**ANNAMALAI UNIVERSITY**

(Affiliated Colleges)

**210 - B.Sc. Biochemistry**

Programme Structure and Scheme of Examination (under CBCS)

(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Part | Course Code | Study Components & Course Title | Credit | Hours/Week | Maximum Marks |
| CIA | ESE | Total |
|  |  | SEMESTER – I |  |  |  |  |  |
| I | 23UTAML11/23UHINL11/23UFREL11 | Language– InghJ jkpo; - I: தமிழிலக்கிய வரலாறு-1/Hindi-I/French-I | 3 | 6 | 25 | 75 | 100 |
| II | 23UENGL12 | General English - I | 3 | 6 | 25 | 75 | 100 |
| III | 23UBIOC13 | Core – I: Nutritional Biochemistry | 5 | 5 | 25 | 75 | 100 |
| 23UBIOP14 | Core – II: Practical – I: Nutritional Biochemistry Practical  | 5 | 4 | 25 | 75 | 100 |
| 23UMICE15 | Elective – I Fundamentals of Microbiology | 2 | 3 | 25 | 75 | 100 |
| 23UMICEP1 | Fundamentals of Microbiology Practical- I | 1 | 2 | 25 | 75 | 100 |
| IV | 23UTAMB1623UTAMA16 | Skill Enhancement Course – I\*NME-I/Basic Tamil – I /Advanced Tamil - I | 2 | 2 | 25 | 75 | 100 |
| 23UBIOF17 | Foundation Course:First Aid | 2 | 2 | 25 | 75 | 100 |
|  |  | Total | 23 | 30 |  |  | 800 |
|  |  | SEMESTER – II |  |  |  |  |  |
| I | 23UTAML2123UHINL21/23UFREL21 | Language– IIபொது தமிழ் -II: தமிழிலக்கிய வரலாறு-2/Hindi-IIFrench-II | 3 | 6 | 25 | 75 | 100 |
| II | 23UENCL22 | General English – II | 3 | 6 | 25 | 75 | 100 |
| III | 23UBIOC23 | Core – III: Cell Biology | 5 | 5 | 25 | 75 | 100 |
| 23UBIOP24 | Core – IV: Practical – II: Cell Biology Practical | 5 | 4 | 25 | 75 | 100 |
| 23UMICE25 | Elective – IIApplied Microbiology | 2 | 3 | 25 | 75 | 100 |
|  | 23UMICEP2 | Applied Microbiology Practical – II | 1 | 2 | 25 | 75 | 100 |
| IV | 23UTAMB2623UTAMA26 | Skill Enhancement Course – II\*NME-II/Basic Tamil – II /Advanced Tamil - II  | 2 | 2 | 25 | 75 | 100 |
| 23USECG27 | Skill Enhancement Course – IIIInternet and its Applications (Common Paper) | 2 | 2 | 25 | 75 | 100 |
| 23UNMSD01 | Language Proficiency for employability: Overview of English Communication\*\* | 2 | - | 25 | 75 | 100 |
|  |  | Total | 25 | 30 |  |  | 900 |

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | SEMESTER – III |  |  |  |  |  |
| I | 23UTAML3123UHINL31/23UFREL31 | Language– IIIபொது தமிழ் -III: தமிழக வரலாறும், பண்பாடும்Hindi-IIIFrench-III | 3 | 6 | 25 | 75 | 100 |
| II | 23UENCL32 | General English – III | 3 | 6 | 25 | 75 | 100 |
| III | 23UBIOC33 | Core –V: Biomolecules | 5 | 5 | 25 | 75 | 100 |
| 23UBIOP34 | Core –VI: Practical III Biomolecules | 5 | 4 | 25 | 75 | 100 |
| 23UCHEE35 | Elective-III: Chemistry for Biological Sciences - I | 2 | 3 | 25 | 75 | 100 |
|  | 23UCHEEP3 | Chemistry Practical for Biological Sciences – I | 1 | 2 | 25 | 75 | 100 |
| IV | 23UBIOS36 | Skill Enhancement Course – IV:Microbial Techniques | 1 | 2 | 25 | 75 | 100 |
| 23UBIOS37 | Skill Enhancement Course – V:Biomedical Instrumentation | 2 | 2 | 25 | 75 | 100 |
|  | Environmental studies | - | 1 | - | - | - |
|  |  | Total | 22 | 30 |  |  | 800 |

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | SEMESTER – IV |  |  |  |  |  |
| I | 23UTAML4123UHINL41/23UFREL41 | Language– IVபொது தமிழ் -IV: Hindi-IVFrench-IV | 3 | 6 | 25 | 75 | 100 |
| II | 23UENCL42 | General English – IV | 3 | 6 | 25 | 75 | 100 |
| III | 23UBIOC43 | Core –VII: Biochemical techniques | 5 | 5 | 25 | 75 | 100 |
| 23UBIOP44 | Core –VIII: Practical IV -Biochemical Techniques | 5 | 3 | 25 | 75 | 100 |
| 23UCHEE45 | Elective-IV: Chemistry for Biological Sciences – II | 2 | 3 | 25 | 75 | 100 |
|  | 23UCHEEP4 | Chemistry Practical for Biological Sciences – II | 1 | 2 | 25 | 75 | 100 |
| IV | 23UBIOS46 | Skill Enhancement Course - VI:Tissue Culture | 2 | 2 | 25 | 75 | 100 |
| 23UBIOS47 | Skill Enhancement Course - VII: Medical Coding | 2 | 2 | 25 | 75 | 100 |
| 23UEVSG48 | Environmental studies | 2 | 1 | 25 | 75 | 100 |
|  |  | Total | 25 | 30 |  |  | 900 |

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | SEMESTER – V |  |  |  |  |  |
| III | 23UBIOC51 | Core –IX: Enzymes | 4 | 5 | 25 | 75 | 100 |
| 23UBIOC52 | Core –X: Intermediary Metabolism | 4 | 5 | 25 | 75 | 100 |
| 23UBIOC53 | Core –XI: Clinical Biochemistry | 4 | 5 | 25 | 75 | 100 |
| 23UBIOD54 | Core – XII: Project with Viva-Voce | 4 | 5 | 25 | 75 | 100 |
| 23UBIOE55-123UBIOE55-2 | Elective – V: Immunology ***(*or)**Biochemical Pharmacology | 3 | 4 | 25 | 75 | 100 |
|  | 23UBIOE56-123UBIOE56-2 | Elective – VI: Bioentrepreneurship (OR)Research methodology | 3 | 4 | 25 | 75 | 100 |
| IV | 23UVALG57 | Value Education | 2 | 2 | 25 | 75 | 100 |
| 23UBIOI58 | Summer Internship**++** | 2 | - | 25 | 75 | 100 |
|  |  | Total | 26 | 30 |  |  | 800 |

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | SEMESTER – VI |  |  |  |  |  |
| III | 23UBIOC61 | Core –XIII: Molecular Biology  | 4 | 6 | 25 | 75 | 100 |
| 23UBIOC62 | Core –XIV Human Physiology | 4 | 6 | 25 | 75 | 100 |
| 23UBIOC63 | Core –XV: Plant Biochemistry & Plant Therapeutics | 4 | 6 | 25 | 75 | 100 |
| 23UBIOE64 | Elective VII: Practical- Clinical Biochemistry | 3 | 5 | 25 | 75 | 100 |
| 23UBIOE65-123UBIOE65-2 | Elective – VIII: Bioinformatics (or)Biotechnology | 3 | 5 | 25 | 75 | 100 |
| IV | 23UBIOF66 | Professional Competency Skill:Molecular Diagnostics | 2 | 2 | 25 | 75 | 100 |
| V | 23UBIOX67 | Extension Activity | 1 | - | 25 | 75 | 100 |
|  |  | Total | 21 | 30 |  |  | 700 |
|  |  | Grand Total | 142 | 180 |  |  | 4900 |

**Remarks: English Soft Skill Two Hours will be handled by English Teachers**

 **(4+2 = 6 hours for English).**

**List of Non – Major Electives offered to other Departments**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| IV | 23UBION16 | Health and Nutrition | 2 | 2 | 25 | 75 | 100 |
| 23UBION26 | Lifestyle Diseases | 2 | 2 | 25 | 75 | 100 |

\* PART-IV: NME / Basic Tamil / Advanced Tamil (Any one)

Students who have not studied Tamil upto 12th Standardand have taken any Language other than Tamil in Part-I, must choose Basic Tamil-I in First Semester & Basic Tamil-II in Second Semester.

Students who have studied Tamil upto 10th & 12th Standardand have taken any Language other than Tamil in Part-I, must choose Advanced Tamil-I in First Semester and Advanced Tamil-II in Second Semester.

\*\* The course “23UNMSD01: Overview of English Communication” is to be taught by the experts from Naan Mudhalvan Scheme team. However, the faculty members of Department of English should coordinate with the Naan Mudhalvan Scheme team for smooth conduct of this course.

++Students should complete two weeks of internship before the commencement of V semester.

**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credit and Hours Distribution System**

**for all UG courses including Lab Hours**

**First Year – Semester-I**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| Part I | Language – Tamil  | 3 | 6 |
| Part II | English | 3 | 6 |
| Part III | Core Theory, Practical & Elective Courses  | 13 | 14 |
| Part IV | Skill Enhancement Course SEC-1 (NME-I) | 2 | 2 |
| Foundation Course | 2 | 2 |
|  |  | **23** | **30** |

**Semester-II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| Part I | Language – Tamil | 3 | 6 |
| Part II |  English | 3 | 6 |
| Part III | Core Theory, Practical & Elective Courses  | 13 | 14 |
| Part IV | Skill Enhancement Course -SEC-2 (NME-II) | 2 | 2 |
| Skill Enhancement Course -SEC-3 (Discipline / Subject Specific) | 2 | 2 |
|  |  | **23** | **30** |

**Second Year – Semester-III**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| Part I | Language - Tamil | 3 | 6 |
| Part II |  English | 3 | 6 |
| Part III | Core Theory, Practical & Elective Courses | 13 | 14 |
| Part IV | Skill Enhancement Course -SEC-4 (Entrepreneurial Based) | 1 | 1 |
| Skill Enhancement Course -SEC-5 (Discipline / Subject Specific) | 2 | 2 |
|  E.V.S  | - | 1 |
|  |  | **22** | **30** |

**Semester-IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| Part I | Language - Tamil | 3 | 6 |
| Part II |  English | 3 | 6 |
| Part III | Core Theory, Practical & Elective Courses | 13 | 13 |
| Part IV | Skill Enhancement Course -SEC-6 (Discipline / Subject Specific) | 2 | 2 |
| Skill Enhancement Course -SEC-7 (Discipline / Subject Specific) | 2 | 2 |
|  E.V.S  | 2 | 1 |
|  |  | **25** | **30** |

**Third Year**

**Semester-V**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| Part III | Core Theory, Practical, Project & Elective Courses | 22 | 28 |
| Part IV | Value Education  | 2 | 2 |
| Internship / Industrial Visit / Field Visit | 2 | - |
|  |  | **26** | **30** |

**Semester-VI**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| Part III | Core Theory, Practical & Elective Courses | 18 | 28 |
| Part IV | Professional Competency Skill | 2 | 2 |
| Part V | Extension Activity | 1 | - |
|  |  | **21** | **30** |

**Consolidated Semester wise and Component wise Credit distribution**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parts**  | **Sem I** | **Sem II** | **Sem III** | **Sem IV** | **Sem V** | **Sem VI** | **Total Credits** |
| **Part I** | 3 | 3 | 3 | 3 | - | - | 12 |
| **Part II** | 3 | 3 | 3 | 3 | - | - | 12 |
| **Part III** | 13 | 13 | 13 | 13 | 22 | 18 | 92 |
| **Part IV**  | 4 | 4 | 3 | 6 | 4 | 2 | 23 |
| **Part V** | - | - | - | - | - | 1 | 1 |
| **Total** | 23 | 23 | 22 | 25 | 26 | 21 | **140** |

**\*Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components Part IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

**CREDIT DISTRIBUTION FOR U.G. PROGRAMME**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Part** | **Course Details** | **No. of Courses** | **Credit per course** | **Total****Credits** |
| **Part I** | Tamil | 4 | 3 | 12 |
| **Part II** | English | 4 | 3 | 12 |
| **Part III** | Core Courses  | 15 | 4/5 | 68 |
| Elective Courses: Generic / Discipline Specific (3 or 2+1 Credits) | 8 | 3 | 24 |
| **Part I, II and III Credits**  | 116 |
| **Part IV** | Skill Enhancement Courses / NME / Language Courses | 7 | 1/2 | 15 |
| Professional Competency Skill Course | 1 | 2 | 2 |
| Environmental Science (EVS) | 1 | 2 | 2 |
| Value Education  | 1 | 2 | 2 |
| Internship | 1 | 2 | 2 |
| **Part IV Credits** | **23** |
| **Part V** | Extension Activity (NSS / NCC / Physical Education) | 1 | 1 | 1 |
| **Total Credits for the UG Programme**  | **140** |

|  |
| --- |
| **Methods of Evaluation** |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze(K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate(K5)** | Longer essay/Evaluation essay, Critique or justify with pros and cons |
| **Create(K6)** | Check knowledge in specific or off beat situations, Discussion, Debating or Presentations |

|  |  |
| --- | --- |
| **Programme Outcomes:** | **PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study**PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one’s views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.**PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one’s learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.**PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation**PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team**PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.**PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.**PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability toembrace moral/ethical values in conducting one’s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstratingthe ability to identify ethical issues related to one‟s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.**PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.**PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn‟, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling. |
| **Programme Specific Outcomes:** | **PSO1 – Placement:** To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.**PSO 2 - Entrepreneur:**To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations**PSO3 – Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.**PSO4 – Contribution to Business World:**To produce employable, ethical and innovative professionals to sustain in the dynamic business world.**PSO 5 – Contribution to the Society:**To contribute to the development of the society by collaborating with stakeholders for mutual benefit |

**PROGRAM OUTCOMES**

|  |  |
| --- | --- |
| **PO1** | Acquire knowledge in Biochemistry and apply the knowledge in their day to day life for betterment of self and society  |
| **PO2** | Develop critical ,analytical thinking and problem solving skills |
| **PO3** | Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret and draw conclusion from data |
| **PO4** | Address and develop solutions for societal and environmental needs of local, regional and national development |
| **PO5** | Work independently and engage in lifelong learning and enduring proficient progress |
| **PO6** | Provoke employability and entrepreneurship among students along with ethics and communication skills |

**PROGRAM SPECIFIC OUTCOMES**

|  |  |
| --- | --- |
| **PSO1** | Comprehend the knowledge in the biochemical, analytical, biostatistical and computational areas |
| **PSO2** | Ability to understand the technical aspects of existing technologies that help in addressing the biological and medical challenges faced by human kind |
| **PSO3** | Acquiring analytical and hands on skills to perform research in multidisciplinary environments |
| **PSO4** | Use library search tools and online databases and sources to locate and retrieve scientific information about a topic and techniques related to biochemistry |

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| --- | --- | --- |
| **SEMESTER: I****CORE-I****PART: III** | **Core - I: Nutritional Biochemistry (**23UBIOC13**)** | **CREDIT: 5****HOURS: 5/W** |

**Learning Oobjectives**

The objectives of this course are to

* Create awareness about the role of nutrients in maintaining proper health
* Understand the nutritional significance of carbohydrates, lipids and proteins.
* Understand the importance of a balanced diet.
* Study the effect of additives, emulsifiers, and flavor enhancing substances in food.
* Study the significance of nutraceuticals.

**Unit I** : Concepts of food and nutrition. Basic food groups - energy yielding, body building and functional foods. Units of energy. Calorific and nutritive value of foods. Measurement of Calories by bomb calorimeter. Basal metabolic rate (BMR)- definition, determination of BMR and factors affecting BMR. Respiratory quotient (RQ) of nutrients and factors affecting the RQ. SDA-definition and determination- Anthropometric measurement and indices – Height, Weight, chest and waist circumference BMI. 12 Hrs

**Unit II:** Physiological role and nutritional significance of carbohydrates, lipids and protein. Evaluation of proteins by nitrogen balance method- Biological value of proteins- Digestibility coefficient, Protein Energy Ratio and Net Protein Utilization. Protein energy malnutrition – Kwashiorkor and Marasmus, Obesity-Types and preventive measures.

12 Hrs

**Unit III** : Balanced diet, example of low and high cost balanced diet- for infants, children, adolescents, adults and elderly people. ICMR classification of five food groups and its significance food pyramid. Junk foods- definition and its adverse effects .

12 Hrs

**Module IV** : Food additives: Structure, chemistry, function and application of preservatives, emulsifying agents, buffering agents, stabilizing agents, natural and artificial sweeteners, bleaching, starch modifiers, antimicrobials, food emulsions, fat replacers, viscosity agents, gelling agents and maturing agents. Food colors, flavors, anti-caking agent, antioxidants. Safety assessment of food additives.

12 Hrs

Unit **V**: Nutraceuticals and Functional Foods: Definition, properties and function of Nutraceuticals, food Supplements, dietary supplements prebiotics and probiotics, and functional Foods. Food as medicine. Natural pigments from plants – carotenoids, anthocyanins and its benefits.

12 Hrs

**Course Outcomes**

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| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program outcomes** |
| CO1 | Cognizance of basic food groups viz. Carbohydrates, proteins and lipids and their nutritional aspects as well as calorific value | PO1,PO5 |
| CO2 | Identify and explain nutrients in foods and the specific functions in maintaining health. | PO1 |
| CO3 | Classify the food groups and its significance | PO1,PO2 |
| CO4 | Understand the effect of food additives | PO1,PO2 |
| CO5 | Describe the importance of nutraceuticals and pigments | PO1,PO5,PO6 |

**Text books**

1. Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner. 2013. Wardlaw's Perspectives in Nutrition: A Functional Approach. McGraw-Hill, Inc., NY, USA.

2. M.Swaminadhan (1995) Principles of Nutrition and Dietics. Bappco.

3. Tom Brody (1998). Nutritional Biochemistry (2nded), Academic press, USA

4. Garrow, JS,James WPT and Ralph A (2000). Human nutrition and dietetics (10thed)

Churchill Livingstone.

5. Andreas M.Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1sted) CRC

**Reference Books**

1. Branen, A.L., Davidson PM &Salminen S. 2001. Food Additives. 2nd Ed. Marcel Dekker.

2. Gerorge, A.B. 1996. Encyclopedia of Food and Color Additives. Vol. III. CRC Press.

3. Advances in food biochemistry, FatihYildiz (Editor), CRC Press, Boca Raton, USA, 2010

4. Food biochemistry & food processing, Y.H. Hui (Editor), Blackwell Publishing, Oxford, UK, 2006.

5. Geoffrey Campbell-Platt. 2009. Food Science and Technology. Wiley-Blackwell ,UK.

**Web resources**

http://old.noise.ac.in/SecHmscicour/english/LESSON O3.pdf

 https://study.com/academy/lesson/energy-yielding-nutrients-carbohydratesfat-protein.html.

<https://www.nhsinform.scot/healthy-living/food-and-nutrition/eatingwell/vitamins-and-minerals>

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  | 2 |  | 3 | 3 | 3 | 3 |
| **CO 2** | 3 |  |  |  |  |  | 3 | 3 |  | 3 |
| **CO 3** | 3 | 2 |  |  |  |  | 3 | 1 |  | 3 |
| **CO 4** | 3 | 2 |  |  |  |  | 3 | 3 |  | 3 |
| **CO5** | 3 |  |  |  | 2 | 2 | 3 | 3 |  | 3 |

**S-Strong (3) M-Medium (2) L-Low (1)**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: I****CORE-II****PART: III** | **Core II-Practical 1- Nutritional Biochemistry (23UBIOP14)** | **CREDIT: 5****HOURS: 4/W** |

**Learning objectives**

The objectives of this course are to

* Impart hands-on training in the estimation of various constituents by titrimetric method
* Prepare Biochemical preparations
* Determine the ash content and extraction of lipid

**TITRIMETRY 20 hrs**

1. Estimation of ascorbic acid in a citrus fruit.

2. Estimation of calcium in milk.

3. Estimation of glucose by Benedict’s method in honey.

4. Estimation of phosphorous (Plant source)

**BIOCHEMICAL PREPARATIONS 15 Hrs**

Preparation of the following substances and its qualitative tests

5. Lecithin from egg yolk.

6. Starch from potato.

7. Casein and Lactalbumin from milk.

**GROUP EXPERIMENT 10Hrs**

8. Determination of ash content and moisture content in food sample

9. Extraction of lipid by Soxhlet’s method.

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program outcomes** |
| CO1 | Estimate the important biochemical constituents in the food samples. | PO1,PO3 |
| CO2 | Prepare the macronutrients from the rich sources. | PO1,PO3 |
| CO3 | Determine the ash and moisture content of the food samples | PO1,PO3 |
| CO4 | Extract oil from its sources | PO1,PO3,PO6 |

**Text books**

1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers, 2011,

2. An Introduction to Practical Biochemistry, David T. Plummer, 3 rd edition, Tata McGraw-

Hill Publishing Company Limited, 2001.

**Reference books**

1. Biochemical Methods, Sadasivam S and Manickam A, 4h edition, NewAge International Publishers, 2016

2. Essentials of Food and Nutrition, Vol. I &amp; II, M.S. Swaminathan.

3 Bowmen and Robert M. 2006. Present Knowledge in Nutrition. 9th edition, International Life Sciences Publishers.

4. Indrani TK. 2003. Nursing Manual of Nutrition and Therapeutic Diet, 1st edition Jaypee Brothers medical publishers.

5. Martha H. and Marie A. 2012. Biochemical, Physiological, and Molecular Aspects of Human Nutrition. 3rd edition. Chand Publishers.

**Web resources**

1.https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors

2.http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/ Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf

3.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical\_biochemistrypdf.pdf?sequence=1&isAllowed=y

4.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical\_biochemistrypdf.pdf?sequence=1&isAllowed=y

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO 2** | 3 |  | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO 3** | 3 |  | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO 4** | 3 |  | 3 |  |  | 3 | 3 | 3 | 3 | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

**Elective: FUNDAMENTALS OF MICROBIOLOGY**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Subject Code | L | T | P | S | Credits | Instructional Hours | Marks |
| CIA | External | Total |
| 23UMICE15 | 3 | 1 |  |  | 2 | 4 | 25 | 75 | 100 |
| **Course Outcomes** |
| CO1 | Understand the classification of Microorganisms and structure of bacteria |
| CO2 | Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms. |
| CO3 | Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes. |
| CO4 |  Understand the skills in working procedures of Microscopes. |
| CO5 | Understand about the nutritional requirements of Microorganisms. |
| **UNIT** | **Contents** | **No.of Hours** |
| I | History and scope of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Scope of microbiology – Role of microbes in biotechnology. |  15 |
| II | Structure of bacteria - Bacterial growth and measurement of growth, Media – types and preparation- plating methods - staining methods (Gram’s, capsule, spore, LCB mount)- methods of preservation and storage of microbes. Culture of fungi, virus and algae. | 15 |
| III | Sterilization methods - physical and chemical methods- Mode of action – Antibiotic in clinical use - Resistance to antibacterial agents - MRSA, ESBL. | 15 |
| IV | Microscopy: Principle and applications of Bright field, Dark field, Phase contrast, Fluorescent Microscope, Electron microscope-TEM and SEM. | 15 |
| V | Microbial metabolism: Nutritional requirements - macro and micro nutrients - Nutritional groups-Nutrient Transport: Active, passive and facilitated-Microbial Growth-Growth curve - Factors affecting growth (temperature, acidity, alkalinity, water availability and oxygen requirement) -measurement of growth,-Bacterial growth kinetics-Batch, continuous culture and synchronous growth. | 15 |
| **Total** | **75** |
| **Text Books** |
| 1 | Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,McGraw –Hill, New York. |
| 2 | Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co. |
| 3 | Prescott, Harley, Klein, Microbiology, 10th Edition, McGraw – Hill, 2016. |
| 4 | Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC |
| **Reference Books** |
| 1 | Madigan, Martinko, Bender, Buckley, Stahl, Brock Biology of Microorganisms, 14th edition, 2017. |
| 2 | Boyd, R.F. (1998). General Microbiology,2nd Edition., Times Mirror, Mosby CollegePublishing, St Louis. |
| 3 | [Dr. C.B.Powar](https://www.amazon.in/s/ref%3Ddp_byline_sr_book_1?ie=UTF8&field-author=Dr.+C.B.Powar&search-alias=stripbooks) (Author), [Dr.H.F. Daginawala](https://www.amazon.in/s/ref%3Ddp_byline_sr_book_2?ie=UTF8&field-author=Dr.H.F.+Daginawala&search-alias=stripbooks). January 2010.General Microbiology Vol. I Vol.II. Himalalya Publishing home. |
| 4 | Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11th Edition., A La Carte Pearson. |

|  |
| --- |
| **Web Resources** |
| 1 | Horst W. Doelle (2004). Microbial Metabolism and Biotechnology. Proceedings of an E-seminar organized by the International organization for Biotechnology and Bioengineering (IOBB) |
| 2 | <http://www> ejb.org/content. |
| 3 | www. Biotech.kth.se Electronic Journal of biotechnology |
| 4 | https://www.cliffsnotes.com/study guides/biology/microbiology/introduction-to- microbiology/a-brief-history-of-microbiology |
| 5 | [https://bio.libretexts.org/@go/page/9188](https://bio.libretexts.org/%40go/page/9188) |

**MAPPING WITH PROGRAMME OUTCOMES**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  | M |  |  | L | M | L |  | M |
| CO2 |  |  |  | S |  |  | L | L | L |  |  |
| CO3 |  |  |  | S |  |  | M | M | L |  | M |
| CO4 |  |  |  | S |  |  | M | L | L |  |  |
| CO5 |  |  |  | S |  |  | M | L | L |  |  |

**Elective Practical I -Fundamentals of Microbiology Practical**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **L** | **T** | **P** | **S** | **Credits** | **Instructional Hours** | **Marks** |
| **CIA** | **External** | **Total** |
| 23UMICEP1 | **2** |  | **4** |  | **1** | **4** | **25** | **75** | **100** |
| **Course Outcomes** |
| CO1 | Describe the general Laboratory safety & Sterilization Techniques  |
| CO2 | Develop Skills in Media Preparation, Isolation & Serial Dilution Techniques and Pure Culture Techniques  |
| CO3 | Microscopically analyze the morphological features of Bacteria and fungi and define various Staining Techniques. |
| CO4 | Perform the Motility of organisms. |
| CO5 | Able to characterize and identify bacteria using Biochemical tests.  |
| **UNIT** | **Contents** | **No.of Hours** |
| I | Sterilization techniques – Preparation of Media | 9 |
| II | Inoculation techniques- Pour plate, spread plateIsolation of bacteria from various sources and dilution techniques. | 9 |
| III | Staining techniques: Simple, Gram’s, Capsule (Negative), Spores,Preparation of temporary mounts- Lacto phenol cotton blue staining. | 9 |
| IV | Motility tests: Hanging drop technique.  | 9 |
| V | Biochemical characterization - catalase, oxidase, IMVIC test and TSI.Antibiotic sensitivity test (demonstration). | 9 |
| **Total** | **45** |
| **Text Books** |
| 1 | James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996. |
| 2 | Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications. |
| 3 | Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications. |
| 4 | Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi. |
| 5 |  R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing. |
| **Reference Books** |
| 1 | Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers. |
| 2 | Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India. |
| 3 | Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS. |
| 4 | Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication. |
| 5 | Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications. |
| **Web Resources** |
| 1 | <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>. |
| 2 | <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635> |
| 3 | [https://www.grsmu.by/files/file/university/cafedry//files/essential\_microbiology.pdf](https://www.grsmu.by/files/file/university/cafedry/files/essential_microbiology.pdf) |
| 4 | <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology> |

**MAPPING WITH PROGRAMME OUTCOMES**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | M |  |  |  |  |  |  |  |  |  |  |
| CO2 | M |  |  |  |  |  |  |  |  |  |  |
| CO3 |  |  |  | S | S | S |  |  |  |  |  |
| CO4 |  |  |  | S | S | S |  |  |  |  |  |
| CO5 |  |  |  |  | S | S |  |  | S |  |  |

|  |  |  |
| --- | --- | --- |
| **SEMESTER: II****Foundation Course:****PART: IV** | **23UBIOF17: First Aid****(Foundation Course)** | **CREDIT: 2****HOURS: 2/W** |

**Learning Objectives**

The main objectives of this course are to:

* Provide knowledge on the basics of first aid.
* Perform first aid during various respiratory issues.
* Demonstrate the first aid to treat injuries.
* Learn the first aid techniques to be given during emergency.
* Familiarize the first aid during poisoning.

**Unit I:** Aims and important rules of first aid, dealing with emergency, types and content of a first aid kit. First aid technique – Dressing and Bandages, fast evacuation technique, transport techniques.6 Hrs

**Unit II:** Basics ofRespiration – CPR, first aid during difficult breathing, drowning, choking, strangulation and hanging, swelling within the throat, suffocation by smoke or gases and asthma. 6 Hrs

**Unit III:**Common medical aid- first aid for wounds, cuts, head, chest, abdominal injuries, shocks, burns, amputations, fractures, dislocation of bones. 6Hrs

**Unit IV:**First aid related to unconsciousness, stroke, fits, convulsions- seizures, epilepsy6Hrs

**Unit V:**First aidin poisonous bites (Insects and snakes), honey bee stings, animal bites, disinfectant ,acid and alkali poisoning .6Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program outcomes** |
| CO1 | Discuss on the rules of first aid, dealing during emergency and first aid techniques | PO1.PO4,PO5 |
| CO2 | Understand the first aid techniques to be given during different types of respiratory problems | PO1.PO4,PO5 |
| CO3 | Provide first aid for injuries, shocks and bone injury | PO1.PO4,PO5 |
| CO4 | Detail on the first aid to be given for unconsciousness, stroke, fits and convulsions | PO1.PO4,PO5 |
| CO5 | Gain expertise in giving first aid for insect bites and chemical poisoning  | PO1.PO4,PO5 |

**Text books**

1) First aid and health Dr. Gauri Goel, Dr. Kumkum Rajput, Dr.ManjulMungali

1SBN-978-93-92208-19-5

2) Indian First Aid Mannual-https://www.indianredcross.org/publications/FA-manual.pdf

3) Red Cross First Aid/CPR/AED Instructor Manual

|  |  |  |
| --- | --- | --- |
| **SEMESTER: II****CORE-III****PART: III** | **Core-III: Cell Biology (23UBIOC23)** | **CREDIT: 5****HOURS: 5/W** |

**Learning Objectives**

The main objectives of this course are to

* Provide basic understanding of architecture of cells and its organelles.
* Understand the organization of prokaryotic and eukaryotic genome.
* Educate on the structural organization of bio membrane and transport mechanism
* Impart knowledge on cell cycle, cell division and basics of cells
* Familiarize the concept of mechanism of cell-cell interactions.

**Module I:** 12 Hrs

Architecture of cells- Structural organization of prokaryotic and eukaryotic cells microbial, plant and animal cells. The ultrastructure of nucleus, mitochondria, RER, SER, golgi apparatus, lysosome, peroxisome and their functions

**Module II:** 12 Hrs

Cytoskeleton- microfilament, microtubules and intermediary filament- structure, composition and functions. Organization of Genome - prokaryotic and eukaryotic genome. Organization of chromatin – histones, nucleosome concept, formation of chromatin structure. Special types of chromosomes – lamp brush chromosomes, polytene chromosomes.

**Module III:** 12Hrs

Biomembranes-Structuralorganizationofbilipidlayermodelandbasicfunctions- transport across cell membranes- uniport, symport and antiport. Passive and active transport.

**Module IV:** 12 Hrs

Cellcycle-DefinitionandPhasesofCellcycle-Celldivision-MitosisandMeiosis and its significance, Cancer cells- definition, types and characteristics of cancer cells.

**Module V:** 12 Hrs

Extracellular matrix – Collagen, laminin, fibronectin and proteoglycans- structure and biological role. Structure and role of cadherin, selectins, integrins, Cell -cell interactions- Types-gap junctions, tight junctions and Desmosomes

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 | Explain the structure and functions of basic components of prokaryotic and eukaryotic cells, especially the organelles. | PO1 |
| CO2 | Familiarize the cytoskeleton and chromatin | PO1,PO2 |
| CO3 | Illustrate the structure, composition and functions of cell membrane related to membrane transport | PO1,PO2 |
| CO4 | Elaborate the phases of cell cycle and cell division-mitosis and meiosis and characteristics of cancer cells. | PO1, PO2 |
| CO5 | Relate the structure and biological role of extracellular matrix in cellular interactions | PO1,PO2 |

**Text books**

1. Arumugam. N, Cellbiology.Saraspublication(10ed, paperback), 2019

2. Devasena.T.Cell Biology.OxfordUniversityPressIndia-ISBN: 9780198075516, 0198075510, 2012

3. Bruce Alberts and Dennis Bray. 2013, Essential Cell Biology. (4”ed). Garland Science.

**Referencebooks**

1. S.C,R.CellBiology.NewagePublishers -ISBN-10: 8122416888/ISBN-13: 978- 8122416886, 2008

2. Cooper, G.A. TheCell:AMolecularApproach.SinauerAssociates,Inc -ISBN10: 0878931066 / ISBN 13: 9780878931064, 2013

3...E.M.F.,D.R,Cell and Molecular Biology.LippincottWilliams&WilkinsPhiladelphia - ISBN: 0781734932 9780781734936, 2006

4. LodishH.A ,Berk C.A, Kaiser M, Krieger M.P, Scott A, Bretscher H, Ploegh and Matsudaira. 2007. Molecular Cell Biology, 6th Edition, WH. Freeman Publishers, New York, USA.

**Web resources**

https://nicholls.edu/biol-ds/bio1155/Lectures/Cell%20Biology.pdf

https://www.medicalnewstoday.com/article/320878.php

https://biologydictionary.net /cell

**Mapping with Program Outcome**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 2** | 3 | 3 |  |  |  |  | 3 |  |  | 3 |
| **CO 3** | 3 | 3 |  |  |  |  | 3 |  |  | 3 |
| **CO 4** | 3 | 3 |  |  |  |  | 3 | 3 |  | 3 |
| **CO5** | 3 | 3 |  |  |  |  | 3 |  |  | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: II****Core-IV practical II** **PART: III** | **Core-IV: Practical II: Cell Biology Practical (23UBIOP24)** | **CREDIT: 5****HOURS: 4/W** |

**Learning Objectives**

The main objectives of this course are to

* Learn the parts of microscope
* Investigate the cells under microscope.
* Image the cells using different stains
* Identify the cells, organelles and stages of cell division
* Identify the spotters

**I MICROSCOPYANDSTAININGTECHNIQUES**

1. Study the parts of light and compound microscope
2. Preparation of Slides and Micrometry
3. Examination of prokaryotic and eukaryotic cell
4. Visualization of animal and plant cell by methylene blue
5. Visualization of nuclear fraction by acetocarmine stain
6. Staining and visualization of mitochondria by Janusgreenstain

**II GROUP EXPERIMENT**

 7. Identification of different stages of mitosis in onion root tip

 8. Identification of different stages of meiosis in onion bulb

**III SPOTTERS**

 9. a) **Cells**: Nerve, plant and Animal cell

 b) **Organelles**: Mitochondria, Chloroplast, Endoplasmicreticulum,

 c) **Mitosis stages** – Prophase,Anaphase,Metaphase,Telophase

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program outcomes** |
| CO1 | Identify the parts of microscope. | PO1,PO2 |
| CO2 | Preparation of Slides | PO1,PO2 |
| CO3 | Identify the stages of mitosis & meiosis | PO1,PO2 |
| CO4 | Visualize nucleus and mitochondria by staining methods | PO1,PO2 |
| CO5 | Identify the spotters of cells, organelles and stages of cell division | PO1,PO2 |

**Text books**

1. Rickwood, Dand J.R.HarriscellBiology: EssentialTechniques, Johnwikey1996.

2. Davis, J.M. Basic Cell culture: A practical approach, IRL 1994.

3. Ganesh M.K. and Shivashankara A.R. 2012. Laboratory Manual for Practical Biochemistry Jaypee publications, 2ndEdn.

**Referencebooks**

1) Essential practical handbook of Cell biology ,Genetics andMicrobiology -A Practical manual- Debarati Das Academic publishers, ISBN, 9789383420599, 1st Edition 2017

2) CellbiologyPractical,Dr.VenuguptaISBN8193651219,Prestigepublisher,1stJan2018.

 3) Cell and Molecular biology, DeRobertis, 8th edition, 1st June, 1987

**Web resources**

1.http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1

2. https://www.microscopemaster.com/organelles.html

3. <https://www.pdfdrive.com/biochemistry-books.htm>

4.http://medcell.med.yale.edu/histology/cell\_lab.php#:~:text=The%20electron%20microscope%20is%20necessary,and%20small%20granules%20and%20vesicles.

5. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1

6.https://www.khanacademy.org/science/ap-biology/heredity/meiosis-and-geneticdiversity/a/phases-of-meiosis

7. https://www.microscopemaster.com/organelles.html

8. https://www.pdfdrive.com/biochemistry-books.html

**Mapping with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 2 | 3 |  |  |  |  | 3 | 3 | 3 | 3 |
| **CO 2** | 2 | 3 |  |  |  |  | 3 | 3 | 3 | 3 |
| **CO 3** | 2 | 3 |  |  |  |  | 3 | 3 | 3 | 3 |
| **CO 4** | 2 | 3 |  |  |  |  | 3 | 3 | 3 | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

**Elective II: APPLIED MICROBIOLOGY**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **L** | **T** | **P** | **S** | **Credits** | **Instructional Hours** | **Marks** |
| **CIA** | **External** | **Total** |
| **23UMICE25** | **3** | **1** |  |  | **2** | **4** | **25** | **75** | **100** |
| **Course Outcomes** |
| CO1 | Understand beneficial role of microorganisms in dairy and food products. |
| CO2 | Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms. |
| CO3 | Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes. |
| CO4 |  Exhibit knowledge in analyzing the importance of Bio insecticides, Bio fertilizer sprebiotics and probiotics. |
| CO5 | Distinguish between normal flora and pathogens and describe the role of microbes in food intoxications. |
| **UNIT** | **Contents** | **No.of Hours** |
| I | Microorganisms as food and feed: SCP, Mushroom-Oyster (Pleurotus) and Button (Agaricus) mushroom. Dairy products-cheese, yoghurt; Beverages-Beer and Wine. Probiotics. |  15 |
| II | Microorganisms in Agriculture: Bacterial Biofertilizers, Phosphate solubilizers, Vasicular Arbusucular Mycorrhizae, Algal Biofertilizers. | 15 |
| III | Biocontrol of microbial pathogens-Bio pesticide-Bactericide-*Bacillus thuringiensis*; Fungicide-*Trichoderma viridae-*Viral Biopesticides-CPV and NPV | 15 |
| IV | Microorganisms and Environment: liquid waste and solid waste-liquid waste management-water recycling- Industrial effluent treatment (sugar mill effluent, tannery effluent)- Solid waste management -Composting and vermicomposting. | 15 |
| V | Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria). | 15 |
| **Total** | **75** |
| **Text Books** |
| 1 | Rangaswami G and Bagyaraj DJ (2002). Agricultural Microbiology. Second edition, PHI Learning (P) Ltd., New Delhi |
| 2 | Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co. |
| 3 | Prescott, Harley, Klein, Microbiology, 10th Edition, McGraw – Hill, 2016. |
| **Reference Books** |
| 1 | . Adams, M.R and M.O. Moss (2005). Food Microbiology. 1st edition. Reprinted, Published byNew Age International (P) Ltd, Publishers-New Delhi. |
| 2 | Gillespie, Bamford, Medical Microbiology and Infection at a Glance, 4th edition, 2012. |
| 3 | Maier, R.M., Pepper, I.L. & Gerba, C.P. (2009). Environmental Microbiology. 2nd Ed. Academic Press. |
| 4 | Ananthanarayanan, Paniker, Kapil, Textbook book of Microbiology, 9th edition, Orient BlackSwan, 2013. |
| **Web Resources** |
| 1 | <http://www> ejb.org/content. |
| 2 | www. Biotech.kth.se Electronic Journal of biotechnology |
| 3 | [https://bio.libretexts.org/@go/page/9188](https://bio.libretexts.org/%40go/page/9188) |

**MAPPING WITH PROGRAMME OUTCOMES**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  | M |  |  | L | M | L |  | M |
| CO2 |  |  |  | S |  |  | L | L | L |  |  |
| CO3 |  |  |  | S |  |  | M | M | L |  | M |
| CO4 |  |  |  | S |  |  | M | L | L |  |  |
| CO5 |  |  |  | S |  |  | M | L | L |  |  |

**ELECTIVE PRACTICAL II –APPLIED MICROBIOLOGY PRACTICAL**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **L** | **T** | **P** | **S** | **Credits** | **Instructional Hours** | **Marks** |
| **CIA** | **External** | **Total** |
| **23UMICEP2** | **2** |  | **4** |  | **1** | **4** | **25** | **75** | **100** |
| **Course Outcomes** |
| CO1 | Describe the techniques to estimate the quality of dairy products  |
| CO2 | Develop Skills in enzyme production  |
| CO3 | Microscopically analyze the morphological features of algae and root nodules bacteria |
| CO4 | Learn the methods available to check the water quality |
| CO5 | Understand the pathogenic bacteria in various sample  |
| **UNIT** | **Contents** | **No.of Hours** |
| I | Detection of bacteria in milk by SPC, Methylene Blue reduction test, Microscopic observation of curd  | 9 |
| II | Demonstration of enzymes producing bacteria (lipase, amylase, protease) | 9 |
| III | Azolla- morphological study, Isolation of Rhizobium from root nodules,  | 9 |
| IV | Enumeration of bacteria from water sample, test for coliforms by MPN method | 9 |
| V | Isolation of pathogenic bacteria from air, water, and food specimens | 9 |
| **Total** | **45** |
| **Text Books** |
| 1 | James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996. |
| 2 | Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications. |
| 3 | Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications. |
| 4 | Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi. |
| 5. | Rajan. S and Selvi Christy (2015). Experiments Procedure in Life Science, Anjanaa book House Publisers, Chennai |
| 6 |  R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing. |
| **Reference Books** |
| 1 | Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers. |
| 2 | Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India. |
| 3 | Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS. |
| 4 | Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication. |
| 5 | Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications. |
| **Web Resources** |
| 1 | <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>. |
| 2 | <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635> |
| 3 | [https://www.grsmu.by/files/file/university/cafedry//files/essential\_microbiology.pdf](https://www.grsmu.by/files/file/university/cafedry/files/essential_microbiology.pdf) |
| 4 | <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology> |

**MAPPING WITH PROGRAMME OUTCOMES**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | M |  |  |  |  |  |  |  |  |  |  |
| CO2 | M |  |  |  |  |  |  |  |  |  |  |
| CO3 |  |  |  | S | S | S |  |  |  |  |  |
| CO4 |  |  |  | S | S | S |  |  |  |  |  |
| CO5 |  |  |  |  | S | S |  |  | S |  |  |

|  |  |  |
| --- | --- | --- |
| SEMESTER: INME- IPART - IV | **23UBION16: Health and Nutrition****(NME- I)** | CREDIT: 2HOURS: 2/W |

**Learning Objectives**

The main objectives of this course are to

* Gain basic knowledge about health.
* Understand about vitamins.
* Learn about functions of fat on health.
* Understand the types of minerals and its functions
* Know about the importance of carbohydrates and proteins on health

**Unit -I:** Health – definition, Factors affecting human health. Importance of health care of children, adults and elderly people. Balanced diet and calorific value**. 6Hrs**

**Unit -II:** Vitamins-definition, classification, sources, properties, functions and deficiency symptoms. Recommended daily allowances. **6Hrs**

**Unit -III:** Sources and functions of dietary fats, role of fats in health and diseases**. 6Hrs**

**Unit -IV:** Minerals- Role of minerals on human health, sources, biological functions, deficiency disorders with special reference to Calcium, Phosphorus, Potassium, Copper, Iron, Zinc and Selenium. Minerals in biological systems and their importance –Iron, Calcium, Phosphorus, Iodine, Copper, Zinc**. 6Hrs**

**Unit -V:** Role of proteins and carbohydrates in health. Functions of protein and carbohydrate and their calorific value. Dietary sources and deficiency disorders – Kwashiorkor and Marasmus – supplementation programs in India and their implications. **6Hrs**

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 |  Understand about the importance of health and diet | PO1 |
| CO2 | Discuss about the classification properties and deficiencies of vitamins | PO1 |
| CO3 | Understand about sources and functions of fats and lipids on health | PO1.PO4 |
| CO4 | Detail about the different types of minerals and its role in health | PO1,PO4 |
| CO5 | Relate the role of proteins and carbohydrates on health  | PO1,PO4 |

**Text books**

1 **Davidson S and. Passmore JR**. Human Nutrition and Dietetics, (8th ed), Churchill Livingstone .1986

2. **Garrow JS, Philip W, James T, Ralph A** , Human Nutrition and Dietetics (10th ed), Churchill Livingstone .2000

3.**Swaminathan M.** Principles of Nutrition and Dietetics, Bappco, Banglore.1985

**Reference Books**

1**. Margaret Mc Williams**.Food Fundamentals (10th ed), Prentice Hall.2012

**Web Resources**

1. <https://www.universalclass.com/articles/health/nutrition/nutritional-needs-for-differentages>.

 2. nhp.gov.in/healthyliving/healthydiet

3. [www.anme.com.mx/libros/PrinciplesofNutrition.pdf](http://www.anme.com.mx/libros/PrinciplesofNutrition.pdf)

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  |  |  | 3 | 3 |  | 3 |
| **CO 2** | 3 |  |  |  |  |  | 3 | 3 |  | 3 |
| **CO 3** | 3 |  |  | 2 |  |  | 3 | 3 |  | 3 |
| **CO 4** | 3 |  |  | 2 |  |  | 3 | 3 |  | 3 |
| **CO5** | 3 |  |  | 2 |  |  | 3 | 3 |  | 3 |

**S-Strong (3) M-Medium (2) L-Low (1)**

|  |  |  |
| --- | --- | --- |
| SEMESTER: IINME- IIPART - IV | **23UBION26: Lifestyle Diseases** **(NME- II)** | CREDIT: 2HOURS: 2/W |

**Learning Objectives**

The objectives of this course are to

* Create awareness on lifestyle diseases among adolescents.
* List out the lifestyle diseases.
* Explain the common lifestyle diseases and their prevention.
* Acquaint in the disorders associated with women’s health.
* Impart life skills to prevent lifestyle diseases.

**Unit -I:** Lifestyle diseases: Definition, Factors contributing to lifestyle diseases – Physical inactivity, Poor food habits, disturbed biological clock, sleep deprivation. **6Hrs**

**Unit -II:** Top lifestyle diseases, Impact of Lifestyle diseases on family, society and economy of country**. 6 Hrs**

**Unit-III**: Causes, symptoms**,** types, preventive measures and treatment of Obesity, cardiovascular diiiseases, diabetes and cancer. **6 hrs**

**Unit -IV:** Women’s lifestyle diseases: Polycystic Ovarian Disease, Infertility, Breast and cervical cancer and Osteoporosis**. 6 hrs**

**Unit -V:** Prevention of lifestyle diseases: Balanced diet, sufficient intake of water, physical activity ,sleep-wake cycle, stress management and meditation. **6Hrs**

**Course outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of the course the students will be able to** | **Program Outcomes** |
| CO1 | Define Lifestyle diseases and describe the contributing factors | PO1 |
| CO2 | Enumerate the top lifestyle diseases and its impact on life. | PO1,PO4,PO5 |
| CO3 |  Elaborate the treatment and prevention measures of common lifestyle diseases. | PO1,PO4,PO5 |
| CO4 | Highlight the lifestyle diseases that affects the women’s health | PO1,PO4,PO5 |
| CO5 | Illustrate the various measures for prevention of lifestyle diseases | PO1,PO4,PO5 |

**Textbooks**

1. **James MR.** Lifestyle Medicine,2ndEdition,CRCPress,2013
2. **Akira Miyazaki.** .New Frontiers in Lifestyle-Related Disease,Springer,2008

**Reference books**

1. **Steyn K**, Lifestyle and related risk factors for chronic diseases. Disease and Mortality in Sub-Saharan Africa, The International Bank for Reconstruction and Development, The World Bank, Washington DC.2006.
2. **Willett WC**, Prevention of chronic disease by means of diet and lifestyle. Review article in Disease Control Priorities in Developing Countries. 2nd edition. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2006. Chapter 44.
3. **Kumar M** and **Kumar R**,. Guide to prevention of life style diseases. Deep & Deep publications.2004

**Web resources**

1.https://youtu.be/jDdL2bMQXfE

 2. https://youtu.be/7WnpSB14nDM

3. https://youtu.be/ollz9MqtW-U

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 2 |  |  |  |  |  | 3 | 3 |  | 3 |
| **CO 2** | 2 |  |  | 2 | 3 |  | 3 | 3 |  | 3 |
| **CO 3** | 2 |  |  | 2 | 3 |  | 3 | 3 |  | 3 |
| **CO 4** | 2 |  |  | 2 | 3 |  | 3 | 3 |  | 3 |
| **CO 5** | 2 |  |  | 2 | 3 |  | 3 | 3 |  | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

**SECOND YEAR:** **SEMESTER III**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: III****CORE -V****PART: III** | **23UBIOC33: BIOMOLECULES** | **CREDIT: 5****HOURS: 5/W** |

**Learning objectives**

The main objectives of this course are to:

* Introduce the structure, properties and biological significance of carbohydrates
* Comprehend the classification, functions and acid base properties of amino acids
* Elucidate the various levels of organization of Proteins.
* Impart knowledge on the classification, properties and characterization of lipids.
* Acquaint with the classification, structure, properties and functions of nucleic acids

**Unit-I:** Carbohydrates-Classification and biological significance, physical properties - stereo isomerism, optical isomerism, anomers,epimers and mutarotation. Monosaccharides: Occurrence, linear and cyclic structure, Reactions of monosaccharides due to the presence of hydroxyl, aldehyde and keto groups. Disaccharides: Structure and properties of reducing disaccharides (lactose and mannose), non-reducing disaccharide (sucrose).Polysaccharides: Homopolysaccharides - Occurrence, structure and biological significance of starch, glycogen and cellulose. Heteropolysaccharides - Structure and biological significance of mucopolysaccharides - hyaluronic acid, chondroitin sulphate and heparin. (structural elucidation not needed).12 hrs

**Unit-II :**Amino acids -Classification based on composition of side chain and nutritional significance. General structure of amino acids. 3 - and 1- letter abbreviations. Modified amino acids in protein non - protein amino acids. Physical properties of amino acids, isoelectric point, titration curve (alanine, lysine, glutamic acid), optical activity. Chemical reactions due to carboxyl group, amino group and side chains. Colour reactions of amino acids. 12Hrs

**Unit-III :** Proteins-Classification based on shape, composition, solubility and functions. Properties of proteins - Ampholytes, isoelectric point, salting in and salting out, denaturation and renaturation, UV absorption. Levels of Organization of protein structure- Primary structure, Formation and characteristics of peptide bond, phi and psi angle, Secondary structure-α helix (egg albumin), β- pleated sheath (keratin), triple helix (collagen). Tertiary structure – with reference to myoglobin. Quaternary structure with reference to haemoglobin. 12 Hrs

**Unit-IV :**Lipids- Lipids: Bloor’s classification, chemical nature and biological functions. Fatty acids: classification, nomenclature, structure and properties of fatty acids. Simple and mixed triglycerides: structure and general properties, Characterization of fats- iodine value, saponification value, acid number, acetyl number, polensky number, Reichert –Meissl number along with their significance. Compound lipids -Structure and functions of phospholipids and glycolipids. Derived lipids-Structure and functions of cholesterol, bileacids and bile salts.12Hrs

**Unit-V :** Nucleic acids-Structure of purine and pyrimidine bases, nucleosides and nucleotides and their biological importance. Types of DNA: A, B, C, Z DNA, structure and biological significance, super helicity. Types of RNA: mRNA, tRNA, rRNA, hnRNA, snRNA ,Secondary and tertiary structure of tRNA. Properties of DNA- Hypochromic and hyperchromic effect, melting temperature, viscosity. Denaturation and annealing.12Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program outcomes** |
| CO1 | Classify illustrate the structure and explain the physical and chemical properties of carbohydrates. | PO1 |
| CO2 | Indicate the classification, structure, properties and biological functions of amino acids. | PO1 |
| CO3 | Explain the classification and elucidate the different levels of structural organization of proteins. | PO1 |
| CO4 | Elaborate on classification, structure, properties, functions and characterization of lipids | PO1,PO4 |
| CO5 | Describe the structure, properties and functions of different types of nucleic acids | PO1 |

**Textbooks**

1. Biochemistry, U.Sathyanarayana & U.Chakrapani, 2013, 5th edition Elsevier India Pvt.Ltd., Books & Allied Pvt. Ltd.

2. Fundamentals of Biochemistry, J.L.Jain, Sunjay Jain, Nitin Jain, 2013, 7theditionS.Chand&CompanyLtd.

3.Textbook of Medical Biochemistry, MNChatterjea, RanaShinde, 2002, 8thedition, Jaypee Brothers.

**Reference books**

1.David L.Nelson,MichaelM.Cox,2005,Principles of Biochemistry, 4thedition W.H.Freeman and Company.

2.Voet.D,Voet.J.G.andPratt,C.W,2004,PrinciplesofBiochemistry,4theditionJohnWiley&Sons,Inc.

3.Zubay G.L,*et.al*.,1995,PrinciplesofBiochemistry,1stedition,WmC.BrownPublishers.

**Web resources**

https://www.britannica.com/science/biomolecule<https://en.wikipedia.org/wiki/Biomolecule><https://www.khanacademy.org/science/biology/macromolecules>

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 2** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 3** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 4** | 3 |  |  | 2 |  |  | 3 | 2 |  | 3 |
| **CO5** | 3 |  |  |  |  |  | 3 |  |  | 3 |

**S-Strong(3) M-Medium (2) L-Low**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: III****CORE PRACTICAL-III****PART: III** | **23UBIOP34: CORE VI: PRACTICAL III BIOMOLECULES** | **CREDIT: 5****HOURS: 4/W** |

**Learning Objectives**

The main objectives of this course are to

* Identify the biomolecules carbohydrates and aminoacids by qualitative test
* Determine the quality of Lipids by titrimetric methods
* Isolate nucleic acids from plant and animal source

I**)Qualitative test for 15 Hrs**

 1) Carbohydrates

 a) Glucose b) Fructose c) Arabinose d) Maltose e) Sucrose f) Lactose g)Starch

 2) Amino acids

a) Arginine b)Cysteine c) Histidine d)Proline e) Tryptophan f) Tyrosine g) Methionine

**II Titrimetric methods15 Hrs**

1) Determination of Saponification value of an edible oil

 2) Determination of Iodine number of an edible oil

 3) Determination of Acid number of an edible oil

**III. Group Experiments 15 hrs**

1) Isolation of DNA from plant/animal source.

2) Isolation of RNA from rich source.

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 | Qualitatively analyze the carbohydrates and report the type of carbohydrate based on specific tests | PO1,PO2,PO3 |
| CO2 | Qualitatively analyze amino acids and report the type of amino acids based on specific tests | PO1,PO2,PO3 |
| CO3 | Determine the Saponification, Iodine and acid number of edible oil | PO1, PO3,PO4 |
| CO4 | Isolate the nucleic acid from biological sources | PO1,PO3 |

**Text books**

1. David T Plummer, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw-Hill Edition

2. J. Jayaraman Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015

 3. S. Sadasivam A. Manickam Biochemical Methods New age International Pvt Ltd publisher’s third edition 2018

**Reference books**

1. Rageeb, Kiran Patil, M. Bakshi Rahman, Sufiyan Ahmad Raees A Practical book on Biochemistry Everest publishing house1st Edition, 2019

2. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005.

3. Biochemical Tests – Principles and Protocols. Anil Kumar, SarikaGarg and NehaGarg.VinodVasishtha Viva Books Pvt Ltd, 2012.

4. Harold Varley, Practical Clinical Biochemistry, CBS. 6 edition, 2006.

5. Keith Wilson and John Walker. Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain.1995.

**Web resources**

1.https://www.pdfdrive.com/instant-notes-analytical-chemistry-e912659.html 14

2.https://www.pdfdrive.com/analytical-biochemistry-e46164604.html

3. https://www.pdfdrive.com/biochemistry-books.html

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 2 | 3 | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **3CO 2** | 2 | 3 | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO 3** | 2 |  | 3 | 2 |  |  | 3 | 3 | 3 | 3 |
| **CO 4** | 2 |  | 3 |  |  |  | 3 | 3 | 3 | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

|  |  |
| --- | --- |
| **Title of the Course** | **CHEMISTRY FOR BIOLOGICAL SCIENCES I** **(FOR BOTANY AND ZOOLOGY STUDENTS)** |
| **Course Code** | **23UCHEE35** |
| **Category** | **Generic****Elective** | **Year** | II | **Credits** | 2 | **Course****Code** |  |
| **Semester** | III |
| **Instructional****hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** |
| 3 | - | - | 3 |
| **Prerequisites** | Higher secondary chemistry |
| **Objectives of the course** | This course aims at providing knowledge on* basics of atomic orbitals, chemical bonds, hybridization and fundamentals of organic chemistry
* nuclear chemistry and industrial chemistry
* importance of speciality drugs and
* separation and purification techniques.
 |
| **Course Outline** | **UNIT I****Chemical Bonding and Nuclear Chemistry**Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals. M. O diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions- group displacement law. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes - carbondating, rock dating and medicinal applications. |
| **Unit II****Industrial Chemistry**Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required).Silicones: Synthesis, properties and uses of silicones.Fertilizers: Urea, ammonium sulphate, potassium nitrate NPK fertilizer, superphosphate, triple superphosphate. |
| **UNIT III****Fundamental Concepts in Organic Chemistry**Hybridization: Orbital overlap hybridization and geometry of CH4,C2H4, C2H2 and C6H6. Polar effects: Inductive effect and |

|  |  |
| --- | --- |
|  | consequences on Ka and Kb of organic acids and bases, electromeric, |
| mesomeric, hyper conjugation and steric-examples and explanation. |
| Reaction mechanisms: Types of reactions- aromaticity-aromatic |
| electrophilic substitution; nitration, halogenation, Friedel-Craft’s |
| alkylation and acylation. |
| Heterocyclic compounds: Preparation, properties of pyrrole and |
| pyridine. |
| **UNIT IV****Drugs and Speciality Chemicals** |
| Definition, structure and uses: Antibiotics viz., Penicillin, |
| Chloramphenicol and Streptomycin; Anaesthetics viz., Chloroform |
| and ether; Antipyretics viz., aspirin, paracetamol and ibuprofen; |
| Artificial Sweeteners viz., saccharin, Aspartame and cyclamate; |
| Organic Halogen compounds viz., Freon, Teflon. |
| **UNIT V:****Analytical Chemistry**Introduction qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques: extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography. |
| Extended Professional Component (is a part of internal component only,Not to be included in the externalExamination question paper) | Questions related to the above topics, from various competitiveexaminations UPSC/ JAM /TNPSC others to be solved(To be discussed during the Tutorial hours) |
| Skills acquiredfrom this course | Knowledge, Problem solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. V.Veeraiyan, Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition,2009.
2. S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur,2006.
3. ArunBahl, B.S.Bahl, Advanced Organic Chemistry; S.Chand and Company, New Delhi, twenty third edition,2012.
4. P.L.Soni, H.M.Chawla, Text Book of Inorganic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.
 |
| **Reference Books** | 1. P.L.Soni, Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007.
2. B.K,Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.
3. Jayashree gosh, Fundamental Concepts of Applied Chemistry;

Sultan & Chand, Edition 2006. |
| **Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to****CO1:** state the theories of chemical bonding, nuclear reactions and its applications.**CO 2:** evaluate the efficiencies and uses of various fuels and fertilizers.**CO 3:** explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.**CO 4:** demonstrate the structure and uses of antibiotics, anaesthetics, antipyretics and artificial sugars.**CO 5:** analyse various methods to identify an appropriate method for the separation ofchemical components. |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of****Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO’s and CO’s**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of****Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO’s and CO’s**

|  |  |
| --- | --- |
| **Title of the Course** | **CHEMISTRY PRACTICAL FOR BIOLOGICAL SCIENCES – I****(for Botany and Zoology II Year/III Semester)** |
| **Course Code** | **23UCHEEP3** |
| **Category** | **Generic Elective** | **Year** | I/ II | **Credits** | 1 | **Course Code** |  |
| **Semester** | I/III |
| **Instructional****hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** |
| - | - | 2 | 2 |
| **Prerequisites** |  |
| **Objectives of the course** | This course aims to provide knowledge on the* basics of preparation of solutions.
* principles and practical experience of volumetric analysis
 |
| **Course Outline** | **VOLUMETRIC ANALYSIS**1. Estimation of sodium hydroxide using standard sodium carbonate.
2. Estimation of hydrochloric acid using standard oxalic acid.
3. Estimation of ferrous sulphate using standard Mohr's salt.
4. Estimation of oxalic acid using standard ferrous sulphate.
5. Estimation of potassium permanganate using standard sodium hydroxide.
6. Estimation of magnesium using EDTA.
7. Estimation of ferrous ion using diphenyl amine as indicator.
 |
| **Reference Books** | V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principles ofPractical Chemistry; Sultan Chand & sons, Second edition, 1997. |
| **Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to**CO 1: gain an understanding of the use of standard flask and volumetric pipettes, burette. CO 2: design, carry out, record and interpret the results of volumetric titration.CO 3: apply their skill in the analysis of water/hardness.CO4: analyze the chemical constituents in allied chemical products |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 12 | 12 | 12 | 12 | 12 |
| **Weighted percentage of****Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO’s and CO’s**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 12 | 12 | 12 | 12 | 12 |
| **Weighted percentage of****Course Contribution to POs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO’s and CO’s**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: III****SEC - 4****PART: III** | **23UBIOS36: MICROBIAL TECHNIQUES** | **CREDIT: 1****HOURS: 2/W** |

**Learning objectives**

The objectives of this course are to

* Study the growth of bacteria
* Know the parts & uses of microscope
* Learn staining methods to identify microbes
* Learn different types of culture methods
* Study food preservation methods

**Unit – I:** Growth of bacteria- Definition, growth phases, factors affecting growth (pH, temperature, and oxygen), cell count (hemocytometer, Bacterial cell- Bacillus subtilis), fungal cell (Saccharomyces) and human blood cell.6 Hrs

**Unit – II:** Microscopy- Principle, types - Compound microscope, electron microscope- TEM, SEM, use of oil immersion objective.6 Hrs

**Unit – III :**Stains and staining- Principles of staining, simple staining, negative staining, Differential staining, Gram and acid-fast staining, flagella staining, capsule and endospore Staining. Staining of yeast (methylene blue), lactophenol cotton blue, staining of mold (Penicillium, Aspergillus), Agaricus.6 Hrs

**Unit – IV: Cultivation** of bacteria– Types of growth media (natural, synthetic, complex, enriched, selective- definition with example), culture methods (streak plate, spread plate, pour plate, stab culture, slant culture, liquid shake culture, anaerobiosis) - aerobic and Anaerobic bacteria.6 Hrs

**Unit – V:** Food microbiology- Microbiological examination of food: microscopic examination and culture, phosphatase test of Pasteurized milk. Preservation of food- High temperature (boiling, pasteurization, appreciation), low temperature (freezing), dehydration, osmotic pressure, chemical preservations, radiation. Microorganisms as food SCP.6 Hrs

**Course Outcome**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program****Outcomes** |
| CO1 | Understand the growth of bacteria and to perform cell count | PO1,PO2 |
| CO2 | Acquire knowledge of microscope and its uses | PO1,PO2 |
| CO3 | Identify the microbes by staining methods | PO1,PO2,PO6 |
| CO4 | Culture microbes by various methods | PO1,PO2,PO6 |
| CO5 | Preserve foods at high and low temperature | PO,PO2,PO6 |

**Text books**

1. Sherris Medical Microbiology, 7th Edition byAuthors: Kenneth Ryan, C. George Ray, Nafees Ahmad, W. Lawrence Drew, Michael Lagunoff, Paul Pottinger, L. Barth Reller and Charles R. Sterling.

2. Food Microbiology: Fundamentals and Frontiers, 5th Edition by Editor(s): Michael P. Doyle, Francisco Diez-Gonzalez, Colin Hill.

3.Text book of microbiology by Ananthanarayan and Panicker’s.

4. Textbook of microbiology by P.C. Trivedi Sonali Pandey Seema Bhadauria5. 5.Prescott’s Microbiology, 10th Edition by Authors: Joanne Willey, Linda Sherwood and Christopher J. Woolverton.

**Reference books**

1.Bailey & Scott’s Diagnostic Microbiology, 14th Edition by Author: Patricia Title

2. Medical Microbiology, 7th Edition Authors: Patrick R. Murray, Ken S. Rosenthal and Michael A. Pfaller

3. Microbiology: Laboratory Theory and Application, 3rd Edition Authors: Michael J. Leboffe and Burton E. Pierce

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 2 | 3 |  |  |  |  | 3 | 3 | 3 | 3 |
| **CO 2** | 2 | 3 |  |  |  |  | 3 | 3 | 3 | 3 |
| **CO 3** | 2 | 3 |  |  |  | 2 | 3 | 3 | 3 | 3 |
| **CO 4** | 2 | 3 |  |  |  | 2 | 3 | 3 | 3 | 3 |
| **CO5** | 2 | 3 |  |  |  | 2 | 3 | 3 | 3 | 3 |

**S - Strong (3) M - Medium (2) L -Low(1)**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: III****SEC - 5****PART: III** | **23UBIOS37:** **BIOMEDICAL INSTRUMENTATION** | **CREDIT: 2****HOURS: 2/W** |

**Learning Objectives**

The objectives of this course are to

* Provide insights about the blood pressure and its measurement.
* Elaborate the mechanismof instruments related to respiration.
* Highlight the importance of imaging techniques.
* Acquaint students about the basics of medical assisting devices.
* Familiarize about the life saving therapeutic equipments.

**Unit - I:**Measurement of blood pressure – sphygmomanometer. Cardiac output – Cardiac rate – Heartsound – Stethoscope, ECG – EEG – EMG – ERG.6 Hrs

**Unit - II:** Monitoring of inspired/expired anaesthetic gases, capnograph, inhalators, nebulizers,aspirators, infant respirator, Plethysmography.6 Hrs

**Unit - III:** Medical imaging: X-ray machine - Radio graphic and fluoroscopic techniques – Computed tomography – MRI – PET, Ultrasonography – Endoscopy – Thermography.6 Hrs

**Unit - IV:** Assisting equipments: Pacemakers – Defibrillators – Ventilators6 Hrs

**Unit - V:** Therapeutic equipments: Nerve and muscle stimulators –Diathermy – Heart – Lung machine – Audio meters – Dialyzers. 6 Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programme outcome** |
| CO1 | Illustratethe functions of instruments used for measuring blood pressure. | PO1,PO2, PO5 |
| CO2 | Elaborate the devices required for monitoring of respiratory gases. | PO1,PO2, PO5 |
| CO3 | Understand the operation of the imaging and sonographic instruments. | PO1,PO2, PO5 |
| CO4 | Differentiate between the action of pacemakers , defibrillators and ventilators. | PO1,PO2, PO5 |
| CO5 | Demonstrate the function of therapeutic equipments | PO1,PO2, PO5 |

**Text books**

1. M.Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies.

2. L.A. Geddes and L.E.Baker, ‘Principles of Applied Bio-Medical Instrumentation’, John

Wiley & Sons.

3. J.Webster, ‘Medical Instrumentation’, John Wiley & Sons.

4. C.Rajarao and S.K.Guha, ‘Principles of Medical Electronics and Bio-medicalInstrumentation’, Universities (India) Ltd, Orient Longman Ltd.

**Reference books**

1. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, ‘Bio-Medical Instrumentation and

Measurements’, II Edition, Pearson Education, 2002.

2. R.S.Khandpur, ‘Handbook of Bio-Medical instrumentation’, Tata McGraw Hill

Publishing Co Ltd.,

**WebResources**

<https://youtu.be/GkUCmb0cKwo?list=PLCZ9KmODEcu138IlVeHClJ4nskArYr1Dg>

**Mapping with Program Outcomes**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 2 | 3 |  |  | 3 |  | 3 | 3 | 3 | 3 |
| **CO 2** | 2 | 3 |  |  | 3 |  | 3 | 3 | 3 | 3 |
| **CO 3** | 2 | 3 |  |  | 3 |  | 3 | 3 | 3 | 3 |
| **CO 4** | 2 | 3 |  |  | 3 |  | 3 | 3 | 3 | 3 |
| **CO 5** | 2 | 3 |  |  | 3 |  | 3 | 3 | 3 | 3 |

**S-Strong(3) M-Medium (2) L-Low**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: IV****CORE -VII****PART: III** | **23UBIOC43: BIOCHEMICAL TECHNIQUES** | **CREDIT: 5****HOURS: 5/W** |

**Learning objectives**

The objectives of this course are to

* Introduce the basic principles, types and applications of various sedimentation technique.
* Provide an understanding of the underlying principles of chromatographic techniques
* Demonstrate experimental skills in various electrophoretic techniques.
* Appraise the use of colorimetric and spectroscopic techniques in biology
* Impart knowledge about the measurement of radioactivity and safety aspects of radioactive isotopes.

**Unit-I :** Centrifugation  -Basic principles, RCF**,** Sedimentation coefficient,Svedberg constant. Types of rotors. Preparative centrifugation- differential and density gradient centrifugation, Ratezonal and Isopycnic techniques, construction, working and applications of analytical ultracentrifuge-Determination of molecularweight (Derivation excluded)15 Hrs

**Unit-II:** Chromatography - adsorption, partition. Principle, instrumentation and applications of paper chromatography, thin layer chromatography, ion-exchange chromatography, gel permeation chromatography and affinity chromatography.  15 Hrs

**Unit-III :** Electrophoresis – General principles, factors affecting electrophoretic mobility. Tiselius moving boundary electrophoresis.Electrophoresis with paper and starch.Principle, instrumentation and applications of agarose gel electrophoresis and SDS-PAGE. 15 Hrs

**Unit-IV:** Basics of Electromagnetic radiations- Energy, wavelength, wavenumber and frequency. Absorption and emission spectra, Lambert – Beer Law, Lightabsorption and transmittance. Colorimetry - Principle, instrumentation and applications. Visible and UV spectrophotometry – Principle, instrumentation and applications -enzymeassay, structural studies of proteins and nucleicacids. 15 Hrs

**Unit-V:** Radioactivity **-** Types of Radioactive decay, half-life, units of radioactivity, Detection and measurement of radioactivity - Methods based upon ionization -Geiger MullerCounter. Methods based upon excitation - Solid & Liquid scintillation counters. Autoradiography. Biological applications and safety aspects of radioisotopes. 15 Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 | Describe types of rotors and identify the centrifugation  technique for the separation of biomolecules. | PO1,PO2,PO6 |
| CO2 | Demonstrate the principles,operational procedure and applications of planar and column chromatography. | PO1,PO2, PO6 |
| CO3 | Specify the factors and explain the separation of DNA and protein using electrophoretic technique. | PO1,PO2, PO6 |
| CO4 | State Beer’s Law and illustrate the instrumentation and uses of colorimeter and spectrophotometer . | PO1,PO2, PO6 |
| CO5 | Enumerate various methods of measurement of radioactivity and safety aspects of radioactive isotopes. | PO1,PO2, PO6 |

**Textbooks**

1.Avinash Upadhyay,Kakoli Upadhyay &NirmalenduNath,2002,Biophysical Chemistry, Principles and Techniques, 3rd edition, Himalaya PublishingHouse.

2.L.Veerakumari, 2009, Bioinstrumentation,1stedition,MJPPublishers.

3.Keith Wilson & John Walker, 2000, Practical Biochemistry-Principles andtechniques,

CambridgeUniversityPress,4thedition.

**Reference books**

1.Terrance G. Cooper The tools of Biochemistry ,. 1977, , John Wiley &Sons,Singapore.

2.Gurumani, Research Methodology for Biological Sciences, 2011,1stedition,MJPPublishers.

3.SarojDua, Neera Garg, Biochemical Methods of Analysis,2010, 1stedition,NarosaPublishinghouse.

**Web Resources**

1.<https://www.britannica.com/science/chromatography>

2.<https://www.youtube.com/watch?v=xgxFBQZYXlE>

3.<https://www.youtube.com/watch?v=7onjVBsQwQ8>

**Mapping with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 2 | 3 |  |  |  | 2 | 3 | 3 | 3 | 3 |
| **CO 2** | 2 | 3 |  |  |  | 2 | 3 | 3 | 3 | 3 |
| **CO 3** | 2 | 3 |  |  |  | 2 | 3 | 3 | 3 | 3 |
| **CO 4** | 2 | 3 |  |  |  | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 2 | 3 |  |  |  | 2 | 3 | 3 | 3 | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

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| --- | --- | --- |
| **SEMESTER: IV****CORE -VIII****PART: III** | **23UBIOP44: BIOCHEMICAL TECHNIQUES** | **CREDIT: 5****HOURS: 3/W** |

**Learning objectives**

The objectives of this course are to:

* Acquaint the students with colorimetric estimations of biomolecules.
* Equip skills on various separation techniques.
* Impart knowledge about the estimation of minerals and vitamins.

**I Colorimetry**

1. Estimation of amino acid by Ninhydrin method.

2. Estimation of protein by Biuret method.

3. Estimation of DNA by Diphenylamine method.

4. Estimation of RNA by Orcinol method.

5. Estimation of Phosphorus by Fiske and Subbarow method.

**II Chromatography**

1. Separation and identification of sugars and amino acids by paper chromatography.

2. Separation and identification of amino acids and lipids by thin layer chromatography.

**III Demonstration**

1. Separation of serum and plasma from blood by centrifugation.
2. Separation of serum proteins by SDS-PAGE.

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 | Estimate the amount of biomolecules by Colorimetric method. | PO1,PO3,PO6 |
| CO2 | Quantify the amount of minerals by Colorimetric method | PO1,PO3,PO6 |
| CO3 | Separate and identify sugars, lipids and amino acids by chromatography | PO1,PO3 |
| CO4 | Operate centrifuge for the separation of serum and plasma | PO1,PO3,PO6 |
| CO5 | Demonstrate the separation of proteins electrophoretically | PO1,PO3,PO6 |

**Text books**

1. J. Jayaraman, Laboratory Manual in Biochemistry New Age International ( P) Limited Fifth edition 2015.

2. Sadasivam A.Manickam Biochemical Methods Newage International PvtLtd publishers third edition 2018.

3. KeithWilson and JohnWalker Principles and techniques of Practical Biochemistry Cambridge University Press2010, Seventh edition.

**Reference books**

1. S. K. Sawhney andRandhir Singh, Introductory Practical Biochemistry. Alpha Science International, Ltd 2nd edition, 2005.

2.David T. Plummer, 2001, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw- Hill publishing company limited.

3. Varley’s Practical Clinical Biochemistry by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition,1988.

**Web resources**

https://www.pdfdrive.com/biochemistry-books.html

**Mapping with Program Outcomes**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 2 |  | 3 |  |  | 2 | 3 | 3 | 3 | 3 |
| **CO 2** | 2 |  | 3 |  |  | 2 | 3 | 3 | 3 | 3 |
| **CO 3** | 2 |  | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO 4** | 2 |  | 3 |  |  | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 2 |  | 3 |  |  | 2 | 3 | 3 | 3 | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

|  |  |
| --- | --- |
| **Title of the Course** | **CHEMISTRY FOR BIOLOGICAL SCIENCES II****(FOR BOTANY AND ZOOLOGY STUDENTS)** |
| **Code** | **23UCHEE45** |
| **Category** | **Generic****Elective** | **Year** | II | **Credits** | 2 | **Course****Code** |  |
| **Semester** | IV |
| **Instructional****hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** |
| 3 | - | - | 4 |
| **Prerequisites** | **Chemistry for Biological Sciences I** |
| **Objectives of the course** | This course aims to provide knowledge on* nomenclature of coordination compounds and carbohydrates.
* Amino Acids and Essential elements of biosystem
* understand the concepts of kinetics and catalysis
* provide fundamentals of electrochemistry and photochemistry
 |
| **Course Outline** | **UNIT I****Co-ordination Chemistry and Water Technology**Co-ordination Chemistry**:** Definition of terms - IUPAC Nomenclature- Werner’stheory - EAN rule - Pauling’s theory – Postulates - Applications to [Ni(CO)4], [Ni(CN)4]2-,[Co(CN)6]3- Chelation - Biological role of Hemoglobin and Chlorophyll (elementary idea) - Applications in qualitative and quantitative analysis.Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method-Purification techniques –BOD and COD. |
| **Unit II Carbohydrates**Classification, preparation and properties of glucose and fructose. Discussion of open chain ring structures of glucose and fructose. Glucose-fructose interconversion. Preparation and propertiesof sucrose, starch and cellulose. |
| **UNIT III****Amino Acids and Essential elements of biosystem**Classification - preparation and properties of alanine, preparation of dipeptides using Bergmann method - Proteins- classification – structure - Colour reactions – Biological functions – nucleosides -nucleotides – RNA and DNA – structure. Essentials of trace metals in biological system-Na, Cu, K, Zn, Fe, Mg. |

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|  | **UNIT IV****Electrochemistry**Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials -electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications - electroplating - Nickel and chromeplating – Types of cells -fuel cells-corrosion and its prevention. |
| **UNIT V****Photochemistry**Grothus - Drapper’s law and Stark-Einstein’s law of photochemical equivalence, Quantum yield - Hydrogen -chloride reaction. Phosphorescence, fluorescence, chemiluminescence andphotosensitization and photosynthesis (definition with examples). |
| Extended Professional Component (is a part of internal component only, Not to be included in the external examinationquestion paper) | Questions related to the above topics, from various competitive examinations UPSC/ JAM /TNPSC others to be solved(To be discussed during the Tutorial hours) |
| Skills acquiredfrom this course | Knowledge, Problem solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. V.Veeraiyan, Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition, 2009.
2. S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
3. Arun Bahl, B.S.Bahl, Advanced Organic Chemistry; S.Chand and Company, New Delhi, twenty third edition, 2012.
4. P.L.Soni, H.M.Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.
 |
| **Reference Books** | 1. Arun Bahl, B.S.Bahl, Advanced Organic Chemistry; S.Chand and Company, New Delhi, twenty third edition, 2012.
2. P.L.Soni, H.M.Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.

P.L.Soni, Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007.1. B.R.Puri, L.R.Sharma, M.S.Pathania, Text book Physical Chemistry; Vishal Publishing Co., New Delhi, forty seventh edition, 2018.
2. B.K,Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.
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| --- | --- | --- | --- | --- | --- |
| **CO /PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to****PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of****Course Contribution to POs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO’s and CO’s**

|  |  |
| --- | --- |
| **Title of the Course** | **CHEMISTRY PRACTICAL FOR BIOLOGICAL SCIENCES – II****(For Botany and Zoology II year/IV semester)** |
| **Subject Code** | **23UCHEEP4** |
| **Category** | **Generi c Electiv****e** | **Year** | II | **Credits** | 1 | **Course Code** |  |
| **Semester** | IV |
| **Instructional****hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** |
| - | - | 2 | 2 |
| **Prerequisites** |  |
| **Objectives of the course** | This course aims to provide knowledge on* identification of organic functional groups
* different types of organic compounds with respect to their properties.
* determination of elements in organic compounds..
 |
|  | **SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS**The analysis must be carried out as follows:Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehyde and glucose].Detection of elements (N, S, Halogens).To distinguish between aliphatic and aromatic compounds.To distinguish – Saturated and unsaturated compounds. |
| **Reference Books** | V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principles ofPractical Chemistry; Sultan Chand & sons, Second edition, 1997. |
| **Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to**CO 1: gain an understanding of the use of standard flask and volumetric pipettes, burette. CO 2: design, carry out, record and interpret the results of volumetric titration.CO 3: apply their skill in the analysis of water/hardness.CO4: analyze the chemical constituents in allied chemical products |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 12 | 12 | 12 | 12 | 12 |
| **Weighted percentage of****Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO’s and CO’s**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 12 | 12 | 12 | 12 | 12 |
| **Weighted percentage of****Course Contribution to POs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO’s and CO’s**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: IV****SEC – 6****PART: III** | **23UBIOS46: TISSUE CULTURE** | **CREDIT: 2****HOURS: 2/W** |

**Learning Objectives**

The objectives of this course are to

* Introduce the tools and techniques used in tissue culture technique.
* Acquire knowledge on preparation of growth medium for culture techniques.
* Impart knowledge on procedures involved gene transfer.
* Acquaint with the process of tissue culture technique.
* Understand the importance of plant and animal tissue culture for the production and evaluation of bioactive compounds.

**Unit - l:** Introduction to Tissue culture, Types- seed, embryo, Callus, Organ, Protoplast culture, Advantages and importance of tissue culture, Tools and techniques 6 Hrs

**Unit - II :**Media and Culture Preparation - pH, temperature, solidifying agents. Role of Micro and macro nutrients. Maintenance of cultures.6 Hrs

**Unit - III :** Methods of gene transfer in plants and animals - direct and indirect gene transfer methods.6 Hrs

**Unit - IV :**Cell culture technique-Explants selection, sterilization and inoculation. 6 Hrs

**Unit - V :** Transgenic plants for crop improvement. Transgenic plants for molecular farming. Animal Cloning - An overview-Application of animal cell culture 6 Hrs

**Course outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 | Introduction to plant tissue culture | PO1,PO2.PO3 |
| CO2 | Brief knowledge on preparation of tissue culture media | PO1,PO2 |
| CO3 | Understanding on different methods of gene transfer | PO1,PO2.PO3 |
| CO4 | Gain knowledgeon plant and animal cell culture techniques | PO1,PO2,PO3 |
| CO5 | Study of applications of genetically modified plants and animals. | PO1,PO2,PO3 |

**Text books**

1.Trivedi, P.C.2000. Applied Biotechnology: Recent Advances. PANIMA Publishing corporation.

2,Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill.

3.Lycett, G.W. and Grierson, D. (ed). 1990. Genetic Engineering of crop plants.

4.Grierson and Covey, S.N.1988. Plant Molecular biology. Blackie.

5.Chawla, H.S., “Introduction to Plant Biotechnology”, 3rd Edition, Science Publishers, 2009.

**Reference books**

1.Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, arias Publications. 1995.

2.Stewart Jr., C.N., “Plant Biotechnology and Genetics: Principles, Techniques and Applications” Wiley-Interscience, 2008.

3.Freshney, R. I. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 2010. 6th Edition.

4.Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi.

5.Davis, J. M. (2011). Animal Cell Culture. John Willy and Sons Ltd. USA.6Freshmen R. I. (2005). Culture of Animal Cells. John Willy and Sons Ltd. USA.

6.Butler, M. (2004). Animal Cell Culture and Technology. Taylor and Francis. Keywork USA.

7.Verma, A. S. and Singh, A. (2014). Animal Biotechnology. Academic Press, ELSEVIER, USA

**Web Resources**

<https://www.britannica.com/science/tissue-culture>

<https://en.wikipedia.org/wiki/Plant_tissue_culture>

<https://microbeonline.com/animal-cell-culture-introduction-types-methods-applications/>

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 2 | 3 | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO 2** | 2 | 3 |  |  |  |  | 3 | 3 | 3 | 3 |
| **CO 3** | 2 | 3 | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO 4** | 2 | 3 | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO5** | 2 | 3 | 3 |  |  |  | 3 | 3 | 3 | 3 |

S - Strong (3) M - Medium (2) L -Low(1)

|  |  |  |
| --- | --- | --- |
| **SEMESTER: IV****SEC – 7****PART: III** | **23UBIOS47: MEDICAL CODING** | **CREDIT: 2****HOURS: 2/W** |

**Course objectives**

The objectives of this course are to

* Understand the basic concept of Medical coding
* Familiarize the student about medical terminology
* Understand about the classification of diseases based on WHO/AHA
* Understand about the CPT code used for diseases as per American Medical Association (AMA)

**Unit - I :** Introduction to Medical coding, coding theory, Healthcare Common Procedure Coding, First Aid and CPR 6Hrs

**Unit - II:** Introduction to Medical Terminology, specialization I & II, Diagnostic coding, factors affecting diagnostic coding 6Hrs

**Unit – III :** Documenting medical records- Importance of Documentation, Types of dictation formats 6Hrs

**Unit - IV :** Introduction to Human Anatomy and Coding, ICD-10- CM classification system

6Hrs

**Unit - V :** Introduction to CPT coding, types of CPT coding Medical Law and Ethics6hrs

**Course Outcome**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program****Outcomes** |
| CO1 | Explaining the basic concept of coding and its application. Possess the knowledge about the First aid and CPR | PO1,PO2,PO6 |
| CO2 |  Possess the knowledge about medical terminology used in Medical coding industry  | PO1,PO2,PO6 |
| CO3 |  Possess the knowledge about the ICD-10 CM international classification of diseases based on WHO | PO1,PO2,PO6 |
| CO4 |  Possess the knowledge about the CPT codes used for diseases as per American Medical Association (AMA) | PO1,PO2,PO6 |
| CO5 | Understand CPT coding and its types | PO1,PO2,PO6 |

**Text books**

**1**.Understanding Medical Coding,A comprehensive guideSandraLJohnsonRobin Linker

2.Buck’s Step – by – step Medical CodingElsevier reference

**Reference books**

1.Terry Tropin M Shai, RHIA, CCS-P, AHIMAICD-10-CMcoding guidelines made easy2017.

4.Besty J Shiland- Medical terminology and anatomy for ICD-10.

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 2 | 3 |  |  |  | 3 | 3 |  | 2 | 3 |
| **CO 2** | 2 | 3 |  |  |  | 3 | 3 |  | 2 | 3 |
| **CO 3** | 2 | 3 |  |  |  | 3 | 3 |  | 2 | 3 |
| **CO 4** | 2 | 3 |  |  |  | 3 | 3 |  | 2 | 3 |
| **CO5** | 2 | 2 |  |  |  | 2 | 3 |  | 2 | 3 |

**S - Strong (3) M - Medium (2) L -Low(1)**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: V****CORE: IX****PART: III** | **23UBIOC51: ENZYMES** | **CREDIT: 4****HOURS: 5/W** |

**Learning objectives**

The main objectives of this course are to

* Provide fundamental knowledge on enzymes and their properties.
* Understand the mechanism of action of enzymes and the role of coenzymes in catalysis.
* Introduce the kinetics of enzymes and determine the Km and Vmax.
* Explain the effect o finhibitors on enzyme activity
* Understand the role of enzymes in clinical diagnosis and industries.

**Unit - I: Introduction** to Enzymes: Nomenclature and Classification based on IUB with examples, enzyme as catalyst-Activation energy, Enzyme specificity-absolute, Group, linkage and stereo specificities. Concept of Active site, Lock and key hypothesis and induced fit theory, Enzyme expression Units-IU, turnover number, katal and specific activity.18Hrs

**Unit - II: Mechanism of enzyme catalysis –** Acid Base catalysis, covalent catalysis, electrostatic catalysis,metal ion catalysis, proximity and orientationeffect. Coenzymes -Definition, types, co-enzymatic forms of vitamins- NAD/NADP,FAD, FMN, Coenzyme A TPP,PLP, lipoic acid and biotin. Multienzyme complexes - Pyruvate dehydrogenase complex. Isoenzyme with reference to LDH and CK. 18Hrs

**Unit - III: Enzymekinetics** -- Definition of kinetics, Factors affecting enzyme activity - temperature, pH, substrate and enzyme concentration, activators-cofactors, Derivation of Michaelis-Menton equation for unisubstrate reactions , Lineweaver - Burk plot, Eadie -Hofsteeplot Significance of Km and V max andtheirdeterminationusing the plots. 18Hrs

**Unit - IV:** Enzyme inhibition **-** Reversible and irreversible inhibition-types of reversible inhibitors, competitive, non-competitive, un-competitive inhibitors. Graphical representation by L-B plot,(Kinetic derivations not required),Determination ofKmandVmaxinthe presence and absence of inhibitors. Allosteric enzymes - Sigmoidal curve, positive and negative modulators 18Hrs

**Unit - V:** Applications of enzymes **-**Immobilized enzymes - methods of immobilization-adsorption, covalent bonding, cross linking, encapsulation,entrapment and applications of immobilized enzymes. Biosensors – e.g. Glucose sensors. Industrial applications of enzymes –Food, textile and pharmaceutical industries. 18Hrs

**Course Outcomes**

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| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programme outcome** |
| CO1 | Identify the major classes of enzymes,differentiate between a chemical catalyst and a biocatalyst and define the units of enzymes. | PO1 |
| CO2 | Explain the mechanism of enzyme catalysis and the role of coenzymes in enzyme action. | PO1,PO2 |
| CO3 | Illustrate the steady state kinetics,, interpret MMplot and LBplot based on kinetics data, and determine Km andVmax. | PO1,PO3 |
| CO4 | Distinguish the types of inhibition along with its importance in biochemical reactions. | PO1,PO3 |
| CO5 | Comprehend the various methods for production of immobilized enzymes and discuss the application of enzymes in clinical diagnosis and various industries. | PO1,PO2,PO6 |

 **Textbooks**

1.U.Sathyanarayana&U.Chakrapani,2013,Biochemistry, 4th edition, Elsevier India Pvt. Ltd., Books &Allied Pvt. Ltd.

2.Dr. G.R Agarwal, Dr. Kiran Agarwal & O.P. Agarwal, 2015, Textbook ofBiochemistry(Physiologicalchemistry),18thedition,GoelPublishingHouse

3.T.Devasena,2010,Enzymology,1stedition,OxforduniversityPress.

**Reference books**

1.Trevor Palmer, 2008, Enzymes: Biochemistry, Biotechnology, ClinicalChemistry,2ndedition,EastWestPressPvt.Ltd.

2.DavidL.Nelson,MichaelM.Cox,2005,PrinciplesofBiochemistry,4theditionW.H.FreemanandCompany,

3.Voet.D,Voet.J.G.andPratt,C.W,2004,PrinciplesofBiochemistry,4theditionJohnWiley&Sons,Inc.

 4.ZubayG.L,*et.al*.,1995,PrinciplesofBiochemistry,1stedition,WmC.BrownPublishers.

**Web resources**

[www.biologydiscussion.com/notes/enzymes-notes](http://www.biologydiscussion.com/notes/enzymes-notes)<https://www.britannica.com/science/protein/The-mechanism-of-enzymatic-action><https://www.youtube.com/watch?v=oVJ2LJxO6tU>

**Mapping with Program Outcomes**

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|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 2** | 3 | 2 |  |  |  |  | 3 |  |  | 3 |
| **CO 3** | 3 |  | 2 |  |  |  | 3 |  |  | 3 |
| **CO 4** | 3 |  | 2 |  |  |  | 3 |  |  | 3 |
| **CO 5** | 3 | 2 |  |  |  | 2 | 3 | 3 | 3 | 3 |

**S-Strong(3) M-Medium (2) L-Low (1**

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| --- | --- | --- |
| **SEMESTER: V****CORE: X****PART: III** | **23UBIOC52: INTERMEDIARY METABOLISM** | **CREDIT: 4****HOURS: 5/W** |

**Learning Objectives**

The main objectives of this course are to

* Review the basic concepts of free energy transformation and describe biological oxidation.
* Illustrate the pathways of carbohydrate metabolism.
* Explain the pathways of oxidation and biosynthesis of lipids.
* Detail the catabolism of amino acids and synthesis of specialized products from aminoacids.
* Acquaint the metabolism of nucleicacids and its regulation

**Unit - I: Bioenergetics**-High energy compounds**:** Role of high energy compounds, free energy hydrolysis of ATP and other organophosphates, ATP-ADPcycle.

Biological Oxidation: Electron transport chain -its organization and function. Inhibitors of ETC. Oxidative phosphorylation, P/Oratio, Peter Mitchell’s chemiosmotic hypothesis. Mechanism of ATP synthesis, uncouplers of oxidative phosphorylation, substrate level phosphorylation with examples. 15 Hrs

**Unit - II:** Metabolism of carbohydrates -Glycolysis, TCA Cycle, Amphibolicnature and integrating role of TC Acycle. Anaplerosis, Pentose Phosphate Pathway (HMP shunt), Gluconeogenesis, Glycogenesis, Glycogenolysis anditsregulation, glyoxylate cycle, Entner- Duodoroff pathway andCoricycle.15 Hrs

**Unit - III**: Metabolism of lipids -Oxidation of fatty acids - α, β and ω -oxidation of saturated fatty acids, Oxidation of fatty acids with odd number of carbonatoms and unsaturated fatty acids, Ketogenesis, Biosynthesis of saturated fatty acids and unsaturated fattyacids, Biosynthesis and degradation of triglycerides, phospholipids and cholesterol. 15 Hrs

**Unit - IV:** Metabolism of amino acid- Metabolic nitrogen pool, Catabolism of amino acid: Oxidative deamination, non – oxidative deamination, transamination and decarboxylation, Biogenic amines, Urea cycle and its regulation.15 Hrs

**Unit - V:** Metabolism of nucleotides-Biosynthesis of purines and pyrimidines, - denovo synthesis and salvage pathways, Degradation of purines and pyrimidines, Conversion of ribonucleotide to deoxyribonucleotide.15 Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program outcomes** |
| CO1 | State the concepts of bioenergetics and illustrate the mechanism of flow of electrons andthe production of ATP. | PO1,PO2 |
| CO2 | Elaborate the biochemical reactions and integration of pathways of carbohydrate metabolism. | PO1, |
| CO3 | Sketch the oxidation and biosynthesis of fattyacids, phospholipids, triglycerides and cholesterol with suitable examples | PO1 |
| CO4 | Explain catabolism of amino acids, synthesis of nonessential aminoacids and specialize dproducts from aminoacids. | PO1 |
| CO5 | Describe the metabolism of nucleicacids with necessary illustrations and its regulation. | PO1 |

**Textbooks**

1, U.Sathyanarayana&U.Chakrapani,2015,Biochemistry,4thElsevierIndiaPvt.Ltd.,

2.M.N. Chatterjea andRanaShinde,2002, Textbook of Medical Biochemistry, 5thedition Jaypee Brothers Medical Publishers Pvt. Ltd.

**Reference books**

1.Lehninger PrinciplesofBiochemistry, David L. Nelson, Michael M.Cox, 2008,5thedition,W.H.FreemanandCompany.

2.RobertK.Murray,DarylK.Granner,VictorW.Rodwell,2006,Harper’sIllustratedBiochemistry,27thedition,McGrawHillPublishers.

3.PrinciplesofBiochemistry Voet.D,Voet.J.G,andPrattC.W.,2010,,Fourthedition,JohnWiley&Sons,Inc,.

4.PrinciplesofBiochemistry,GeoffreyL.Zubay,WilliamW.Parson,DennisE.Vance,1995,2ndEdition,Wm.C. BrownPublishers.

5.Biochemistry,Garret,R.H.andGrisham,C.M.2005,3rdEdition.Thomson Learning INC.

**Web resources**

1.https://nptel.ac.in/courses/104/105/104105102/ [2.http://www.nptelvideos.in/2012/11/bioche](http://www.nptelvideos.in/2012/11/biochemistry-i.html)mi[stry-i.html](http://www.nptelvideos.in/2012/11/biochemistry-i.html) 3.https:/[/www.saddleba](http://www.saddleback.edu/faculty/jzoval/mypptlectures/ch15_metabolism/lecture_notes_)c[k.edu/faculty/jzoval/mypptlectures/ch15\_metabolism/lecture\_notes\_](http://www.saddleback.edu/faculty/jzoval/mypptlectures/ch15_metabolism/lecture_notes_) ch15\_metabolism\_current-v2.0.pdf

**Mapping with Program Outcomes**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 | 2 |  |  |  |  | 3 |  |  | 3 |
| **CO 2** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 3** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 4** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 5** | 3 |  |  |  |  |  | 3 |  |  | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

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| **SEMESTER: V****CORE: XI****PART: III** | **23UBIOC53: CLINICAL BIOCHEMISTRY** | **CREDIT: 4****HOURS: 5/W** |

**Learning objectives**

The main objectives of this course are to

* Comprehend the basic concepts and disorders of carbohydrate metabolism
* Explain the disorders of lipid metabolism.
* Elucidate the liver function test and kidney function test.
* Designate the gastric function test.
* Familiarize the clinical enzymology.

**Unit - I :**Disorders of carbohydrate metabolism: Maintenance of blood glucose by hormone with special reference to insulin and glucagon. Abnormalities in glucose metabolism: Diabetes mellitus;types, causes, biochemical manifestations, diagnosis and treatment, glycated hemoglobin. Inborn errors of carbohydrate metabolism, glycosuria, Fructosuria, Pentosuria, Galactosemia andGlycogenstoragediseases.15 hrs

**Unit - II:** Disorders of Lipid Metabolism**:** Lipid Profile, Atherosclerosis, Fattyliver and hyperlipidemia. Hypercholesterolemia, Lipidosis and Xanthomatosis, Tay-Sach`s disease, Niemann-Pick disease, lipotropic agents 15 Hrs

**Unit - III :**Liver Function Tests**:** Bilirubin metabolism and jaundice, Estimation of conjugated and total bilirubinin serum(Diazomethod). Detection of bilirubin and bilesalts in urine(Fouchet’stest and Hay’s Sulphur test).Thymol turbidity test,prothrombin time,serum enzymes in liver disease serum transaminases (SGPT & SGOT) and lactate dehydrogenase (LDH). 15 Hrs

Kidney FunctionTests**:** Measurement of urine pH, volume, specific gravity, osmolality, sediments in urine, inulin, urea and creatinine clearance tests. Concentration and dilution tests. Phenol red test. Levels of plasma protein and its significance related to kidney function. Proteinuria. 15Hrs

**Unit - IV :**Gastric Function test: Composition of gastric juice, collection of gastric contents,examination of gastric residuum, fractional test meal (FTM), stimulation test-alcohol and histamine stimulation, Tubeless gastric analysis1.5 Hrs

**Unit - V**:Clinical enzymology**:** Enzymes of diagnostic importance- LDH, creatine kinase, transaminases, phosphatases, Isoenzymes of lactate dehydrogenase.15 Hrs

**Course Outcomes**

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| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 |  Explain the concepts of hormones and their importance to maintain glucose and types of Diabetes, diagnosis and treatment. | PO1,PO3,PO6 |
| CO2 | Analyzethelipid profile and different deficiency state. | PO1,PO3,PO6 |
| CO3 | Describe the liver and kidney functions and specific diagnostic methods used for biological sample. | PO1,PO3,PO6 |
| CO4 | Detail about the composition of gastric juice and special test for diagnosis. | PO1,PO3,PO6 |
| CO5 | Elaboratetheenzyme markers used for diagnostic studies. | PO1,PO3,PO6 |

**Text books**

1. NChatterjee and Rana Shinde, Text Book of Medical Biochemistry, Jaypee Brothers Medical Publishers (P) LTD, New Delhi, 8th Edition,2012

2. Ambika Shanmugam’s Biochemistry for medical students, 8th edition, Published by Wolters Kluwer India Pvt. Ltd.

**Reference books**

1.Philip.D.Mayne,ClinicalChemistryindiagnosisandtreatment.ELBSPublication,6th edition, 1994.

2. Thomas M. Devlin (2014) Text book of Biochemistry with clinical correlations (7th ed). John Wiley and sons.

3. Tietz Fundamentals of clinical chemistry and molecular Diagnostics (2014) (7th ed) Saunders.

**Web Resources**

1. https:/[/www.britannica.com/scienc](http://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate-)e[/metabolic-disease/Disorders-of-carbohydrate-](http://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate-) metabolism

2. https:/[/www.slideshare.net/MohitAdhikary/gastric](http://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests)-[and-pancreatic-function-tests](http://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests) 3.https://onlinecourses.nptel.ac.in/noc20\_ge13/preview

**Mapping with Program Outcomes**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  | 3 |  |  | 2 | 3 | 2 | 2 | 3 |
| **CO 2** | 3 |  | 3 |  |  | 2 | 3 | 2 |  | 3 |
| **CO 3** | 3 |  | 3 |  |  | 2 | 3 | 3 | 2 | 3 |
| **O 4** | 3 |  | 3 |  |  | 2 | 3 | 3 | 2 | 3 |
| **CO 5** | 3 |  | 3 |  |  | 2 | 3 | 3 | 2 | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

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| --- | --- | --- |
| **SEMESTER: V****PART: III** | **23UBIOD54: PROJECT WITH VIVA-VOCE** | **CREDIT: 4****HOURS: 5/W** |

**(Refer to the Regulations)**

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| **SEMESTER: V****ELECTIVE: V****PART: III** | **23UBIOE55-1: IMMUNOLOGY** | **CREDIT: 3****HOURS: 4/W** |

**Learning Objectives**

The objective of this course are to

* Introduce the structure and functions of lymphoid organs and cells of the immune system
* Illustrate the structure and classification of antibodies and adaptive immune response
* Impart knowledge on the types of immunity and uses of vaccines
* Provide an understanding of immune related diseases and transplantation
* Study the Ag-Ab interaction and immunological techniques to identify antigens and antibodies

**Unit - I** :Structure and function of primary lymphoid organs ( thymus ,bone marrow), secondary lymphoid organs (spleen, lymph node), Cells involved in immune system- Functions-Phagocytosis -Inflammation 15 Hrs

**Unit - II**: Antigens - Nature, Immunogens, haptens ,cross reactions - Immunoglobulin- types- structure and function. Cells involved in antibody formation, Clonal selection theory, Co-operation of T-cell with B-cell. Differentiation of T and B lymphocyte -Humoral and cell mediated immunity. Monoclonal antibody – Production and application in biology. 15Hrs

**Unit - III**- Immunity and its types-Innate, Acquired, active and passive.- Natural and Artificial - Commonly used toxoid vaccines, killed vaccines, live attenuated vaccines, rDNA Vaccines, DNA and subunit vaccines 15Hrs

**Unit - IV**: Hypersensitivity – Immediate (Type 1) and Delayed (Type IV), Auto- immune diseases with examples. Organ specific and systemic autoimmunity. SLE, RA. Transplantation – Types of Grafts, structure& functions of MHC, graft Vs host reaction, immunosuppressive Agents. 15Hrs

**Unit - V**: Antigen-antibody reactions, General features of Antigen Antibody reactions. Precipitation, Immuno diffusion, SID and DID -Oudin Procedure, Oakley Fulthrope Procedure, Radio immunodiffusion, Ouchterlony double diffusion, CIE, Rocket electrophoresis, Agglutination-Coomb’s test Complement Fixation test-Wasserman’s reaction, RIA, ELISA. 15Hr

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 | Associate structure and function of the organs involved in our body’s natural Defence | PO1 |
| CO2 | Classify antigens and antibodies and the role of lymphocytes in defending the host | PO1,PO2 |
| CO3 | Describe the types of immunity and the uses of vaccines | PO1, PO4 |
| CO4 | Understand the immune related diseases and mechanism of transplantation | PO1,PO2 |
| CO5 | Examine the immunological tests and relate it to the immune status of an Individual | PO1,PO3 |

**Text Books**

1. Kuby, J. (2018). Immunology (5th ed). W.H. Freeman - ISBN-10 : 1319114709 / ISBN-13 : 978-1319114701

2. Rao, C. V. (2017 ). Immunology (3rd ed.). Chennai: Alpha Science Int. Ltd - ISBN-10 : 1842652559/ ISBN 13:978-1842652558

3. Tizard (1995). An Introduction to Immunology. Harcourt Brace College Publications

**References Books**

1. Kenneth M. Murphy, Paul Travers, Mark Walport - (2007), Janeway’s Immunobiology, 7thedition, Garland Science.

2. Abul K. Abbas, Andrew H. Lichtman, Jordan S. Pober - (1994), Cellular and molecular immunology, 2ndedition, B. Saunders Company.

3. Basic Immunology Functions and Disorders of the Immune System, 6th Edition - January 25, 2019 Authors: Abul Abbas, Andrew Lichtman, Shiv Pillai, ISBN: 9780323549431eBook ISBN: 9780323639095

4. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt - (2006),Roitt's Essential Immunology, 11th edition, Wiley-Blackwell

**Web resources**

1.<https://onlinecourses.nptel.ac.in/noc22_bt40/preview>

2.https://onlinecourses.swayam2.ac.in/cec20\_bt05/preview

 3.https://youtu.be/8uahFPl6ny8

**Mapping with ProgramOutcomes**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 2** | 3 |  | 2 |  |  |  | 3 |  |  | 3 |
| **CO 3** | 3 |  |  | 2 |  |  | 3 | 3 |  | 3 |
| **CO 4** | 3 | 2 |  |  |  |  | 3 | 1 |  | 3 |
| **CO 5** | 3 |  | 3 |  |  |  | 3 | 3 | 3 | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

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| --- | --- | --- |
| **SEMESTER: V****ELECTIVE: V****PART: III** | **23UBIOE55-2: BIOCHEMICAL PHARMACOLOGY** | **CREDIT: 3****HOURS: 4/W** |

**Learning Objectives**

The objectives of this course are to

* Introduce the basic concepts of pharmacology.
* Explain the metabolism of drugs and factors responsible for metabolism.
* Acquaint the adverse response and side effects of drugs .
* Familiarize important drugs used for common metabolic disorders.
* Provide an understanding about the action of antibiotics .

**Unit - I**: Drugs – classification based on sources, routes of drug administration - Oral/Enteral, Parenteral and Local application. Absorption of drugs, factors influencing drug absorption, distribution and excretion of drugs. 15 Hrs

**Unit - II:** Drug metabolism **-** Phase I and Phase II reactions, role of cytochrome P450 , non- microsomal reactions of drug metabolism. Factors influencing drug metabolism. Therapeutic index. 15 Hrs

**Unit - III**: Drug allergy, Drug tolerance - IC 50, LD50 of a drug, Drug intolerance, Drug addiction, Drug abuses and their biological effects. Drug resistance - biochemical mechanism. 15 Hrs

**Unit - IV :** Therapeutic Drugs - Analgesics and Non-steroidal anti-inflammatory drugs (NSAIDs) – Aspirin and Acetaminophen. Insulin, Oral antidiabetic drugs - Sulfonylureas, Biguanides. Antihypertensive drugs - ACE inhibitors, Calcium channel blockers. Anti-cancer agents – Antimetabolites. 15 Hrs

**Unit - V**: Antibiotics - Definition, Examples and Biochemical mode of action of penicillin, streptomycin, tetracyclines and chloramphenicol. 15 Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program outcomes** |
| CO1 | Classify the different routes of drug administration, describe the absorption, distribution, metabolism and excretion of drugs. | PO1 |
| CO2 | Illustrate the metabolism of drugs, classify the microsomal and non- microsomal reactions and explain the role of cytochromes.  | PO1 |
| CO3 | List out the various adverse response and side effects of drugs. | PO1,PO2,PO4 |
| CO4 | Justify the use of synthetic drugs and elucidate its pharmacological actions and its adverse effects for different disease. | PO1,PO4 |
| CO5 | Highlight the importance and explain the mode of action of important antibiotics. | PO1,PO4 |

**Text Books**

1. N.Murugesh, A concise text book of Pharmacology –Sathya Publishers.
2. Jayashree Ghosh, A Textbook of Pharmaceutical chemistry –S. Chand & Company Ltd.
3. S C Metha, Ashutosh Kar, Pharmaceutical Pharmacology –New Age International (P) Limited, Publishers.

**References Books**

1. Lippincott’s illustrated Reviews- Pharmacology by Mary J.Mycek, Richard A.Harvey, Pamela C. Champe, Lippincott – Raven publishers, New Delhi.
2. David . E. Golan, Principles of Pharmacology, Wolters Kluwer (India) Pvt.Ltd.
3. R.S. Satoskar, S. B. Elsevier Pharmacology and pharmacotherapy. - ISBN-10 : 9788131248867 / ISBN-13 : 978-8131248867 ,2017.
4. Tripathi, K.Essentials of Medical Pharmacology. Jaypee Publishers- ISBN-10 : 9350259370 / ISBN-13 : 978-9350259375.2018.

**Web Resources**

[https://slideplayer.com/slide/3728296/64/video/What+is+bioremediation%3F.mp4](https://slideplayer.com/slide/3728296/64/video/What%2Bis%2Bbioremediation%3F.mp4)

**Mapping with Program Outcomes**

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|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 2** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 3** | 3 | 2 |  | 2 |  |  | 3 | 2 |  | 3 |
| **CO 4** | 3 |  |  | 2 |  |  | 3 | 2 |  | 3 |
| **CO 5** | 3 |  |  | 2 |  |  | 3 | 2 |  | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

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| --- | --- | --- |
| **SEMESTER: V****ELECTIVE: VI****PART: III** | **23UBIOE56-1: BIOENTREPRENEURSHIP** | **CREDIT: 3****HOURS: 4/W** |

**Learning Objectives**

The objectives of this course are to

* Impart knowledge on bio entrepreneurship and the types of industries
* Learn about business plan, proposal and funding agencies
* Understand the market strategy and the role of information technology in expansion of business
* Provide insights on legal requirement and accounting to establish as Bio entrepreneurship
* Familiarize about business bio incubators centres

**Unit - I:** Introduction to Bio entrepreneurship; Types of industries – Biopharma, Bio agriculture and CRO; Introduction to Trademarks, Copyrights and patents 15 Hrs

**Unit - II:** Business Plan, Budgeting and Funding Idea or opportunity; Business proposal preparation; funds/support from Government agencies like MSME/banks, DBT, BIRAC, Start-up and make in India Initiative; dispute resolution skills; external environment changes; avoiding/managing crisis; Decision making ability. 15 Hrs

**Unit - III:** Market Strategy- Basics of market forecast for the industry; distribution channels – franchising, policies, promotion, advertising, branding and market; Introduction to information technology for business administration and Expansion15 Hrs

**Unit - IV:** Legal Requirements, Finance and Accounting; Registration of company in India; Ministry of Corporate Affairs (MCA); basics in accounting: introduction to concepts of balance sheet, profit and loss statement, double entry, bookkeeping; finance and break-even analysis; difficulties of entrepreneurship in India.15 Hrs

**Unit - V:**Role of knowledge centres such as universities, innovation centres, research institutions (public & private) and business incubators in Entrepreneurship development; quality control and quality assurance; Definition, role and importance of CDSCO, NBA, GLP, GCP, GMP.15 Hrs

**Course Outcomes**

After completion of the course the students will be able to

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 | Understand the concept and scope for entrepreneurship | PO1 |
| CO2 | Identify various operations involved in a venture creation | PO1.PO5,PO6 |
| CO3 | Gather funding and launching a winning business | PO1.PO5,PO6 |
| CO4 | Nurture the organization and harvest the rewards | PO1.PO5,PO6 |
| CO5 |  Illustrate about the Business incubator centres and Bio entrepreneurship | PO1.PO5,PO6 |

**Text books**

1. Adams, D. J. (2008). Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion - ISBN 10: 1904842364 / ISBN 13: 9781904842361

2. Shimasaki, C. (2014). Biotechnology Entrepreneurship: Starting, managing, and Leading Biotech Companies. Academic London Press - ISBN 10: 0124047300 / ISBN 13: 9780124047303

3. Onetti, A. &. (2015). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge - ISBN 10: 1138616907 / ISBN 13: 9781138616905

4. Kapeleris, D. H. (2006). Innovation and entrepreneurship in biotechnology: Concepts, theories & cases - ISBN-13: 978-1482210125, ISBN-10: 1482210126

**Reference books**

1.Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management New Himalaya. New Himalaya House Delhi:pub - ISBN : 9789350440810 9350440814

2.Ono, R. D. (1991). The Business of Biotechnology, From the Bench of the Street. Butterworth-Heinemann - ISBN 10: 1138616907 / ISBN 13: 9781138616905

3. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press - ISBN-10 : 812243049X ,ISBN-13 : 978-8122430493

**Web sources**

**1**. http://www.simplynotes.in/e-notes/mbabba/entrepreneurship-development/

2.https://openpress.usask.ca/entrepreneurshipandinnovationtoolkit/chapter/chapter-1-introductionto-entrepreneurship**/**

**Mapping with Program Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 2 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 2** | 2 |  |  |  | 2 | 3 | 3 |  |  | 3 |
| **CO 3** | 2 |  |  |  | 2 | 3 | 3 |  |  | 3 |
| **CO 4** | 2 |  |  |  | 2 | 3 | 3 |  | 3 | 3 |
| **CO 5** | 2 |  |  |  | 2 | 3 | 3 |  |  | 3 |

**S-Strong (3) M-Medium (2) L-Low (1)**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: V****ELECTIVE: VI****PART: III** | **23UBIOE56-2: RESEARCH METHODOLOGY** | **CREDIT: 3****HOURS: 4/W** |

**Learning objectives**

The objectives of the course are to:

* Introduce the components of research.
* Acquaint on the experimental design and literature survey
* Analyse the data and find out the significance statistically
* Highlight the importance of computation in research.
* Provide mechanics of writing a research report hands-on experience in designing and working on small projects.

**Unit - I:** Characteristics and types of Research, Research Methods versus Methodology, Research designs in Biochemistry: experimental, *in vitro, in vivo, in situ*, clinical trials. Identification and criteria of selecting a research problem (Hypothesis); Formulation of objectives; Research plan and its components.15 Hrs

**Unit - II:** Experimental design - Objective, Design of work, Guidelines for design of experiments, Literature Search - Databases for literature search, Material and methods, Designing biological experiments, Compilation and documentation of data15 Hrs

**Unit - III:** Statistical Analysis: Measures of variation - standard deviation, Non-linear regression, Standard error. Analysis of variance for one-way and two-way classified data and multiple comparison procedures. Significance - students “t” test, chi-square test. Dunnet’s test 15Hrs

**Unit - IV**: Computer and its role in research: Basics of MS word, MS Excel: tabulation, calculation and data analysis, preparation of graphs, histograms and charts. Use of statistical software SPSS. Power Point: preparation of presentations and scientific poster designing 15 hrs.

**Unit - V**: Scientific writing for journals - Preparation of Abstract, Impact factor, h-index, i-10 index, citation index, Dissertation/Thesis writing : format, content and chapterization, writing style, drafting titles & sub-titles, captions and legends. Writing results, discussion and conclusions. Bibliography and references, referencing style - Harvard and Vancouver systems, Appendices and acknowledgement; Ethical issues in research; Intellectual property right and plagiarism.15 Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programme outcome** |
| CO1 | Explain the types of research and formulate and plan the research. | PO1,PO3 |
| CO2 | Design experimental setup, review the literature, compile and document the data. | PO1,PO3 |
| CO3 | Analyze and validate the experimental data using statistical tools | PO1,PO2,PO3 |
| CO4 | Interpret the data using computational tools. | PO1,PO2,PO3 |
| CO5 | Compile and draft a research report, present results findings and publish ethically. | PO1,PO3,PO4 |

**Text Books**

 1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.

2. Kothari, C.R., Research Methodology: Methods and Techniques. 2004, New Age International.

3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.

4. Gurumani.N, Research Methodology for biological Sciences, 2014, MJP Publishers.

**Reference Books**

1. Dr. Prabhat Pandey ,Dr.Meenu Mishra Pandey, Research Methodology: Tools and Techniques 2015

2.Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.

4. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.

5. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications

 6. Scientific Thesis Writing and Paper Presentation . MJP Publishers.2010

7. Research Methodology (2 Vols-Set) ,Suresh C. Sinha and Anil K. Dhiman, Vedams Books (P) Ltd.2002.

**Web Resources**

1. <https://explorable.com/research-methodology>

2. <http://www.scribbr.com>

3. <http://www.open.edu>

4. http://www.macmillan .ihe.com.

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  | 3 |  |  |  | 3 |  |  | 3 |
| **CO 2** | 3 |  | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 2 | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 2 | 3 |  |  |  | 3 | 3 | 3 | 3 |
| **CO 5** | 3 |  | 3 | 2 |  |  | 3 | 3 | 33 | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: V****PART: IV** | **23UVALG57: VALUE EDUCATION** | **CREDIT: 2****HOURS: 2/W** |

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| --- | --- | --- |
| **SEMESTER: V****PART: IV** | **23UBIOI58: SUMMER INTERNSHIP** | **CREDIT: 2****HOURS: ---** |

**(Refer to the Regulations)**

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| --- | --- | --- |
| **SEMESTER: VI****CORE: XIII****PART: III** | **23UBIOC61: MOLECULAR BIOLOGY** | **CREDIT: 4****HOURS: 6/W** |

**Learning Objectives**

The objectives of this course are to

* Provide insights into the central dogma of molecular biology and explain the mechanism of DNA replication.
* Elaborate the mechanism of transcription and reverse transcription.
* Highlight the characteristics of genetic code and describe the processof protein synthesis.
* Introduce the concept of regulation of gene expression in prokaryotes
* Familiarize the different types of mutations and explain the mechanism of DNA repair.

**Unit - I:** Central Dogma of molecular Biology, DNA as the unit of inheritance. Experimental evidence by Griffith’s transforming principle, Avery, McLeod and McCarthy’s experiment, and Hershey and Chase Experiment. Replication in prokaryotes: Modes of replication, Meselson and Stahl’s experimental proof for semi conservative replication. Mechanism of Replication – Initiation, events at Ori C, Elongation – replication fork, semi discontinuous replication, Okazaki fragments, and termination. Bidirectional replication, Inhibitors of replication. Models of replication-theta, rolling circle and D loop model. 15 Hr

**Unit - II:** Transcription - Mechanism of transcription: DNA dependent RNA polymerase(s), recognition, binding and initiation sites, TATA/ Pribnow box, elongation and termination. Post-transcriptional modifications; inhibitors of transcription. RNA splicing and processing of mRNA, tRNA and rRNA. Reverse transcription. 15 Hrs

**Unit - III**: Genetic Code and its characteristics, Wobble hypothesis. Translation: Adaptor role of tRNA, Activation of amino acids, Initiation, elongationandterminationofproteinsynthesis,post-translationalmodificationsandinhibitors of protein synthesis 15 Hrs

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**Unit - IV:** Regulation of Gene Expression In Prokaryotes – Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, regulation of lac operon and trp operon.15 Hrs

**Unit - V:** Mutation: Types-Nutritional, Lethal, Conditional mutants.Missense mutation and other point mutations. Spontaneous mutations; chemical and radiation – induced mutations. DNA repair: Direct repair, Photoreactivation, Excision repair, Mismatch repair, Recombination repair and SOS repair. 15 Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 | Illustrate the Central Dogma of molecular biology, explain the multiplication of DNA in the cell and describe the types and modes of replication. | PO1 |
| CO2 | Elaborate the mechanism of transcribing DNA into RNA, discuss the formation of different types of RNA. | PO1 |
| CO3 | Decipher the genetic code and summarize the process of translation. | PO1 |
| CO4 | Comprehend the principles of gene expression and explain the concept of operon in prokaryotes. | PO1,PO2 |
| CO5 | Distinguish the types of mutations and explain the various mechanisms of DNA repair. | PO1,PO2 |

**Textbooks**

1. Veer Bala Rastogi, 2008, Fundamentals of Molecular Biology, 1st edition, An ebooks India.

2. David Friefelder, 1987, Molecular Biology, 2nd edition, Narosa Publishing House.

3. Dr.P.S.VermaandDr.V.K.Agarwal, 2013, Cellbiology, Genetics, Molecular Biology, Evolution and Ecology,1stedition, S.Chand & Company Pvt. Ltd.

**Reference books**

1.Karp,G.,2010,CellandMolecularBiology:ConceptsandExperiments,6thedition,JohnWiley&Sons.Inc.

2.DeRobertis,E.D.P.andDeRobertis,E.M.F.,2010,CellandMolecularBiology,8thedition,LippincottWilliams and Wilkins, Philadelphia.

 3. James.D.Watson, 2013,Molecular Biology of the Gene7thedition,BenjaminCummings.

4.GeorgeM. Malacinski,1992, Freifelder's Essentials of Molecular Biology, 4thedition, Narosa publishing House.

**Web resources**

1. [www.mednotes.net/notes/biology](http://www.mednotes.net/notes/biology)

2. [https://www.onlinebiologynotes.com/repair-mechanism-of mutation/](https://www.onlinebiologynotes.com/repair-mechanism-of%20mutation/)

3. <https://teachmephysiology.com/biochemistry/protein-synthesis/dna-translation/>

**Mapping with Program Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 2** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 3** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 4** | 3 | 2 |  |  |  |  | 3 |  |  | 3 |
| **CO 5** | 3 | 2 |  |  |  |  | 3 | 1 |  | 3 |

**S-Strong(3) M-Medium (2) L-Low (1)**

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| --- | --- | --- |
| **SEMESTER: VI****CORE: XIV****PART: III** | **23UBIOC62: HUMAN PHYSIOLOGY** | **CREDIT: 4****HOURS: 6/W** |

**Learning Objectives**

The main objectives of this course are to

* Aid in understanding the physiology of respiratory and circulatory systems
* Explain the structure and physiology of the nervous and muscular system
* Explicate the functions of digestive and excretory system of the body.
* Impart knowledge about the process of reproduction.
* Emphasize the importance of various endocrine factors that regulate metabolism, growth, homeostasis and reproduction.

**Unit - I:** Respiratory System- Overview of respiratory system, Types of respiration, Transport of respiratory gases, Exchange of respiratory gases in lungs and tissues –Chloride Shift & Bohr’s effect, Lung surfactant. Circulatory System**-**Structure and functions of the Heart. Arterial and venous system, Cardiac cycle, Pace maker, Blood pressure and Factors affecting blood pressure. 15Hrs

**Unit - II**: Nervous system- Structure of neuron, synaptic transmission, reflex action, neurotransmission- Resting membrane and Action potential. neuro transmitters- acetylcholine, Nor adrenaline, Dopamine, Serotonin, Histamine, GABA, Substance P.Muscular system-structure and types of muscles - skeletal, smooth and cardiac muscles, muscle proteins- types and functions, mechanism of muscle contraction. 15Hrs

**Unit - III**: Digestive system- composition, functions of saliva, gastric pancreatic intestine and bile secretions, structure of digestive system, Digestion, absorption of carbohydrates, lipids, proteins. Excretory system- Structure of nephron, mechanism of urine formation, Concentration and acidification of Urine. Role of kidneys in the maintenance of acid base balance. 15Hrs

**Unit - IV:** Reproductive system:**-**Oogenesis, spermatogenesis, capacitation and transport of sperm- blood testis barrier. Fertilization, early development, Implantation, Placentation and Parturition. 15Hrs

**Unit - V**: Endocrinology- Classification of hormones, endocrineglandsand their secretions, structure and functions of Insulin, thyroxine. Steroid hormones- Corticosteroids, Sex hormones – testosterone and estrogen, menstrual cycle. 15Hrs

**Course Outcomes**

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| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program outcomes** |
| CO1 | Explain the exchange of gases, design of blood vessels and cardiac cycle. | PO1 |
| CO2 | Summarize the events in transmission of nerve impulses and mechanism of muscle contraction.  | PO1 |
| CO3 | Elaborate the structure and functions of digestive system, structure of nephron and mechanism of urine formation and role of kidney in maintenance of pH. | PO1 |
| CO4 | Describe the process of Oogenesis, Spermatogenesis, Fertilization, and Parturition. | PO1,PO2 |
| CO5 | Understand the role of different hormones that regulate metabolism, growth, glucose homeostasis and reproductive function. | PO1.PO2 |

**Textbooks**

1.K.Sembulingam&PremaSembulingam,2016,EssentialsofMedicalPhysiology,7thedition,JaypeeBrothersMedicalPublishers(P)Ltd.

 2. Chatterjee.C.C.,1988,HumanPhysiology-VolI&II,1stedition,MedicalAlliedAgency.

 3. AnimalPhysiology-MariakuttikanandArumugam,Saraspublication,2017.

**Reference books**

1. Text book of medical biochemistry physiology- MN. Chatterjee and Rana shinde, 7th edition, Jaypee brothers- medical publishers, 2007.

2. Meyer,Meyer&Meij,2002,HumanPhysiology,3rdedition,A.I.T.B.SPublishers.

 3. Guyton and Hall, 2011, Textbook of MedicalPhysiology, 12thedition, W.B.Saunders Company.

4. Testbook of Medical Physiology –Guyton&Hall,12thedition, Saunders Publishers, 2010

 5. Human anatomy and physiology–ElaineN.Marieb,3rdedition, Benjamin/Cummings (a Pearson education company), 1995.

**Web resources**

<https://www.youtube.com/watch?v=6qnSsV2syUE>

 <https://www.youtube.com/watch?v=9_h0ZXx1lFw>

 <https://slideplayer.com/slide/9431799/>

**Mapping with Program Outcomes**

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|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  |  |  | 3 | 2 |  | 3 |
| **CO 2** | 3 |  |  |  |  |  | 3 | 2 |  | 3 |
| **CO 3** | 3 |  |  |  |  |  | 3 | 2 |  | 3 |
| **CO 4** | 3 | 3 |  |  |  |  | 3 | 2 |  | 3 |
| **CO5** | 3 | 3 |  |  |  |  | 3 | 2 |  | 3 |

**S-Strong (3) M-Medium (2) L-Low (1)**

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| --- | --- | --- |
| **SEMESTER: VI****CORE: XV****PART: III** | **23UBIOC63: PLANT BIOCHEMISTRY AND PLANT THERAPEUTICS** | **CREDIT: 4****HOURS: 6/W** |

**Learning Objectives**

The main objectives of this course are to

* Convey the knowledge of photosynthesis.
* Detail the structure and types of secondary metabolites.
* Impart the idea on various plant hormones.
* Emphasize the effects of free radicals and the importance of antioxidants
* Understand the role of medicinal plants in treating diseases.

**Unit - I:** Photosynthesis- Photosynthesis apparatus, pigments of photosynthesis, photo chemical reaction, photosynthetic electron transport chain, path of carbon in photosynthesis- Calvin cycle, Hatch – lack pathway (4 ways) CAM path way, significance of photosynthesis. 15Hrs

**Unit - II:** Secondary metabolites: Structure, Types, Sources, Biosynthesis and function of phenolics, tannins, lignins, terpenes and alkaloids. Medicinal properties of secondary metabolite15Hrs

**Unit - III:** Plant hormones Structure and function of plant hormones such as ethylene, cytokinIns, auxins, Absicic acid, Florigin and Gibberlins. 15Hrs

**Unit - IV:** Free radicals, types, production, free radical induced damages, lipid peroxidation, reactive oxygen species, antioxidant defense system, enzymatic and non-enzymatic antioxidants, role of antioxidants in prevention of disease, phytochemicals as antioxidants.15Hrs

**Unit - V:** Plant therapeutics: Bioactive principles in herbs, plants with antidiabetic, anticancer, antibacterial, antiviral, anti-malaria and anti-inflammatory properties.15Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Program outcomes** |
| CO1 | Gain knowledge on photosynthetic apparatus, pigments present, pathways, and significance of photosynthesis | PO1 |
| CO2 | Learn in detail about the structure, types, sources, biosynthesis and functions of secondary metabolites. | PO1,PO3 |
| CO3 | Understand the structure and functions of plant hormones. | PO1 |
| CO4 | Discuss about free radicals, types and its harmful effects. Role of enzymatic and non-enzymatic antioxidant in defence mechanism, prevention in disease. | PO1,PO2.PO3 |
| CO5 | Identify the plants with antidiabetic, anticancer, antibacterial, antiviral, anti-malaria and anti-inflammatory properties. | PO1, PO2,PO3 |

**Text books**

1. SinghM.PandPanda.H2005.MedicinalHerbswiththeirformulations,Daya publishing house, Delhi

2. PlantPhysiology-DevlinN.RobertandFrancisH.Witham,CBSPublications

 3. Molecular activities of plant cell – An Introduction to Plant Biochemistry. John. W.

4. Anderson and John Brardall, Black well Scientific Publications, 1994.

**Reference books**

1. Khan,I.A and Khanum.A 2004.Roleofbiotechnologyinmedicinalandaromatic plants, Vol.1andVol.10,Ukka2publications,Hyderabad.

2. Plant Biochemistry and Molecular Biology – Hans Walter Heldt, Oxford University, 4th Edition, 2010

3. Plant biochemistry (2008), Caroline bowsher, Martin steer, Alyson Tobin, garland science.

4.Plant physiology and development (sixth edition) by Lincoln Taiz ,Eduardo Zeiger , Ian Max Moller and Angus Murphy publisher ; Oxford university press

**Web resources**

1 [https://www.intechopen.com/books/secondary-metabolites-sources-and-applications/anintroductory- chapter-secondary-metabolites](https://www.intechopen.com/books/secondary-metabolites-sources-and-applications/anintroductory-%20%20chapter-secondary-metabolites)

2 [https://www.toppr.com/guides/biology/plant-growth-and development/plantgrowth](https://www.toppr.com/guides/biology/plant-growth-and%20%20development/plantgrowth)

**Mapping with Program Outcomes**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 2** | 3 |  | 2 |  |  |  | 3 | 3 |  | 3 |
| **CO 3** | 3 |  |  |  |  |  | 3 |  |  | 3 |
| **CO 4** | 3 | 3 | 3 |  |  |  | 3 | 3 |  | 3 |
| **CO5** | 3 | 3 | 3 |  |  |  | 3 | 3 |  | 3 |

**S-Strong (3) M-Medium (2) L-Low (1)**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: VI****ELECTIVE: VII** **PART: III** | **23UBIOE64: CLINICAL BIOCHEMISTRY** | **CREDIT: 3****HOURS: 5/W** |

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| **SEMESTER: VI****ELECTIVE: VIII** **PART: III** | **23UBIOE65-1: BIOINFORMATICS** | **CREDIT: 3****HOURS: 5/W** |

**Learning Objectives**

The objective of this course are to

* Impart knowledge on bioinformatics and applications
* Learn about biological databases
* Understand the local and global sequence alignment
* Provide insights on BLAST and Microarray
* Familiarize about structural genomics and visualization tools

**Unit - I**:Introduction to Bioinformatics – Bioinformatics and its applications. –Genome, Metabolome-Definition and its applications. Metabolome-Metabolome database-E.coli metabolome database, Human Metabolome database.Transcriptome-Definition and applications.15 Hrs

**Unit - II** :Biological Databases - definition, types and examples –, Nucleotide sequence database (NCBI, EMBL, Genebank, DDBJ) Protein sequence database- SwissProt, TrEMBL, Structural Database-PDB,Metabolic database-KEGG15 Hrs

**Unit - III :** Sequence Alignment-Local and Global alignment-Dot matrixanalysis, PAM, BLOSUM. Dynamic Programming, Needleman- Wunch algorithm, Smith waterman algorithm. Heuristic methods of sequence alignment 15 Hrs

**Unit - IV** : BLAST-features, types (BLASTP, BLASTN, BLASTX), PSI BLAST, result format. DNA Microarray-Procedure and applications.15 Hrs

**Unit - V**: Structural genomics-Whole genome sequencing (Shotgun approach), Comparative genomics-tools for genome comparison, VISTA servers and precomputed tools. Molecular visualizationtools. RASMOL, Swiss PDB viewer. Nutrigenomics-Definition and applications15 Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 | Introduce the fundamentals of Bioinformatics and its applications Genome, metabalome& Transcriptome. | PO1 |
| CO2 | Classify biological database and to correlate the different file formatsused by nucleic acid, protein database, structural and metabolic database.. | PO1,PO2.PO3 |
| CO3 | Develop algorithms for interpreting biological data. | PO1,PO2 |
| CO4 | Discuss the concepts of sequence alignment and its types. Understand the tool used to detect the expression of genes | PO1.PO2,PO3 |
| CO5 | Apply the various tools employed in genomic study and protein visualization. Analyse the entire genome by shot gun method. | PO1.PO2 |

**Text books**

1. Basic of Bioinformatics by Rui Jiang Xuegong Zhang and Michael Q. Zhang Editors

2. Bioinformatics for Beginners Genes, Genomes, Molecular Evolution, Databases and Analytical Tools By: SupratimChoudhuri(Author)

3. Bioinformatics by Saras publication

4. Introduction to Bioinformatics by Arthur Lesk

**Reference books**

1. Computation in BioInformatics Multidisciplinary Applications S Balamurugan, Anand T. Krishnan, Dinesh Goyal, Balakumar Chandrasekaran

2. Chemoinformatics and Bioinformatics in the Pharmaceutical Sciences

Navneet Sharma PhD Pharmaceutics, Himanshu Ojha, Pawan Raghav, Ramesh K. Goyal

**Web resources**

1.https://nptel.ac.in/courses/102/106/102106065/

2 http://www.digimat.in/nptel/courses/video/102106065/L65.html

3 https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes

**Mapping with Program Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  |  |  |  |  | 3 |  | 2 | 3 |
| **CO 2** | 3 | 3 | 3 |  |  |  | 3 |  | 3 |  |
| **CO 3** | 3 | 3 |  |  |  |  | 3 |  | 3 |  |
| **CO 4** | 3 | 3 | 3 |  |  |  | 3 |  | 3 |  |
| **CO5** | 3 | 3 |  |  |  |  | 3 |  | 3 |  |

**S-Strong (3) M-Medium (2) L-Low (1)**

|  |  |  |
| --- | --- | --- |
| **SEMESTER: VI****ELECTIVE: VIII** **PART: III** | **23UBIOE65-2: BIOTECHNOLOGY** | **CREDIT: 3****HOURS: 5/W** |

**Learning objectives**

The main objectives of this course are to

* Impart knowledge on gene manipulation and gene transfer technologies
* Make the students understand the procedures involved in plant tissue culture.
* Acquire knowledge on animal cell culture and stem cell technology.
* Improve the employability skills of students by providing knowledge in recent techniques such as PCR, blotting, ELISA etc.
* Understand the application of fermentation technology.

**Unit - I: Recombinant DNA technology**

Recombinant DNA technology - Principles of gene cloning: restriction endonucleases and other enzymes used in manipulating DNA molecules. Ligation of DNA molecules, DNA ligase, linkers and adapters, homopolymer tailing. end labeling and construction maps of PBR322, λ bacteriophage.15 Hrs

**Unit - II: Plant Tissue culture**

Plant tissue culture- basic requirements for culture, M S medium, callus culture, protoplast culture. Vectors – Ti plasmid (cointegration vector and binary vector), Viral vectors- TMV, CaMV and their applications. Transgenic plants – pest resistant, herbicide resistant and stress tolerant plants**.**15 Hrs

**Unit - III:** **Animal Tissue culture**

Animal cell lines and organ culture - culture methods and applications. Transgenic animals: transgenic mice- Production and its applications. Stem cell technology: definition, types, and applications. 15 Hrs

**Unit - IV: Molecular Techniques**

PCR –Principle, types and its application in clinical diagnosis and forensic science. Southern blotting, Northern blotting and DNA finger printing Technique-principle and their applications. 15 Hrs

**Unit - V: Fermentation technology**

Fermentation technology – Fermentors - general design, fermentation processes - Media used, downstream processing. Production and applications of ethanol, Streptomycin and Proteases.Production of edible vaccines. 15 Hrs

**Course Outcomes**

|  |  |  |
| --- | --- | --- |
| **CO** | **On completion of this course, students will be able to** | **Programoutcomes** |
| CO1 | Acquire knowledge on rDNA technology, DNA manipulation, and use of restriction endonuclease | PO1,PO3 |
| CO2 | Get acquainted with the use of cloning and vectors in plant tissue culture. | PO1,PO2,PO3 |
| CO3 | Understand the methods for production of proteins using recombinant DNA technology and their applications, basics of tissue culture, transgenesis, stem cell technology, risks, and safety aspects and patenting in biotechnology | PO1,PO3 |
| CO4 | Gain knowledge about the importance of gene and gene manipulation technologies | PO1,PO3 |
| CO5 |  Know the concept fermentation technology and its applications. | PO1,PO3 |

**Text Books**

1.James D. Watson , Amy A. Caudy , Richard M. Myers , Jan Witkowski (2006)Recombinant DNA: Genes and Genomes - a Short Course (3rd ed),W.H.Freeman & Co

2. Satyanarayana U (2008), Biotechnology, Books & Allied (P) Ltd.

3. Cassida L (2007) Industrial Microbiology , New Age International

**Reference books**

1. Reed G (2004) Prescott and Dunn’s Industrial Microbiology, CBS Publishers & Distributors

2.Biotechnology: applying the genetic revolution- David P. clark , Pazdernik N. J, Elsevier (2009).

3.Click B.R. and Pasternark J.J (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. (4th ed) American Society for Microbiology

**Web Sources**

NPTEL Certification course - Gene Therapy by Sachin Kumar <https://nptel.ac.in/courses/102/103/102103041/>

Coursera Certification course –Vaccines

https://futureoflife.org/background/benefits-risks-biotechnology/

https://www.sciencedirect.com/topics/neuroscience/genetic-engineering

http://www.biologydiscussion.cm/biotechnology/techniques-biotechnology/important-techniques-of-biotechnology-3-techniques/15683

https://iopscience.iop.org/book/978-0-7503-1347-6/chapter/bk978-0-7503-1347-6ch1

https://www.slideshare.net/zeal\_eagle/fermentation-technology

https://www.slideshare.net/zeal\_eagle/fermentation-technology

<https://www.slideshare.net/Chepkitwai/blotting-techniques-6129300>

**Mapping with Program Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
| **CO 1** | 3 |  | 3 |  | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 |  | 3 |  | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 |  | 3 |  | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 |  | 3 |  | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 |  | 3 |  | 3 | 3 | 3 | 3 | 3 | 3 |

**S-Strong (3) M-Medium (2) L-Low (1)**

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| **SEMESTER: VI****PART: V** | **23UBIOF66** **PROFESSIONAL COMPETENCY SKILL - I****MOLECULAR DIAGNOSTICS** | **CREDIT:2** **HOURS:2** |

**Learning Outcome:**

The paper provides adequate knowledge to learn the significance and history of molecular diagnostics. In the course objectives are framed to give different immunodiagnostic methods and their specific applications.

**Course outcomes**:

At the end of the Course, the Student will be able to:

|  |  |
| --- | --- |
| CO-1 | Understand the basic concepts of molecular diagnostics. |
| CO-2 | Learn the traditional methods of disease diagnosis. |
| CO-3 | Understand about the molecular methods of disease diagnosis. |
| CO-4 | Understand the applications of molecular diagnostic procedures. |
| CO-5 | Knowledge the Diagnose and interpret different diseases using assays. |

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| **Unit** | **Content** | **Hours** |
| **I** | Introduction and History of diagnostics of diseases, mode of infection, types of infectious diseases, philosophy, and general approach to clinical specimens. | 6 |
| **II** | Diagnosis of infectious diseases caused by bacteria, fungi, viruses, protozoa, and Helminthes. Detection and quantification of biochemical parameters. | 6 |
| **III** | Disease identification and Genetic tests of disorders; Population screening for genetic disorders; Treatment and management of genetic disorders. | 6 |
| **IV** | PCR-based microbial typing; Culture-independent analysis of bacteria; Molecular diagnosis of fungal pathogens; RAPD for animals and plants. | 5 |
| **V** | Types [RIA, ELISA, Chemiluminescent IA, FIA] and specific applications; Immunohistochemistry – principle, and techniques. Different Levels of Biosafety, Containment. | 6 |
| **Reference Book**1. Bruce Alberts. Molecular biology of the cell. 6th Edition.
2. Darnell J, Lodish H, and Baltimore D. Molecular Cell Biology.
3. De Robertis EDP and De Robertis EMF. Cell and Molecular Biology.
4. Ralph Michael Aloisi, Lippincott Williams, and Wilkins. Principles of Immunology and Immunodiagnostics.
5. Valones et al., Braz. J. Microbiol., (2009). Principles and applications of polymerase chain reaction in medical diagnostic fields: a review 40, 1–11.
6. Daniel. C.L., “Introduction to Proteomics”, Humana Press. 2002
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| **SEMESTER: VI****PART: V** | **23UBIOX67: EXTENSION ACTIVITY** | **CREDIT: 1****HOURS: ---** |

**(Refer to the Regulations)**