 05a -Research Project (6) (OR) DSE 05b -Biostatistics (3) 3+0+0 & DSE 05c -Cell Signaling (3) 3+0+0 | - | - | 19 |
| Award of B.Sc., (Hons) in Biochemistry 176 Credits | | | | | |

Curriculum Structure for the Undergraduate Degree Program
B.Sc., (Hons) in Biochemistry

| SEMESTER I | | | | | | | | |
|-------------|--------------------------|------------------------------------------|-----------------------------|-------------------|-----|------------------------|------------|---------------|
| Sl. No. | Study Component and Code | Title of the Paper | Hours of Instruction / Week | Examination | | | | Total Credits |
| | | | | Duration in Hours | CIA | Theory/ Practical Exam | Max. Marks | |
| 1 | DSC 01 | Chemical Foundation of Biochemistry | 3 | 3 | 30 | 70 | 100 | 3 |
| 2 | Practical 01 | Chemical Foundation of Biochemistry | 4 | 3 | 15 | 35 | 50 | 2 |
| 3 | DSC 02 | Fundamentals of Laboratory Techniques | 3 | 3 | 30 | 70 | 100 | 3 |
| 4 | Practical 02 | Fundamentals of Laboratory Techniques | 4 | 3 | 15 | 35 | 50 | 2 |
| 5 | OEC 01 | Principles of Biochemistry | 3 | 3 | 30 | 70 | 100 | 3 |
| 6 | Language 1 | Part-I English I | 3 | 3 | 30 | 70 | 100 | 3 |
| 7 | Language 2 | Part II English I/Kannada I/French I | 3 | 3 | 30 | 70 | 100 | 3 |
| 8 | SEC 01 | Digital Fluency | 3 | 3 | 30 | 70 | 100 | 3 |
| 9 | VBC 01 | Health & Wellness | 2 | 2 | - | 50 | 50 | 2 |
| | Total Marks and Credits | | | | | | 750 | 24 |
| SEMESTER II | | | | | | | | |
| 1 | DSC 03 | Bioorganic Chemistry | 3 | 3 | 30 | 70 | 100 | 3 |
| 2 | Practical 03 | Bioorganic Chemistry | 4 | 3 | 15 | 35 | 50 | 2 |
| 3 | DSC 04 | Analytical Biochemistry | 3 | 3 | 30 | 70 | 100 | 3 |
| 4 | Practical 04 | Analytical Biochemistry | 4 | 3 | 15 | 35 | 50 | 2 |
| 5 | OEC 02 | Tools and Techniques in Biochemistry | 3 | 3 | 30 | 70 | 100 | 3 |
| 6 | Language 1 | Part-I English II | 3 | 3 | 30 | 70 | 100 | 3 |
| 7 | Language 2 | Part II English II/Kannada II/ French II | 3 | 3 | 30 | 70 | 100 | 3 |
| 8 | AECC 01 | Environmental Studies | 3 | 3 | 30 | 70 | 100 | 3 |
| 9 | ABC 01 | Minor Project (RBPT) (Report+ Viva Voce) | 2 | 2 | - | 50 | 50 | 2 |
| | Total Marks and Credits | | | | | | 750 | 24 |

| SEMESTER III | | | | | | | | |
|--------------|--------------------------|-------------------------------------------------------------------------------------|----------------------------|-------------------|-----|------------------------|------------|--------------|
| Sl. No. | Study Component and Code | Title of the Paper | Hours of Instruction/ Week | Examination | | | | Total Credit |
| | | | | Duration in Hours | CIA | Theory/ Practical Exam | Max. Marks | |
| 1 | DSC 05 | Biochemistry of Macromolecules | 3 | 3 | 30 | 70 | 100 | 3 |
| 2 | Practical 05 | Biochemistry of Macromolecules | 4 | 3 | 15 | 35 | 50 | 2 |
| 3 | DSC 06 | Nutrition | 3 | 3 | 30 | 70 | 100 | 3 |
| 4 | Practical 06 | Nutrition | 4 | 3 | 15 | 35 | 50 | 2 |
| 5 | OEC 03 | Biochemical Basis of Diseases | 3 | 3 | 30 | 70 | 100 | 3 |
| 6 | Language 1 | Part-I English III | 3 | 3 | 30 | 70 | 100 | 3 |
| 7 | Language 2 | Part II English III/Kannada III/ French III | 3 | 3 | 30 | 70 | 100 | 3 |
| 8 | AECC 02 | Indian Constitution | 2 | 2 | - | 50 | 50 | 2 |
| 9 | SEC 02 | Artificial Intelligence | 2 | 2 | - | 50 | 50 | 2 |
| | Total Marks and Credits | | | | | | 700 | 23 |
| SEMESTER IV | | | | | | | | |
| 1 | DSC 07 | Intermediary Metabolism | 3 | 3 | 30 | 70 | 100 | 3 |
| 2 | Practical 07 | Intermediary Metabolism | 4 | 3 | 15 | 35 | 50 | 2 |
| 3 | DSC 08 | Clinical Biochemistry | 3 | 3 | 30 | 70 | 100 | 3 |
| 4 | Practical 08 | Clinical Biochemistry | 4 | 3 | 15 | 35 | 50 | 2 |
| 5 | OEC 04 | Diagnostic Biochemistry | 3 | 3 | 30 | 70 | 100 | 3 |
| 6 | Language 1 | Part-I English IV | 3 | 3 | 30 | 70 | 100 | 3 |
| 7 | Language 2 | Part II English IV/Kannada IV/ French IV | 3 | 3 | 30 | 70 | 100 | 3 |
| 8 | SEC 03 | Cyber Security | 2 | 2 | - | 50 | 50 | 2 |
| 9 | ABC 02 | Case Study/ Observership in Hospitals/ Internship in Industries (Report+ Viva Voce) | 2 | 2 | - | 50 | 50 | 2 |
| | Total Marks and Credits | | | | | | 700 | 23 |

| SEMESTER V | | | | | | | | |
|-------------|----------------------------|-------------------------------------------------------|----------------------------|-------------------|-----|------------------------|------------|--------------|
| Sl. No. | Study Component and Code | Title of the Paper | Hours of Instruction/ Week | Examination | | | | Total Credit |
| | | | | Duration in Hours | CIA | Theory/ Practical Exam | Max. Marks | |
| 1 | DSC 09 | Human Anatomy and Physiology | 3 | 3 | 30 | 70 | 100 | 3 |
| 2 | Practical 09 | Human Anatomy and Physiology | 4 | 3 | 15 | 35 | 50 | 2 |
| 3 | DSC 10 | Cell Biology | 3 | 3 | 30 | 70 | 100 | 3 |
| 4 | Practical 10 | Cell Biology | 4 | 3 | 15 | 35 | 50 | 2 |
| 5 | DSC 11 | Immunology | 3 | 3 | 30 | 70 | 100 | 3 |
| 6 | Practical 11 | Immunology | 2 | 2 | 15 | 35 | 50 | 1 |
| 7 | DSE 01a (OR) DSE 01b | Membrane Biology (OR) Bioenergetics | 3 | 3 | 30 | 70 | 100 | 3 |
| 8 | SEC 04 | Proteomics | 3 | 3 | 30 | 70 | 100 | 3 |
| 9 | VBC 02 | Ethics & Self Awareness | 2 | 2 | - | 50 | 50 | 2 |
| | Total Marks and Credits | | | | | | 700 | 22 |
| SEMESTER VI | | | | | | | | |
| 1 | DSC 12 | Biochemical Techniques | 3 | 3 | 30 | 70 | 100 | 3 |
| 2 | Practical 12 | Biochemical Techniques | 4 | 3 | 15 | 35 | 50 | 2 |
| 3 | DSC 13 | Enzymology | 3 | 3 | 30 | 70 | 100 | 3 |
| 4 | Practical 13 | Enzymology | 4 | 3 | 15 | 35 | 50 | 2 |
| 5 | DSC 14 | Fundamentals of Genetics | 3 | 3 | 30 | 70 | 100 | 3 |
| | Practical 14 | Fundamentals of Genetics | 2 | 2 | 15 | 35 | 50 | 1 |
| 6 | DSE 02a (OR) DSE 02b | Protein Chemistry and Technology (OR) Metabolomics | 3 | 3 | 30 | 70 | 100 | 3 |
| 7 | SEC 05 | Professional / Societal Communication | 3 | 3 | 30 | 70 | 100 | 3 |
| | Total Marks and Credits | | | | | | 650 | 20 |

| SEMESTER VII | | | | | | | | |
|---------------|----------------------------------|------------------------------------------------------------------|-----------------------------|-------------------|-----|------------------------|------------|---------------|
| Sl. No. | Study Component and Code | Title of the Paper | Hours of Instruction / Week | Examination | | | | Total Credits |
| | | | | Duration in Hours | CIA | Theory/ Practical Exam | Max. Marks | |
| 1 | DSC 15 | Molecular Biology & Gene Regulation | 3 | 3 | 30 | 70 | 100 | 3 |
| 2 | Practical 15 | Molecular Biology & Gene Regulation | 4 | 3 | 15 | 35 | 50 | 2 |
| 3 | DSC 16 | Biophysical Techniques | 3 | 3 | 30 | 70 | 100 | 3 |
| 4 | Practical 16 | Biophysical Techniques | 4 | 3 | 15 | 35 | 50 | 2 |
| 5 | DSC 17 | Genetic Engineering | 3 | 3 | 30 | 70 | 100 | 3 |
| 6 | Practical 17 | Genetic Engineering | 4 | 3 | 15 | 35 | 50 | 2 |
| 7 | DSE 03a (OR) DSE 03b | Cell Culture & Animal Models (OR) Biosafety and Bioethics | 3 | 3 | 30 | 70 | 100 | 3 |
| 8 | DSE 03c | Principles of Research Methodology | 3 | 3 | 30 | 70 | 100 | 3 |
| | Total Marks and Credits | | | | | | 650 | 21 |
| SEMESTER VIII | | | | | | | | |
| 1 | DSC 18 | Plant Biochemistry | 3 | 3 | 30 | 70 | 100 | 3 |
| | Practical 18 | Plant Biochemistry | 4 | 3 | 15 | 35 | 50 | 2 |
| 2 | DSC 19 | Medicinal Chemistry | 3 | 3 | 30 | 70 | 100 | 3 |
| | Practical 19 | Medicinal Chemistry | 4 | 3 | 15 | 35 | 50 | 2 |
| 3 | DSE 04a (OR) DSE 04b | Stem Cell Biology & Regenerative Medicine (OR) Pharmacovigilance | 3 | 3 | 30 | 70 | 100 | 3 |
| 4 | DSE 05a (OR) DSE 05b and DSE 05c | Research Project (OR) Biostatistics and Cell Signaling | 6 | 3 | 60 | 140 | 200 | 6 |
| | | | 3 | 3 | 30 | 70 | 100 | |
| | | | 3 | 3 | 30 | 70 | 100 | |
| | Total Marks and Credits | | | | | | 600 | 19 |

Abbreviations: DSC – Discipline Specific Core; DSE – Discipline Specific Elective; AECC – Ability Enhancement Compulsory Course; SEC – Skill Enhancement Course

Students may choose any one elective course among the choice offered, specific to the discipline

*Project Proposal, Presentations, Teamwork and Professional Ethics, Industrial/Institutional Visits etc.

Semester One

DSC 01 – Chemical Foundation of Biochemistry

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 5 |

Course Objectives:

- To give insights of electrons, chemical bonding, and molecules in living system
- To highlight the importance of water, solutions, and buffers in regulation of life
- To impart fundamental knowledge of chemistry to understand complexity of life

Course Outcomes:

Successful completion of the course

1. Gain the insights of cellular and chemical foundations of life
2. Better understanding of relationship between physical, chemical, and biological properties of molecules and their interactions
3. Demonstrate the ability of students to calculate and prepare the reagents, solutions, and buffers

Theory

Unit-I: Atom, atomic structure, periodic table, periodicity, orbitals and their shapes, s, p, d, and f sub-shells, electron configuration, octet rule, electronic theory of chemical bonding, formation and properties of non-covalent and covalent bonds, hydrogen bonds, ionic bonds, van der Waals interactions, London forces, dipole-dipole interactions, electrostatic interactions, hydrophobic interactions, sigma, pi and co-ordinate bonds, back bonding. Bond Parameters.

Unit-II: Acids, bases, Arrhenius concept, proton transfer theory, Lewis, Lowry and Bronsted concepts. pH, pH scale, buffers, composition, buffer capacity, Henderson-Hasselbalch equation, pK value, isoelectric pH, structure of water, phase diagram of pure water, ionic product of water, special properties of water, physiological buffer systems of the human body and their functions.

Unit-III: Solutions, types of solutions, colloids, true solutions, emulsions, and suspensions. Ionizable and non-ionizable solutes, colligative properties, and anomalous colligative properties of solutions, vapor pressure and its application in distillation, Vant Hoff law, Rault's law, boiling point, freezing point, de-icing, osmosis and osmotic pressure determination, reverse osmosis, dialysis, diffusion, Brownian movements, viscosity, surface tension.

Unit-IV: Chemical Catalysis: Definition, characteristics, types, intermolecular, multifunctional, theories of catalysis, properties, characteristics of enzyme catalysis, autocatalysis, industrial catalysis, and their role in biological systems. Reaction Kinetics: Rate constant, order of reaction, molecularity, activation energy, zero, first and second order kinetics, catalysis, and elementary enzyme reactions.

Practical 01 - Chemical Foundation of Biochemistry

1. Preparation of standard sodium carbonate solution, standardization of HCl (Methyl orange) and estimation of NaOH in the given solution. (Methyl orange or phenolphthalein).
2. Preparation of standard oxalic acid. Standardization of NaOH and estimation of H₂SO₄ in the given solution (phenolphthalein).
3. Determination of pH of solutions and biological fluids.
4. Determination of boiling point of a substance.
5. Determination of melting point of a substance.
6. Determination of density and viscosity of liquids.
7. Demonstration of osmosis.
8. Demonstration of dialysis.

References

1. Inorganic Chemistry, 2014, Miessler GL, Paul Fischer PJ, and Tarr DA, 5th edition, Pearson Publication
2. Inorganic Chemistry, 2015, Overton, Rourke, Weller, Armstrong and Hagerman, Oxford Press
3. Physical Chemistry: A molecular approach ,2019, Donald A, McQuarrie and Simon JD, Viva Books Publication
4. Physical chemistry 2019, Atkins P, Paula JD, Keeler J, 11th edition, Oxford Press
5. Principles of Practical Chemistry- M. Viswanathan
6. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
7. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
8. Vogel textbook of quantitative chemical analysis. G.H. Jeffery, J. Basset.
9. Quantitative chemical analysis. S. Sahay (S. Chand & Co.).

DSC 02- Fundamentals of Laboratory Techniques

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 5 |

Course Objectives:

- To give insights of good laboratory practices, safety, and precautions
- To impart the fundamental knowledge of laboratory equipment and instruments
- To provide the basics of laboratory techniques and protocols to nurture students to get jobs in clinical, academic, and industrial laboratories

Course Outcomes:

Successful completion of the course

1. Enables students to understand good laboratory practices and gain insights of laboratory safety and precautions
2. Demonstrate the proficiency in use of glassware and analytical instruments
3. Demonstrate the ability to calculate, prepare reagents/solutions/buffers and perform a variety of assays
4. Enables students to handle the laboratory equipment and instruments used in diagnostic centers/hospitals/chemistry laboratories

Theory

Unit-I: An overview of SI units and metric system. Molecular weight, equivalent weight, mole concept, molality, molarity, normality, mole to molar conversion, percentage (w/w, w/v, v/v), density and specific gravity, their significances. Preparation of standard solutions, molar and normal solutions, and buffers. Preparation of a stock standard and working standard. Proper method of dilution of a solution or a laboratory sample. Serial dilutions of samples. Saturated and supersaturated solutions. Significance of volumetric flask in preparing standard solutions.

Unit-II: Introduction to glass wares: Pipettes and their calibration (graduated, volumetric and auto-mated pipettes). Burettes and beakers. Flasks and their applications (volumetric, conical, and round bottomed). Reagent bottles, funnels, and their uses. Measuring cylinders, test tubes and serum tubes. Test tube draining rack, bottle racks, pipette stands, tripod stand, wire gauze and Bunsen burner. Cuvettes and their application. Bottle dispensers and their maintenance. Maintenance, Care, and cleaning of laboratory glassware.

Unit-III: Introduction to the Laboratory Instruments and their use, care & maintenance: Water bath, Oven, Incubators, Water Distillation Plant and Deionizers, Refrigerators, Centrifuges, Laboratory Balance and Direct Readout Electrical Balances, pH meter and its calibration. Working principles and applications of colorimeter, spectrophotometer, microplate reader, fluorimeter, and microscope.

Unit-IV: Basic concepts of acids, bases, salts, buffers, buffer capacity, and indicators. Theory of acid base indicators. Choice of indicators. pH titration curves, isoelectric pH, standard hydrogen electrode, Calomel electrode, glass electrode, electrode potential and

its measurement. Importance of pH, acids, bases, salts, and indicators in laboratory and living systems.

Practical 02 - Fundamentals of Laboratory Techniques

1. Introduction to laboratory safety measures, chemicals, reagents, and solutions.
2. Demonstration of pipettes, distillation unit, filtration, homogenizer, sonicator, magnetic stirrer, mechanical shaker, centrifuge, hot air oven, incubator, and microscope.
3. Calibration of volumetric glassware (burette, pipette and measuring cylinder).
4. Calculation and preparation of normal, molar and percentage solutions.
5. Demonstration of colorimeter, spectrophotometer, microplate reader, and fluorimeter.
6. Determination of absorption maxima and molar extinction coefficient.
7. Establish standard curve of potassium permanganate solution.
8. Formol titration of a given amino acid solution.

References

1. Victor W. Rodwell, David A. Bender. Harper's Illustrated Biochemistry, 30th edition. A Lange Medical book (2015).
2. Textbook of Biochemistry 4th edition – U. Satyanarayana and Chakrapani.
3. Upadhyay, K. Upadhyay and N. Nath Biophysical Chemistry (2000) Himalaya Publishing House.
4. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge University Press.
5. Manual of Laboratory & Diagnostic Tests – McGraw Hill.
6. Textbook of Medical Laboratory Technology 5th edition – Praful B. Godkar.
7. Textbook of Medical Laboratory Technology 5th edition – Ramnik Sood.
8. Textbook of Biochemistry for Medical Students 5th edition – DM Vasudevan.
9. Textbook of Medical Biochemistry 3rd edition. Dinesh Puri.

OEC 1 – Principles of Biochemistry

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

Course Objectives:

- To give insights of biochemistry aspects essential for maintenance of life.

Course Outcomes:

Successful completion of the course,

- Enables students to appreciate the importance of Biochemistry
- Gain the insights of cellular and chemical foundations of life

Theory

Unit-I: An overview of atoms, elements, biomolecules, and chemical reactions in living organisms. Different types of chemical bonds: bond characteristics; Ionic bonding, covalent bonding, co-ordinate bonding, Van der Waal's forces, ion- dipole, dipole-dipole interactions, London forces, hydrophobic interaction, hydrogen bonding. Organization of life: Hierarchy of complexity, Characteristics of Life.

Unit-II: Biology of elements from molecules to the biosphere. Biogeochemical cycles: Carbon cycle, Hydrogen Cycle. Oxygen Cycle; Nitrogen cycle Fixation of atmospheric nitrogen – symbiotic and non-symbiotic. Phosphorous cycle. Importance of carbon, hydrogen, oxygen, nitrogen, and phosphorus in biological system. Importance of compounds of sulfur and selenium in biological system.

UNIT III: Definition, classification, and biological functions of Carbohydrates (Monosaccharide, disaccharide, polysaccharide), Lipids (simple, complex, derived), Proteins (Amino acids, Peptides, Proteins), Nucleic acids (Deoxyribonucleic acid, Ribonucleic acid), Vitamins (Water- and Fat-soluble), and Minerals (Micro and Macro).

Unit IV: Scope and significance of Biochemistry in Research & Development. Important discoveries in Biochemistry. Role of Biomolecules in health and diseases. Nutritional, Diagnostic and Therapeutic applications.

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- Biochemistry by L. Stryer (1995) W.H. Freeman Press, San Francisco, USA.
- Biochemistry, by Voet, D. and Voet, J.G. (2004). 3rd Edition, John Wiley & Sons, Inc. USA.
- Biochemistry by U. Sathyanarayana Books and Allied (P) Ltd. Kolkata, (2014).
- Textbook of Biochemistry by J.L Jain (2016)
- Textbook of Biochemistry by D.M. Vasudevan (2018)
- Textbook of Biochemistry by A.C. Deb, 9th revised edition (2017)

Language 1 – Part I English I

| L | T | P | C |
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Course Objectives:

- Improve and enhance the communication skills of the learners.
- Improve speech pronunciation, grammar, and vocabulary.

Course Outcomes:

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

1. Have better language, communication, and pronunciation skills.
2. Have enhanced their vocabulary since they would have learned about root words, synonyms, antonyms, phobias, and manias.
3. Use the Language Lab by Senako Software to improve their vocabulary. The Language Lab is equipped with exercises for language learning. The Voice Pronounce guides the students to improve their pronunciation through instant feedback and visual indication of what sounds and words to improve on.

Unit-I: Grammar – I

1. Correct Use of Nouns
2. Correct Use of Pronouns
3. Reading Comprehension Passage

Unit-II: Grammar – II

1. The rules and sequence of tenses
2. Types of sentences: Simple, Compound and Complex sentences, clauses, phrases, adjuncts, and gerunds
3. Subject Verb Agreement

Unit-III: Vocabulary

1. Roots A to F
2. Synonyms and Antonyms
3. Phobias and Manias

Unit-IV: Essay

Excerpts from APJ Abdul Kalam's "Wings of Fire "

References

1. S.C Gupta, 2021, English Grammar and Composition, Arihant Publishers
2. S. P. Bakshi, 2021, Objective General English, Arihant Publishers

Language 2 – Part II English I

| L | T | P | C |
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Course Objectives:

- Improve and enhance the literary skills of the learners.
- Develops language skills such as reading, writing, speaking, and listening.
- Help the students to grasp the ideas of the writer.

Course Outcomes:

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

1. Express their thoughts, ideas, feelings, and observations.
2. Develop philosophical, historical, and critical perspectives in their writings.

Unit-I: British Poetry

1. “When in Disgrace” by Shakespeare
2. “Spring” by Christina Rossetti

Unit-II: Post-Colonial Literature

1. “The Night of the Scorpion” by Nissim Ezekiel
2. “I Am Not That Woman” by Kishwar Naheed

Unit-III: Contemporary and British Literature

1. “The Kanda Man-eater” by Jim Corbett
2. “A Man Who Had No Eyes” by MacKinlay Kantor
3. “A Child’s Story” by Charles Dickens

Unit-IV: Indian English Literature

“The Education System in India” by Dr. V. Shashi Kumar

References:

1. Jim Corbett, 1944. The Man-Eaters of Kumaon, Oxford University Press.
2. Charles Dickens, 2013. Children’s Stories, Bottom of The Hill Publishing.

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|---|---|---|---|
| 3 | 0 | 0 | 3 |

ಚೆವಿಸ್‌ವಿಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಅಕ್ಯಾಡೆಮಿ ಮೈಸೂರು

ಬೇವವಿಜ್ಞಾನ ಮತ್ತು ನೈಸರ್ಗಿಕ ವಿಜ್ಞಾನ ವಿಭಾಗಗಳು.

ಬಿಎಸ್ಸಿ ಮೊದಲನೆಯ ಚಾತುರ್ಮಾಸ (ಸೆಮಿಸ್ಟರ್)

ಸಾಹಿತ್ಯ ಸಿಂಚನ - ೧

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ನಾಡು ನುಡಿಯ ಬಗ್ಗೆ ಅಭಿಮಾನ ಮೂಡಿಸುವುದು
- ಭಾಷೆಯ ಅಭಿವೃದ್ಧಿಗೆ ಅವಕಾಶ ಕಲ್ಪಿಸುವುದು
- ನವೋದಯ ಕಾಲಘಟ್ಟದ ಕವಿಗಳ ಬಗ್ಗೆ ಬೆಳಕು ಚೆಲ್ಲುವುದು
- ಭೂಮಿ ಕುರಿತ ಕವಿಗಳು ಹಾಗೂ ಲೇಖಕರ ಸೃಜನಶೀಲ ಬರವಣಿಗೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಆಡಳಿತ ಭಾಷೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ನಾಡು ನುಡಿಯ ಬಗ್ಗೆ ಅಭಿಮಾನ ಬೆಳೆಸಿಕೊಳ್ಳುವರು
- ಭಾಷೆಯ ಅಭಿವೃದ್ಧಿಗೆ ಅವಕಾಶ ಪಡೆದುಕೊಳ್ಳುವರು
- ನವೋದಯ ಕಾಲಘಟ್ಟದ ಕವಿಗಳ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ಭೂಮಿಯ ಬಗೆಗಿನ ಕವಿಗಳು ಹಾಗೂ ಲೇಖಕರ ಸೃಜನಶೀಲ ಬರವಣಿಗೆಯ ಬಗ್ಗೆ ಅರಿತುಕೊಳ್ಳುವರು
- ಆಡಳಿತ ಭಾಷೆಯ ಬಗ್ಗೆ ಜ್ಞಾನ ಪಡೆದುಕೊಳ್ಳುವರು

ಜೆಎಸ್‌ಎಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಅಕ್ಯಾಡಮಿ ಮೈಸೂರು
ಬೇವವಿಜ್ಞಾನ ಮತ್ತು ನೈಸರ್ಗಿಕ ವಿಜ್ಞಾನ ವಿಭಾಗಗಳು. ಬಿಎಸ್ಸಿ ಮೊದಲನೆಯ ಚಾತುರ್ಮಾಸ (ಸೆಮಿಸ್ಟರ್)

ಸಾಹಿತ್ಯ ಸಿಂಚನ-೧

ಘಟಕ - ೧, ನಾಡು-ನುಡಿ-ಚಿಂತನೆ

- | | |
|--------------------------|--------------------------|
| ೧) ನಾಡು, ನುಡಿ , ಸಂಸ್ಕೃತಿ | : ಶ್ರೀ ವಿಜಯನ ಕವಿರಾಜಮಾರ್ಗ |
| ೨) ಕಾಣಿಕೆ | : ಬಿ.ಎಂ.ಶ್ರೀಕಂಠಯ್ಯ |
| ೩) ರತ್ನನ ಪದಗೊಳ್ | : ಜಿ.ಪಿ.ರಾಜರತ್ನಂ |
| ೪) ಕಟ್ಟುವವು ನಾವು | : ಎಂ ಗೋಪಾಲ ಕೃಷ್ಣ ಅಡಿಗ |

ಘಟಕ -೨ , ಭೂಮಿ

- | | |
|-------------------------------------|-----------------------|
| ೧) ಬೆಳಗಾಗಿ ನಾನೆದ್ದು ಯಾರ್ಯಾರ ನೆನಯಾಲಿ | : ಜನಪದ |
| ೨) ಭೂಮಿ ತಾಯಿಯ ಚೊಚ್ಚಲ ಮಗ | : ದ.ರಾ. ಬೇಂದ್ರೆ |
| ೩) ಕುಂಕುಮ ಭೂಮಿ | : ಕೆ.ಎಸ್ ನರಸಿಂಹಸ್ವಾಮಿ |
| ೪) ಅವ್ವ | : ಪಿ.ಲಂಕೇಶ |

ಘಟಕ - ೩, ವೈಜ್ಞಾನಿಕ ಮನೋಧರ್ಮ

- | | |
|-----------------------------|----------------------------|
| ೧) ಧನ್ವಂತರಿ ಚಿಕಿತ್ಸೆ | : ಕುವೆಂಪು |
| ೨) ವಂಡೂರಿನ ಹವಳದ ದಂಡೆಗಳು | : ಕೆ.ಪಿ ಪೂರ್ಣಚಂದ್ರ ತೇಜಸ್ವಿ |
| ೩) ನಿಸರ್ಗದ ನಿಗೂಢ ಕುರಿಂಜಿಲೋಕ | : ನಾಗೇಶ ಹೆಗಡೆ |

ಘಟಕ - ೪, ಭಾಷಾ ಭಾಗ

- | |
|------------------------------------------|
| ೧) ಪತ್ರ ವ್ಯವಹಾರ, ಸಾಮಾನ್ಯ ಪತ್ರ, ಮನವಿ ಪತ್ರ |
| ೨) ಆಡಳಿತ ಕನ್ನಡ ಬೆಳೆದು ಬಂದ ದಾರಿ |
| ೩) ಆಡಳಿತ ಭಾಷೆಯ ಸ್ವರೂಪ ಮತ್ತು ಲಕ್ಷಣ |

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ : ಕವಿರಾಜ ಮಾರ್ಗ- ಶ್ರೀ ವಿಜಯ,

ಕುವೆಂಪು ಕೃತಿ ವಿಮರ್ಶೆ- ಪ್ರೊ.ಅರವಿಂದ ಮಾಲಗತ್ತಿ

ಆಧುನಿಕ ಕನ್ನಡ ಕಾವ್ಯ- ಎಚ್.ಎಂ ಚನ್ನಯ್ಯ

ಆಡಳಿತ ಕನ್ನಡ - ಎಚ್‌ಎಸ್‌ಕೆ

Language 2 – Part II French I

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Course Objectives

- The course aims at making the learner understand and use familiar day-to-day expressions and very basic phrases in French.
- The learners are taught to introduce themselves and others, ask and answer questions about personal details in French.

Course Outcomes:

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

1. Improve the listening and speaking skills by listening to audio lessons.
2. Read, comprehend, and analyze a wide range of texts such as small paragraphs and comprehension in French.

Unit 1

1. Greet people
2. Talk about yourself

Unit 2

1. Talk about where you live

Unit 3

1. Talk about your family members

Unit 4

1. Talk about your likes and dislikes

References:

1. Stahl Christian, 2018. 100 French Short Stories for Beginners Learn French with Stories Including Audiobook published by Lulu.com.
2. S. Singh Kajal Chawla_Toujours Francais:- French Volume -0, language Learning Books for beginners, Easy French Step-by-Step Learning method:-Educational book published by Souvenir Publishers Pvt. Ltd.

SEC 01 – Digital Fluency

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| L | T | P | C |
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Course Objectives:

- To introduce students to the realm of technology.
- To impart knowledge regarding the benefits of digitization.
- To help students gain digital literacy.

Course Outcomes:

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

1. Have an intelligent conversation on the key concepts and applications of Artificial Intelligence, Big Data Analytics, Internet of Things, Cloud Computing and Cybersecurity.
2. Develop holistically by learning essential skills such as problem-solving, design thinking and teamwork.

Theory

Unit-I: Emerging Technologies – Overview of emerging Technologies – Artificial Intelligence (AI), Machine Learning, Deep Learning. Database Management for Data Science, Big Data Analytics. Internet of Things (IoT) and Industrial Internet of Things (IIoT). Cloud computing and its service models. Introduction to Cyber Security and Types of cyber-attack.

Unit-II: Applications of Emerging Technologies – Artificial Intelligence (AI), Big Data Analytics, Internet of Things, Cloud Computing, Cyber Security.

UNIT III: Essential skills beyond Technology: Safe usage of the internet, Creative Problem solving & Critical Thinking, Innovation and Design Thinking, Use of tools in enhancing skills.

References

1. Mehrotra D., 2019. Basics of artificial intelligence & machine learning, Notion Press.
2. Zsolt N., 2018. Artificial Intelligence & Machine Learning Fundamentals, Packt Publishers.

VBC 01 – Health & Wellness

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

Course Objectives:

- To introduce the concept of health, food, nutrition and diet and their role in malnutrition, communicable and non-communicable diseases.
- Relationship between of yoga and Ayurveda.
- The psychology, various emotions, and behavioral aspects.

Course Outcomes:

At the end of the course, students would be able to understand the

- Need of food, nutrition, diet and causes of malnutrition and various disease conditions.
- Gains knowledge of yoga and Ayurveda their health benefits.
- Psychology, various personalities, and their effect on concentration.

Unit I: Definition of health, food, nutrients, nutrition, diet, RDA (ICMR & WHO), Balanced Diet, malnutrition. Exercise & fitness. Incidence of Nutritional problems, signs, symptoms, and treatment- Protein Energy Malnutrition, Micronutrient deficiencies (Vit-A, Iron, Iodine and Zinc)- Causes & consequences of malnutrition. Intervention programs: Mid-Day Meal Programme, NIPPCD Fortification and enrichment of foods, NIN, ICMR, WHO, FAO.

Unit – II: Communicable Diseases causes and prevention -cholera, polio, measles, HIV. Impact of NCDs on public health. Non-communicable diseases causes and prevention: Obesity, Diabetes mellitus, hypertension, CVD, Cancer, Osteoporosis

Unit – III: Yoga and health science- Introduction to Yoga; Objective of Yoga; Concept of Mind according to Yoga; Importance of Yoga & Misconceptions of Yoga. Ayurveda-Principles; Dosha theory. Interrelation between Yoga and Ayurveda. Herbal remedies and Nutraceuticals.

Unit – IV: Psychology, emotion, personality, motivation, cognition, cognitive learning, memory, forgetting and Artificial Intelligence - definitions and types. Understanding basic behavioral aspects- attention and concentration.

References

1. Vinodini Reddy., Pralhad Raj, Gowrinath Sastry J, Kashinath, K.C. (1993), Nutrition Trends in India, NIN, Hyderabad.
2. Park and park (1995), Text book of preventive and social medicine, Banarsidas published by Jabalpu.
3. Jellifee, D.D and Pathes (1989), Assessment of Nutritional status of community, WHO, Geneva.
4. Baron RA and Misra G, (2014), Psychology, Fifth Edition, New Delhi, By Pearson education.
5. Yoga Health by Dr H R Nagendra & Dr R Nagarathna.

Semester Two

DSC 03 - Bioorganic Chemistry

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 5 |

Course Objectives:

- To give basics of organic chemistry essential for life functions and health applications
- To impart the fundamental knowledge of organic reaction mechanisms
- To provide the platform to extrapolate organic reactions for metabolic reactions of the living organisms

Course Outcomes:

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

1. Relate the chemical structure of biomolecules to reactivity
2. Discuss similarities and differences between transformations of biomolecules in living systems (aquatic environment) and *in vitro*, e.g., industrial synthesis
3. Extrapolate reaction mechanisms

Theory

Unit-I: Introduction to Organic Chemistry: Classification of organic compounds, unique characteristics, IUPAC nomenclature of organic compounds (including bifunctional) and biomolecules. Reaction mechanisms: Concept of inductive effect, resonance and hyperconjugation. Classification of organic reactions (substitution, addition, elimination, and rearrangement), with two examples for each. Concept of carbanions, carbocations, free radicals, carbenes, nucleophiles and electrophiles.

Unit-II: Aliphatic hydrocarbons: Mechanism of Markownikoff and anti-Markownikoff addition. Addition of HBr to propene. Dienes – types with examples, 1,3 butadiene – Preparation, stability, and mechanism of addition of HBr. Diels-Alder reaction. Conformational analysis of ethane. Cycloalkanes: Reactivities and relative stability. Bayer's strain theory. Sachse-Mohr theory. Boat and chair forms of cyclohexanes.

Unit-III: Arenes: Structure of benzene – by Resonance and molecular orbital theories. Aromaticity. Mechanism of Nitration and Friedel- craft reaction. Resonance structures of Naphthalene and Anthracene. Nucleophilic Substitution Reactions: SN1 and SN2 reaction- with example. Elimination reactions-E1 and E2 with example. Alcohols: Definition, Classification, monohydric alcohols - distinguishing reactions for Primary, Secondary and Tertiary alcohols.

Unit IV: Stereochemistry: stereoisomerism, types, Fischer-projection formulae, chiral carbon atom, asymmetry and dissymmetry, chirality, conditions for optical isomerism (Examples: glyceraldehyde, lactic acid, tartaric acid), Nomenclature of enantiomers, diastereomers. D and L notation, R and S system, racemization, and resolution (biochemical, chemical, and physical methods). Geometrical isomerism.

Practical 03 - Bioorganic Chemistry

1. Systematic qualitative analysis of the organic compounds:

Urea, Aniline, m-cresol, Chlorobenzene, Naphthalene, p-Toluidine, Benzoic acid, Salicylic acid, Resorcinol.

2. Organic Preparations:

- a) Aspirin from salicylic acid.
- b) Benzoic acid from benzaldehyde.
- c) para-bromo acetanilide from acetanilide.
- d) meta-dinitrobenzene from nitrobenzene.

References:

- 1. Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand. *
- 2. Finar L, Organic Chemistry (Vol. I & II), E. L. B. S. *R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
- 3. Organic Chemistry Vol. I (Sixth Edn.) and Vol. II (Fifth Ed.,) by I.L. Finar ELBS.
- 4. Organic Chemistry (Fifth Ed.,) by Morrison and Boyd, PHI, India.
- 5. Organic Chemistry (Fifth Ed.,) by Francis A. Carey Tata Mc Graw Hill publishing company Limited, New Delhi.
- 6. Reaction Mechanism in Organic Chemistry by Mukherjee Sirigh, N.T. Nigam, India.
- 7. A guidebook to mechanism in Organic Chemistry by Peter Sykes, ELBS.
- 8. Advanced organic chemistry by Jerry March (4th Edition) Wiley Eastern.
- 9. Chemistry of Natural Products, K.W. Bentley by stereochemistry of carbon compounds by E. Eliel, John Wiley & Sons, Inc.
- 10. Stereochemistry of Organic compounds by D. Nasipuri.

DSC 04 - Analytical Biochemistry

| L | T | P | C |
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Course Objectives:

- To give basics of physiochemical parameters analysis of different food items
- To impart the fundamental knowledge of laboratory instrumentation for analysis
- To provide the basics of principle and applications of methodology adopted in the analysis of biomolecules

Course Outcomes:

Successful completion of the course,

1. Enables students to understand basic laboratory techniques
2. Understands the insights of centrifugation, electrophoresis basics and other extraction techniques.
3. Demonstrate the adaptation of different analytical techniques.

Theory

Unit-I: Homogenization, cell lysis and separation. Principle and applications of centrifugation, basic rules of sedimentation, Svedberg unit, factors affecting sedimentation velocity, types of centrifuges and rotors, principles and applications of preparative and analytical ultracentrifuges, differential centrifugation and density gradient centrifugation, molecular weight determination using centrifugation.

Unit-II: Classification of separation methods. Classical and advanced methods of separation, Extraction techniques, theory and applications on liquid-liquid, liquid-solid, solid-phase micro extractions and stir-bar sorptive extraction techniques. Working principle and applications of Thin-Layer Chromatography, HPTLC, Silica gel column chromatography. Bioassay guided fractionation and phytochemical analysis.

Unit-III: Radiochemical methods, basic concepts, detection, counting methods and applications- Proportional counter, Geiger-Müller counter and scintillation counter. Cerenkov radiation. Examples of biologically useful radionuclides. Use of radioisotopes in biological research, autoradiography, pulse chase experiment. Biomedical applications of radiography.

Unit-IV: Proximate analysis of food: Determination of moisture, ash content, fibers, protein, carbohydrates, and fat in different food items; Water analysis: Water quality assessment for biological and physiochemical parameters. Conductometry, potentiometry, polarography, amperometry, voltammetry, chronopotentiometry. Thermometric analysis: Thermogravimetry, differential thermal analysis, differential scanning calorimetry, thermometric titrations.

Practical 04 - Analytical Biochemistry

1. Tissue homogenization and separation using centrifugation.
2. Separation of plasma and serum from blood sample.
3. Solvent extraction using Soxhlet apparatus.
4. Separation of plant pigments using silica gel column chromatography.
5. Thin layer chromatography of plant metabolites.
6. Effect of solvent system on the R_f value of two solutes.
7. Demonstration of Geiger–Müller counter.
8. Water Quality Analysis- Hardness, pH, Chloride & Fluoride content.

References

1. Biophysical chemistry- Principles and techniques- Upadhyay, Upadyay and Nath, Himalaya Publication House Mumbai.
2. Physical chemistry- Puri and Sharma, Pathania Vishal Publication and Co.,Jalandhar
3. Introduction to Practical Biochemistry – Eds., SK Sawhney and Randhir Singh, Narosa Publishing House, New Delhi
4. An Introduction to Practical Biochemistry. 3rd Ed. David T. Plummer. McGraw Hill Education Pvt. Ltd., Chennai
5. Biochemistry by U. Sathyanarayana Books and Allied (P) Ltd. Kolkata, (2014).

OEC 02 - Tools and Techniques in Biochemistry

| L | T | P | C |
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Course Objectives:

- To give insights of good laboratory practices, safety, and precautions
- To impart the fundamental knowledge of laboratory equipment and instruments
- To provide the basics of laboratory techniques and protocols to nurture students to get jobs in clinical, academic, and industrial laboratories

Course Outcomes:

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

1. Understand good laboratory practices and gain insights of laboratory safety
2. Demonstrate the proficiency in use of glassware and analytical instruments
3. Demonstrate the ability to calculate, prepare reagents/solutions/buffers and perform a variety of assays
4. Handle the laboratory equipment and instruments used in diagnostic centers/hospitals/chemistry laboratories

UNIT-I: Good laboratory practices-Introduction, WHO guidelines on GLP; Quality assurance, Biosafety in Laboratory. Laboratory associated infections and other hazards. Assessment of Biological Hazards and levels of biosafety. Biosafety guidelines. Introduction to Biological safety cabinets. Primary Containment of Biohazards, Recommended Biosafety Levels for Infectious Agents, and Infected Animals.

UNIT-II: Calibration of volumetric glassware, Preparation, and standardization of reagents; Concentration units: Avogadro's number, mole, mole fraction, molarity, equivalent weight, normality, molality, percentage, ppm, ppb (Problems to be worked out). Ionic equilibria: Lewis's concept of acids and bases. pH, pH scale; buffers, Henderson-Hasselbalch equation, buffer capacity, preparation of acidic and basic buffer solutions.

UNIT-III: Theory of acid base indicators. Choice of indicators. pH titration curves and isoelectric pH of amino acids. Electrodes (Hydrogen Electrode & Calomel electrode), electrode. Conductometric titrations [Strong acid against strong base, weak acid (amino acid) against NaOH].

UNIT-IV: Principles and applications of spectrophotometer, colorimeter, fluorimeter, Polymerase Chain Reaction, electrophoresis- vertical, horizontal, paper chromatography, column chromatography.

References

1. Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath – Himalaya Publ. House.
2. Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ. Press. Chromatography – G. Abbot.
3. Upadhyay A, Upadhyay K and Nath N. Biophysical Chemistry (2000) Himalaya Publishing House.
4. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge University Press.

Language 1 – Part I English II

| L | T | P | C |
|---|---|---|---|
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Course Objectives:

- Understand and apply the purpose of adjectives, adverbs, and prepositions
- Apply the rules of reported speech in dialogue writing
- Bring life to the words and enhance creativity in writing by using figures of speech like alliteration, metaphor, and simile

Course Outcomes:

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

1. Correct errors in sentences by applying rules of adjectives, adverbs, and prepositions.
2. Reveal the tone and moods of the characters and improve writing of dialogues by applying the rules of Reported Speech.
3. Use figurative language to elicit emotion, help readers form mental images and draw readers into the work.

Unit-I: Grammar

1. Correct Use of Adjectives
2. Reported Speech
3. Correct Use of Adverbs
4. Correct Use of Prepositions
5. Formal Letters (**Resume and Cover letter**) and Writing Emails
6. Reading Comprehension Passage

Unit-II: Vocabulary – I

1. Roots: G to L
2. Figures of Speech: Alliteration, Metaphor, Simile

Unit-III: Vocabulary – II

1. Prefixes and Suffixes
2. New Words in English

Unit-IV: Essay: Indian English Literature

Swami Vivekananda's Address at Parliament of Religions in Chicago

References

1. Lewis Norman (2016) Word Power Made Easy, published by Goyal Publishers & Distributors Pvt. Ltd.
2. Raymond Murphy (2009) Grammar in Use Intermediate Student's Book with answers: Self-study Reference and Practice for Students of North American English, published by Books wagon.
3. Raymond Murphy (2013) English Grammar in Use: A Self Study Reference and Practice Book Intermediate Learners Book published by Cambridge University Press.

Language 2 – Part II English II

| L | T | P | C |
|---|---|---|---|
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Course Objectives:

- Learn and appreciate different kinds of literature like Indian English, British and American literature.
- Learn to appreciate the importance of moral and ethical values in life through study of literature.

Course Outcomes:

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

1. Critically analyze the aftereffects of Industrial Revolution in Britain through the poem “The Chimney Sweepers” by William Blake
2. Know about the importance of nature. Nature is the best teacher which can teach humans about what is evil and what is good through the poem “The Tables Turned” by William Wordsworth.
3. Learn that every person must understand his/her own abilities and talents and not be fooled by a critic who may not have the best intentions through the poem “The Frog and the Nightingale” by Vikram Seth.

Unit-I: Poetry from the Romantic period

1. “The Chimney Sweepers” by William Blake
2. “The Tables Turned” by William Wordsworth

Unit-II: Indian English Poetry

1. “The Frog and the Nightingale” by Vikram Seth
2. “Battle with Death”, Translating Atal Bihari Vajpayee’s Hindi poem “Maut Se Thann Gayi”.

Unit-III: British and American Prose

1. “The Mammon and The Archer” by O’Henry
2. “The Tell-Tale Heart” by Edgar Allan Poe
3. “The Case for The Defence” by Graham Greene

Unit-IV: Drama Translation Works

“Yama’s Defeat” by Kuvempu translated from Kannada to English by Dr. C. Naganna

References:

1. Vajpayee Atal Bihari 21 poems by Atal Bihari Vajpayee, translated by Pavan K Verma published by Penguin Books India Pvt Ltd.
2. Henry O ‘100 Selected Stories published by Vasant Book Depot.
3. Edgar Allan Poe (2019) The Tell-Tale Heart published by Blurb.
4. Thomson Sharada’s Savitri published by Wordcatcher Publishing.

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ಜೆಎಸ್‌ಎಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಅಕ್ಯಾಡಮಿ, ಮೈಸೂರು

ಜೀವವಿಜ್ಞಾನ ಮತ್ತು ನೈಸರ್ಗಿಕ ವಿಜ್ಞಾನ ವಿಭಾಗಗಳು

ಬಿಎಸ್ಸಿ ಎರಡನೆಯ ಚಾತುರ್ಮಾಸ (ಸೆಮಿಸ್ಟರ್)

ಸಾಹಿತ್ಯ ಸಿಂಚನ -೨

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕುವೆಂಪು ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ವಚನಗಾರ್ತಿಯರ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು
- ವಚನಗಾರರ ಬಗ್ಗೆ ಬೆಳಕು ಚೆಲ್ಲುವುದು
- ಪರಿಸರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಪ್ರಬಂಧ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ಕುವೆಂಪು ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ವಿಸ್ತಾರವಾದ ತಿಳುವಳಿಕೆ ಹೊಂದುವರು
- ವಚನಗಾರ್ತಿಯರ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ವಚನಗಾರರ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಜ್ಞಾನ ಪಡೆದುಕೊಳ್ಳುವರು
- ಪರಿಸರದ ಬಗ್ಗೆ ಅರಿತುಕೊಳ್ಳುವರು
- ಪ್ರಬಂಧ ಸಾಹಿತ್ಯವನ್ನು ಗ್ರಹಿಸಿಕೊಳ್ಳುವರು.

ಜೆಎಸ್‌ಎಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಅಕ್ಯಾಡೆಮಿ, ಮೈಸೂರು
ಜೀವವಿಜ್ಞಾನ ಮತ್ತು ನೈಸರ್ಗಿಕ ವಿಜ್ಞಾನ ವಿಭಾಗಗಳು. ಬಿಎಸ್ಸಿ ಎರಡನೆಯ ಚಾತುರ್ಮಾಸ (ಸೆಮಿಸ್ಟರ್)

ಸಾಹಿತ್ಯ ಸಿಂಚನ -೨

ಘಟಕ - ೧, ಜೀವನ ಕಲೆ

೧) ಜಲಗಾರ : ಕುವೆಂಪು

ಘಟಕ - ೨, ಕನಸು

೧) ಅಕ್ಕ ಕೇಳವ್ವ ನಾನೊಂದು ಕನಸು ಕಂಡೆ : ಅಕ್ಕ ಮಹಾದೇವಿ

೨) ಶವದ ಮನೆ : ಚದುರಂಗ

೩) ರಂಗಣ್ಣನ ಕನಸಿನ ದಿನಗಳು : ಎಸ್.ವಿ ರಂಗಣ್ಣ

ಘಟಕ- ೩, ಮಳೆ

೧) ಮುಕ್ಕಣ್ಣ ಮಳೆ ಕರುಣಿಸೋ : ಜನಪದ ಕಾವ್ಯ

೨) ತೆಂಕಣಗಾಳಿಯಾಟ : ಪಂಜೆ ಮಂಗೇಶರಾಯರು

೩) ಅಮೆಜಾನ್ ಮಳೆಕಾಡಿಗೆ ಅಗ್ನಿ ಪರೀಕ್ಷೆ : ಟಿ. ಆರ್ ಅನಂತರಾಮು

ಘಟಕ -೪, ಭಾಷಾ ಭಾಗ

೧) ಗಾದೆ, ಸ್ವರೂಪ ಲಕ್ಷಣ

೨) ಪ್ರಬಂಧ, ಸ್ವರೂಪ ಲಕ್ಷಣ

೩) ಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರ, ಅಧಿಕೃತ, ಅರೆ ಅಧಿಕೃತ ಪತ್ರಗಳು

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ :

ಕುವೆಂಪು ಸಂಚಯ - ಡಾ.ಪ್ರಧಾನ್ ಗುರುದತ್ತ

ಕನ್ನಡದ ಅತ್ಯುತ್ತಮ ಸಣ್ಣ ಕತೆಗಳು - ನರಸಿಂಹ ಮೂರ್ತಿ

ಆಡಳಿತ ಕನ್ನಡ - ಡಾ. ಮುರಿಗೆಪ್ಪ

Language 2 – Part II French II

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Course Objectives:

- The students are taught to interact in a simple way provided the other person talks slowly and clearly and is prepared to help.

Course Outcomes:

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

1. Gain an appreciation and understanding of the diversity of the Francophone world within the broader framework of multicultural communities and global perspectives.
2. Comprehend and respond with grammatical accuracy to spoken and written French as well as demonstrate cultural awareness.

Unit 1

1. Engage in a simple buy-and-sell situation

Unit 2

1. Ask about the day, the time, and the date
2. Accept and refuse

Unit 3

1. Read simple notices, posters, and catalogs

Unit 4

1. Fill in a simple form
2. Write a simple postcard

References:

1. Verma Rashmi, 2020. French Made Easy published by Goodwill Publishing House.
2. Kendris Christopher, 2011. Barron'S Foreign Language Guides - 501 French Verbs (with CD) published by Goyal Publishers & Distributors Pvt. Ltd.

AECC 01 - Environmental Studies

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Course Objectives:

- To identify and solve the environmental problems.
- To avoid environmental pollution & Global Problems.
- To create awareness among the people about the protection of the environment.

Course Outcomes:

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

1. Get knowledge about the different types of resources like land, water, mineral and energy.
2. Gain knowledge about the different types of pollutions and their control technologies.
3. Get information about the ecosystem and about its functions like Food chain, Ecological pyramids etc.

Theory

Unit-I: Introduction to environmental studies - Multidisciplinary nature of environmental studies; Scope and importance of environmental studies, Ecosystems, Structure, and function of the ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystem: Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, rivers, oceans). Natural Resources: Renewable and Non-renewable Resource, Land resources and land-use change; Land degradation, soil erosion and desertification. Water: Use and over-exploitation of surface and groundwater, conflicts over water (international & interstate). Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources.

Unit-II: Biodiversity and Conservation- Levels of biological diversity: genetic, species and ecosystem diversity; values of biodiversity 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.

Unit-III: Environmental Pollution & Policies - Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, Nuclear hazards and human health risks, Solid waste management, Climate change, global warming, ozone layer depletion, acid rain, Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

Unit-IV: Human Communities and the Environment - Human population growth: Impacts on environment, human health, and welfare. Resettlement and rehabilitation project-affected persons; case studies. Disaster management: floods, earthquakes,

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). Fieldwork activities (Study of simple ecosystems)

References

1. Textbook of Environmental Studies for undergraduate courses by Erach Bharucha.
2. Deswal, S. and Deswal, A. 2005. A Basic Course in Environmental Studies. Dhanpat Rai & Co Ltd., Delhi.
3. Singh, N. and Sontakke, N.A. 2002. On Climatic fluctuations and Environment changes on Indo-Gangetic Plains, India.
4. Deswal, S. and Deswal, A., 2003, Energy, ecology, Environment and Society, Dhanpat Rai & Co Ltd., Delhi.
5. Singh, G.B. and Sharma, B.R. 1998. Fifty Years of Natural Resource Management Research, Indian Council of Agriculture Research, New Delhi.

ABC 01– Minor Project (RBPT)

| L | T | P | C |
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| 0 | 0 | 2 | 2 |

Course Objectives:

- To address a small research problem
- To design and interpret the results
- To foster the critical thinking and problem-solving abilities

Course Outcomes:

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

1. Understand designing experiments based on the research problem
2. Know compiling and analyzing the data
3. Write a comprehensive project report

Minor Projects can be done at

1. Diagnostic laboratories
2. Industrial visit – R&D laboratories
3. Visit to any central research institutes or Universities or laboratories
4. Field studies

Semester Three

DSC 05 - Biochemistry of Macromolecules

| L | T | P | C |
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Course Objectives:

- To highlight the role of biomolecules in structure and function of life
- To give insights of the significance and methodology involved in characterizing biomolecules

Course Outcomes:

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

1. Gain better understanding of biomolecules and key contributions of scientists
2. Study carbohydrates, proteins, lipids, nucleic acids, and their importance.
3. Understand the process of fermentation and manufacture of Biodiesel
4. Understand methods of determination of amino acid and nucleotide sequence

Theory

Unit-I: Carbohydrates. Monosaccharides: Configuration and conformation of monosaccharides, Reducing and optical properties of sugars, Derived monosaccharides; Amino sugars. Disaccharides: Stability of glycosidic bond. Polysaccharides: Homopolysaccharides and hetero-polysaccharides, Structural polysaccharide; Storage polysaccharides; Stearic factors in polysaccharides folding, sugar code and lectin, Glycosaminoglycans, mucopolysaccharides; Bacterial cell wall – proteoglycans and peptidoglycans. Glycoproteins. Blood group polysaccharides.

Unit-II: Amino acids: Nomenclature, classification, and buffering properties of amino acids, zwitter ionic structure, reaction of amino acids, unusual amino acids, non-protein amino acids. Peptides: Features of the peptide bond, naturally occurring peptides; Hierarchy of protein structure. Tertiary and quaternary structures: Protein folding: Anfinsen's experiment. Bonds in protein folding. Chaperones in protein folding and Levinthal paradox. Denaturation and renaturation of proteins. Protein-protein interactions. Structures of myoglobin haemoglobin, immuno-globulin, collagen, chymotrypsin, and keratin.

Unit-III: Lipids: Classification and biological role. Fatty acids – Nomenclature of saturated and un-saturated fatty acids. Physiological properties of fatty acids. Acylglycerols: Mono, di and tri-glycerol. Saponification, saponification value, iodine value, peroxide value, acid value and significance. Phosphoglycerides: Structure and roles of lecithin, cephalins, phosphatidylinositol, plasmalogens, and cardiolipin. Sphingolipids: Structure and importance of sphingomyelin. Glycosphingolipids: Structure and importance of gangliosides and cerebrosides. Eicosanoids: Structures and Biological roles.

UNIT-IV: Nucleic Acids: Nitrogenous bases: Purines, Pyrimidines; Chargaff's rule; nucleosides, nucleotides, unusual bases. Physiochemical properties of nucleic acids. Difference between RNA and DNA. Chemical reactions of DNA and RNA. Secondary structure of DNA. Watson and Crick model; B and Z DNA, other models of DNA structure. Supercoiling of DNA. Denaturation and renaturation of Nucleic acids. Melting of DNA, T_m ; factors affecting T_m , Cot curve, classification of DNA based on cot curve. DNA protein interactions. Genetic Code, Types and roles of RNA, Secondary structure of tRNA: cloverleaf model.

Practical 05 - Biochemistry of Macromolecules

1. Qualitative analysis of Carbohydrates.
2. Qualitative analysis of amino acids and proteins.
3. Qualitative analysis of Lipids.
4. Qualitative tests for nucleic acids.
5. Isolation of genomic DNA from biological source.
6. Determination of purity of nucleic acids by spectrophotometry.
7. Estimation of DNA by Diphenylamine method.
8. Estimation of RNA by Orcinol method.

References:

1. Biochemistry by L. Stryer (1995) W.H. Freeman Press, San Francisco, USA.
2. Biochemistry, by Voet, D. and Voet, J.G. (2004). 3rd Edition, John Wiley & Sons, Inc. USA.
3. Biochemistry by U. Sathyanarayana Books and Allied (P) Ltd. Kolkata, (2014).
4. Textbook of Biochemistry by J.L Jain (2016)
5. Medical Biochemistry by Ramakrishnan (2012)
6. Textbook of Biochemistry by D.M. Vasudevan (2018)

DSC 06 - Nutrition

| L | T | P | C |
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Course Objectives:

- Aims to provide general theoretical information on micronutrients, water and electrolytes in nutritional biochemistry and their functions in metabolism
- Explains how nutrients are delivered to the body and describes the function of various nutrients including how they are metabolized to form energy used by the human body.

Course Outcomes:

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

1. Understand the nutritional essentiality of biomolecules
2. Get insights of biochemical aspects of nutrition, which would help them to apply it into research or in their day-to-day life.

Theory

Unit-I: Introduction: Concept of nutrition, essential nutrients and their classification, calorific value of foods and its determination (Bomb calorimeter). Different components of energy expenditure, respiratory quotient, basal metabolic rate (BMR), determination of BMR, factors affecting BMR. Specific Dynamic Action (SDA) of foods. Energy expenditure at rest and work. Water metabolism & Regulation. Electrolytes - Concept, balance, and acid-base balance. Balanced diet-- recommended dietary allowances for different categories of the human beings.

Unit-II: Carbohydrates: Dietary types, dietary sources, requirements, utilization and functions, nutritional importance, sources, glycemic index and its uses, essentiality and adverse effects of dietary fibers, protein sparing action of carbohydrates. Proteins: Dietary sources, nutritional classification, and role of proteins in growth and development. nutritive value of proteins – Protein Efficiency Ratio (PER), Net protein utilization (NPU) and biological value (BV) of proteins. Essential amino acids, nitrogen balance, mutual supplementation of proteins, supplementary value of proteins, nitrogen balance. Malnutrition- Kwashiorkor and Marasmus.

Unit-III: Fats: Dietary types, dietary sources, requirements, utilization and functions, invisible fat, essential fatty acids, and their biological importance. Saturated, unsaturated, MUFA, PUFA, cis and trans fatty acids, dietary intake. Role of lipoproteins, cholesterol, and triglycerides in health and disease. Dietary sources, requirements, deficiency symptoms and biological role of fat-soluble vitamins (vitamin A, D, E and K). Hypovitaminosis and hypervitaminosis. Vitamin like compounds.

Unit-IV: Dietary sources, requirements, deficiency symptoms and biological role of water-soluble vit-amins (thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folic acid, vitamin B12, vitamin C). Minerals: Macro and micronutrients, dietary sources, requirements, functions, and deficiency symptoms. Recommended dietary allowances and factors affecting it. Antinutritional factors: sources and harmful effects of anti-

vitamins (avidin, dicoumarol), Natural toxicants (Lathyrus sativa) and adulterants (butter yellow, lead chromate, malachite green).

Practical 06 - Nutrition

1. Determination of
 - Moisture content of foods
 - Calcium in grains
 - Iron in vegetables
 - Vitamin-C in citrus fruits.
2. Estimation of total carbohydrates.
3. Estimation of reducing sugars by Hedgedon and Jensen method.
4. Determination of saponification value of oil or fat.
5. Determination of iodine value of oil or fat.
6. Determination of peroxide value of oil or fat.
7. Determination of acid value of oil or fat.
8. Test for Food adulterants- Qualitative analysis

References

1. M. Swaminathan, 2015, Food & Nutrition Volume I and II, Bappco
2. Tom Brody, 1998, Nutritional Biochemistry, Academic Press, Second Edition.
3. Walter Santos, Nabuco Lopes, J. J. Barbosa, Dagoberto Chaves, José Carlos Valente, 2013, Nutritional Biochemistry and Pathology. Springer
4. Joan Webster-Gandy, Angela Madden, and Michelle Holdsworth, 2011; Oxford Handbook of Nutrition and Dietetics by Oxford Medical Handbooks.
5. Food science by B. Sreelakshmi (2010)
6. Nutrition and Dietetics by Davidson S and Pasmor JR (2001)
7. Food facts and principles –SakunthalaManay, Sadhakshara Swami. (2008).

OEC 3 - Biochemical Basis of Diseases

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Course Objectives:

- To provide knowledge regarding the analysis of biological fluids for its chemical constituents & correlating the same in health & disease

Course Outcomes:

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

1. Get acquainted with human diseases and their biochemical basis.
2. Understand the importance of improper dietary constituents and balanced diet to prevent nutritional disorders/diseases.
3. Understand biochemical basis of diseases; inherited metabolic disorders, digestive, and infectious diseases.

Theory

Unit-I: Inborn Errors of Metabolism – Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, Histidinemia. Disorders of Carbohydrate Metabolism – Diabetes mellitus, glycogen storage diseases, pentosuria, galactosemia.

Unit-II: Disorders of Lipids – Hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, Ketoacidosis, Abetalipoproteinemia. Digestive diseases – Maldigestion, malabsorption, creatorrhoea, diarrhoea and steatorrhoea. Disorders of liver and kidney – Jaundice, fatty liver, chronic kidney disease (CKD), Polycystic kidney disease (PKD)

Unit-III: Abnormalities in Nitrogen Metabolism – Uremia, hyperuricemia, porphyria. Haemorrhagic disorders – Haemophilia, von Willebrand's disease, Rendu-OslerWerber dis-ease, thrombotic thrombocytopenic purpura (TTP).

Unit-IV: Infectious diseases: Bacterial infections: Tetanus, Diphtheria, Tuberculosis, Typhoid, Cholera. Viral infection: Polio, Measles, Mumps, influenza, HIV. Protozoan: Malaria and Trypanosomi-asis. Parasitic infection: Leishmaniasis.

References:

1. Biochemistry (2013) 4th ed., Voet, D., Voet, J. & Pratt, C. Wiley & Sons, Inc. (New Jersey), ISBN:978-1-11809244-6.
2. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J. L. and Stryer, L., W.H Freeman and Company (New York)
3. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York)
4. Klein's Microbiology, (2008) 7th ed., Prescott, Harley, Wiley, J.M. Sherwood, L.M. Woolverton, C.J. McGraw Hill International Edition (New York) ISBN: 978-007-126727.

Language 1 – Part I English III

Course Objectives:

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- Learn the importance of Superfluous Expressions otherwise known as redundant or unnecessary expressions.
- Learn to use Active and Passive Voice in speech and writing and understand them.

Course Outcomes:

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

1. Add variety to their writing through the use of conjunctions and articles so that they can be used to create sentences with different styles and meanings.
2. Add flexibility in their language by proper use of Active and Passive voice.
3. Successfully remove redundant and superfluous expressions in their speech and writing.
4. Express nuances in meaning by using modal auxiliary verbs.

Unit-I: Grammar

1. Correct use of Conjunctions
2. Correct use of Articles
3. Superfluous Expressions and commonly mispronounced words in English
4. Active and Passive Voice
5. Modal Auxiliaries
6. Reading Comprehension Passage

Unit-II: Vocabulary

1. Roots: M to R
2. Homonyms, homophones and homographs
3. Figures of Speech: Hyperbole, Euphemism, Onomatopoeia, Personification
4. Foreign expressions

Unit-III: Creative Writing

1. Paragraph writing
2. Précis Writing

Unit-IV: Essay

Sardar Vallabhi Bhai Patel's letter to Nehru after drafting the Constitution.

References:

1. Sudhir S Padhye, 2017. English Grammar and Writing Skills, Notion Press
2. S.P Bakshi, Richa Sharma, 2017. Descriptive English, Arihant Publication

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Course Objectives:

- Critically analyze American, Anglo American, Neoclassical and Victorian Poetry.
- Learn about the importance of historical fiction and diary entries.

Course Outcomes:

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

1. Think and ponder about the plight of not only Jewish refugees but refugees all over the world and raise broader questions about isolation, loneliness, and exile.
2. Understand and appreciate the revolutionary and patriotic spirit of Bhagat Singh's last three years (1929-31) in Lahore's Central Jail, through Bhagat Singh's jail diary.
3. Learn about several life-changing lessons like revengeful instinct can only lead to one's doom and not to give up on life despite all hurdles.

Unit-I: American and Anglo-American Poetry

1. "The Road Not Taken" by Robert Frost
2. "Refugee Blues" by W H Auden

Unit-II: Neoclassical and Victorian Poetry

1. "On His Blindness" by John Milton
2. "The Last Duchess" by Robert Browning

Unit-III: Drama, Historical Fiction and Diary Entries

1. "The Proposal" by Anton Chekov
2. "Remember the Roses" by Avery Taylor
3. Bhagat Singh's jail diary

Unit-IV: Epic Literature

"The Mahabharatha"

References:

1. Chekhov Anton, 2017. The Very Best of Anton Chekov - Short Stories published by Embassy Books.
2. Sandhu Yadvinder Singh, 2020. Bhagat Singh's Jail Diary, Prabhat Prakashan.
3. Frost Robert, 1993. The Road Not Taken and Other Selected Poems, Wilder Publications.

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ಜೆಎಸ್‌ಎಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಅಕ್ಯಾಡಮಿ ಮೈಸೂರು

ಜೀವವಿಜ್ಞಾನ ಮತ್ತು ನೈಸರ್ಗಿಕ ವಿಜ್ಞಾನ ವಿಭಾಗಗಳು

ಬಿಎಸ್ಸಿ ಮೂರನೆಯ ಚಾತುರ್ಮಾಸ (ಸೆಮಿಸ್ಟರ್)

ಸಾಹಿತ್ಯ ಸಿಂಚನ - ೩

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಜನಪದ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಒಲವು ಮೂಡಿಸುವುದು
- ಪ್ರವಾಸ ಸಾಹಿತ್ಯದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು
- ವೈಚಾರಿಕತೆಯ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಶಿವರಾಮ ಕಾರಂತರ ಬದುಕು ಬರವಣಿಗೆಯ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಓದಿಗೆ ಅನುವು ಮಾಡಿಕೊಡುವುದು
- ಲೇಖನ ಚಿಹ್ನೆಗಳ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು.

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ಜನಪದ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಒಲವು ಹೊಂದುವರು
- ಪ್ರವಾಸ ಸಾಹಿತ್ಯದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ವೈಚಾರಿಕತೆಯ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ವಿಸ್ತಾರ ಜ್ಞಾನ ಪಡೆಯುವರು
- ಶಿವರಾಮ ಕಾರಂತರ ಬದುಕು ಬರಹದ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಜ್ಞಾನ ಪಡೆವರು
- ಲೇಖನ ಚಿಹ್ನೆಗಳ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು

ಜೆಎಸ್‌ಎಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಆಕ್ಯಾಡಮಿ ಮೈಸೂರು

ಜೀವವಿಜ್ಞಾನ ಮತ್ತು ನೈಸರ್ಗಿಕ ವಿಜ್ಞಾನ ವಿಭಾಗಗಳು. ಬಿಎಸ್ಸಿ ಮೂರನೆಯ ಚಾತುರ್ಮಾಸ (ಸೆಮಿಸ್ಟರ್)

ಸಾಹಿತ್ಯ ಸಿಂಚನ - ೩

ಘಟಕ - ೧, ಮಾನವೀಯತೆ

೧) ಸತ್ಯ ಶರಣೆ ಸಂಕಮ್ಮ : ಡಾ. ಪಿ.ಕೆ. ರಾಜಶೇಖರ

೨) ಚಂದ್ರಮತಿಯ ಪ್ರಲಾಪ : ರಾಘವಾಂಕ

೩) ಅಮ್ಮ ಹೇಳಿದ ಎಂಟು ಸುಳ್ಳುಗಳು : ಮಣಿಕಾಂತ್ ಎ.ಆರ್

ಘಟಕ - ೨, ಪ್ರವಾಸ ಸಾಹಿತ್ಯ

೧) ನನ್ನ ಗ್ರಹಿಕೆಯ ನೇಪಾಳ : ನಾಗತಿಹಳ್ಳಿ ಚಂದ್ರಶೇಖರ್

ಘಟಕ - ೩, ವಿಚಾರ ಕ್ರಾಂತಿ

೧) ಕತ್ತೆ ಮತ್ತು ಧರ್ಮ : ಡಾ. ಸಿದ್ದಲಿಂಗಯ್ಯ

೨) ವೈಚಾರಿಕತೆ : ಎಚ್. ನರಸಿಂಹಯ್ಯ

೩) ನಮ್ಮ ಅಳತೆಯನ್ನು ಮೀರಲಾರದ ದೇವರು : ಡಾ.ಕೆ. ಶಿವರಾಮ ಕಾರಂತ

ಘಟಕ - ೪, ಭಾಷಾ ಭಾಗ

೧) ಸುತ್ತೋಲೆ

೨) ಕಡತ (ಫೈಲುಗಳು) ಕಛೇರಿ ಟಿಪ್ಪಣಿಗಳು

೩) ಲೇಖನ ಚಿಹ್ನೆಗಳು

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ : ಹೊನ್ನೂರು ಜನಪದ ಗೀತೆಗಳು - ಡಾ. ಪಿ.ಕೆ. ರಾಜಶೇಖರ

ಅಮ್ಮ ಹೇಳಿದ ಎಂಟು ಸುಳ್ಳುಗಳು : ಮಣಿಕಾಂತ್ ಎ.ಆರ್

ತೆರೆದ ಮನ - ಡಾ. ಎಚ್ ನರಸಿಂಹಯ್ಯ

ಆಡಳಿತ ಕನ್ನಡ - ಎಚ್‌ಎಸ್‌ಕೆ

Language 2 – Part II French III

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

Course Objectives:

- This course aims to enable the learners to understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. very basic personal and family information, shopping, local geography, employment).

Course Outcomes:

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

1. Understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. local geography, employment, accommodation, health and illness)
2. Understand short, simple texts, incl. letters and everyday material (e.g. advertisement, menus, magazine articles, hotel webpages) related to areas of most immediate relevance (e.g. local geography, employment, holidays, consulting a doctor)
3. Communicate verbally in simple and routine tasks requiring simple and direct exchange of information on familiar and routine matters (e.g. asking where places are, finding your way around, visiting the doctor, renting an apartment)

Unit 1

1. Talk about yourself, your educational background, your job, your family, your neighborhood
2. Talk about your hobbies and daily activities

Unit 2

1. Ask for goods in a shop where goods are displayed
2. Order a meal in a restaurant if dishes are either displayed or illustrated on the menu

Unit 3

1. Book a hotel room (face to face)
2. Ask for basic services in a post office or bank

Unit 4

1. Indicate the nature of a medical problem to a doctor
2. Make inquiries about a journey at a travel agency

References:

1. Makowski Francois, 1995. Beginners French Made Easy with CD, Goyal Publishers & Distributors Pvt. Ltd.
1. Cantel JB., 1860. The Pronunciation of French Made Easy, Nabu Press

AECC 02 - Indian Constitution

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

Course Objectives

- The course aims to imbue students with the process of constitutional making and its formulations. Further, it is offered with the objective to acquaint students to have the basic understanding of the constitution of India.

Unit I: Constitution – Structure and Principles

- Meaning and importance of Constitution
- Making of Indian Constitution
- Salient features of the Constitution

Unit II: Fundamental Rights and Directive Principles

- Fundamental Rights
- Fundamental Duties
- Directive Principles

Unit III: The Union Government

- President of India – Election & Powers
- Prime Minister and Council of Ministers
- Lok Sabha – Composition and Powers
- Rajya Sabha - Composition and Powers

Reference:

- 1) Durga Das Basu, Introduction to the Constitution of India, Gurgaon; LexisNexis, 2018 (23rd edn.)
- 2) M. V. Pylee, India's Constitution, New Delhi; S. Chand Pub., 2017 (16th edn.)
- 3) J.N. Pandey, The Constitutional Law of India, Allahabad; Central Law Agency, 2018 (55th edn.)
- 4) Constitution of India (Full Text), India. Gov. in., National Portal of India, https://www.india.gov.in/sites/upload_files/npi/files/coi_part_full.pdf
- 5) Durga Das Basu, Bharatada Samvidhana Parichaya, Gurgaon; Lexis Nexis Butterworths Wadhawa, 2015.
- 6) Kb Merunandan, Bharatada Samvidhana Ondu Parichaya, Bangalore, Meragu Publications, 2015.

SEC 02 – Artificial Intelligence

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

Course Objectives:

Course Outcomes:

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

Curriculum awaited from GoK

Semester Four

DSC 07 - Intermediary Metabolism

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 5 |

Course Objectives:

- To provide insight into the phases of metabolism and highlight the importance of metabolism in health and disease
- To study the metabolic pathways of carbohydrates, lipids, proteins, and nucleic acids, and the mechanism of respiratory chain.

Course outcomes:

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

1. Understand different steps involved in the pathways of carbohydrates, lipids, proteins, and nucleic acids.
2. Gets insights of mechanisms of energy generation mechanism in respiratory chain.

Theory

Unit-I: Definition, phases of metabolism, Anabolism, Catabolism and amphibolic pathway- definition, schematic representation of metabolism. Glycolysis; Pathways and Energetics. Substrate level phosphorylation reactions of glycolysis. Glucose paradox. Fate of pyruvate- formation of Acetyl-CoA. TCA cycle- Pathways and Energetics, Anaplerosis, HMP shunt, Uronic acid pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis, Cori cycle, Glucose-alanine cycle, Utilization of lactose and fructose.

Unit-II: Blood lipids and fate of dietary lipids. Oxidation of fatty acid – α , β and ω types, Knoop's experiment, β -oxidation of even number saturated fatty acids. Energetics of β -oxidation, Carnitine cycle, Schematic representation of biosynthesis of even number saturated fatty acids and cholesterol biosynthesis. Formation of ketone bodies. Biosynthesis and degradation: Lecithin, cephalin, phosphatidyl inositol and phosphatidyl serine. Plasma lipoproteins (composition). Biosynthesis of glycolipids.

Unit-III: Fate of dietary proteins, Metabolic nitrogen pool, General reactions of amino acid degradation-Transamination, deamination, and decarboxylation. Ketogenic and glucogenic amino acids. Urea cycle and its significance. Metabolism of individual amino acids – glycine, phenyl alanine and tyrosine. Interrelationship between carbohydrate, lipid, and protein metabolism.

Unit-IV: Nucleosides and nucleotides, Synthesis of purine and pyrimidine, de novo and salvage pathway; Degradation of purine and pyrimidine, Chemistry of porphyrins, Biosynthesis and degradation of heme, Bile pigments formation.

Practical 07 - Intermediary Metabolism

1. Determination of pKa and PI values of an amino acid by titrimetric method.
2. Estimation of proteins by Lowry's method.
3. Estimation of proteins by Biuret method.
4. Determination of total carbohydrates by Phenol-Sulfuric Acid method.
5. Determination of reducing sugars by DNS method.
6. Estimation of cholesterol by Zak's method.
7. Estimation of urea by DAM method.

References

1. Principles of Biochemistry – 7th edition, Lehninger, Nelson & Cox, Macmillan worth Publishers, 2013.
2. Essentials of Biochemistry- U. Sathyanarayana, Books and Allied (P) Ltd. 8/1, Chintamani Das lane, Kolkata, 2004.
3. Biochemistry, 5th edition, Stryer W.H Freeman. Donald Voet, J.G. Voet, John Wiley, J O H N WI VP & Publisher Kaye Pace, 2005.
4. Biochemistry. 29th edition, Robert Harper's, McGraw Hill, 2012.
5. General Biochemistry – Weil (Wiley Eastern, India).
6. Primer for the Exercise and Nutrition Sciences: Thermodynamics, Bioenergetics, Metabolism, Christopher B. Scott. 2010.
7. Bioenergetics (Biochemistry Research Trends), Jeffrey W. Berkin, 2011.

DSC 08 – Clinical Biochemistry

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 5 |

Course Objectives:

- To demonstrate how biochemistry and analytical chemistry can be applied to medical diagnosis, treatment, and management
- To learn about different clinical disorders, the biochemical consequences of disease process and the response to therapy

Course Outcomes:

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

1. Gain concepts of assessing the human physiology using biological fluids.
2. Illustrate the mechanism of metabolic disorders at molecular level Possess a detailed and conceptual understanding of molecular processes viz. DNA to trait
3. Get employability in diagnostic laboratories and research institutes

Theory

Unit-I: Specimen collection, processing, and analyses (Blood, urine, feces, other body fluids); Metabolite profiling. Organ Function Tests- Endocrine, Lung, Cardiac, Gastric, Pancreatic, Liver, Renal. Enzymes of diagnostic importance- LDH, Creatinine kinase, transaminase (AST- SGOT, ALT-SGPT), alkaline phosphatase, pancreatic lipase, amylase, choline esterase.

Unit-II: Hypoglycemia and Hyperglycemia. Diabetes Mellitus- Type I & II, glucose tolerance test (GTT), HbA1c, diabetic ketoacidosis, diabetic retinopathy, diabetic nephropathy, Glaucoma, diabetic coma, gestational diabetes, juvenile diabetes. Inborn errors of carbohydrate metabolism. Glycosuria, fructosuria, pentosuria, galactosemia, Glucose-6-phosphate dehydrogenase (G6PD) deficiency and glycogen storage diseases. Hyperglucagonemia, Lactose intolerance. Advanced glycation end products.

Unit-III: Lipid profile., fatty liver, atherosclerosis, arteriosclerosis, lipid storage diseases, hypolipoproteinemia and hyperlipoproteinemia, Niemann-Pick disease, Gaucher's disease, Tay-Sach's disease, LCAT deficiency, Fabry's disease, Jaundice, hepatitis, cholestasis, cirrhosis, and gallstones. Cystinuria, Phenylketonuria, Maple syrup disease, Alkaptonuria, Albinism and Hartnup disease, Lesch-Nyhan syndrome, Hyperuricemia, Gout, Hypouricemia- Xanthinuria and liathiasis, Orotic aciduria, renal calculi, uremia.

Unit-IV: Hypo and hyper acidity, gastric ulcers, malabsorption syndrome, steatorrhea, diarrhea. Hemophilia A & B. Thalassemia, Sickle cell anemia; Microcytic-, normocytic- and macrocytic –anemia. Porphyria and porphyrinuria. Hypo- and Hyper secretion of hormones, Acromegaly, Gigantism, Dwarfism, Cushing's syndrome, Grave's disease, Hashimoto disease, Addison's disease, Diabetes insipidus, Hypertension and cardiovascular complications.

Practical 08 - Clinical Biochemistry

1. Qualitative analysis of normal constituents of urine.
2. Qualitative analysis of abnormal constituents of urine - glucose, albumin, bile pigments, bile salts and ketone bodies.
3. Serum enzyme assays:
 - a. alkaline phosphatase
 - b. SGOT
 - c. SGPT
4. Glucose Tolerance Test.
5. Determination of A/G ratio of serum.
6. Estimation of Uric acid by Caraway's method.
7. Estimation of Creatinine by Jaffe's method.
8. Estimation of Phosphorous by Fiske and Subbarow's method.
9. Estimation of Iron by Wong's method.

References

1. Varley, H., Gowenlock, A. H., McMurray, J. R., & McLauchlan, D. M, 1988, Varley's practical clinical biochemistry. Heinemann Medical.
2. Oser, B. L., & Hawk, P. B, 1965, Hawk's physiological chemistry. McGraw-Hill.
3. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K, 2013, Textbook of biochemistry for medical students. JP Medical Ltd.
4. Geoffrey Beckett, Simon Walker, Peter Rae. Clinical Biochemistry. 2013. Wiley-Blackwell; 8th edition

OEC 4 – Diagnostic Biochemistry

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

Course Objectives:

- To introduce the students to pathological conditions and their diagnosis
- To help understand the importance of clinical biochemistry in diagnosis
- To provide insights of various risk factors and biomarkers of diseases

Course Outcomes:

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

1. Explore the scope of clinical biochemistry in disease diagnosis
2. Gain knowledge of various diagnostic tests for different pathologic conditions
3. Gain concepts of risk factors and biomarkers in assessing the health
4. Understand the concepts of communicable and non-communicable diseases

Theory

Unit-I: General health, syndrome, and common diseases – communicable and non-communicable diseases. Blood grouping, Hb, Blood: Total cell count, differential count, erythrocyte sedimentation rate. BMR, Biochemical analysis of blood, urine, pleural fluid, synovial fluid, cerebrospinal fluid, and tissues.

Unit-II: Enzyme assay (SGOT, SGPT, Alkaline phosphatase, GGT), Total protein, albumin/globulin ratio and their significance. Urea and creatinine estimation and their significance. Blood pressure (systolic and diastolic), lipid profile (cholesterol, triglycerides, HDL, LDL) and their importance. Bleeding time, clotting time.

Unit-III: Koch postulations. Bacterial, viral, fungal, and protozoan infection. Tuberculosis, Cholera, Hepatitis, HIV, H1N1, Candidiasis and Malaria. TORCH – Panel (infertility profile), Infection in pregnancy. Microscopic examination of body fluids, ELISA, and PCR tests.

Unit-IV: Diabetes and types, blood sugar, urine sugar, glucose tolerance test, HbA1c. Cancer: Etiology, prognosis, diagnosis, and treatment. Heart and Lung diseases- Etiology, diagnosis, and treatment., Doping in sports; Drug addition.

References

1. Varley, H., Gowenlock, A. H., McMurray, J. R., & McLauchlan, D. M, 1988, Varley's practical clinical biochemistry. Heinemann Medical.
2. Oser, B. L., & Hawk, P. B, 1965, Hawk's physiological chemistry. McGraw-Hill.
3. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K, 2013, Textbook of biochemistry for medical students. JP Medical Ltd.
4. Geoffrey Beckett, Simon Walker, Peter Rae. Clinical Biochemistry. 2013. Wiley-Blackwell; 8th edition

Language 1 – Part I English IV

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

Course Objectives:

- Know the importance of CV Writing to display skills, education, and work history.
- Build confidence and fluency, assess progress, and put learning into action by enacting role-plays.
- Boost conversational English skills by using idioms and proverbs.

Course Outcomes:

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

1. Express certain ideas or opinions and improve creative writing by using idioms and proverbs.
2. Improve their interview preparation skills.
3. Create engaging and well-thought essays on current and relevant topics.
4. Understand that one should never be content with what is, nor consider oneself an expert, which is the message of Steve Jobs's "Stay Hungry, Stay Foolish".

Unit - I: Grammar

1. Report Writing (Magazine Report, News Report)
2. Preparing CV's and Facing Interviews: Do's and Don'ts.
3. Role Plays
4. Reading Comprehension Passage

Unit - II: Vocabulary

1. Roots: S to Z
2. Figures of speech: Pun, Oxymoron, Irony, Antithesis
3. Idioms and Proverbs
4. Phrasal Verbs

Unit - III: Creative Writing

1. Story Writing
2. Essay writing

Unit - IV: Essay

"Stay Hungry Stay Foolish", by Steve Jobs

References:

1. Hundiwalla S. (2012) Facing the Corporate Interviews Useful and Time-Tested Tips for Job Interviews in Multinational Companies published by Arihant Publishers.
2. Malhotra Jyoti (2014) IELTS - Vocal Cosmetics published by V&S publisher.
3. Bell James Scott (2017) How to Write Short Stories and Use Them to Further Your Writing Career.
4. Mitra Bashu (2006) Encyclopaedia of Idioms and Proverbs published by Anmol Publications Pvt Ltd.

| | | | |
|---|---|---|---|
| L | T | P | C |
| 3 | 0 | 0 | 3 |

Course Objectives:

- Learn about Modern and Post-Modern literature.
- Learn about the glory of the Vijayanagara Empire through chronicles of Paes.
- Learn about racial discrimination through African American writings.

Course Outcomes:

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

1. Understand and critically appreciate the century-old conflict between the Ruling class and the Artist community through “The Burning of the Books” by Bertolt Brecht
2. Comprehend that any person who is oppressed or "caged" will always continue to "long" for freedom, knowing that if others are entitled to it, they should be entitled to it, too through Maya Angelou’s poem I Know Why a Caged Bird Sings.
3. Appreciate the glory of the Vijayanagara Empire through the travelogues of Paes.

Unit-I: Poetry from the Modern and Post-Modern periods

1. “The Burning of the Books” by Bertolt Brecht
2. “Birches” by Robert Frost

Unit-II: British and African American Literature

1. “Ah, Are You Digging on My Grave?” by Thomas Hardy
2. “I Know Why a Caged Bird Sings” by Maya Angelou

Unit-III: Indian English Literature, Travelogues and French Prose

1. “Eidgaah” by Munshi Prem Chand
2. Chronica dos reis de Bisnaga’ (Chronicles of the Vijayanagara Empire) by Paes
3. “La Parure” or “The Necklace” by Guy de Maupassant

Unit IV: British Drama

“The Dear Departed” by Stanley Houghton

References:

1. Robert Frost (1993) The Road Not Taken, Birches, and Other Poems published by Coyote Canyon Press.
2. Munshi Prem Chand (1969) Selected Short Stories published by Maple Press.
3. Guy De Maupassant (1992) The Necklace and Other Stories published by Vishv Books Private. Ltd.
4. Stanley Houghton (2018) The Dear Departed published by Palala Press.

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

ಜೆ.ಎಸ್.ಎಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಆಯಾಡಮಿ, ಮೈಸೂರು

ಜೀವವಿಜ್ಞಾನ ಮತ್ತು ನೈಸರ್ಗಿಕ ವಿಜ್ಞಾನ ವಿಭಾಗಗಳು

ಬಿಎಸ್ಸಿ ನಾಲ್ಕನೆಯ ಚಾತುರ್ಮಾಸ (ಸೆಮಿಸ್ಟರ್)

ಸಾಹಿತ್ಯ ಸಿಂಚನ - ೪

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ದಮನಿತ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ವಚನ ಸಾಹಿತ್ಯದ ವೈಶಿಷ್ಟ್ಯಗಳ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು
- ಮಹಿಳಾ ಸಾಹಿತ್ಯದ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಶ್ರೀ ಸಾಮಾನ್ಯರ ಬದುಕು ಬವಣೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳಲು ಅನುವು ಮಾಡಿಕೊಡುವ
- ಕನ್ನಡ ಮತ್ತು ಗಣಕ ವಿಜ್ಞಾನದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು.

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ದಮನಿತ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಅರಿತುಕೊಳ್ಳುವರು
- ವಚನ ಸಾಹಿತ್ಯದ ವೈಶಿಷ್ಟ್ಯಗಳ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ಮಹಿಳಾ ಸಾಹಿತ್ಯದ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ಅರಿವು ಪಡೆದುಕೊಳ್ಳುವರು
- ಶ್ರೀ ಸಾಮಾನ್ಯರ ಬದುಕು ಬವಣೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ಕನ್ನಡ ಮತ್ತು ಗಣಕ ವಿಜ್ಞಾನದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಜ್ಞಾನ ಸಂಪಾದಿಸುವರು

ಜೆ.ಎಸ್.ಎಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಆಕ್ಯಾಡಮಿ, ಮೈಸೂರು
ಜೀವವಿಜ್ಞಾನ ಮತ್ತು ನೈಸರ್ಗಿಕ ವಿಜ್ಞಾನ ವಿಭಾಗಗಳು. ಬಿಎಸ್ಸಿ ನಾಲ್ಕನೆಯ ಚಾತುರ್ಮಾಸ (ಸೆಮಿಸ್ಟರ್)

ಸಾಹಿತ್ಯ ಸಿಂಚನ - ೪

ಘಟಕ - ೧, ದಮನಿತ ಲೋಕ

೧) ಚಂದ್ರಗಿರಿ ತೀರದಲ್ಲಿ : ಸಾರಾ ಅಬೂಬಕ್ಕರ್

ಘಟಕ - ೨, ಸಹಿಷ್ಣುತೆ

೧) ಸಹಿಷ್ಣುತೆ ಸಾರುವ ವಚನಗಳು : ಬಸವಣ್ಣ, ಮಡಿವಾಳ ಮಾಚಯ್ಯ

೨) ಕುಲ ಕುಲವೆಂದು ಹೊಡೆದಾಡದಿರಿ : ಕನಕದಾಸರು

೩) ಬುರ್ಖಾ : ಫಕೀರ್ ಮಹಮ್ಮದ್ ಕಟ್ಟಾಡಿ

ಘಟಕ - ೩, ಶ್ರೀ ಸಾಮಾನ್ಯರ ಬದುಕು

೧) ಕೊನೆಯ ಗಿರಾಕಿ : ನಿರಂಜನ

೨) ವಾಣಿಯ ಸಮಸ್ಯೆ : ಕೊಡಗಿನ ಗೌರಮ್ಮ

೩) ಮಾರಿಕೊಂಡವರು : ದೇವನೂರು ಮಹಾದೇವ

ಘಟಕ - ೪, ಭಾಷಾಭಾಗ

೧) ಜಾಹೀರಾತು ಹಾಗೂ ಜಾಹೀರಾತುಗಳ ಮಾದರಿ ರಚನೆ

೨) ಕರಪತ್ರ (ಪಾಂಪ್ಲೆಟ್), ಭಿತ್ತಿ ಪತ್ರ (ಪೋಸ್ಟರ್), ಫಲಕ ಬರಹ

೩) ಕನ್ನಡ ಮತ್ತು ಗಣಕ ವಿಜ್ಞಾನ, ಕನ್ನಡ ಮತ್ತು ಅಂತರ್ಜಾಲ

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ : ಸುಳಿ - ಸಾರಾ ಅಬೂಬಕ್ಕರ್

ಸಣ್ಣ ಕಥೆಗಳು : ಕಂನಾಡಿಗ ನಾರಾಯಣ

ಕನಕ ದಾಸರ ಕೀರ್ತನೆಗಳು ಮತ್ತು ಮುಂಡಿಗೆಗಳ - ಪ್ರೊ. ಸುಧಾಕರ

ಆಡಳಿತ ಕನ್ನಡ - ಡಾ.ಮುರಿಗೆಪ್ಪ

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Language 2 – Part II French IV

Course Objectives:

- Students are taught to communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters.
- Students are taught to describe in simple terms the aspects of his/her background, immediate environment and matters in areas of immediate basic need.

Course Outcomes:

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

1. Communicate in writing in simple and routine tasks requiring simple and direct communication of information on familiar and routine matters (e.g. applying for a job, booking a room by email, making an appointment)
2. Demonstrate knowledge and understanding of key aspects of the culture of the target language (e.g. food, festivities)
3. Use basic grammar in simple and routine tasks requiring direct communication of information on familiar and routine matters, as well as articulating personal opinions
4. Use high frequency vocabulary related to areas of immediate relevance (e.g. personal and family information, school/work, leisure, general culture).

Unit I

1. Use public transport (buses, trains, and taxis)
2. Ask your way and give directions

Unit II

1. Buy tickets
2. Read notices, posters, catalogues, timetables, brochures, menus, advertisements, signs

Unit III

1. Write notes and simple messages
2. Note down times, dates and places from notice boards and announcements

Unit IV

1. Note down instructions and requests such as client orders and delivery dates.
2. Describe events and daily activities

References:

1. Dr. Ramesh Chilukuri, 2020. Breathe French: Learning made as easy as Breathing published by Prowess Publishing.
2. Beaujolie Florence, 2019. French Made Easy 2 in 1 published by M & M Limitless Online Inc.

SEC 03 – Cyber Security

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Course Objectives:

Course Outcomes:

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

Curriculum awaited from GoK

ABC 02 - Case Study & Observership in Hospitals/Internship in Industries

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Course Objectives:

- To understand the clinical/biomedical research and to gain insights of clinical practice and ethical issues
- To foster and prepare students job ready for R&D, CROs and Biotechnological industries
- To train students in biochemical analyses at hospitals and diagnostics

Course Outcomes:

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

1. Able to design clinical research studies
2. Competent to work in biochemistry laboratories both in diagnostic centres and hospitals

ABC 02 can be done at

1. Case Study and Observership - Hospitals
2. Internship - R&D labs, Contract Research Organizations, Biotech Companies

Semester Five

DSC 09 - Human Anatomy and Physiology

| L | T | P | C |
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Course Objectives:

- The paper aims in highlighting the structural and functional aspects of the organ systems of the human body
- To provide insight into how various processes occur within these systems

Course outcomes:

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

1. The students will be able to appreciate the biochemistry behind the anatomical and physiological aspects of the human body
2. Students will gain insights into the functioning of heart, lungs, brain, digestive system, kidneys, liver, muscles, and reproductive system
3. Students will get to understand hormones and their regulation

Theory

Unit-I: Introduction to Human Anatomy and Physiology- Overview and definition; Basic Anatomical and Physiological terms, levels of structural organization and organ system. Homeostasis and control mechanisms (negative and positive feedback mechanisms). Nervous system: central and peripheral nervous system, types of neurons, Blood brain barrier, cerebrospinal fluid, neurotransmission, membrane potentials, synapses, neurotransmitters, neuromodulators.

Unit-II: Organization of systematic and pulmonary circulation- cardiac cycle, blood pressure- regulation, Anatomy, and functions of respiratory system; site of gas exchange, lung mechanics, Transport of oxygen and carbon dioxide, Haldane and Bohr's effect, acid-base balance, Control of respiration. Endocrine system: Endocrine organs, classification, roles, and regulation of hormones. Hypo and hyper production of hormones. Mechanism of hormone action. Reproductive system: Overview, Gametogenesis. Menstrual cycle.

Unit-III: Skeletal System- Functions of skeleton. Classification of bones; Long bone, Composition, growth, remodeling, and structure, Factors affecting its growth, Muscular System: Characteristics, structure and functions of Skeletal, Smooth and Cardiac muscles. Sliding filament model of skeletal muscle contraction. Sense Organs: Mechanism of vision, olfaction, taste, touch, and hearing.

Unit-IV: Anatomy and functions of gastrointestinal tract- Enteric reflexes, Physiology of digestion, assimilation & peristalsis, Gastric and digestive juices, Glands associated with digestive system, regurgitation. Hepatic System: Structure of hepatic lobule, liver functions- metabolic, storage and detoxification. Formation and secretion of bile. Excretory system: Kidney and the nephron; formation of urine.

Practical 09 - Human Anatomy and Physiology

1. Tissue sectioning and processing of vital organs.
2. Hematoxylin and Eosin staining of sections of vital organs.
3. Preparation of blood smear and differential leucocyte count.
4. RBC and WBC counting, Calculation of blood Indices.
5. Estimation of hemoglobin.
6. Blood grouping.
7. Specimen identification: anatomy and physiology. (Visit to Museum).

References:

1. Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.
2. Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
3. Textbook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
4. Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
5. Textbook of medical physiology: A. C. Gyton, and J. E Hall Saunders. Elsevier Publications, A division of Reed Elsevier India Pvt. Ltd. New Delhi ISBN 81-8147-084-2.
6. Evelyn C Peace: Anatomy and Physiology for Nurses (Jaypee Brothers, New Delhi, India, 1997).

DSC 10 - Cell Biology

| L | T | P | C |
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| 3 | 0 | 2 | 5 |

Course Objectives:

- To study the basic components of a cell and its regulation
- To understand the function of various subcellular organelles

Course outcomes:

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

1. Students will learn about cell theory, basic cell structure, cell fractionation and cell visualization techniques
2. Besides, students will understand the composition of cytoskeleton and extracellular matrix
3. Students will acquire knowledge of cell cycle, cell division and cell death mechanisms

Theory

Unit-I: Cell Structure- Structural organization of cell and functions of intracellular organelles. Cell wall, plasma membrane, mitochondria, endoplasmic reticulum, Golgi bodies, lysosomes, peroxisomes, plastids, vacuoles, chloroplast, nucleus, nucleolus, mechanism and regulation of vesicular transport, Golgi and post Golgi sorting, receptor mediated endocytosis, exocytosis.

Unit-II: Structure & function of cytoskeleton- Its role in cell motility and cell shape. Actin- architecture and assembly, myosin- muscle contraction; microtubules- structure, assembly and dynamics and microtubule associated proteins; Cilia, flagella, intermediate filaments. Structure and function of plant cell wall.

Unit-III: Cell division- (amitosis, mitosis, meiosis) and cell cycle. Stages of cell division and cell cycle, cell cycle in early embryonic development, yeast cell cycle, regulation of cell cycle, cyclins, cyclin-dependent kinases and their inhibitors, regulation of cell division. Cell differentiation, cell proliferation, cell migration, cell transition, hypertrophy, hyperplasia, cell death and apoptosis.

Unit-IV: Role of extracellular matrix- hyaluronan and proteoglycan, matrix proteins and their receptors, adhesive proteins, and cell junctions in multicellularity. Stoichiometry of cell growth and product formation. Platelet derived growth factor, vascular endothelial growth factor and their mechanism of action. Plant growth factors and hormones- auxins, gibberellins, cytokinin and others.

Practical 10 - Cell Biology

1. To study different parts of microscope.
2. Cytochemical staining of proteins by Methylene blue.
3. Cytochemical staining of polysaccharides by PAS.
4. Cytochemical staining of RNA by Methyl Green.
5. Study of stages of Mitosis using onion root tip.
6. Study of stages of Meiosis in onion flower buds/ grasshopper testes.
7. To study cell organelles using electron micrographs.
8. To study the effect of isotonic, hypotonic and hypertonic solutions on cells.

References:

1. Molecular biology of the Cell –Alberts et al.
2. Molecular Cell Biology. 5th Edn. Lodish, H, et al., W H Freeman
3. Cell and Molecular Biology. Karp, J. John Wiley and Sons Inc.
4. The Cell-Molecular approach. 4th Ed. Geoffrey M Cooper and Robert E Hausman.
5. Cell Biology- A Laboratory Handbook. 3rd Ed, 4th Vol, Julio E Celis

DSC 11 - Immunology

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|---|---|---|---|
| L | T | P | C |
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Course Objectives:

- To give the cellular and molecular basis of immune responsiveness
- To understand the roles of the immune system in both maintaining health and contributing to disease
- To train students with essentiality of molecules, cells, tissues, and organs involved in the defense mechanism

Course outcomes:

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

1. Understand the immune system, its components, and their functions
2. Know about immunology-based techniques to analyze antigen-antibody interaction
3. Gain insight into informatics-based approaches for prediction of allergen epitopes
4. Predict immunologically reactive epitopes and computational vaccine design using immunoinformatic tools

Theory

UNIT I: Introduction- Historical development and milestones in immunology. Antigenicity, immunogenicity, innate and acquired immunity. Primary and secondary lymphoid organs. Antigens and antibodies; haptens and determinants: epitopes and paratopes. Biomolecules and cells as antigens. Classes and subclasses of immunoglobulins, structure of immunoglobulins, hyper variable region isotypic, allotypic, and idiotypic variation.

UNIT II: Cellular Basis of Immunity Primary and secondary immune response. Development of B and T cells and their subsets. T-helper cells, T-killer cells, T-suppressor cells. B and T cell receptors, antigen processing and presentation. Cytokines and co-stimulatory molecules; lymphokines, interleukins, structure and function of IL-1, IL-2, TNF-alpha. Suppression of immune response, Generation of immunoglobulin diversity, gene rearrangement and other mechanisms, clonal selection theory of Burnet.

UNIT III: MHC- MHC gene and its polymorphism, role of MHC in immune response and transplantation. Transplantation: Autograft, isograft, allograft and xenograft. Graft rejection, graft vs. host reaction. Immunosuppressive drugs. Tumor immunology: Tumor associated antigens, factors favoring tumor growth, immune surveillance. Tumor necrosis factors, Antitumor drugs, and Immunotherapy.

UNIT IV: Disorders of immunity- Immunological tolerance, Autoimmunity. Immunodeficiency disorders, SCID, AIDS. Production & applications of Monoclonal &

Polyclonal antibodies, Immunological techniques: agglutinations, complement fixation, Immunodiffusion, Immunoelectrophoresis, RIA & ELISA, Western blotting. Systemic Lupus Erythomatosus. Vaccines: Adjuvants, vaccines, and their preparations.

Practical 11 - Immunology

1. Isolation of IgY from chicken egg yolk.
2. Antigen Antibody reaction: Ouchterlony Double Diffusion method
3. ELISA. Enzyme-Linked Immunosorbent Assay.
4. Western Blotting

References:

1. Roitt I M, Brostoff J and Male D K, 1993. Immunology Mosby – Yearbook Europe Ltd., London -3rd edition
2. Roitt I M, Delves P J. 2001. Essential Immunology, Blackwell Scientific Publications – 10th edition.
3. Boyd W C. 1964. Fundamentals of Immunology, Toppan Co. Ltd., Tokyo.
4. Kimball J W. 1983. Introduction to Immunology, Macmillan Publishing Co. Inc. New. York.
5. Kubay J. 2001. Immunology. W H Frecman & Company New York–2nd edition.
6. Abbas A K Lichtman A H, 2007. Cellular and Molecular Immunology. Oxford University Press, Oxford 3rd edition.

DSE 01a- Membrane Biology

| L | T | P | C |
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Course Objectives:

- To study biological membrane structure and function
- To study physiological process of biological membranes

Course Outcomes:

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

1. After successful completion of the course the student able to understand properties of biological membrane, and different models of membranes explaining the biological function.
2. Understand membrane asymmetry and other properties using various methods.
3. Understand the complex mechanism involved in transportation of biomolecules across membranes.

Theory

Unit-I: Biomembranes- Physicochemical properties of biological membranes, compositions, supra molecular organization. Models of membrane; Gorter and Grendel's experiment, bilayer structure, Danielli-Davson model of membrane, Singer and Nicholson's model. Membrane asymmetry; lipids, proteins and carbohydrates and their lateral diffusion. Biogenesis of lipids and proteins, polarized cells, membrane domains; caveolae, rafts, membrane lipid and protein turnover, intracellular targeting of proteins. Biogenesis of subcellular organelles.

Unit-II: Methods of study of membrane structure- Lipid transfer proteins, phospholipases, chemical methods, amino-phospholipid translocation, TNBS reagent, freeze fracture and freeze-etching. Lipid vesicles; liposome preparations and application, function of sterols in membranes. FRET, FRAP, single particle tracking, EM of membranes, calorimetry, confocal microscopy of membrane dynamics. Cell fusion, shedding of membrane. Physico-chemical properties of membranes: membrane lipid phases, bilayer phase, non-bilayer phase, phase transition, membrane potential and bilayer nature.

Unit-III: Membrane transport- Laws of diffusion across membranes, simple diffusion, facilitated diffusion and active transport. Glucose transporters, Ca²⁺ ATPase, Na⁺ -K⁺ ATPase (Structure and mechanism of action), bacterial phosphotransferase system. Endocytosis, receptor mediated endocytosis, exocytosis, ion channels; gated and non-gated, aquaporin channel.

Unit-IV: Nerve transmission- Acetylcholine receptor and neurotransmitters, mechanisms of nerve conduction, resting and action potential, ion channels, ionophores, patch clamp technique. Presynaptic and postsynaptic membranes. nicotinic and

muscarinic neurons. GABA, NMDA, structure, and function. Muscle contraction: Mechanisms, role of calcium, calmodulin, and phospholamban

References:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641- 0962-1.
2. Molecular Cell Biology (2013) 7th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2.
3. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning
4. (Boston), ISBN-13:978-0-495-11464-2.
5. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2.

DSE 01b- Bioenergetics

| L | T | P | C |
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| 3 | 0 | 0 | 3 |

Course Objectives:

- To provide basic concepts of bioenergetics and relevance to living system
- To realize mechanisms of oxidative phosphorylation and photophosphorylation

Course Outcomes:

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

1. Discuss the importance of order (organization) of living systems
2. Explain the concept of energy, cite examples, and assess its importance
3. Restate the two laws of thermodynamics in your own words.

Theory

Unit-I: Thermodynamics- Concept of free energy, standard free energy, determination of ΔG for a reaction. Relationship between equilibrium constant and standard free energy change, biological standard state & standard free energy change in coupled reactions. Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials & free energy change. High-energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates along with reasons for high ΔG . Energy charge.

Unit-II: Oxidative phosphorylation- Mitochondria. Electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. FoF₁ATP synthase, structure, and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. ROS production and antioxidant mechanisms. Thermogenesis. Alternative respiratory pathways in plants.

Unit-III: Photophosphorylation- General features of photophosphorylation, historical background, Hills reaction, photosynthetic pigments, light harvesting systems of plants and microbes and resonance energy transfer. Z-scheme of photosynthetic electron flow, oxygen evolving complex and action of herbicides. Cyclic photophosphorylation and its significance. Photo inhibition. Evolution of oxygenic photosynthesis. Bacterial photophosphorylation in purple bacteria, green sulfur bacteria and *Halobacterium salinarum*.

Unit-IV: Substrate level phosphorylation- Thermodynamics of Biomolecular Systems. Use of thermodynamics in protein folding. Free energy and Relationship between thermodynamics and statistics. Importance of chemical potential in drug action. Thermodynamic cycle. Statistical thermodynamics in predicting the structure of biomolecules and their interaction with drug molecules. Macromolecular vs. micromolecular correlation using thermodynamics and statistical thermodynamics.

References:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.
2. Molecular Cell Biology (2013) 7th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2.
3. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning
4. (Boston), ISBN-13:978-0-495-11464-2.
5. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2

SEC 04 - Proteomics

| L | T | P | C |
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Course Objectives:

- To introduce students to current trends in proteomics and its importance in drug design and discovery
- To give an overall understanding of molecular modeling, databases, software used for molecular docking and drug discovery

Course Outcomes:

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

1. Understand the advantages and disadvantages of proteomics over experimental methods with emerging technologies
2. Empowered with *in silico* molecular modeling concepts necessary for drug design and discovery at R&D laboratories and pharmaceutical companies
3. Gain the knowledge of process involved during drug design and drug development

Theory

Unit-I: Protein sequence analysis using software: Emboss, Data mining proteomes, Motif mapping using Prosite, Prodom, protein expression profiling, protein - protein interactions, protein complexes. Mapping protein modifications. Protein secondary structure analysis, Molecular visualization protein 3D structure using Rasmol, pdb file format.

Unit-II: Molecular modeling, Concepts of Molecular Modeling, Molecular structure and internal energy, Energy minimization of small molecules, Ab initio, DFT and semi-empirical methods, Construction of initial model, Refining the Model, Manipulating the model, Rotamer libraries, Three- Dimensional structure prediction, comparative modeling, Homology modeling, Threading, Energy based prediction of protein structures, Modeling software SPDBV. SWISS - Model.

Unit-III: Introduction to basic concepts, Molecular recognition by receptor and ligand design, Generation of Rational Approaches in Drug design, Introduction to drug designing, discovering a drug, Target identification and validation, Identifying the lead compound, Optimization of lead compound.

Unit-IV: Docking methods introduction, three dimensional descriptions of binding site environment and Energy calculation, Automatic Docking Method, Three-Dimensional database search Approaches, Design of ligands, Drug-receptor interactions automated structure Construction methods, AUTODOCK.

References:

1. Creighton TE (1993) Proteins: structures and molecular properties: Macmillan.
2. Bioinformatics – 2008. Principles and Applications, 1st ed. Ghosh, Z. and Mallick, B., Oxford University Press (India),
3. M. Michael Gromiha, 2010. Protein Bioinformatics: From Sequence to Function, Academic Press.
4. Bioinformatics: Sequence and Genome Analysis (2001), 1st ed., Mount, D.W. Cold Spring HarborLaborator Press (New York)
5. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (2005), 3rd ed., Baxevanis, A.D. and Ouellette, B.F., John Wiley & Sons, Inc. (New Jersey). Sharma, P.D. 1990. Ecologyandenvironment. Rastogi publications, Meerut.

VBC 02 – Ethics & Self Awareness

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Course Objectives:

Course Outcomes:

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

Curriculum awaited from GoK

Semester Six

DSC 12 - Biochemical Techniques

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Course Objectives:

- To demonstrate methods for purifying proteins, and analyzing biological molecules by electrophoresis, Western blotting, and enzyme activity assays
- To give knowledge on skills required to design and interpret the scientific data
- To emphasize the learning of basic laboratory skills and good lab practices

Course Outcomes:

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

- Understand the methods of protein purification and analyses of biological molecules by electrophoresis, Western blotting, and enzyme assays
- Gain the knowledge which is crucial for implementation of research ideas at molecular level
- Increase their employability in R&D laboratories, CROs, biotechnological and pharmaceutical industries, analytical laboratories, and research institutes.

Theory

Unit-I: Principles of Chromatography- adsorption and partition, methods, and applications of chromatography – Paper--Ascending, descending and circular, 2D – chromatography, thin layer, ion exchange, gel filtration and affinity chromatography, GLC, HPLC, UPLC and chromatofocussing.

Unit-II: Polyacrylamide gel electrophoresis, SDS-PAGE, 2D-electrophoresis, agarose gel electrophoresis, isoelectric focusing, pulsed field gel electrophoresis, high voltage electrophoresis, capillary electrophoresis, isotachopheresis. Separation of proteins, lipoproteins, and nucleic acids. Visualizing separated components; staining, fluorescence, PAS staining, zymogram and reverse zymogram

Unit-III: Radiochemistry: Natural and artificial radioactivity, characteristics of radioactive elements, units of radioactivity, disintegration constant, half-life, α , β and γ radiation. Detection of radioactivity by GM counter. Applications of radioisotopes – ^3H , ^{14}C , ^{131}I , ^{60}Co and ^{32}P . Biological effects of radiations. Safety measure in handling radio isotopes.

Unit-IV: Staining: Dyes and stains, Importance, Definitions of terms: Stain, Chromogen, Acidic stain, Basic stain, Neutral and Amphoteric stain, Smear, Fixation, Mordant, Intensifier, Compound stain, Leuco compounds, Dyes used as pH indicators. Physical and Chemical theory of staining Monochrome staining, Negative staining, and differential staining: Gram staining, Acid fast staining, Structural staining techniques: Capsule, Metachromatic, spore staining.

Practical 12 - Biochemical Techniques

1. Identification of amino acids by circular paper chromatography.
2. Ascending paper chromatography of amino acids.
3. Separation of carbohydrates using paper chromatography.
4. Separation of secondary metabolites by column chromatography using silica gel-G.
5. Native & SDS Polyacrylamide gel electrophoresis of proteins.
6. Demonstration of separation of lipids by TLC.
7. Demonstration of Gel Filtration Chromatography.

References:

1. Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath – Himalaya Publ. House.
2. Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ. Press. Chromatography – G. Abbot.
3. AUpadhyay, K. Upadhyay and N. Nath Biophysical Chemistry (2000) Himalaya Publishing House.
4. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge University Press.

DSC 13 - Enzymology

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 5 |

Course Objectives:

- To impart the knowledge on enzyme-mediated catalysis and mechanisms
- To illustrate the reaction catalysis, enzyme kinetics and regulation
- To highlight the importance of enzymes in living systems

Course Outcomes:

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

- Understand the significant features of the biochemical catalysts
- Gain the knowledge of enzyme and its regulation which could be applied as technology in industrial level
- Apply the knowledge in designing a drug for the management of diseases
- Increase their employability in R&D laboratories, biotechnological and pharmaceutical industries.

Theory

Unit-I: Classification of enzymes, properties of enzymes – catalytic power, specificity. Enzyme localization and assay of enzymes, Units of enzyme activity, Active site – Fisher and Koshland models, formation of enzyme – substrate complex and experimental evidence. Nature of active site, mapping of enzyme active site through chemical procedures and site directed mutagenesis, Factors affecting enzyme activity, Modern concepts of evolution of catalysis, ribozymes, abzyme and synzymes.

Unit-II: Kinetics of single substrate enzyme catalyzed reactions, Michaelis – Menten equation, Lineweaver - Burk, Eadie – Hofstee and Hanes plots: Primary and secondary plots. Significance of V_{max} , K_m , K_{cat} , specificity constant (K_{cat}/K_m) Kinetics of multisubstrate reaction – Classification with examples. Rate expression for non-sequential (ping-pong) and sequential (ordered and random) mechanisms. Use of initial velocity, inhibition, and exchange studies to differentiate between multi substrate reaction mechanisms. Flexibility and conformational mobility of enzymes. reversible inhibition – competitive, non-competitive, uncompetitive inhibition, mixed inhibition; irreversible inhibition, Determination of K_i values.

Unit-III: Types of reaction catalysis – General acid – base, electrostatic, covalent, intermolecular, metal – ion catalysis, proximity, and orientation. Mechanism of reaction catalyzed by serine proteases – trypsin and chymotrypsin, carboxypeptidase, lysozyme, triose phosphate isomerase, ribonuclease Rotational catalysis – ATPase. Mechanism of catalysis with coenzymes – pyridoxal phosphate, flavin nucleotides, thiamine lpyrophosphate, biotin, tetrahydrofolate, lipoic acid.

Unit-IV: Enzyme regulation – general mechanisms of enzyme regulation. Allosteric enzymes (ATCase). Cooperativity phenomenon. Hill and Scatchard plots. Sigmodal kinetics and their physiological significance, Symmetric and sequential models of action of allosteric enzymes and their significance. Feedback inhibition and feed forward stimulation. Reversible and irreversible activation. Isoenzymes, Multifunctional enzymes,

Multi – enzyme systems – properties, mechanism of action and regulation of Pyruvate dehydrogenase and Fatty acid synthase complex.

Practical 13 - Enzymology

1. Determination of specific activity of salivary amylase.
2. Effect of pH & temperature on salivary amylase activity.
3. Time kinetics of salivary amylase
4. Determination of K_m and V_{max} of salivary amylase
5. Effect of activators/inhibitors on salivary amylase.
6. Isolation of urease and demonstration of its activity
7. Isolation of acid phosphatase and demonstration of its activity
8. Isolation of alkaline phosphatase and demonstration of its activity.
9. Isolation of protease and demonstration of its activity.
10. Demonstration of Zymogram.

References:

1. Palmer T. Understanding Enzymes. 1995. Ellis Horwood Ltd , Publisher
2. Nelson, D. L., Lehninger, A. L., & Cox, M. M. 2008, Lehninger principles of Biochemistry. Macmillan.
3. Berg, J. M., Tymoczko, J. L., & Stryer, L, 2002, Biochemistry – 5th edition.
4. Price NC, Frey PA (2001) Fundamentals of enzymology. Biochemistry and Molecular Biology Education 29: 34-35.

DSC 14 – Fundamentals of Genetics

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| L | T | P | C |
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Course Objectives:

- To highlight the scope and significance of genetics in living organisms
- To empower the students with the principles of genetic transmission, gene interactions, heredity, mutations, and genetic disorders
- To impart the basic knowledge of genetics to the students and encourage them to critically think and apply it to applied sciences

Course outcomes:

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

- Learn the molecular aspects of genetic disorders and mutations
- Appreciate concepts of gene and relationship between genotype and phenotype
- Motivate students to apply the principles of genetics in applied sciences

Theory

Unit-I: Introduction to Genetics, Scope, and significance of genetics. Principles of Genetic Transmission: Concept of dominance, Principle of dominance and segregation, Principle of independent assortment, Mendel's Experiments, Symbols and terminology, Mendelian inheritance, and use of probability (Multiplication and Addition rules). Extension of Mendelism: Incomplete dominance, codominance, multiple allelism, Gene action (from genotype to phenotype), Gene interaction, penetrance, expressivity, epistasis, pleiotropy, interaction with environment.

Unit-II: Allelic variation and gene function. Chromosome theory of inheritance. Experimental evidence, non-disjunction as proof of chromosome theory, chromosomal basis of Mendel's principles. Linkage and crossing over, sex linkage, sex limited, and sex influenced characters. Polygenic inheritance, extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Sex Determination: Sex chromosomes, Chromosomal and molecular basis of sex determination. Dosage compensation: Genic balance, Gene dose, Molecular basis of dosage compensation in Drosophila and man.

Unit-III: Chromosome banding techniques. Population genetics, Gene pool, Gene frequency Hardy Weinberg equation. Linkage, genetic drift. Mutations: Types, Spontaneous, Induced mutation, Conditional lethal mutations –Base substitution mutation, Missense, Nonsense and Silent mutations. Chemical, Physical and Biological mutagenesis. Quantification and Detection of mutations.

Unit-IV: Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Genetic disorder - Color blindness, Cystic fibrosis, Down syndrome, Duchenne muscular dystrophy, Hemophilia, Klinefelter syndrome, Sickle-cell disease, Turner syndrome.

Practical 14 - Fundamentals of Genetics

1. Study of morphology of *Drosophila melanogaster*.
2. Study of mutants of *Drosophila melanogaster*.
3. Study of polytene chromosomes of *Drosophila melanogaster*.
4. Preservation of genetic material (DNA, RNA).

References:

1. Hartl, D. L., & Jones, E. W. (1998). *Genetics: Principles and analysis*. Jones and Barlett Publishers.
2. Simmons, M. J., & Snustad, D. P. (2006). *Principles of genetics*. John Wiley & Sons.
3. Brooker, R. J. (1999). *Genetics: Analysis and Principles*. Reading, MA: Addison-Wesley.
4. Gardner E J, Simmons M J, Snustad D P 1991. *Analysis and Principles of Genetics*. Ed. Benjamin Cummings. California.
5. Griffith A J F, Miller J H, Suzuki D T, Lewontin R C, Gelbert W M. 1996. *Principles of Genetics*. John Wiley & Sons, Inc.

DSE 02a - Protein Chemistry and Technology

| L | T | P | C |
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Course Objectives:

- To understand methods in purification and characterization of proteins
- To highlight the importance of protein sequencing, structure determination and protein engineering

Course outcomes:

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

- Gain in-depth knowledge of the structure-function relationship of proteins
- Know the techniques used to produce and characterize proteins
- Get insights of protein engineering strategies to improve enzyme applications

Theory

UNIT I: Localization, isolation, purification, and characterization of proteins. Criteria of purity of proteins, fold purity. Protein digestion techniques; Mass Spectrometers for protein and peptide analysis. Protein identification by peptide mass fingerprinting, X-ray crystallography.

UNIT II: Determination of amino acid composition. N- and C- terminal sequencing, Automated sequencers, Determination of type of linkage (o-glycosyl and n-glycosyl). Determination of s-s-bond position. Secondary structure prediction methods: Ramachandran plot; Chou Fasman Algorithm.

UNIT III: Strategies in protein engineering (Directed evolution, Comparative design, Rational design). Applications and case studies. Physical basis for protein denaturation/stability; Preferential binding and preferential hydration models; Various stabilizers and their applications. Artificial peptide synthesis and their applications.

UNIT IV: Protein engineering strategies to improve enzyme stability, specificity and activity, engineering thermostable and cryostable enzymes. Protein engineering of antibody and catalytic antibodies (abzymes), Engineering of peptide-based therapeutics and antibiotics. Process of making protein isolates and concentrates; Factors affecting quality of isolates and concentrates.

References:

1. Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath – Himalaya Publ. House.
2. Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ. Press. Chromatography – G. Abbot.
3. AUpadhyay, K. Upadhyay and N. Nath Biophysical Chemistry (2000) Himalaya Publishing House.
4. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge University Press.

DSE 02b - Metabolomics

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Course Objectives

- To introduce novel analytical methodologies with application in preclinical, clinical trials, cell models and plant experiments
- To train students in using novel holistic approaches for metabolite evaluation in plants, animals, microbial systems, and their interactions

Course Outcomes:

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

- Understand metabolic processes and use tools for their evaluation
- Gain the ability to understand novel analytical methodologies and their application in pharmaceutical, nutritional and biomedicine
- Critically review up-to-date research literature, currently developing metabolome databases and data processing online platforms

Unit-I: Introduction to metabolomics: Metabolome, Metabolomics, Role of Biomarker in metabolomics, Tools of metabolome studies: NMR, MS, GC, LC, IR and its application, Metabolome projects of plant and human, Future prospective of metabolomics.

Unit-II: Metabolites and metabolite profiling, Metabolomics - applications and its role in systems biology with case studies, Targeted and untargeted metabolomics, General workflow including quenching and sample preparation, detection, and quantification of metabolites by advanced analytical techniques (NMR/Mass spectroscopy, HPLC). Statistical methods (PCA, PLS, PLS-DA) in metabolomics. Pathway and metabolome databases. Software tools available for metabolomics analysis

Unit-III: Metabolic profiling and fingerprinting, Metabolic pathway analysis and metabolic networks, Single Cell Metabolomics, Metabotype Concept. Computational Methods to Interpret and Integrate Metabolomic Data, Metabolomics data processing workflow, Chemical ontologies, online metabolic databases (Human Metabolome Databases, KEGG, BioCyc) and pipelines.

Unit-IV: Applications of Metabolomics: Metabolic Pathway as a target for Drug-screening, Metabolomics approach for hazard identification in human health assessment of environmental chemicals, Clinical implications of Metabolomics. Plant metabolomics.

References:

1. Metabolomics – A powerful Tool in Systems Biology, Edited by J.Nielsen and M.C. Jewett, Springer Publishers
2. Metabolome Analyses: An Introduction by Dr. Silas G. Villas-Bôas, Dr. Ute Roessner, Dr. Michael A. E. Hansen, Dr. Jørn Smedsgaard, Dr. Jens Nielsen. John Wiley & Sons, Inc, Print ISBN:9780471743446
3. Metabolomics, by Ute Roessner. Publisher: InTech,
4. Microarray Analysis, by Mark Schena. Publisher: Wiley-Liss

SEC 05 – Professional/Societal Communication

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Course Objectives:**Course Outcomes:**

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

Curriculum awaited from GoK

Semester Seven

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DSC 15 - Molecular Biology & Gene Regulation

Course Objectives:

- To provide basic knowledge related to replication of DNA as the genetic material, how genes are transcribed and translated in prokaryotes and eukaryotes
- To give insights into the processes of gene regulation

Course Outcomes:

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

1. Understand special features of genetic code and the molecular mechanisms involved in central dogma of molecular biology
2. Identify the regulation of biological processes through gene and the significance of such regulation in maintaining cellular pathways

Unit I: Evidence of DNA as genetic material and semiconservative mode of replication. DNA replication: Features of replication, the chemistry of DNA synthesis, DNA polymerase, the replication fork, enzymes and proteins in DNA replication, E coli DNA polymerases, stages of replication-initiation, elongation and termination, replication in eukaryotes end replication problem, telomerase, various modes of replication. Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication.

Unit II: Transcription in prokaryotes: RNA polymerases, sigma factor, initiation, elongation and termination, rho-dependent and rho-independent termination. Inhibitors of transcription and applications as antimicrobial drugs. Transcription in eukaryotes: Comparison between prokaryotic and eukaryotic transcription. Eukaryotic RNA polymerases, transcription by RNA polymerase II, RNA polymerase II core promoters, general transcription factors, transcription by RNA polymerase I and III. Inhibitors of eukaryotic transcription and their applications.

Unit III: RNA Processing: Types of RNA processing- polyadenylation and capping, processing of rRNA and tRNA. Chemistry of RNA splicing, the spliceosome machinery, splicing pathways, group I and group II introns, alternative splicing, exon shuffling and RNA editing.

Translation: Genetic code and its characteristics, triplet nature, degenerate, deciphering the genetic code, Wobble hypothesis. Suppressor tRNAs. Exceptions to the nearly universal genetic code. Messenger RNA, transfer RNA, charging of tRNA. The structure of ribosome. Three stages of translation-initiation, elongation, and termination. Translation in eukaryotes. Regulation of translation. Comparison of prokaryotic and eukaryotic protein synthesis. Inhibitors of translation and their clinical importance.

Unit IV: Regulation of gene expression in prokaryotes: Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, DNA binding domains, regulation of lac operon and trp operon. Regulatory RNAs in bacteria, small RNA and riboswitches. Regulation of gene expression in eukaryotes: Gene regulation by chromatin remodeling, regulation of galactose metabolism in yeast, action of enhancers and insulators, working of activators and

repressors, concept of combinatorial control. Regulatory RNAs in eukaryotes: synthesis and mechanism of siRNA and miRNA.

Practical 15 - Molecular Biology & Gene Regulation

1. Genomic DNA isolation from bacteria
2. Genomic DNA isolation from plant source
3. Genomic DNA isolation from yeast
4. Isolation of plasmid DNA from *E. coli*
5. Agarose Gel Electrophoresis
6. Isolation of total RNA and cDNA synthesis
7. Bacterial Gene Expression studies

References

1. Nelson and Cox, Lehninger's Principles of Biochemistry (2000), Worth Publish., Inc. NewYork.
2. L. Stryer. BIOCHEMISTRY, 4th Edn., (1995), W.H. Freeman Press, San Fransisco, USA.
3. E.J. Gardner and D.P. Snustad. PRINCIPAL OF GENETICS (1984), John Wiley & Sons, Ney York.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press,Pearson Pub.
5. Molecular Biology – Freifelde

DSC 16 - Biophysical Techniques

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Course Objectives:

- To understand the physical methods to study the structure, functions of biomolecules
- To provide insights into essential biotechniques used in modern day research

Course Outcomes:

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

1. Understand the instrumentation, methodology and applications of colorimetry, UV-Visible spectroscopy, spectrofluorometer, turbidimeter, flame photometer
2. Get insights into principle and applications of Atomic Absorption Spectroscopy (AAS), Infrared (IR) spectroscopy, Optical Rotatory Dispersion (ORD), and Circular Dichroism
3. Get knowledge about MALDI-MS, MALDI-TOF-MS, advanced microscopic techniques

Theory

Unit I: Principle, instrumentation, methodology and applications of colorimeter, UV-Visible spectroscopy, spectrofluorometer, turbidometer, flame photometer. Beer-Lambert's Law and its limitations. Extinction coefficient, Polarized Light - Plane and circularly polarized light, fluorescent probes, and their applications.

Unit II

Principle, instrumentation, methodology and applications of Atomic Absorption Spectroscopy (AAS), Infrared (IR) and Raman spectroscopy, Optical Rotatory Dispersion (ORD), and Circular Dichroism (CD), Determining shape and structure of molecules: Magnetic resonance - NMR and ESR - Principles and applications.

Unit III

Mass Spectrometry: Principle, components, working and applications of mass spectrometer, different types of ionization methods used in mass spectrometer (CI, EI, ESI), different types of mass analyzers used in mass spectrometer (magnetic sector, quadrupole), MALDI-MS, MALDI-TOF-MS.

Unit IV

Microscopic techniques: Visualization of cells and sub cellular components by light microscopy, resolving powers of different microscopes, microscopic structure of living cells, scanning and transmission electron microscopy, fixation, and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy, confocal microscopy.

Practical 16 - Biophysical Techniques

1. Determination of absorption maxima (λ_{max}) of proteins and nucleic acids
2. To study the effect of different solvents on UV absorption spectra of proteins
3. Study of spectral changes of proteins at different pH using Spectrophotometry
4. Study of structural changes of proteins at different temperature using UV Spectrophotometry.
5. Differentiate single stranded DNA from double stranded DNA
6. FITC conjugation
7. Fluorescence spectrum of protein and nucleic acids
8. Demonstration of Live cell imaging

References

1. Biophysical chemistry, Upadhyaya, A., Upadhyaya, K. and Nath, N. Himala yan Pub-lishing House.
2. Practical biochemistry- Principles and Techniques. Wilson and Walker. J.Cambride Uni. Press.
3. Physical Biochemistry-David Freifelder, 2ns Edition.
4. Principles of Instrumental Analysis. 5th Ed. Douglas A Skoog, James Holler and Tim-othy A Nieman.
5. Nanotechnology by Richard Booker, Earl Boysen
6. Nano biotechnology. Bioinspired devices and materials of the future by Oded Shoseyov and Ilan Levy.
7. Review articles on individual topics form the major basis for this course as no single book covers all the topics listed above

DSC 17 - Genetic Engineering

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Course Objectives:

- The paper aims to educate the students in strategizing research methodologies employing recombinant DNA techniques
- To provide insights into techniques involved in genetic engineering and gene modification

Course Outcomes:

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

1. Demonstrate the innovative utilization of manipulating enzymes, various cloning and expression vectors and analysis of genomic sequences
2. Interpret the applications of genetic engineering in biotechnological research

Theory

Unit-I: Historical development of genetic engineering: Aim and scope of genetic engineering. Isolation of nucleic acids (DNA and RNA), Purity and integrity of DNA and RNA. cDNA. Gene and cDNA cloning. Restriction endonucleases - cutting of DNA by restriction endonucleases – staggered cut and blunt end, linkers, and adapters, homopolymer tailing, synthetic oligonucleotides. isoschizomers. Separation of fragments by agarose gel electrophoresis. Allocating genes to chromosomes -chromosome walking, RFLP and RAPD.

Unit II: Vectors-plasmids, phage, cosmids and phagemid, Transfections of vectors into host cells: micro-injection, electroporation, and lipofection. Colony and plaque hybridization. Yeast cloning vectors, plant vectors, bacterial artificial chromosome, SV40, shuttle vectors construction of expression vectors. Applications in agriculture, medicine, and industry. Transgenic plants and animals, Knock-in and knock-out technology; Gene therapy. GM foods and Biosafety.

Unit III: Introduction to Next Generation Sequencing. Blotting techniques: Principle, procedure, and applications of dot blot, Southern, northern, and western blot, DNA footprint assay, DNA fingerprint assay, gel-retardation assay, nuclease protection assay.

Unit IV: Fundamentals of polymerase chain reaction, types of PCR; hot start, multiplex, reverse transcriptase PCR and Nested PCR, quantitative PCR, primer designing for PCR, and cloning PCR products. DNA sequencing by Sanger's method including Automated Sanger's DNA sequencing. Human genome project.

Practical 17 - Genetic Engineering

1. Preparation of competent cells and selection- Bacterial Transformation.
2. Restriction digestion of DNA
3. DNA ligation
4. Separation of DNA fragments by Agarose gel electrophoresis.
5. PCR: Primer design and amplification. RT-PCR,
6. Southern Blotting.
7. Northern Blotting,

References

1. Molecular Cell Biology-Darnell, Lodish Baltimore, 4th Ed. W.H. Freeman and Compa-ny, New York.
2. Gene Structure and Expression-Hawkins
3. Microbiology- Prescott, L., Harley, J.P. and Klein, D.A. 7th Ed. 2008, McGraw Hill Publication.
4. Genetic Engineering: Prim rose, S.B.
5. Molecular Bio-technology- Principles and application of Recombinant DNA. GLicks, R. Bernard and Pasternak, J.Jack. Panima Publishing Corporation. Bacterial Plas-mids. Breda, P.

DSE 03a - Cell Culture & Animal Models

| L | T | P | C |
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Course Objectives:

- To propagate the scope of animal cell and tissue culture, plant tissue culture
- To provide information on Animal models of disease and research

Course Outcomes:

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

1. Understand the techniques adopted to culture the plant and animal cells
2. Comprehend about the protocols of seed culture, Embryo culture, Mature embryo culture

Theory

Unit I: History and scope of animal cell and tissue culture; advantages and disadvantages of tissue culture; laboratory facilities for tissue culture; the substrate on which cells grow; treatment of substrate surfaces; feeder layers on substrate; the gas phase for tissue culture; culture media for cells and tissues; culture procedures, Disaggregation (enzymatic and mechanical) of tissue and primary culture; cultured cells and evolution of cell lines; maintenance of culture-cell lines, Tissue culture (slide, flask and test tube cultures); organ culture; whole embryo culture; tissue engineering (artificial skin and artificial cartilage).

Unit II: Plant tissue culture: - History, Laboratory organization, Sterilization methods, Media preparation, Plant Growth Regulators, Micropropagation via axillary and adventitious shoot proliferation; Somatic embryogenesis; production of artificial seeds; Double haploid production by androgenesis and gynogenesis; triploid production by endosperm culture; production of virus free plants by meristem, shoot-tip culture; Cell Suspension cultures; protoplast isolation and regeneration, somatic hybridization and cybridization; protoclonal, somaclonal and gameto-clonal variation for crop improvement; Cryopreservation.

Unit III: Types of culture: Cytodifferentiation, Organogenic differentiation, Types of culture - Seed culture, Embryo culture, Mature embryo culture, Immature embryo culture/embryo rescue, Application of embryo culture, Callus culture, Organ culture, Nucellus culture, Application Endosperm culture, Application cell culture, Micropropagation, secondary metabolite production, haploid production, protoplast isolation & fusion, somaclonal variation

Unit IV: Animal models of disease and research: Hydra as a model for regeneration and morphogenesis; Drosophila & C. elegans as models of genetics, development, drug discovery and neurobiology, Mosquito as model of disease transmission, Zebrafish as apoptotic and drug assessment model, Murine models (Knock-in, knock-out, knock-down, nude and SCID mice).

References

1. Introduction to Biotechnology, P.K.Gupta, Kalyani Publishers, second edition.
Introduction to plant Biotechnology, H.S.Chawala, second ed., PHI Plant Biotechnology – P. C. Trivedi
2. Applied Plant Biotechnology – Ignacimuthu
3. Animal Biotechnology – Babinnk and Philips.
4. Biotechnology – B. D. Singh. Plant Tissue Culture – S.S. Bhojwani, M.K. Razdan.
5. Biotechnology Fundamentals and Applications – Purohis S S

DSE 03b - Biosafety and Bioethics

| L | T | P | C |
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Course Objectives:

- To provide knowledge on ethical practices appropriate to the discipline
- To adopt safe working practices relevant to the bioindustries and field of research

Course Outcomes:

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

1. Assist in technology upgradation and enhancing competitiveness
2. Acquire adequate knowledge in the use of genetically modified organisms and its effect on human health
3. Gain more insights into the regulatory affairs

Unit I: Biosafety; Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Good manufacturing practices (GMP) and Good Lab Practices (GLP); Guidelines for research in transgenic sciences and release of GMOs to environment; Bioterrorism and convention on biological weapons.

Unit II: Biosafety guidelines: Government of India; Definition of GMOs & LMOs; Roles of Institutional; Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

Unit III: Bioethics; Consent; Human vulnerability and personal integrity; Privacy and confidentiality; Equality, justice, and equity; Social responsibility and health; World Medical Association (WMA), Declaration of Helsinki. Use of animals for research and testing and Alternatives for Animals in Research; Three Rs tenets, Animal welfare needs.

Unit IV: Stem cell ethics; ethical issues related to transgenic crops, biosafety, and management. Ethical issues related to biomedical research; Ethical issues associated with consumptions of genetically modified foods and other products, Ethical implications of human genome project, Social and ethical implications of biological weapons, Bioremediations, and environmental impacts of using GMOs.

References:

1. Thomas, J. A. and Fuch, R. L. Biotechnology and Safety Assessment. Academic Press. (2002).
2. Fleming, D. A., Hunt, D. L., Biological safety Principles and practices. ASM Press. (2000).
3. Sateesh, M. K. Bioethics & Biosafety, IK Publishers. (2008).
4. Goel and Prashar, IPR, Biosafety and Bioethics, Pearson education, India (2013)

DSE 03c - Principles of Research Methodology

| L | T | P | C |
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Course Objectives:

- To educate students on research and its importance
- To provide knowledge of research design, methods, methodology, publications, scientific reports, and research proposals

Course Outcomes:

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

1. Understand the real meaning of research and its importance
2. Gain insight into identification of lacunae in already existing research findings and formulation of hypotheses
3. Possess knowledge on research methodology, methods, analyses, and interpretation of scientific data
4. Gain knowledge of scientific reports, publications, and research proposal

Unit I: Introduction to Research: Meaning, objective, motivation, significance of research; Review of literature; identifying the gaps in research and formulating hypothesis. Types of research; research approaches; research process; criteria for good research. Research methods versus methodology, scope, and significance of research methodology.

Unit II: Research problem and research design: Identification and selection of research problem; necessity of defining a problem; techniques involved in defining the problem; need for research design; different research designs; basic principles of experimental design; important experimental designs.

Unit IV: Analyses, interpretation, and report: Analyses and interpretation of results obtained; techniques of interpretation; precautions in interpretation; significance of report writing, layout of research report; types of reports; presentation of research work-oral and poster; writing a research paper; precautions for writing research report. Plagiarism.

Unit III: Publication and research proposal: Manuscript writing; types of publications, components of publication, authorship issues. Writing research proposal; Characteristics of a proposal; content and organization of a research proposal; strengths and weaknesses in proposal seeking funding. Citations, bibliography, references; recording and indexing, classification of references.

References:

1. Mishra, Dr. Shanti Bhushan & Alok, Dr. Shashi. (2017). Handbook of Research Methodology.
2. Phyllis G. Supino and Jeffrey S. Borer. Principles of Research Methodology: A Guide for Clinical Investigators. Springer Science+Business Media, LLC 2012. eBook ISBN 978-1-4614-3360-6.
3. CR Kothari. Research Methodology- Methods and Techniques. 2nd revised edition. 2004. New Age International Publishers. ISBN (13) : 978-81-224-2488-1.

Semester Eight

DSC 18 - Plant Biochemistry

| L | T | P | C |
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Course Objectives:

- To provide information on the physiological processes of plant at molecular level
- To provide insights into biochemical and cellular aspects of photosynthesis, respiration, and other special functions of plants

Course Outcomes:

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

1. Appreciate the functioning of plants by specialized molecular processes
2. Understand the stress physiology and defense system in plants
3. Possess the knowledge on bioactive principles, their isolation and characterization
4. Gain knowledge on plant toxins and medicine
5. Knowledge gained could be extrapolated in their research work

Theory

Unit-I: Electron transport system in plants: oxidative phosphorylation, mitochondrial respiratory complexes, order and organization of electron carriers, electrochemical gradient, chemiosmotic theory, ATP synthase and mechanism of ATP synthesis. Photosynthesis – Photosynthetic apparatus, photosystems I and II; Hill reaction, photosynthetic electron transport and generation of NADPH & ATP, cyclic and non-cyclic photophosphorylation, light harvesting complexes, C3 and C4 pathway and its regulation, Photorespiration.

Unit-II: Nitrogen metabolism: assimilation of nitrate, structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Biological nitrogen fixation by free living and in symbiotic association; structure and function of the enzyme nitrogenase.

Unit-III: Stress physiology in plants –Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature, and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress. Stress avoidance. Relationship between stress and adaptation. Anti-oxidative defense system in plants – reactive oxygen species and their generation. Role of polyamines.

Unit-IV: Secondary metabolites - Terpenes, phenols, flavonoids and nitrogenous compounds and their roles in plant physiology and as alternative medicine. Methods in phytochemicals: Extraction, fractionation, and characterization. Toxins of plant origin – mycotoxins, phytohemagglutinins, lathrogens, nitriles, protease inhibitors, protein toxins.

Practical 18 - Plant Biochemistry

1. Estimation of chlorophylls and carotenoids from leaves
2. Estimation of ascorbic acid, phenols, tannins in fruits and vegetables
3. Determination of radical scavenging activity of plant extracts
4. Estimation of hydrogen peroxide in tissue extracts
5. Extraction and assay of urease from seeds
6. Separation of photosynthetic pigments by TLC and determination of absorption Spectra
7. To study Hill reaction by using artificial electron acceptor.
8. Study the photosynthetic O₂ evolution using Hydrilla plant.

References:

1. AC. Deb, 2001. Fundamentals of Biochemistry, New Central Book Agency (P) Limited.
2. Dey, P. M., & Harborne, J. B. 1997, Plant Biochemistry. Academic Press.
3. Hans-Walter Heldt and Birgit Piechulla. 2010, Plant Biochemistry. London Academic.
4. Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., & Walter, P. 2013, Essential cell biology. Garland Science.

| L | T | P | C |
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Course Objectives:

- To impart fundamental knowledge on the structure, chemistry, and therapeutic value of drugs
- To emphasize on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs
- To give understandings on chemical structure and mechanism of action

Course Outcomes:

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

1. Understand the chemistry of drugs with respect to their pharmacological activity
2. Realize the drug metabolic pathways, adverse effect, and therapeutic value of drugs
3. Gain knowledge on the structural activity relationship (SAR) of different class of drugs & write the chemical synthesis of some drugs

Theory

Unit-I: Classification of drugs, role of intermolecular forces in drug action, lipids, carbohydrates, proteins (enzymes, receptor) and nucleic acids as drug targets. Pharmacokinetics and pharmacodynamics. Routes of drug administration, dosage forms. Absorption, distribution, metabolism, and elimination of drugs (ADME). Bioavailability of drugs, drug addiction and drug toxicity.

Unit-II: Antibacterial agents-mechanism of action-antibacterial agents that act against cell metabolism (sulfonamides), inhibit cell wall synthesis (penicillin, cephalosporins), interact with plasma membrane (valinomycin and gramicidin A), drugs impair protein synthesis (tetracyclines, chloramphenicol) and drugs act on nucleic acids (quinolones and fluoroquinolones, rifamycin). Antiviral agents-general principles-nucleic acid synthesis, inhibitors (HIV, HBV).

Unit-III: Host cell penetration inhibitors, inhibitors of viral protein synthesis. Antifungal agents-azoles, allylamines and phenols. Anti-protozoal drugs (antiamoebic, Giardia, Leishmaniasis, Anthelmintics) Anticancer drugs and their mechanism of action- role of antimetabolites, antisense drugs, alkylating agents and interchelating agents in cancer chemotherapy. Cardiovascular drugs: antiarrhythmic and antihypertension drugs. Gastrointestinal drugs; Peptic ulcer, gastroesophageal reflux disorders.

Unit-IV: Identification of diseases and corresponding targets, bioassays and leads. Stereochemistry and solubility issues in drug design. Structure-activity relationships (SARs): changing size and shape-introduction of new substituents. Quantitative structure activity relationships (QSARs): lipophilicity-electronic and steric effects. Chemical and process development of drugs. Preclinical trials: pharmacology, toxicology, metabolism, and stability studies-formulation. Clinical trials: phase I-IV studies ethical issues.

Practical 19 - Medicinal Chemistry

1. Preparation of drugs/ intermediates
 - a. 1,3-pyrazole
 - b. 1,3-oxazole
 - c. Benzimidazole
 - d. Benztiazole
2. Assay of drugs
 - a. Ibuprofen
 - b. Aspirin
3. Determination of Partition coefficient for any two drugs

References:

1. Fundamentals of Medicinal Chemistry by Gareth Thomas, John Wiley & Sons: Chichester, 2003.
2. Medicinal Chemistry: An Introduction by Gareth Thomas, Wiley-Interscience, 2nd edition, 2008.
3. An introduction to Medicinal Chemistry by Graham L. Patric, Oxford University Press, USA, 3rd edition, 2005.
4. Wilson and Giswald's Textbook of Organic Medicinal and Pharmaceutical Chemistry by John Block and John M Beale (Eds), Lippincott Williams & Wilkins, 11th edition, 2003.
5. The Organic Chemistry of Drug Design and Drug Action by Richard B. Silverman, Academic press, 2nd edition, 2004.
6. Designing Organic Synthesis: The Disconnection Approach by Stuart Warren, Wiley, 2nd edition, 1984.

DSE 04a - Stem Cell Biology & Regenerative Medicine

| L | T | P | C |
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Course Objectives

- To familiarize students with stem cell technology and its applications for betterment of the society
- To give a broad view of mammalian stem cells, reviewing where they are found in the body, the different types and how they are cultured

Course Outcomes

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

1. Understand basic biology of stem cells
2. Appreciate bioengineering and application of stem cells for treatment of diseases

Theory

Unit-I: Introduction to stem cells, properties, proliferation, culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells. Different types of stem cells, process and mechanism of stem cell subset development and their spatial organization during human development.

Unit-II: Types of stem cells. Stem cell biology and therapy, types of embryonic stem cell, adult stem cell, Embryonic stem cells, culture, and the potential benefits of stem cell technology. Ectoderm, mesoderm and endoderm development and process of organogenesis during human development. Organoids and Spheroids.

Unit-III: Introduction, history and evolution of gene therapy, optimal disease targets, failures and successes with gene therapy and prospects, Genetic Perspectives for Gene Therapy, Gene Delivery methods: Viral vectors and Non-viral Vectors.

Unit-IV: Ethical Issues associated with stem cell-based regenerative medicine, Regulatory and Ethical Considerations of stem cell and Gene Therapy, Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapy.

References:

1. Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press
2. Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press
3. Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander Battler, Jonathan Leo, Springer,
4. Stem Cell Biology and Gene Therapy. Quesenberry PJ, Stein GS, eds. Wiley, 1998.
5. Progress in gene therapy, Volume 2, Pioneering stem cell/gene therapy trials, Roger Bertolotti, Keiya
6. Ozawa and H. Kirk Hammond, VSP international science publishers Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003.

DSE 04b - Pharmacovigilance

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

Course Objectives:

- To provide an opportunity for the student to learn about development of pharmacovigilance as a science and global scenario of pharmacovigilance
- To train students on establishing pharmacovigilance programme to generate safety data and signal detection in an organization
- To develop the skills of classifying drugs, diseases, and adverse drug reactions

Course Outcomes:

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

1. Understand the adverse reactions of drugs
2. Comprehend the Reporting Database
3. Appreciate the role of clinical pharmacist in Pharmacovigilance

Theory

Unit-I: Overview and Brief History of Pharmacovigilance. Thalidomide's Impact on Regulations. Scope, definition and aims of Pharmacovigilance. Pharmacovigilance Database. International collaboration on pharmacovigilance- WHO, ICH, CIOMS and ISoP. Case Processing- Global Perspective of Pharmacovigilance. Case Narrative Writing.

Unit-II: Adverse Drug Reactions (ADRs) - Classification, mechanism, predisposing factors, causality assessment for ADRs. ICH Definition of Adverse Drug Reaction. Medical Evaluation of Adverse Events in Pharmacovigilance. Diagnosis and Managements of ADRs.

Unit-III: Reporting Database, Role of clinical pharmacist in Pharmacovigilance. Pharmacovigilance indicators. Rationale and objectives and Classification of pharmacovigilance indicators. Signal Detection, Managements and Risk Assessments & Evaluation in Pharmacovigilance. Regulator Guideline & laws in Pharmacovigilance. Regulatory body, Institutional Review board, Independent Ethic Committee involvement and submissions. Data privacy, informed consent Forms and Adverse Events Forms.

Unit-IV: ICH GCP, Regulatory Aspects in Pharmacovigilance. Pharmacovigilance- Auditing and Inspection. Quality System in Pharmacovigilance. SOPs in Pharmacovigilance. Medical Dictionary for Drug Regulatory Activities MedDRA. Unexpected therapeutic effects, Misuse, Abuse, Rebound effects, Medication errors, treatment non-Compliance with AEs, Overdose/Underdose, Technical complaints or Product Quality Complaints (PQC) and Off Label Uses.

References:

1. Textbook of Pharmacovigilance by SK Gupta. Publisher: Jaypee Brothers, Medical Publishers Pvt. Limited.
2. Practical Manual of Experimental and Clinical Pharmacology by Bikash Medhi, Ajay Prakash. Publisher: Jaypee Brothers, Medical Publishers Pvt. Limited.

3. Stephens' Detection of New Adverse Drug Reactions by John Talbot, Patrick Waller. Publisher: John Wiley & Sons.
4. Cobert's Manual of Drug Safety and Pharmacovigilance by Barton Cobert. ISBN-13: 9780470671047.
5. Mann's Pharmacovigilance, 3rd Edition by Elizabeth B. Andrews and Nicholas Moore. ISBN-13: 9780470671047.
6. Pharmacovigilance Medical Writing: A Good Practice Guide by Justina Orleans-Lindsay. Publisher: John Wiley & Sons.
7. An Introduction Pharmacovigilance by Patrick Waller. Publisher: Wiley-Blackwell
8. ICH of technical requirements for registration of pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for GCP.E6
9. Ethical Guidelines for Biomedical Research on Human Subjects 2000. ICMR, New Delhi
10. Handbook: Good Laboratory Practice (GLP): Quality Practices for Regulated Non-clinical Research and Development, WHO, 2nd Edition.

05a - RESEARCH PROJECT OR

DSE 05a - Research Project

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 6 | 6 |

Course Objectives:

- To train students and build a strong foundation for scientific research
- To advance students to address a research problem, hypothesize and frame objectives
- To design experiments, carry out the research and interpret the results
- To foster the critical thinking and problem-solving abilities

Course Outcomes:

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

1. Understand the concept of research and career in research
2. Design, plan and execute the research problem
3. Compile, analyze and interpret the research data
4. Write a project thesis and research manuscript

Research Projects can be done at

1. Central research institutes
2. UGC recognized Universities or Higher Education Institutions
3. Industries – R&D laboratories

DSE 05b - Biostatistics

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

Course Objectives:

- To help students in understanding the principles of collection of data in biological experiments
- To train students with proper statistical analysis of the data and its presentation

Course Outcomes:

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

1. Understand the importance of sample size and various variables that affect data
2. Gain knowledge on mean, standard error, standard deviation, significance in presenting the data
3. Learn statistical methods which will help in improving their analytical and interpretation skill

Theory

Unit-I: Data Collection and Presentation: Biological data management using statistical tools. Concepts of population and sample, advantages of sampling, Basic concepts in sampling and designing experiments, Estimation of sample size for biological experiments, sources of errors.

Unit-II: Sampling schemes – Simple Random sampling, Systemic sampling, Stratified sampling, Cluster sampling, Nonprobability sampling; Estimation of mean proportion and standard error in cluster sampling, Multistage and multiphase sampling, Types of numerical data – nominal data, ordinal data, ranked data, discrete data, continuous data; Modes of presenting data: Frequency distributions, Relative frequency.

Unit-III: Analysis of variance: Mean, median, mode; Co-efficient of variation and standard deviation; Range and interquartile range; Grouped mean and grouped variance; Frequency distributions; One-way ANOVA; Two-way ANOVA; AMOVA; student's t test. Probability: Operations on events, Venn diagrams, Conditional Probability; Probability distributions.

Unit-IV: Hypothesis testing: General concepts – Null hypothesis, alternative hypothesis. Rejection of hypothesis; Type I and Type II errors; P value and sample size estimation. Regression and Correlation: Chi Square Test – Observed and expected frequencies, Calculating p values, assumptions of a chi square goodness of fit; Correlation –Two-way scatter plot, Pearson's correlation coefficient; Regression – regression concepts, simple linear regression; Calculation of R^2 and ρ .

References:

1. Principles of Biostatistics. M. Pagano and K. Gauvreau (2000); Duxbury Thomas learnings.
2. Analysis of Biological Data. M. Whitlock and D. Schluter (2009); Roberts and company publishers.

DSE 05c - Cell Signaling

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

Course Objectives:

- To enable the students to understand the cellular networks involved in maintenance of living organism
- To give insights of multiple molecules in bringing physiological changes with a systematic approach

Course Outcomes:

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

1. Describe the mechanisms by which different receptors may be activated by their respective ligands
2. Appreciate the importance of components of signal transduction pathways in health and diseases

Unit-1: Cell-cell communication- autocrine, paracrine, endocrine, intracrine, and neuroendocrine. Concept of cell signaling- reception, amplification, and response; Extracellular and intracellular signaling. Types of receptors: membrane-bound, cytosolic, and nuclear. Peptide/protein hormones, steroid hormones, amino acid-derived hormones. Mechanism of action of secondary messengers- cAMP, cGMP, IP₃, DAG, Ca²⁺, NO.

Unit-2: G Protein coupled receptors (GPCRs), - structure and mechanism, regulatory GTPases, heterotrimeric G proteins and effector molecules of G Proteins. Ser/Thr-specific protein kinases and phosphatases. Receptor tyrosine kinases (RTKs), MAP kinase pathway, Cell survival pathway, p53 pathway. Extrinsic and Intrinsic apoptotic pathways; Insulin receptor signaling; vascular endothelial growth factor and platelet derived growth factor signaling pathways.

Unit-3: Signaling by nuclear receptors: ligands, structure and functions of nuclear receptors, nuclear functions for hormones/metabolites - orphan receptors; cytoplasmic functions and crosstalk with signaling molecules, signaling pathway of the steroid hormone receptors. Cytokine receptors- structure and activation of cytokine receptors, JAK-STAT pathway, Janus kinases, STAT proteins.

Unit-4: Cell culture and *in vivo* model systems to study cell signaling pathways. Applications of siRNA, shRNA, adenoviral RNAs. Gene and Protein expression studies. Single and multiple gene expression analysis. Microarray and Super array technologies. Implications of cell-specific and tissue-specific gene overexpression and deletion in cell signaling, health and diseases.

References:

1. Lodish, H, et al., 2016, Molecular Cell Biology. 5th Edn. W. H. Freeman; 8th edition.
2. Alberts et al. 2008, Molecular biology of the Cell –Garland Science; 5th edition.
3. Karp, 2013, Cell and Molecular Biology. J. John Wiley and Sons Inc. Wiley; 7th edition.
4. Geoffrey M Cooper and Robert E Hausman, 2006, The Cell-Molecular approach. Sinauer Associates, Inc.; 4th edition.

Question Paper Pattern

QUESTION PAPER PATTERN

QP CODE:

JSS Academy of Higher Education & Research, Mysuru
(Deemed to be University)

First Semester B.Sc., (Life Sciences) Examination - Year
Branch

Subject:

Note: Draw neat, labeled diagrams wherever necessary.

Your answers should be specific to the questions asked.

Time: 02 Hours

Max Marks: 50

I. LONG ESSAYS (Answer any TWO of the following)

2x10=20 Marks

- 1.
- 2.
- 3.

II. SHORT ESSAYS (Answer any FIVE of the following)

5x4=20 Marks

- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

III. SHORT ANSWERS (Answer all the following)

5x2=10 Marks

- 11.
- 12.
- 13.
- 14.
- 15.

QUESTION PAPER PATTERN

QP CODE:

JSS Academy of Higher Education & Research, Mysuru
(Deemed to be University)

First Semester B.Sc., (Life Sciences) Examination - Year
Branch

Subject:

***Note:** Draw neat, labeled diagrams wherever necessary.*

Your answers should be specific to the questions asked.

Time: 03 Hours

Max Marks: 70

I LONG ESSAYS (Answer any TWO of the following)

2x15=30 Marks

- 1.
- 2.
- 3.

II SHORT ESSAYS (Answer any FIVE of the following)

5x6=30 Marks

- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

III SHORT ANSWERS (Answer all the following)

5x2=10 Marks

- 11.
- 12.
- 13.
- 14.
- 15.
