GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(GITAM)
(Deemed to be University, Estd. u/s 3 of UGC Act 1956)
∗VISAKHAPATNAM ∗HYDERABAD ∗BENGALURU∗
Accredited by NAAC with 'A^{+}' Grade

REGULATIONS AND SYLLABUS

of

Bachelor of Science
(BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS)

(w.e.f. 2020-21 admitted batch)

Website: www.gitam.edu

B.Sc. (DEGREE BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS)

REGULATIONS

(w.e.f. 2020-21 admitted batch)

1.0 ADMISSIONS

Admissions into B.Sc. (Biochemistry, Microbiology and Bioinformatics) of GITAM (Deemed to be University) are governed by GITAM (Deemed to be University) admission regulations.

2.0 ELIGIBILITY CRITERIA

2.1 A pass in Intermediate with Physics, Chemistry and Maths/Biology/+2/ D.Pharmacy/ Vocational course with Fisheries/Sericulture/Dairying/D.MLT with a minimum aggregate of 50% marks or any other equivalent Examination approved by GITAM (Deemed to be University).

2.2 Admission into B.Sc. (Biochemistry, Microbiology and Bioinformatics) will be based on the marks obtained in intermediate or equivalent examination and the rule of reservation, wherever applicable.

3.0 CHOICE BASED CREDIT SYSTEM

Choice based credit system (CBCS) is introduced with effect from the admitted batch of2015-16 based on UGC guidelines in order to promote:

- Student centered learning
- Cafeteria approach
- Inter-disciplinary learning.

Learning goals/objectives and outcomes are specified leading to what a student should be able to do at the end of the program.

4.0 STRUCTURE OF THE PROGRAMME

4.1 The program consists of:

i) Ability enhancement compulsory core courses (AECC)
ii) Core Courses (compulsory) (CC)
iii) Discipline specific electives (DSE)
iv) Discipline Specific Core (DSC)
v) Practical Proficiency Courses (PPC): Laboratory and Project work

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each lecture / tutorial hour.
- Two credits for three hours of practicals.

4.4 The curriculum of six semesters B.Sc. (Biochemistry, Microbiology and Bioinformatics) program is designed to have a total of 127 credits for the award of B.Sc. (Biochemistry, Microbiology and Bioinformatics) degree.

5.0 MEDIUM OF INSTRUCTION:

The medium of instruction (including examinations and project reports) shall be English.

6.0 REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute / University.

7.0 ATTENDANCE REQUIREMENTS

7.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He /She have to repeat the semester along with his / her juniors.

7.2 However, the Vice Chancellor on the recommendation of the Principal/ Director of the University College / Institute may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine medical grounds and on payment of prescribed fee.

8.0 EVALUATION

8.1 The assessment of the student's performance in a Theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end examination (60 marks).

8.2 A student has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24 marks (i.e. 40%) in the theory component at the semester-end examination.

8.2.1 Practical/ Viva voce/ Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table 1.

9.0 REAPPEARANCE

9.1 A student who has secured 'F' grade in a Theory course shall have to reappear at the subsequent semester end examinations held for that course.

9.1.1 A student who has secured 'F' grade in a Practical course shall have to attend Special Instruction Classes held during summer.

9.1.2 A student who has secured 'F' Grade in Project work / Industrial Training etc., shall have to improve his/her report and reappear for Viva – voce at the time of Special Examination to be conducted in the summer vacation.

10.0 SPECIAL EXAMINATION

A student who has completed his/her period of study and still has "F" grade in a maximum of three Theory courses is eligible to appear for Special Examination normally held during summer vacation.

11.0 BETTERMENT OF GRADES

A student who has secured only a Pass or Second class and desires to improve his/her Class can appear for Betterment Examinations only in Theory courses of any Semester of his/her choice, conducted in Summer Vacation along with the Special Examinations. Betterment of Grades is permitted 'only once' immediately after completion of the program of study.

Table 1: Assessment Procedure

S. No.	Component of assessment	Marks allotted	Type of Assessment	Scheme of Examination
1	Theory	40	Continuous evaluation	(i) Two mid semester examinations shall be conducted for 15 marks each. (ii) 5 marks are allocated for quiz. (iii) 5marks are allocated for assignments.
		60	Semester-end examination	The semester-end examination shall be for a maximum of 60 marks.
	Total	100		
2	Practicals	40	Continuous evaluation	Forty (40) marks for continuous evaluation is distributed among the components: regularity, preparation for the practical, performance, submission of records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the Semester.
		60	Continuous evaluation	Sixty (60) marks for two tests of 30 marks each (one at the mid-term and the other towards the end of the Semester) conducted by the concerned lab Teacher and another faculty member of the department who is not connected to the lab, as appointed by the HoD.
	Total	100		

12.0 GRADING SYSTEM

12.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table-2.

Table 2: Grades & Grade Points

Sl.No.	Grade	Grade Points	Absolute Marks
1	O (outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab. (Absent)	0	-

12.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPA of 5 for a Pass in the semester.

13.0 GRADE POINT AVERAGE

13.1 A Grade Point Average (GPA) for the semester/trimester will be calculated according to the formula:

$$GPA = \frac{\Sigma [C \times G]}{\Sigma C}$$

Where C = number of credits for the course, G = grade points obtained by the student in the course.

13.2 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student's performance in all the courses taken, in all the semesters up to the particular point of time.

13.3 CGPA required for classification of class after the successful completion of the program is shown in Table 3.

Table 3: CGPA required for award of Class

Distinction	≥ 8.0*
First Class	≥ 7.0
Second Class	≥ 6.0
Pass	≥ 5.0

* In addition to the required CGPA of 8.0, the student must have necessarily passed all the courses of every semester in first attempt.

14.0 ELIGIBILITY FOR AWARD OF THE B.Sc. DEGREE

14.1 Duration of the program: A student is ordinarily expected to complete B.Sc. program in six semesters of three years. However a student may complete the program in not more than five years including study period.

14.2 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

14.3 A student shall be eligible for award of the B.Sc Degree if he / she fulfills all the following conditions.

a) Registered and successfully completed all the courses and projects.

b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.

c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc, and d) No disciplinary action is pending against him / her.

14.4 The degree shall be awarded after approval by the Academic Council

15.0 Discretionary Power: Notwithstanding anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

Program Educational Objectives (PEOs)

B.Sc., Biochemistry, Microbiology and Bioinformatics science graduates, within three years of graduation should

1. Exhibit an ability to apply fundamental knowledge related to biochemical, microbial and bioinformatic knowledge in an interdisciplinary manner for providing solutions to need based problems.
2. Engross an ability to decisively analyze scientific data, draw objective inferences and apply this knowledge for human welfare.
3. Be able to demonstrate proficiency and ethical perception on areas relevant to Biochemistry, Microbiology and Bioinformatics.
4. Acquire communication skills and exhibit commitment towards teamwork which is necessary for functioning productively and professionally on multidisciplinary fields.

Program Objectives (PO)

At the end of this program, the student will be able to

PO 1: Understand various aspects of biomolecules and an overview of their metabolic events

PO 2: Understand various aspects of cell, cellular events, and genetic basis of life.

PO 3: Gain knowledge in conventional techniques, modern analytical techniques, omics, bioinformatic approaches and nanotechnologies.

PO 4: Acquaint the principles of enzymology, kinetics and their applications in industry and medicine

PO 5: Gain an overview of the organization of vital physiological systems, their function and abnormalities in both animal and plant systems

PO 6: Gain theoretical and practical knowledge of genome, expression of genes and, their regulation, repair and application of rDNA technology for superior traits.

PO 7: Understand various clinically important microorganisms; and the elicitation and regulation of immune response.

PO 8: Gain knowledge of microorganisms and bioprocess technologies with reference to production of enzymes, vitamins, antibiotics and organic acids.

PO 9: Acquire knowledge regarding implementation of various computational approaches to discover and analyze biologically related active compounds

PO 10: Acquaint and apply intellectual property rights (IPR) principles to real problems and analyse the social impact

PO 11: Gain knowledge in diagnosis, prognosis and management of various diseases and addressing clinical problems

PO12: Acquaint core principles and techniques required in the design and implementation of database systems

Program Specific Outcomes (PSOs)

PSO 1: Gain knowledge and insights on various aspects of Biochemistry

PSO 2: Gains knowledge on various microorganisms and their importance and applicability in clinical medicine and in different fields of industry

PSO 3: Apply knowledge, Bioinformatic tools, programing, maintaining databases, drug designing and various applications of Bioinformatics.

B.Sc. (BIOCHEMISTRY, MICROBIOLOGY, BIOINFORMATICS)

SCHEME OF INSTRUCTION

I SEMESTER

Course Code	Subject	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	P		CE	SE	Total Marks
GEL131	Communicative English	AECC	2	2	3	40	60	100
SBC101	Biomolecules	CC	4	-	4	40	60	100
SBC121	Biochemistry: Qualitative Analysis Lab	PPC	-	3	2	100	--	100
SMB101	Introduction to Microbiology	CC	4	0	4	40	60	100
SMB 121	Practices in Microbiology Lab	PPC	-	3	2	100	--	100
SBC105	Fundamentals of Computers	CC	4	-	4	40	60	100
SBC125	Basic Computers Lab	PPC	-	3	2	100	--	100

Total Credits: 21

II SEMESTER

B. Sc. BIOCHEMISTRY, MICROBIOLOGY, BIOINFORMATICS

Course Code	Subject	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	P		CE	SE	Total Marks
SFC 102	Environmental Science	AECC	3	-	2	40	60	100
SBC 102	Nucleic acids and Enzymology	CC	4	-	4	40	60	100
SBC 120	Enzymology Lab	PPC	3	-	2	100	--	100
SMB 100	Bacteriology	CC	4	-	4	40	60	100
SMB 120	Bacteriology Lab	PPC	0	3	2	100	--	100
SBC 106	Basics in Programming	CC	4	-	4	40	60	100
SBC 124	Basic Programming Lab	PPC	-	3	2	100	--	100
VDC111	Venture Discovery	SEC	2		2	100	--	100

Total Credits: 22

III SEMESTER

B. Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

Course Code	Subject	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	P		CE	SE	Total Marks
SBC 201	Bioenergetics and Metabolism I	CC	4	-	4	40	60	100
SBC 221	Biochemistry : Quantitative Analysis Lab	PPC	3	-	2	100	--	100
SMB 201	Microbial Genetics	CC	4	0	4	40	60	100
SMB 221	Microbial Genetics Lab	PPC	-	3	2	100	--	100
SBC 205	Computational biology	CC	4	-	4	40	60	100
SBC 225	Computational biology Lab	PPC	-	3	2	100	--	100
Choose any one								
SSE 279	Mathematics for Biology	SEC	2	-	2	100	--	100
SSE 281	Introduction Algorithms I	SEC	2	-	2	100	--	100

Total Credits: 22

IV SEMESTER

B. Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

Course Code	Subject	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	P		CE	SE	Total Marks
SBC 202	Metabolism II and Biochemical techniques	CC	4	-	4	40	60	100
SBC 220	Biochemical Techniques Lab	PPC	-	3	2	100	--	100
SMB 200	Food And Dairy Microbiology	CC	4	-	4	40	60	100
SMB 220	Food And Dairy Microbiology Lab	PPC	-	3	2	100	--	100
SBC 206	Database Management System	CC	4	-	4	40	60	100
SBC 224	DBMS Lab	PPC	-	3	2	100	--	100
Choose any one								
SSE 282	Purification Techniques	SEC	2	-	2	100	--	100
SSE 284	Biostatistics	SEC	2	-	2	100	--	100

Total Credits: 20

V SEMESTER

B. Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

Course Code	Subject	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	**P**		**CE**	**SE**	**Total Marks**
Choose any one								
SBC 351*	Clinical Biochemistry and Immunology	DSE	4	-	4	40	60	100
SBC 353**	Human Physiology and Nutrition	DSE	4	-	4	40	60	100
Choose any one (*corresponding to theory course)								
SBC 321*	Clinical Biochemistry and Immunology Lab	PPC	-	3	2	100	--	100
SBC 323**	Human Physiology and Nutrition Lab	PPC	-	3	2	100	--	100
Choose any one								
SMB 341	Medical And Diagnostic Microbiology	DSE	4	-	4	40	60	100
SMB 343@	Ecology And Agricultural Microbiology	DSE	4	-	4	40	60	100
Choose any one		**(@ corresponding to theory course)**						
SMB 321	Medical And Diagnostic Microbiology Lab	PPC	3	-	2	100	--	100
SMB 323@@	Ecology And Agricultural Microbiology Lab	PPC	3	-	2	100	--	100
Choose any one								
SBC381	Structural Bioinformatics	DSE	4	-	4	40	60	100
SBC383	Concepts of Genomics and Proteomics	DSE	4	-	4	40	60	100
Choose any one (# corresponding to theory course)								
SBC 339#	Structural Bioinformatics Lab	PPC	-	3	2	100	--	100
SBC 341##	Genomics and Proteomics Lab	PPC	-	3	2	100	--	100
Choose any one								
SSE 381	Basics of Unix	SEC	2	-	2	100	--	100

SSE 383	Industrial Biochemistry	SEC	2	-	2	100	--	100
SSE 385	Introduction to Algorithms-II	SEC	2	-	2	100	--	100

Total Credits: 20

VI SEMESTER

B. Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

Course Code	Subject	Category	Instruction Hours/ week		Credits	Scheme of Instruction		
			L	**P**		**CE**	**SE**	**Total Marks**
Choose any one								
SBC 352*	Applied Biochemistry	DSE	4	-	4	40	60	100
SBC 354**	Molecular Biology	DSE	4	-	4	40	60	100
Choose any one (*corresponding to theory course)								
SBC322*	Applied Biochemistry Lab	PPC	-	3	2	100	--	100
SBC324**	Molecular Biology Lab	PPC	-	3	2	100	--	100
Choose any one								
SMB340	Microbial Physiology And Fermentation Technology	DSE	4	-	4	40	60	100
SMB342	Immunology	DSE	4	-	4	40	60	100
Choose any one (@ corresponding to theory course)								
SMB 320@	Microbial Physiology And Fermentation Technology Lab	PPC	3	-	2	100	--	100
SMB 322@@	Immunology Lab	PPC	3	-	2	100	--	100
Choose any one								
SBC382	Drug Designing	DSE	4	-	4	40	60	100
SBC384	JAVA programming	DSE	4	-	4	40	60	100
Choose any one (# corresponding to theory course)								
SBC 340#	Drug Designing Lab	PPC	-	3	2	100	--	100
SBC 342##	Java programming Lab	PPC	-	3	2	100	--	100
Project								
SBC 392	Minor Research Project	PP	-	5	4	100	--	100

Total Credits: 22

B.Sc. (BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS)
I SEMESTER
GEL-131: COMMUNICATIVE ENGLISH
(B TECH, BBA & BSC SEMESTER I (2020-21)

No. of hours per week: 03 **Credits: 03**

Preamble L T P 2
0 2 3

The course is a unified approach to enhance language skills of learners with an aim to hone their social skills and to increase their employability. The course is designed to acquaint the learners with the necessary LSRW (Listening/ Speaking / Reading/ Writing) skills needed either for recruitment or further studies abroad for which they attempt international exams like TOEFL, IELTS and GRE. It enables the learners improve their communication skills which are crucial in an academic environment as well as professional and personal lives.

Course Objectives

- To enable learners to develop listening skills for better comprehension of academic presentations, lectures and speeches.
- To hone the speaking skills of learners by engaging them in various activities such as just a minute (JAM), group discussions, oral presentations, and role plays.
- To expose learners to key Reading techniques such as Skimming and Scanning for comprehension of different texts.
- To acquaint the learners with effective strategies of paragraph and essay writing, and formal correspondence such as email, letters and resume.
- To provide learners with the critical impetus necessary to forge a path in an academic environment, in the professional life and in an increasingly complex, interdependent world.
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UNIT I

LISTENING: Listening for gist and specific information
SPEAKING: Introducing self and others; Developing fluency through JAM
READING: Skimming for gist and Scanning for specific information
WRITING: Paragraph writing-writing coherent and cohesive paragraph (narrative and descriptive); use of appropriate Punctuation.
GRAMMAR & VOCABULARY: Articles &Prepositions;
Word Families (Verbs, Nouns, Adjectives, Adverbs; Prefixes and Suffixes)

Learning Outcomes:

After completion of this unit, the learners will be able to

- Apply the requisite listening skills and comprehend at local and global level. (L4 and L2) (L5)
- Introduce themselves with accurate structure in diverse social and professional contexts. (L3)
- Apply relevant reading strategies for comprehension of any given text(L3)
- Write a paragraph using cohesive devices maintaining coherence (L3)

- Understand the Use of Articles and Prepositions, and apply appropriately for meaningful communication (L3)

Understand the relevance of various categories in word family and apply them meaningfully in context (L3)

UNIT II

LISTENING: Listening for Note taking and Summarizing
SPEAKING: Role plays and Oral Presentations.
READING: Intensive Reading-Reading for implicit meaning
WRITING: Note making and summarizing
GRAMMAR & VOCABULARY: Verb forms-Tenses; synonyms to avoid repetition in speech and writing.

Learning Outcomes:

After completion of this unit, the learners will be able to

- Employ note taking and summarizing strategies to comprehend the listening text (L2)
- Use strategies for successful and relevant oral presentation (L3, L4)
- Demonstrate effective communication skills by applying turn-taking and role distribution techniques for meaningful and contextual Speaking (L3 and L4)
- Apply various reading strategies imbibing inferential and extrapolative comprehension of any given text. (L2, L3)
- Apply various note-making techniques while comprehending the reading text to present a complete and concise set of structured notes (, L3, L4, L5)
- Apply the notes to draft a summary (L3)
- Use correct tense forms and appropriate structures in speech and written communication (L3)
- Context specific use of Prefixes and Suffixes for meaningful communication (L3)

UNIT III

LISTENING: Listening for presentation strategies: introducing the topic, organization of ideas, conclusion.
SPEAKING: Aided presentations
READING: Inferring using textual clues
WRITING: Formal Letter and Email writing
GRAMMAR & VOCABULARY: Active and Passive Voice; linkers and discourse markers.

Learning Outcomes:

After completion of this unit, the learners will be able to

- Notice and understand effective listening strategies to identify discourse markers in presentations. (L1, L2)
- Make formal oral presentations using effective strategies such as audio – visual aids (L3)
- Infer meaning and inter – relatedness of ideas (L4)
- Understand relevant structures and draft formal letters in suitable format (L3, L4)
- Construct relevant sentences in active and passive voice for meaningful communication (L2, L3)

- Comprehend and apply available vocabulary items relevant to the context (L1, L2, L3)
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UNIT IV

LISTENING: Listening for labeling-maps, graphs, tables, illustrations
SPEAKING: Aided group presentation using charts, graphs etc.
READING: Reading for identification of facts and opinions
WRITING: Information transfer (writing a brief report based on information from graph/chart/table)
GRAMMAR & VOCABULARY: Subject-verb agreement; language for comparison and contrast; Antonyms

Learning Outcomes:
After completion of this unit, the learners will be able to

- Match visual and auditory inputs and use the information comprehensively and will adequately demonstrate important relationships or patterns between data points (L2)
- choose and coordinate resources appropriate to context and speak intelligibly (L3, L4)
- Develop advanced reading skills for analytical and extrapolative comprehension (L4, L5)
- Make decisions on arrangement of ideas and transfer them from visual to verbal form using context appropriate structure. (L3, L4)
- Demonstrate ability to use task specific grammatically correct structures (L3)
  Comprehend and use expressions for negation/contradiction ((L2, L3)

UNIT V

LISTENING: Listening to discussions for opinions
SPEAKING: Group Discussion
READING: Reading for inferences
WRITING**:** Guided Essay Writing (argumentative)
GRAMMAR & VOCABULARY: Editing short texts: correcting common errors in grammar and usage; Action verbs for fluency and effective writing.

Learning Outcomes:
After completion of this unit, the learners will be able to

- Apply analytical and problem-solving strategies to identify and interpret facts and opinions from a dialogue. (L3)
- Able to administer group dynamics to contribute valid ideas to a discussion with clarity and precision (L3)
- Demonstrate techniques to analyze contextual clues(L4)
- Compare and correlate ideas and facts to produce an organized essay with adequate supporting evidences (L4, L5)
- Organize the available structural/grammatical knowledge and apply them in a real time context (L3)
- Comprehend meaning for new words/phrases used and apply them in a new context. (L2, L3)

Course Outcomes

By the end of the course, the learners will be able to:

- Think critically, analytically, creatively and communicate confidently in English in social and professional contexts with improved skills of fluency and accuracy.
- Write grammatically correct sentences employing appropriate vocabulary suitable to different contexts.
- Comprehend and analyze different academic texts.
- Make notes effectively and handle academic writing tasks such as Paragraph writing and Essay writing.
- Effectively handle formal correspondence like e-mail drafting and letter writing .

Reference Books:

1.Arosteguy, K.O. and Bright, A. and Rinard, B.J. and Poe, M. ***A Student's Guide to Academic and Professional Writing in Education***, UK, Teachers College Press,2019
2.Raymond Murphy, ***English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English*** : Cambridge University Press;2019
3.Peter Watkins, ***Teaching and Developing Reading Skills***: UK, CUP, 2018
4.Deeptha Achar et al. ***Basic of Academic Writing***. (1and 2) parts New Delhi: Orient BlackSwan. (2012& 2013).
5.Kumar S and Lata P, ***Communication Skills***: New Delhi Oxford University Press, 2015

B.Sc. (BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS)
I SEMESTER

SBC 101: BIOMOLECULES

No. of hours per week: 04 **Credits: 04**

Preamble:

Biochemistry is a discipline, which aims at understanding the chemical properties of the biomolecules, their structural architecture, principles of stereochemistry and molecular forces responsible for the activities of biomolecules. The course includes their importance in understanding various bio molecular reactions and how they fold to their native, functional forms.

Course Objectives

- To understand the role of water, pH, buffers & osmotic pressure in biological system
- To understand the structural and biological roles of carbohydrates (Mono, oligo,polysaccharides).
- To gain the concept of lipids, their biological and chemical roles.
- To acquire and understand the structures of DNA and RNA, sequence determination andsynthesis.
- To study the structure & biological role of porphyrins and to remember chemistry andphysiological role of vitamins.

UNIT – I

Biophysical Concepts**:** Basic classification of biomolecules, Role of water in biological processes. Biological importance of pH, pKa of functional groups in proteins and nucleic acids. Importance of buffers in biological systems. Significance of osmotic pressure in biologicalsystems

Learning outcomes:

By the end of this Unit, the student will be able to

- Understand the classification of biomolecules (L2).
- Describe the role of water in biological processes (L1).
- Describe the biological role of pH, pKa of functional groups (L1).
- Understand the importance of buffers in biological buffers (L2).
- Understand the significance of osmotic pressure in biological systems (L2).

UNIT – II

Carbohydrates: Classification, monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation, reactions of carbohydrates. Structure and

biological importance of disaccharides (sucrose, lactose, maltose). Biological importance of structural polysaccharides (cellulose) and storage polysaccharides (starch, glycogen).

Learning outcomes:

By the end of this Unit, the student will be able to

- Understand the classification and chemical properties of carbohydrates (L2).
- Describe the chemistry and biological roles of mono and disaccharides (L1).
- Describe the structure and role of homo, heteropolysaccharides (L1).
- Understand the structure and biological role of peptidoglycans, glycosaminoglycans andglycoproteins (L2).
- Elucidate the structure of starch (L2).

UNIT – III

Lipids : Classification, saturated and unsaturated fatty acids, structure and properties of fats and oils. General properties and structures of phospholipids, sphingolipids and cholesterol. Biomembranes - Behavior of amphipathic lipids in water. Formation of micelles, bilayers,vesicles, liposomes.

Learning outcomes:
By the end of this Unit, the student will be able to

- Know the classification and properties of fatty acids, fats and oils (L1)
- Describe the chemistry and biological roles of phospholipids in membranes (L2).
- Describe the biological roles of phospholipids and sphingolipids (L2).
- Understand the biological role of prostaglandins (L2).
- Explain the structure and properties of

cholesterol (L2).

UNIT-IV

Nucleic Acids: Structure of purines and pyrimidines, nucleosides, nucleotides. Importance of phosphodiester bond. Watson-Crick DNA double helix structure, Types of RNA and DNA. Effect of acids, alkali and nucleases on DNA and RNA. Denaturation of nucleic acids. Structure and properties of porphyrins

Learning outcomes:
By the end of this Unit, the student will be able to

- Know the structure and properties of bases, nucleosides, nucleotides (L1).
- Understand the importance of phosphodiester bond (L2)
- Understand the structure of DNA, RNA and its forms (L2).
- Learn the effects of acids, alkali and nucleases on DNA and RNA (L2).
- Know the structure and biological role of porphyrins – Heme (L1).

UNIT-V

Basic structure of Bacteria, plant and animal cell. Membrane composition and organization, Fluid mosaic model. Structure and functions of cell organelles – Mitochondria, Chloroplast, Endoplasmic reticulum, Nucleus, Golgi body.

Recommended books:

1. Text book of Biochemistry by West and Todd, Oxford and IBH, 4th Ed.
2. Principles of Biochemistry by Nelson cox, Freeman, 4th Ed.
3. Biochemistry by Voet and Voet, John Wiley and Sons, 3rd Ed.
4. Outlines of Biochemistry by Conn and Stumpf, John Wiley and Sons, 5th Ed

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
I SEMESTER

SBC 121: BIOCHEMISTRY: QUALITATIVE ANALYSIS LAB

No. of hrs/week: 03 Credits: 02

List of experiments:

1. Preparation of buffers (acidic, neutral and alkaline) and determination of *p*H.
2. Qualitative identification of carbohydrates- glucose, fructose, ribose/xylose, maltose, sucrose, lactose, starch/glycogen.
3. Qualitative identification of amino acids – histidine, tyrosine, tryptophan, cysteine, arginine.
4. Qualitative identification of lipids- solubility, saponification, acrolein test, Salkowski test, Lieberman-Burchard test.
5. Preparation of Osazones and their identification.
6. Absorption maxima of colored substances- *p*-Nitrophenol, Methyl orange.

Recommended books:

1. Biochemical methods by Sadasivam and Manikam, Wiley Eastern Limited.
2. An introduction to practical Biochemistry by D. T. Plummer, McGraw Hill.
3. Laboratory manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited.
4.Introductory Practical Biochemistry by S. K. Sawhney and Randhir Singh, Narosa.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
I SEMESTER
SMB 101: INTRODUCTION TO MICROBIOLOGY

No. of hrs/week: 04 **Credits: 04**

Preamble:
This paper provides a base line understanding of Microbiology and has been designed to enrich students an insight in acquiring the fundamental knowledge on various microorganisms and their importance and applicability in different fields of industry.

Course Objectives:
The objective of this course is to introduce field of microbiology with special emphasis on microbial diversity, morphology, physiology, and nutrition; methods for control of microbes and host-microbe interactions.

UNIT- I
History of microbiology, Spontaneous generation theory. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Beijerinck, Winogradsky, Edward Jenner,Ivanowski.Germ theory of disease, golden era of microbiology.

Learning outcomes:
By the end of the course, the student will be able to: • Develop a detailed knowledge on history of Microbiology and golden age of Microbiology • Learn the contribution of prominent Scientists to the development of Microbiology

UNIT-II
Classification: Whittaker's and Carl Woese's three kingdom classification systems and introduction to Bergey's manual. Prokaryotic and eukaryotic cell organization. Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (bacteria, algae, fungi and protozoa).

Learning outcomes:
By the end of the course, the student will be able to: • Understand the classification systems and Bergey' manual • Learn cell organization of Prokaryotes and eukaryotes • Develop knowledge on Acellular microorganisms

UNIT-III
General characteristics of algae, occurrence, thallus organization, algal cell ultra-structure, pigments, flagella, eyespot food reserves.Vegetative, asexual and sexual reproductions.Economic importance of algae.

Learning outcomes:
By the end of the course, the student will be able to: • Acquire knowledge about mode of reproduction, general characteristics, occurrence, and importance of Algae.

UNIT-IV
General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cellultra-structure, thallus organization, typesofsepta, asexualre production, typesofspores (asexual and sexual), sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic importance offungi.

Learning outcomes:
By the end of the course, the student will be able to: • Acquire knowledge about mode of reproduction, general characteristics, occurrence, and importance of Fungi.

UNIT-V
General characteristics with special reference to *Amoeba, Euglena,* and *Paramecium.* Virus taxonomy, ICTV, Baltimore, virus structure, and cultivation of virus-Embryonated egg, tissue culture; TMV, lytic and lysogenic cycle (T4 and λ phages).

Learning outcomes:
By the end of the course, the student will be able to:
• Acquire knowledge regarding individual microbes
• Develop a detailed knowledge on taxonomy, structure, and cultivation of viruses
• Learn the concepts of viral replication.

Course Outcomes:
On completion of this course, students should be able to
• Describe the main steps and processes used to classify microorganisms
• Discover new useful microorganisms and store them reliably for later use
• Evaluate which molecular techniques are applicable to isolate, identify and culture different types of microbes

RECOMMENDED BOOKS:
1. Microbiology: An Introduction (2016) by Tortora*et al.,* 12th Edition Pearson publishers
2. Prescott's Microbiology (2016) by Joanne Willey *et al.,* 10th Edition McGraw-Hill Education
3. Sherris Medical Microbiology, (2018) by Kenneth J. Ryan *et al.,* 7th Edition McGraw-Hill Education
4. Brock Biology of Microorganisms (2015) by Michael T. Madigan (15th Edition), Pearson publishers
5. Algae (2008) by James E. Graham (2nd Edition), Benjamin Cummings
6. The Fungi by Sarah C. Watkinson, Academic Press; 3rd Edition (2016)
7. Fungi: Experimental Methods in Biology (2019) by Ramesh Maheshwari, 2nd Edition, CRC Press

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
I SEMESTER

SMB 121: PRACTICES IN MICROBIOLOGY LAB

No. of hrs/week: 03 **Credits: 02**

Preamble:

This paper has been designed to enrich students in learning the good laboratory practices and understand the principle and applications of important instruments used in Microbiology laboratory.

Course Objectives:

The objective of this laboratory course is to develop a detailed knowledge on instruments used in Microbiology laboratory and also provide practical skills in operation of basic microbiological instruments and learn the basic techniques of staining and preparation of temporary mounts.

1. Microbiology Good Laboratory Practices and Biosafety.
2. Principle and applications of biological safety cabinets, autoclave, bacteriological incubator, BOD incubator, hot air oven, light microscope, pH meter and colony counter
3. Study of *Rhizopus*, *Penicillium*, *Aspergillus* using temporary mounts
4. Study of *Spirogyra* and *Chlamydomonas, Volvox* using temporary mounts
5 Study of the following protozoans using permanent mounts/photographs: Amoeba, Entamoeba, Paramecium and Plasmodium

RECOMMENDED BOOKS:

1. Laboratory Exercises in Microbiology (2016) by John Harley 8th Edition, McGraw-Hill Education
2. Microbiology: A Laboratory Manual (2016) by James G. Cappuccino 11th Edition Pearson publishers
3. Microbiology: Laboratory Theory and Application (2015) 4th Edition by Michael J. Leboffe, Morton Publishing Company

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
I SEMESTER

SBC 105: FUNDAMENTALS OF COMPUTERS

No. of hrs/week: 04 **Credits: 04**

Preamble:

Computer education involves learning of how the basic concepts related to a computer works, gaining the basic knowledge of computer operation, knowing about the basic components of a computer, the basic concepts behind the use of computers and knowing how some of the elementary computer applications constitute computer education. As computers are widely used today, acquiring computer education is the need of the day today.The basic computer skills that every person should know include common application programs such as Microsoft Word, Microsoft Excel, Power point as well operation of internet based applications.

Course Objectives:

At the end of the course a student is expected to:

- describe the organization and operation of a computer processor, primary and secondarymemory, peripheral devices and to give computer specifications;
- explain the representation of data and information in computer systems and types of operating systems
- use standard word, and spreadsheets, graphics generation using power point
- use internet via search engines and information retrieval

UNIT – 1

Basic applications of computer; Concept of hardware and software, Components of computer system: CPU, input and output devices; Computer memory and various memory devices.

Learning Outcomes:

By the end of this unit, the student will be able to

- Differentiate between hardware and software and their role in computer.
- Explain about computer components in a computer system.
- Describe the types of computer memory devices and their applications.

UNIT – II

Concept of computing, data and information; Operating System: Structure, Features, Applications, Basics of popular OS: Linux, Windows.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the concept and terms of computing, data and information.
- Explain about role, features and applications of operating systems.
- Describe different types of OS.

UNIT – III

Basics of Word Processing & Spreadsheet: opening/closing documents, text/table creation, manipulation and formatting; Spread Sheet - manipulation of cells, formulas and functions.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the features of MS-word and spreadsheets.
- Describe the operation and applications of MS-word and spreadsheets.

UNIT – IV

Basics of Power Point: creation/preparation of slides, presentation of slides, Slide show, Basics of Computer Network: LAN, MAN, WAN; Types of network topologies.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the features and operation of MS-PowerPoint.
- Explain the concept of computer network and topologies
- Describe the types of computer networks.

UNIT – V

Concept of Internet and its Applications; World Wide Web, Web browsing software's, Understanding URL; Domain name; IP Address; Search engines, Communication using E-mail and media applications.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the concept of internet and applications.
- Describe the terms of internet like URL, IP and search engines.
- Describe the features and operation of communication and media applications.

Reference Books:

1. Computers Today, S.K BasandraGalgotia Publications, 2004.
2. Computer fundamentals by PK Sinha, BPB, New Delhi (1992) 2nd Edition.
3. Peter Norton's Computing Fundamentals Student Edition, Peter Norton, McGraw Hill Higher Education; 5th edition.

Course Outcomes:

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

- Bridge the fundamental concepts of computers with the present level of knowledge of the students
- Familiarise operating systems, programming languages, peripheral devices, networking, multimedia and internet
- Demonstrate the building up of documents, sheets, powerpoint by MS office applications.
- Understand the concept of internet and information retrieval via websites.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
I SEMESTER
SBC 125: BASIC COMPUTERS LAB

No. of hrs/week: 03 **Credits: 02**

Preamble:

Computer knowledge is very essential in day-to-day communication oriented applications. The usage of MS-office programs and internet is the minimum essential component in every one's life as the entire modern world is dependent on data driven applications. This course involves in understanding the features, operation of basic internet and office applications to meet industry requirements.

Course Objectives

- To explore Windows OS interface and features.
- To perform operation and explore features of MS-Office applications.
- To perform internet searches by search engines and communication through email.

Practical's Laboratory Sessions:

1. Understanding Windows OS interface and features.
2. Usage of applications software.
3. Usage of word processor and document preparation.
4. Usage of spread sheet.
5. Preparation of slide presentation.
6. Usage of search engines.
7. E-mail communication.
8. Usage of E-governance sites.

Learning outcomes:

By the end of this practical, the student will be able to

1. Use word processor and do documentation.
2. Use PowerPoint for presentations.
3. Use spreadsheets for data entry and compute basic calculations.
4. Search and retrieval of data using various search engines
5. Communicate to other online users via email.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
II SEMESTER

SFC 102: ENVIRONMENTAL SCIENCE

(Common syllabus for all UG science programmes of VSP, HYD and BLR campuses**)**

No. of hours per week: 03 **Credits: 02**

Preamble:

The dynamic changes in the Environment require as precise understanding to adjust to the changes. Thispaper provides a base line understanding of Environmental changes problems.

Objectives:

To enable student, understand importance of environmental science
To introduce student to ecosystem and its process, sources, and effects of Environmental Pollution.To Sensitize student regarding day to day social & environmental issues.

UNIT-I

The Multidisciplinary nature of environmental studies–Definition, Scope and Importance, Need for Public awareness. Natural Resources: Classification – Renewable and Non Renewable Resources. Renewable Resources: Forest, Water and Energy Resources Non Renewable Resources: Mineral, Food and Land resources (Uses, reasons for over-utilization and effects)

Learning Outcome:

By the end of the unit the student

- Will understand importance of Environmental Science & Natural Resources

UNIT-II

Eco-system: Structure of an Ecosystem, Producers, consumers and de-composers. Structure of Terrestrial Ecosystems (Forest ecosystem, Grassland ecosystem and Desert ecosystem) and Aquatic Ecosystems (Pond ecosystem and ocean ecosystem). Function of an ecosystem -food chains, food web and ecological pyramids - energy flow in the ecosystem. Environmental Pollution: Causes, effects and control measures of Air, Water, soil pollution, Thermal pollution, and nuclear hazards. Municipal solid waste management.

Learning Outcome:

By the end of the unit the student

- Will appreciate ecosystems and its process

UNIT-III

Environmental problems: Global Environmental Problems, Green house effect, Ozone layer depletion, acid rains and Climate change. National Environmental Problems: Deforestation – Causes and Effects, Environmental Problems associated with dams. Mining and Environmental effects.

Learning Outcome:

By the end of the unit the student

- Will gain knowledge as sources and effects of Environmental Pollution

UNIT-IV

Social Issues and the Environment: Environmental ethics, Issues and possible solutions. Waste land reclamation, Consumerism and waste products. Environmental Legislation: Environment Protection Act, Air Act, Water Act, Wildlife Protection act and Forest conservation act.

Learning Outcome:

By the end of the unit the student.

- Will get exposure towards social problems and gain understand on environmental legislation.

UNIT-V

Human Population and the Environment: Population growth, variation among nations, Population explosion-Family welfare programme. Environment and human health. Human rights, Value education, HIV/AIDS, Women and Child welfare, Role of information technology in environment and human health.

Learning Outcome:

By the end of the unit the student

- Will be to explain patterns of population growth and problems associated with it.

Course Outcomes:

On completion of this course, students will be able to

- Stay updated in environmental science and technologies by applying information resources andindustrial contacts
- Explain the role of information technology in environment and human health
- Hypothesize different environmental legislation acts and issues involved in enforcement oflegislation

RECOMMENDED BOOKS:

1. Text Book of Environmental studies for Undergraduate courses by Bharucha ErachPublished byV.G.C
2. Environmental Science: A Global Concern by William P.Cunningham andBarabaWoodworth Saigo.
3. A text book of Environmental Science byP.C.Joshi
4. A text book of Environmental Science by ArvindKumar
5. A text book of Environmental Science byS.C.Santra
6. Ecology & Environment byP.D.Sharma

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
II SEMESTER

SBC 102: NUCLEIC ACIDS AND ENZYMOLOGY

No. of hrs/week: 04 **Credits: 04**

UNIT-I

Nucleic Acids: Nature of nucleic acids. Structure of purines and pyrimidines, nucleosides, nucleotides. Stability and formation of phosphodiester linkages. Effect of acids, alkali and nucleases on DNA and RNA. Watson-Crick DNA double helix structure, denaturation of nucleic acids. Types of RNA and DNA.

UNIT-II

Porphyrins: Structure of porphyrins; Protoporphyrin, porphobilinogen properties, Identification of Porphyrins. Structure of metalloporphyrins – Heme, cytochromes and chlorophylls.

UNIT-III

Enzymes – Classification, Nomenclature. Enzyme specificity. Active site. Principles of energy of activation, transition state. Interaction between enzyme and substrate- lock and key, induced fit models. Definition of holo-enzyme, apo-enzyme, coenzyme, cofactor. Fundamentals of enzyme assay, enzyme units.

UNIT-IV

Enzyme Kinetics - Factors affecting the catalysis- substrate concentration, pH, temperature. Michaelis - Menten equation for uni-substrate reaction (derivation not necessary), significance of KM and Vmax. Enzyme inhibition- irreversible and reversible, types of reversible inhibitions- competitive and non-competitive.

UNIT-V

Mechanism and regulation of Enzyme action : Outline of mechanism of enzyme action- acid-base catalysis, covalent catalysis. ATCase as an allosteric enzyme, covalent modulation- phosphorylation, zymogen activation- activation of trypsinogen and chymotrypsinogen.

Recommended Books:

1. Fundamentals of Enzymology by Nicoles C. Price and Lewis Stevens, Oxford Uni. Press.
2. Understanding Enzymes by Trevor Palmer, Harvard publishing
3. Biochemistry by Voet and Voet, John Wiley and Sons, 3rd Ed.
4. Biochemistry by Stryer, WH Freeman and CO. 4th Ed.
5. Biochemistry by Lehninger, Kalyani Publishers.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
I SEMESTER

SBC 120: ENZYMOLOGY LAB

No. of hrs/week:03 **Credits: 02**

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1. Assay of amylase
2. Assay of protease
3. Assay of urease
4. Assay of catalase.
5. Assay of phosphatase
6. Determination of optimum temperature for phosphatase.
7. Determination of optimum pH for phosphatase.

Recommended Books:

1. Experimental Biochemistry: A student companion by Beedu Sashidhar Rao and Vijay Deshpande, I.K. International Pvt. Ltd., New Delhi.
2. Laboratory Manunal in Biochemistry by Jayaraman, New Age International Publishers, New Delhi.
3. Introductory practical biochemistry by SK Sawhney&Randhirsingh. Narosa publications.
4. Biochemical methods by S Sadasivan&AManickam. New Age international publishers.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
II SEMESTER
SMB 100: BACTERIOLOGY

No. of hrs/week: 4 **Credits: 4**

Preamble:

This course has been designed to introduce field of bacteriology with special emphasis on bacterial diversity, morphology, physiology, and nutrition; methods for control of bacteria and its culture techniques with precise methods of how to characterize the organisms.

Course Objectives:

1. To study morphological diversity of bacteria using microscopy techniques.
2. To identify and demonstrate how to control microbial growth.
3. To learn about different methods of culturing of bacteria on an animate media.

UNIT-I

Microscopy: Bright field microscope, dark field microscope, phase contrast microscope, fluorescence microscope, confocal microscopy, scanning and transmission electron microscope. Staining techniques: simple and differential staining, Gram and acid fast, spore, capsular, flagellar staining.

Learning outcomes:

By the end of the course, the student will be able to:

- Learn microscopic techniques to study ultrastructure of bacteria
- Understand the application of stains or dyes, in examining the morphology of bacteria bymicroscopy.

UNIT-II

Cell size, shape and arrangement, morphology and ultrastructure of bacteria, actinomycetes and mycoplasma. Endospore: structure, formation, stages of sporulation**.** Bacterial growth, binary fission, growth curve, phases of growth, generation time and specific growth rate. Growth measurement: optical density, colony forming units, batch, synchronous and continuous cultures.Chemostat and turbidostat.

Learning outcomes:

By the end of the course, the student will be able to:

- Learn the shape, morphological variations in arrangement of cells and to understand theultrastructure of bacterial cell
- Study the bacterial growth kinetics and will be able to learn the techniques used in measuringthe bacterial growth

UNIT-III

Physical methods: Dryheat-hot air oven, incineration; moist heat: boiling water, tyndallization, autoclaving, pasteurization, radiation: ionizing and non ionizing radiations; filtration. Chemical methods: alcohols, phenols, halogens, quaternary ammonium compounds, aldehydes,and gases. Antiseptics and disinfectants.

Learning outcomes:

By the end of the course, the student will be able to:

1. Learn about different kinds of methods to control microorganisms
2. Learn the mechanism of sterilizing agents and their applications in day today life.

UNIT-IV

Nutritional requirement of bacteria, microbiological media- natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media. Pure culture techniques: pour plate, streak plate, and spread plate; preservation and maintenance of pure cultures; cultivation of anaerobic bacteria.

Learning outcomes:

By the end of the course, the student will be able to:

- Learn about the nutrients which enhance the growth of microorganisms
- Learn various culture techniques to cultivate bacteria in lab conditions

UNIT-V

Identification and characterization of bacterial cultures, and archaea morphological, biochemical, (IMViC, catalase, oxidase, urease, nitrate reductase; sugar fermentations, amylase,protease) metabolic, genetic, ecological, and molecular characteristics.

Learning outcomes:

By the end of the course, the student will be able to:

- Learn how to classify the microorganisms based on biochemical parameters
- Identify the taxon of bacteria based on various characteristic features.

Course Outcomes: By the end of this course, the students will be able to

- Identify the taxon of bacteria based on various characteristic features
- Learn various culture techniques to cultivate bacteria in lab conditions
- Understand the bacterial growth kinetics and will be able to learn the techniques used inmeasuring the bacterial growth

RECOMMENDED BOOKS:

1.Microbiology: An Introduction (2016) by Tortora et al., 12th Edition Pearson publishers 2.Microbiology: A Systems Approach (2017) by Kelly Cowan 5th Edition McGraw-Hill Education 3.Prescott's Microbiology (2016) by Joanne Willey et al., 10th Edition McGraw-Hill Education 4.Sherris Medical Microbiology, (2018) by Kenneth J. Ryan et al.,7th Edition McGraw-Hill Education

5.Microbiology: Principles and Explorations (2015) by Black et al.,9th Edition, Wiley Pulishers 6.Brock Biology of Microorganisms (2015) by Michael T. Madigan (15th Edition), Pearson publishers.

7. Microbiology: Laboratory Theory and Application (2015) 4th Edition by Michael J. Leboffe,Morton Publishing Company.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
II SEMESTER

SMB 120: BACTERIOLOGY LAB

No. of hrs/week: 03 **Credits: 02**

Preamble:

This course has been designed to train students with basic techniques of microbiology and the role of microbes in the daily life as well as in the various fields of science, Imparts advanced training in Microbiology for the students and also how the microbes can be controlled is also dealt with.

Course Objectives:

- Is to provide practical skills on basic microbiological techniques.
- Is to isolate, characterize and identify common bacterial organisms.
- Is to preserve bacterial cultures.

1. SterilizationofglasswareusingHotAirOvenandassessmentforsterility
2. PreparationandsterilizationofmediumusingAutoclaveandassessmentforsterility
3. Sterilizationofheatsensitivematerialbymembranefiltrationandassessmentforsterility
4. Preparation of different media: synthetic media, Complex media-Nutrient agar, McConkeyagar, EMB agar.
5. Simple staining, Negative staining
6. Gram's staining
7. Acid fast staining-permanent slide only.
8. Capsule staining
9. Endospore staining.
10. Isolation of pure cultures of bacteria by streaking method.
11. Estimation of CFU count by spread plate method/pour plate method.
12. Motility by hanging drop method.
13. Preservation of bacterial cultures by various techniques.

Course outcomes: By the end of the course, the student will be able to

- Learn how to make slides for microbial examinations and will equip themselves with the basicstaining aspects to be performed in the laboratory.
- Isolate and characterize the microorganisms based on morphology

- Enumerate the microbes by different plating methods.
- Learn all aspects of microbiology as it is required for Biotechnology course.

RECOMMENDED BOOKS:

1. Laboratory Exercises in Microbiology (2016) by John Harley 8th Edition, McGraw-Hill Education
2. Microbiology: A Laboratory Manual (2016) by James G. Cappuccino
11th Edition Pearsonpublishers
3. Microbiology: Laboratory Theory and Application (2015) 4th Edition by
Michael J. Leboffe,Morton Publishing Company.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
II SEMESTER

SBC 106: BASICS IN PROGRAMMING

No. of hrs/week: 04 **Credits: 04**

Preamble

The computer is often a very handy tool when solving complex technical problems in engineering and scientific explorations. Programming a computer is a fundamental task in finding solutions to such problems.The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language.

Course Objectives

At the end of the course a student is expected to:

- gain a thorough understanding of the fundamentals of C programming
- code, compile and test C programs
- enhance their analyzing and problem solving skills and use the same for writing programs in C
- increase the ability to learn new programming languages

UNIT–I

Introduction to programming languages: Machine Language, Assembly Language, High level Language, Types of high level languages, Complier, Interpreter, Assembler, Loader, Linker.

UNIT–II

Introduction to C programming: C Character set, Identifiers, Keywords, Datatypes, Constants, Variables, Declarations, Expressions, Statements.

UNIT–III

Operators: Arithmetic, Unary, Relational, Logical, Assignment and Conditional operators; Library functions; Basic data input and output functions.

UNIT-IV

Writing a C program: Simple C programs, Error diagnostics, Debugging techniques. Control Statements: if, if-else, while, do-while, for, nested-if-else, switch, break, continue and goto statement.

UNIT-V

Definition and importance of Functions, Arrays, Strings and Pointers.

Recommended Books:

1. Byron Gottfried “Programming with ‘C’ Second addition. Tata McGrawhill, (2000).

2. RG Dromey “How to solve it by computer”, Prentice Hall of India, 7th Edition, (2001).
3. E. Balaguruswami “Programming with Ansi-C”, Pearson Education, 1st Edition, (2002).
4. Kamthane “Programming with ANSI and Turbo C”, Pearson Education, First Edition, (2002).
5. Venugopal and Prasad “ Programming with C” Tata McGrawhill, 1st Edition, (1997).
6. BW Kemighan and DM Ritchie “The C Programming Language”, Prentice Hall of India, Second edition, (2001).

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
II SEMESTER

SBC 124: BASIC PROGRAMMING LAB

No. of hrs/week: 03 **Credits: 02**

Preamble:

This course focuses on developing the C programming to do a variety of programming tasks related to biological applications using turbo C. At the end of the course the student will be developing adequate skills in programming and will be known to understand the implementation of various biological tasks using C language.

Course Objectives:

- To teach the student to write programs in C and to solve the problems.
- To demonstrate problem solving techniques using biological sequence data.

1. Program for Transcription using C.
2. Program for Concatenation of 2 strings using C.
3. Program for Base Count of DNA.
4. Program for Calculating Melting Point of DNA.
5. Program for Reverse Complement.
6. Program for Amino acid Sequence Count.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
II SEMESTER
VDC111: Venture Discovery

No. of hrs/week: 02 **Credits: 02**

Course description and learning outcomes

India as part of its Make in India initiative has been focusing on creating incubation centers within educational institutions, with an aim to generate successful start-ups. These start-ups will become employment creators than employment seekers, which is the need of the hour for our country.

This common course for all the disciplines is a foundation on venture development. It is an experiential course that lets students venture and find out what is a business, financial and operating models of a business are. How to design and prototype a solutions that meets their customers' needs and generate revenue for the business.

LEARNING OBJECTIVES

- Discover who you are – Values, Skills, and Contribution to Society.
- Gain experience in actually going through the innovation process.
- Conduct field research to test or validate innovation concepts with target customers.
- Understand innovation outcomes: issues around business models, financing for start-ups, intellectual property, technology licensing, corporate ventures, and product line or service extensions.

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

	Learning Outcome	Assessment
1	Understand conceptual framework of the foundation of a venture	A1, A2
2	Understand the concept of purpose, mission and value-add service offered by a venture	A3
3	Analyze design and positioning of the product	A3
4	Demonstrate prototyping	A3
5	Analyze business, revenue and operating models	A3

Course outline and indicative content

Unit I (6 sessions)

Personal Values: Defining your personal values, Excite & Excel, Build a Team, Define purpose for a venture. Four stages: Personal Discovery, Solution Discovery, Business Model Discovery, Discovery Integration.

Unit II (6 sessions)

Solution Discovery: Craft and mission statement, Experience design, Gaining user insight, Concept design and positioning, Product line strategy, Ideation & Impact.

Unit III (6 sessions)

Business Model Discovery: Prototyping solutions, Reality Checks, Understand your industry, Types of business models, Define Revenue Models, Define Operating Models

Unit IV (6 sessions)

Discovery Integration: Illustrate business models, Validate business models, Define company impact

Unit V (6 sessions)

Tell a Story: Can you make money, Tell your venture story.

Assessment methods

Task	Task type	Task mode	Weightage (%)
A1. Assignments	Individual	Report/Presentation	20
A2. Case / Project/Assignment	Groups* or Individual	Presentations/Report/Assignment	40
A3. Project	Individual/Group	Report/Pitch	40

Transferrable and Employability Skills

	Outcomes	Assessment
1	Know how to use online learning resources: G-Learn, online journals, etc.	A1 & A2
2	Communicate effectively using a range of media	A1& A2
3	Apply teamwork and leadership skills	A2
4	Find, evaluate, synthesize & use information	A1 & A2
5	Analyze real world situation critically	A3
6	Reflect on their own professional development	A3
7	Demonstrate professionalism & ethical awareness	A2
8	Apply multidisciplinary approach to the context	A2

Learning and teaching activities

Mixed pedagogy approach is adopted throughout the course. Classroom based face to face teaching, directed study, independent study via G-Learn, case studies, projects and practical activities (individual & group)

Teaching and learning resources

Soft copies of teaching notes/cases etc. will be uploaded onto the G-learn. Wherever necessary, printouts, handouts etc. will be distributed in the class. Prescribed text book will be provided to all. However you should not limit yourself to this book and should explore other sources on your own. You need to read different books and journal papers to master certain relevant concepts to analyze cases and evaluate projects. Some of these reference books given below will be available in our library.

***Prescribed Modules*:**

Access to NU-IDEA online modules will be provided.

***Referential text books and journal papers*:**

Personal Discovery Through Entrereneurship, Marc H. Meyer and Chaewon Lee, The Institute of Enterprise Growth, LLC Boston, MA.

Suggested journals:

Vikalpa, Indian Institute of Management, Ahmedabad
Journal of General Management, Mercury House Business Publications, Limited
Harvard Business Review, Harvard Business School Publishing Co. USA

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
III SEMESTER

SBC 201: BIOENERGITICS AND METABOLISM-I

No. of hrs/week: 04 **Credits: 04**

Preamble: The student will be able to review and consolidate concepts in the areas of Metabolism and Bioenergetics, focusing on the main metabolic pathways in a living cell, their regulation and disturbances in disease, and how energy is obtained and transduced to meet the cell's requirements.

Course Objectives:

•To understand the overview and interplay of metabolic pathways.
•To describe the individual reactions, cofactors, inhibition, energetics and regulation of pathways.
•To correlate the pathways with diseases associated directly or indirectly with them.
•To understand the clinical applications of synthetic purine and pyrimidine analogs
•To comprehend the thermodynamics involved in energetics of biochemical pathways

UNIT- I

Bioenergetics: Thermodynamic principles – Chemical equilibria; free energy, enthalpy (H), entropy (S). Free energy change in biological transformations in living systems; High energy compounds. Oxidation-reduction reactions.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Define the thermodynamic principles and discuss their bioenergetics (L1).
- Explain and give examples of High energy compounds (L1).
- Describe the energy changes that bring about biological transformations (L2).
- Explain the role of ATP coupled reactions and coenzymes that exist in oxidized and reduced form (L2).

UNIT -II

Biological Oxidations in Mitochondria: Organization of electron carriers and enzymes in mitochondria. Classes of electron-transferring enzymes, inhibitors of electron transport. Oxidative phosphorylation. Uncouplers and inhibitors of oxidative phosphorylation.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Explain the organization of electron transport chain(L1).
- Explain the role of electron transferring enzymes (L1).
- Describe what happens in the electron transport chain and oxidativephosphorylation. Explain the role of each process in energy production(L2).

- Identify the sites of drug action in ETC both as inhibitors and uncouplers(L3).

UNIT- III

Carbohydrate metabolism: Broad outlines of Intermediary metabolism. Concept of anabolism and catabolism.Glycolytic pathway. Fate of pyruvate - formation of lactate and ethanol, Pasteur effect. Citric acid cycle.amphipathic role. Anaplerotic reactions. Glycogenolysis and glycogenesis. Pentose phosphate pathway. Gluconeogenesis.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand the function of specific anabolic and catabolic pathways and how these pathways are controlled and interrelated(L1).
- Predict the products from pyruvate under different physiological conditions(L2).
- Describe what happens during carbohydrate metabolism - glycolysis, glycogenesis, and glycogenolysis(L2).
- Explain compensatory pathways that maintain homeostasis in the body(L2).

UNIT- IV

Metabolism in plants – Photosytnthesis - Light and Dark reactions, Calvin cycle, C_4 Pathway.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Extend their knowledge of biochemistry fundamentals and will learn about important metabolic processes taking place in plants (L1).
- Identify the reactants and products of photosynthesis (L2).
- Describe the visible and electromagnetic spectrums of light and light-dependent reactions that take place during photosynthesis (L2).
- Compare and contrast major variations in photosynthesis and the conditions under which these variations are most likely encountered (L3).

UNIT- V

Lipid Metabolism - Catabolism of fatty acids (β- oxidation) with even and odd number of carbon atoms, Ketogenesis, *de novo* synthesis of fatty acids. Biosynthesis and degradation of triacylglycerol and lecithin. Biosynthesis of cholesterol.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Describe what happens in fatty acid oxidation and synthesis as well as in ketogenesis(L1).
- Learn about the oxidation of fatty acids into acetyl CoA and energy production from fattyacids.
- Learn about fatty acid and cholesterol biosynthesis(L1).
- Explain the metabolism of triacylglycerol and lecithin(L2).

Course outcomes:

- Understands the thermodynamics involved in energetics of biochemical pathways (CO1).
- Understands the importance of high energy compounds, electron transport chain,

synthesis of ATP under aerobic and anaerobic conditions (CO2).

- Acquires knowledge related to the role of TCA cycle in central carbon metabolism, importance of anaplerotic reactions and redox balance (CO3).
- Gains insights into metabolic process specific for plants - photosynthesis(CO4).
- Gains an overview and interplay of metabolic pathways of lipids (CO5).

Recommended Books:

1. Text book of Biochemistry by West and Todd, Oxford and IBH, 4th Ed.
2. Principles of Biochemistry by Nelson cox, Freeman, 4th Ed.
3. Biochemistry by Voet and Voet, John Wiley and Sons, 3rd Ed.
4. Outlines of Biochemistry by Conn and Stumpf, John Wiley and sons, 5th Ed.
5. Biochemistry by Matthews, PSN, 3rd Ed.
6. Biochemistry by Lehninger, Kalyani Publishers, 2nd Ed.
7. Biochemistry by Stryer, WH Freeman and CO, 4th Ed.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
III SEMESTER

SBC 221: BIOCHEMISTRY- QUANTITATIVE ANALYSIS LAB

No. of hrs/week: 03 **Credits: 02**

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1. Estimation of amino acid by Ninhydrin method.
2. Estimation of protein by Biuret method.
3. Estimation of protein by Lowry method.
4. Estimation of glucose by DNS method.
5. Estimation of glucose by Benedict's titrimetric method.
6. Estimation of total carbohydrates by Anthrone method.
7. Absorption spectra of protein-BSA, Nucleic acids- Calf thymus DNA.

Recommended Books:

1. Biochemical methods by Sadasivam and Manikam, Wiley Eastern Limited.
2. An introduction to practical Biochemistry by D. T. Plummer, McGraw Hill.
3. Laboratory manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited.
4. Introductory Practical Biochemistry by S. K. Sawhney and Randhir Singh, Narosa.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

III SEMESTER

SMB 201: MICROBIAL GENETICS

No. of hrs/week: 04 **Credits: 04**

Preamble

Understanding microbial genes, genomes, and gene expression is essential for understanding the biologyand evolution of microorganisms and their interactions with the environment. Moreover, microbial genetics is essential for understanding molecular biological studies and for practical applications in diverse areas of biotechnology.

Course Objectives:

1. To make student understand Microbial growth and metabolism.
2. To enable students learn concepts of microbial genetic structure; maintenance, expression, andexchange of genetic materials in microbial cells.
3. To make students learn mutation and mutagenesis and their detection methods.

UNIT-I

Organization of genetic material in prokaryotes.Genome organization: *E.coli*, *Saccharomyces,Tetrahymena.*Structure of genes, types of genes.

Features of T4 phage.Genetic basis of Lytic vs Lysogenic switch of phage λ.

Learning outcomes:

By the end of the unit, the student will be able to:

- Understand the genetic makeup of bacterial cells.
- Comprehend the basics of lytic and lysogenic cycles of bacteriophages

UNIT-II

Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast-2 μ plasmid, plasmid-incompatibility, plasmid replication, plasmid amplification, regulationof copy number, curing of plasmids.

Learning outcomes:

By the end of the unit, the student will be able to:

- Describe the roles of plasmids in bacterial cells and the various genetic elements in natural andsynthetic plasmid.
- Describe the process of DNA replication of plasmids in a bacterial cell.
- Understand the molecular basis of plasmid incompatibility and how plasmid copy
- number is regulated in a bacterial cell.

UNIT-III

Discovery and mechanism of transformation, conjugation- Hfr and F`strains, interrupted mating technique. Transduction-generalized transduction, specialized transduction, mapping by

recombination.

Learning outcomes:

By the end of the unit, the student will be able to:

- Describe the molecular mechanisms of gene transfer by conjugation (including Hfr strains),transformation and transduction

UNIT-IV

Discovery of transposons. Prokaryotic transposable elements – insertion sequences, composite and non-composite transposons, replicative and non-replicative transposition, uses of transposons and transposition.

Learning outcomes:

By the end of the unit, the student will be able to:

- Identify the key characteristics of various types of transposons.
- Describe how transposition occurs at the molecular level.

UNIT-V

Mutations and mutagenesis: definition and types of mutations; physical and chemical mutagens; molecular basis of mutations; functional mutants (loss and gain of function mutants); uses of mutations. Ames test; mutator genes

Learning outcomes:

By the end of the unit, the student will be able to:

- Understand the difference between DNA lesions and mutation.
- Describe the various mechanisms of how mutations can arise spontaneously within a cell orcan be induced.
- Identify the various kinds of DNA mutation detection methods

Course Outcomes: By the end of the course, the student will be able to

- Understand the genetic makeup of bacterial cells
- Describe the process of DNA replication of plasmids in a bacterial cell
- Describe how transposition occurs at the molecular level
- Identify the various kinds of DNA mutation detection methods

RECOMMENDED BOOKS:

1. Molecular Biology: Principles and Practice (2015) by Michael M. Cox 2nd Edition, W. H.Freeman publishers
2.Molecular Genetics of Bacteria, (2013) by by Larry Snyder 4th Edition, ASM Press 3.Molecular Cell Biology (2016) by Lodish *et al.*, 8th Edition, W. H. Freeman publishers 4.Genetics: A Molecular Approach (2009) by Peter J Russell (3rd Edition), Pearson 5.Genetics: A Conceptual Approach (2016) 6th Edition W. H. Freeman publishers
6.Microbiology: An Introduction (2016) by Tortora et al., 12th Edition

Pearson publishers
7.Microbiology: A Systems Approach (2017) by Kelly Cowan 5th Edition McGraw-Hill Education 8.Prescott's Microbiology (2016) by Joanne Willey et al., 10th Edition McGraw-Hill Education 9.Microbiology: Principles and Explorations (2015) by Black et al.,9th Edition, Wiley Pulishers 10.Brock Biology of Microorganisms (2015) by Michael T. Madigan (15th Edition), Pearson publishers

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
III SEMESTER

SMB 221: MICROBIAL GENETICS LAB

No. of hrs/week: 03 **Credits: 02**

Preamble:

This course has been designed to train students with basic techniques of Microbiology. Imparts trainingin growth curve analysis and preparation of replica plates and isolate bacteriophages from sewage.

Course Objectives:

- To introduce students to experiments of microbial analysis – Growth curve.
- To make understand mechanism of conjugation and transduction along with AMES test; what it isand how it is performed.
- To make students learn mechanism of mutagenesis using chemical (HNO_2) and physical (UV)mutagens on bacterial cells.

1. Preparation of Master and Replica Plates
2. Growth curve of *E. coli*.
3. Mutagenesis using chemical (HNO_2) and physical (UV)mutagens on bacterial cells
4. Survival curve of bacteria after exposure to ultraviolet (UV)light
5. Demonstration of Bacterial Conjugation
6. Demonstration of bacterial transformation and transduction
7. Demonstration of Ames test
8. Isolation and enumeration of bacteriophages (PFU)from water/sewage sample usingdouble agar layer technique

Course outcomes: By the end of the course, the student will be able to

- Learn preparation of replica and master plates
- Perform and analyze growth curve of bacteria.
- Understand the mechanism of bacterial conjugation and transduction.
- Analysis of PFU from water/sewage sample helps students learnt to purify a clonal population ofvirus to

RECOMMENDED BOOKS:

1. Laboratory Exercises in Microbiology (2016) by John Harley 8th Edition, McGraw-Hill Education 2.Microbiology: A Laboratory Manual (2016) by James G. Cappuccino 11th Edition Pearson publishers3.Microbiology: Laboratory Theory and Application (2015) 4th Edition by Michael J. Leboffe, Morton Publishing Company

4. Cell and Molecular Biology Lab Manual (2011) by Dr. David A Thompson, CreateSpaceIndependent Publishing Platform

5. Cell and Molecular Biology: A Lab Manual (2013) by K. V. Chaitanya, PHI

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

III SEMESTER

SBC 205: COMPUTATIONAL BIOLOGY

No. of hrs/week: 04 **Credits: 04**

Preamble:

Bioinformatics / Computational Biology is the science of storing, retrieving and analysing large amounts of biological information. The course depicts the types of biological information being generated and stored into the repositories. The important public data banks provide details of biological systems and components will be discussed. It reviews a wide range of applications using biological databases including computational sequence analysis, sequence homology searching, protein sequence analysis and phylogenetic analysis.

Course Objectives:

At the end of the course a student is expected to:

- To understand explosion, nature and types of biological data and its role in biological research to solve real world biological problems.
- To understand the concept and types of literature databases, nucleic acid databases, gene expression databases, protein databases and their uses
- To understand the concept of specialized databases like metabolic pathway databases, motif and protein interaction databases
- To, understand the concept and principles of sequence alignments - types, methods, tools and applications

UNIT – 1

Biological Databases: Nature and Types of Biological Data, Major Bioinformatics resources- NCBI, EBI and Expasy, EST, STS, GSS, Gene expression databases.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the nature of biological data and its classification.
- Explain about major bioinformatics resources.
- Describe the formats of data available from resources and its appropriate usage.

UNIT – II

Protein databases: Sequence, Structural databases, Domain and Motif databases, Protein-protein interaction databases, metabolic pathway databases.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand various kinds of protein data and availability of resources.
- Explain about protein sequence and structural data formats of databases.
- Describe various domain and motif databases.
- Describe the metabolic pathway databases.

UNIT – III

Concepts of Sequence similarity, identity, homology and distances.Homologues, orthologues and paralogues, Scoring matrices-PAM and BLOSUM series.

Learning Outcomes:

By the end of this unit, the student will be able to

- Differentiate between types of sequence similarities.
- Describe the various types of scoring matrices used for alignments.

UNIT – IV

Pairwise sequence alignments: Dot plot matrix, Dynamic programming, Needleman and Wunsch, Smith and Waterman algorithms, Sequence-based searches: BLAST and FASTA.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the concept of sequence alignment.
- Explain the methods for aligning sequences.
- Describe the methodology of BLAST and FASTA for sequence bases searches.

UNIT – V

Concept of MSA and its applications, Description and types of phylogenetic trees.Phylogenetic tree construction and evaluation.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the difference between pairwise and multiple sequence alignments and applications.
- Describe the types of phylogenetic trees and their construction methods.
- Describe tree evaluation methods.

Reference Books:

1. Introduction to Bioinformatics – Arthur M. Lesk, 3rd Ed.
2. Bioinformatics and Functional Genomics – Jonathan Pevsner, 2nd Ed.
3. Essential Bioinformatics – JinXiong.

Course Outcomes:

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

- Classify different types of Biological Databases.
- Understand basics of sequence alignment and implementation of matrices.
- Explain about the concept of pairwise sequence alignment, algorithms and tools for pairwise alignment.
- Describe about Multiple Sequence Alignment, its significance, algorithms and tools used for MSA.
- Describe about the various techniques, algorithms and tools used for Phylogenetic Analysis.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
III SEMESTER

SBC 225: COMPUTATIONAL BIOLOGY LAB

No. of hrs/week:03 **Credits:02**

Preamble:

Bioinformatics / Computational biology is defined as the application of tools of computation and analysis to the capture and interpretation of biological data.This course describes the main tools/databases of the bioinformatics for analysis and provides hands-on demonstrations like how they are being used to interpret biological data and to further understanding of disease.

Course Objectives

- To explore data available in major bioinformatics resources.
- To perform biological literature search.
- To retrieve nucleotide, protein sequences, structural and metabolic data in different formats.
- To identify homologous sequences and phylogentic analysis.

Practical's Laboratory Sessions:

1. Major Bioinformatics Resources: NCBI, EBI, DDBJ.
2. Biological Literature Databases.
3. Nucleic Acid Sequence Databases.
4. Protein Sequence Databases.
5. Protein 3D Structural Databases
6. Metabolic Pathway Databases.
7. Pairwise sequence alignments-BLAST, FASTA
8. Multiple Sequence Alignment
9. Phylogeny

Learning outcomes:

By the end of this practical, the student will be able to

6. Differentiate between three major bioinformatics resources.
7. Search and retrieve right kind of biological literature
8. Retrieve and analyze sequence and structural data in their respective formats and their importance.
9. Identify the homologous sequences and understand the concept of sequence searches.
10. Construct MSAs and phylogentic trees to infer sequence relationships.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
III SEMESTER

SSE 279: MATHEMATICS FOR BIOLOGY

No. of hours per week: 02 **Credits: 02**

Unit I

Functions, Limits and continuity, differentiation and integration, Maxima & Minima and their use in biological problems.

Unit II

Differential Equations, separable variables, homogeneous, exact and linear equations of second order, application of differential equations of Biochemistry. Matrices and determinants, characteristic roots and characteristic equations.

Recommended Books

1. John E. Freund's mathematical statistics with application by Irwin Miller and Marylees Miller; Ed.7th; Pearson; 2006.
2. Essential Mathematical Biology by Nicholas F. Britton; Ed.1st; Springer; 2004.
3. Differential Calculus by Shanti Narayan ; Ed. 30th; S. Chand & Co Ltd; 2005.

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III SEMESTER

SSE 281: INTRODUCTION TO ALGORITHMS – I

No. of hrs/week: 02 **Credits: 02**

UNIT- 1

Introduction to Bioinformatics algorithms, types - Dynamic Programming, Exhaustive Search, Branch-and-Bound Algorithms, Greedy Algorithms, Divide-and-Conquer Algorithms, Machine Learning, Randomized Algorithms.

UNIT -2

Dynamic programming - Longest Common Subsequence & Longest Increasing Subsequence.

Recommended books:

1. An Introduction to Bioinformatics Algorithms, Pevsner, Neil C. Jones and Pavel A. Pevzner, MIT Press, 2004.
2. Introduction to Algorithms, Thomas H. Cormen, MIT Press; third edition edition.
3. Algorithms in Bioinformatics: A Practical Introduction, Wing-Kin Sung, Chapman and Hall/CRC.

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IV SEMESTER

SBC 202: METABOLISM–II AND BIOCHEMICAL TECHNIQUES

No. of hours per week: 04 **Credits: 04**

Preamble: The student will be ableto review and consolidate concepts in the areas of Nitrogen, Amino acid and Nucleic acid Metabolic pathways in a living cell, their regulationand how energy is obtained and transduced to meet the cell's requirements.The syllabus supports to acquire knowledge and understanding of the core principles of Biochemical techniques.

Course Objectives:

- To understand the mechanism of Nitrogen fixation and incorporation into organic compounds
- To describe the individual reactions, cofactors, inhibition, energetics and regulation of amino acid metabolism.
- To understand purine and pyrimidine metabolism
- To study the isolation, purification and characterization of biomolecules using various centrifugal and spectrophotometric techniques
- To understand the concept of radioactivity and its applications

UNIT- I

Nitrogen Fixation**:** Nitrogen cycle, Non-biological and biological nitrogen fixation, Nitrogenase system. Utilization of nitrate ion, Ammonia incorporation into organic compounds.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand the modes of nitrogen fixation (both biological and abiological)(L1).
- Explain the steps involved in nitrogen fixation by free living organisms(L2).
- Explain the mode of symbiotic nitrogen fixation in leguminous plants(L2).
- Describe the assimilation of nitrate, ammonia and amino acid synthesis in plants(L3).

UNIT-II

Metabolism of Amino acids**:** General reactions of amino acids - transamination, decarboxylation and deamination, Urea cycle and regulation, glycogenic and ketogenic amino acids. Metabolism of serine, aspartic acid, methionine, phenylalanine and leucine. Biosynthesis of creatine.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand the general reactions of amino acid(L1)
- Explain catabolism of amino acids and ureacycle(L1).
- List the ketogenic and glycogenic amino acids and describe the general strategies for amino acid synthesis (L2).
- Explain the metabolism of representative amino acids of each class (L2).
- Understand the process of creatine biosynthesis (L1).

UNIT-III

Metabolism of Nucleic acid and heme**:** Definitions of *de novo* and salvage pathways, Biosynthesis and regulation of purine and pyrimidine nucleotides. Catabolism of purines and pyrimidines. Biosynthesis and degradation of heme.

Learning Outcomes:
By the end of this Unit, the student will be able to

- Describe origin and utilization of PRPP in nucleotide synthesis and its importance in determining the overall rate of de novo purine biosynthesis(L1).
- Explain what happens if you don't have the enzyme HGPRT and how PRPP play a role in this(L2).
- Describe the metabolism of purines and pyrimidines (L1)
- Understand the steps involved in heme synthesis and degradation (L2).

UNIT-IV
Biochemical Techniques I **:** Methods of tissue homogenization. Principle and applications of centrifugation techniques- differential, density gradient. Ultra-centrifugation- preparative and analytical.

Learning Outcomes:
By the end of this Unit, the student will be able to

- List the various methods of cell disruption and homogenization (L1).
- Gains the basic principles of centrifugation and factors that determine the rate of sedimentation of a particle (L2).
- Execute differential centrifugation, density centrifugation, continuous and discontinuouscentrifugation. (L2).
- Choose appropriate method for separation of cellular constituents (L2).
- Extend the concepts of centrifugation in characterizing molecules (L3).

UNIT-V
Biochemical Techniques II**:** Laws of light absorption- Beer-Lambert law. UV and visible absorption spectra, molar extinction coefficient, Principle of fluorimetry. Tracer techniques: Radio isotopes, units of radio activity, half-life, β and γ- emitters, use of radioactive isotopes in biology.
Learning Outcomes:
By the end of this Unit, the student will be able to

- Will be able to interpret UV-Visible spectroscopy (L1).
- Explain working of fluorimetry and application in biochemical, medical, and chemical research fields for analyzing organic compounds(L2).
- Explain working principles, taking spectrum and outline of atomic absorption spectroscopy device (L2).
- Understand radioactivity and the properties of alpha, beta, neutron, and gamma radiation (L1).

Course outcomes:

1. Will understand the mechanism of Nitrogen fixation and incorporation into organic Compounds (CO1).
2. Gains knowledge about amino acid metabolism and their conversions in relation carbohydrate and lipid metabolism (CO2).
3. Can comprehend the techniques involved in isolation, identification and separation of biomolecules (CO3).

4. Will be conversant with the techniques required for isolation, purification and characterization of biomolecules(CO4).
5. Gains knowledge about the application of radioactive techniques in biological realm(CO5).

Recommended Books:

1. Text book of Biochemistry by West and Todd, Oxford and IBH, 4th Ed.
2. Principles of Biochemistry by Nelson cox, Freeman, 4th Ed.
3. Biochemistry by Voet and Voet, John Wiley and Sons, 3rd Ed.
4. Outlines of Biochemistry by Conn and Stumpf, John Wiley and sons, 5th Ed.
5. Biochemistry by Matthews, PSN, 3rd Ed.
6. A Biologists guide to Principles and techniques of practical Biochemistry by B. D. Williams, Edward Arnold.
7. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson, John Walker, Cambridge University Press, 7th Ed.
8. Biophysical chemistry principles and techniques by Upadhyay, Upadhyay and Nath, Himalaya publishing.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
IV SEMESTER
SBC 220: BIOCHEMICAL TECHNIQUES LAB

No. of hours per week: 03 **Credits: 02**

Preamble: This skill based course will teach the students the various biochemical separation principles and instrumentations that are used in the analytical laboratories. This course covers both fundamental and applications of the instruments that are routinely used for the characterization of biomolecules.

Course Objectives:

- To describe general principles involved in separation of biomolecules from foods.
- To understand the steps involved in the separation of amino acids and plant pigments by chromatographic approaches.

1. Isolation of egg albumin from egg white.
2. Isolation of cholesterol from egg yolk.
3. Isolation of starch from potatoes.
4. Isolation of casein from milk.
5. Separation of amino acids by paper chromatography.
6. Separation of plant pigments by TLC.
7. Separation of serum proteins by PAGE.

Learning Outcomes:

- Development of an ability to isolate specific macromolecules from different sources. (L1).
- The students will obtain hands-on training in basic separation techniques in biochemistry like electrophoresis, chromatography, etc. (L2).
- Will be able to apply knowledge regarding separation of serum proteins by electrophoresis (L2).

Course Outcomes:

- Gain expertise in the isolation of various biomolecules and organelles (CO1).
- Will be able explain and execute the steps involved in the separation using chromatographic approaches (CO2).
- Will be able to separate serum proteins by electrophoresis (CO3).

At the end of the course, the student has the basic knowledge on the theory, operation and function of analytical instruments.

Recommended Books:

1. Biochemical methods by Sadasivam and Manikam, Wiley Eastern Limited.
2. An introduction to practical Biochemistry by D. T. Plummer, McGraw Hill.
3. Laboratory manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited.
4. Introductory Practical Biochemistry by S. K. Sawhney and Randhir Singh, Narosa.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
IV SEMESTER

SMB 200: FOOD AND DAIRY MICROBIOLOGY

No. of hrs/week: 04 **Credits: 04**

Preamble:
Microbiology is the study of the smallest living organisms (micro-organisms or microbes). Microorganisms play a critical role in the various biogeochemical cycles, as well as being a particularly important component of plant and soil ecosystems. They break down dead plant and animal tissues and make their nutrients, including carbon and nitrogen, available to support plant growth. Food safety is a major focus of food microbiology. Numerous agents of disease and pathogens are readily transmitted via food which includes bacteria and viruses. Microbial toxins are also possible contaminants of food; However, microorganisms and their products can also be used to combat these pathogenic microbes.Specifically, areas of interest which concern food microbiology are food poisoning, food spoilage, food preservation, and food legislation.

UNIT - I

Intrinsic and extrinsic factors. Source of contamination- fruits, vegetable, grains, poultry, meat and fish. Prevention and control measures. Spoilage of vegetables, fruits, meat, eggs, milk, butter, bread and canned foods. Factors affecting spoilage.

Learning Outcomes:
By the end of this Unit, the student will be able to

- Learn the intrinsic and extrinsic factors of source of contamination of various food materials.
- Learn about prevention and control measures of contamination
- Study about spoilage of vegetables, fruits, meat, eggs, milk etc
- Learn about factors affecting food spoilage

UNIT – II

Physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging. Chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.

Learning Outcomes: By the end of this Unit, the student will be able to

- Learn about various physical methods of food preservation.
- Learn about aseptic packaging.
- Learn about chemical methods of food preservation.
- Get insights into role of antibiotics in food preservation.
- Learn about regulation of bacteriocins.

UNIT-III

Milk composition. Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, dahi and cheese, other fermented foods, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market. FSSAI regulations

Learning Outcomes: By the end of this Unit, the student will be able to

- Learn about milk composition and dairy starter cultures.

- Learn about fermented dairy products: yogurt, acidophilus milk etc.
- Learn about probiotics and their health benefits
- Learn about the types of probiotic foods available in market.
- Learn about FSSAI regulations.

UNIT-IV

Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni. Microorganisms in food spoilage.

Learning Outcomes: By the end of this Unit, the student will be able to

- Learn about role of Staphylococcus aureus, Clostridium botulinum and mycotoxins in food intoxication.
- Learn about role of Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis in food infections.
- Learn about role of Shigellosis, Yersinia enterocolitica, Listeria monocytogenesin food infections
- Learn about role of microorganisms in food spoilage.

UNIT-V

Hazard Analysis Critical Control Points (HACCP), indices of food sanitary quality and sanitizers, cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology.

Learning Outcomes: By the end of this Unit, the student will be able to

- Learn about Hazard Analysis Critical Control Points (HACCP).
- Learn about indices of food sanitary quality and sanitizers.
- Learn about rapid detection methods of food borne pathogens in foods
- Get insights into predictive microbiology.

Course Outcomes:

1. Learn the intrinsic and extrinsic factors of source of contamination of various food materials.
2. Learn about various physical and chemical methods of food preservation andaseptic packaging.
3. Learn about the types of probiotic foods available in market.
4. Learn about FSSAI regulations.
5. Learn about role of microorganisms in food spoilage and intoxication.
6. Learn about rapid detection methods of food borne pathogens in foods
7. Get insights into predictive microbiology.

Recommended Books:

1. Food Microbiology: An Introduction (2017) by Thomas J. Montville *et al.,* 4thedition, ASM Press
2. Food Microbiology (2015) by Martin R Adams, Royal Society of Chemistry; 4th Edition
3. Food Microbiology: Fundamentals and Frontiers (2012) by Michael P. Doyle 4th Edition,ASM Press
4. Fundamental Food Microbiology (2013) by Bibek Ray, 5th Edition, CRC Press;
5. Food-Borne Infections and Intoxications (Food Science and Technology) (2005), by Riemann *et al.,* Academic Press Inc.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
IV SEMESTER

SMB 220: FOOD AND DAIRY MICROBIOLOGY LAB

No. of hrs/week: 03 **Credits: 02**

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1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of food borne bacteria
4. Isolation of microorganisms from spoiled vegetables/fruits.
5. Isolation of bread mold
6. Preparation of Yogurt/Dahi.
7. Isolation of yeast from grapes
8. Platform tests for Milk - organoleptic evaluation- Odor / Smell, General Appearance, Colour, Consistency, Temperature
9. Platform tests for Milk - Clot on boiling test, Alcohol test, Sediment test and Resazurin test.

Recommended Books:

1. Food Microbiology Laboratory (Contemporary Food Science) (2003) by Lynne McL and sborough 1st Edition, CRC Press
2. Food Microbiology: A Laboratory Manual (2002) by Ahmed E. Yousef, 1st Edition, Wiley- Inter science.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
IV SEMESTER

SBC 206: DATABASE MANAGEMENT SYSTEM

No. of hrs/week: 04 **Credits: 04**

Preamble

This course introduces the core principles and techniques required in the design and implementation of database systems. This introductory application-oriented course covers therelational database systems RDBMS, Entity-Relational model, Normalization, Relationalmodel, Relational algebra, and data access queries as well as an introduction to SQL.

Course Objectives

At the end of the course a student is expected to:

- Describe a basic introduction to the discipline of database management systems.
- Understand basic idea of various data models and their usage in RDBMS
- Demonstrate the principles behind conceptual design, logical design through normalization
- Introduce the concepts of basic SQL as a universal Database language

UNIT – I

Introduction to Databases: What is database system, purpose of database system, view of data, relational databases, database architecture.

UNIT – II

Data Models: Importance Evolution of data models, Basic building blocks, Data abstraction. ER, Hierarchical, Network, Object-oriented and Relational, Distributed databases.

UNIT – III

Overview of ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, Database Design, Unified Modeling Language (UML)

UNIT – IV

Relational database model and Design: Logical view of data, keys, integrity rules, features of good RDB, atomic domain, Normalization – Pitfalls in RDB, Decomposition, Functional dependencies, types (1NF, 2NF, 3NF, BCNF).

UNIT – V

Constraints, Views and SQL: Constraints and types, Integrity constraints, Introduction to views, data independence, security, updates on views, comparison between tables and views SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers.

Recommended Books:

1. Essentials of Database Management Systems – Alexis and Mathews.
2. Database System Concepts – Abraham, Korth and Sudarshan, 6th Ed.
3. The Complete Reference SQL – James and Paul, 2nd Ed.

Course Outcomes

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

- Explain the basic concepts and the applications of database systems
- Design conceptual models of a database using ER modeling
- Create and populate a RDBMS for a real life application, with constraints and keys, using SQL
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL
- Retrieve any type of information from a data base by formulating complex queries in SQL

Improve the database design by normalization

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
IV SEMESTER

SBC 224: DBMS LAB

No. of hrs/week: 03 **Credits: 02**

Preamble

This course introduces the core principles and techniques required in the design and implementation of database systems. It provides students with theoretical knowledge and practical skills in the use of databases and database management systems in information technology applications.

Course Objectives

At the end of the course a student is expected to:
•demonstrate various commands to implement data tables &their usage in RDBMS
•demonstrate the principles behind conceptual design, logical design
•demonstrate the basic SQL commands

1. Understanding database design for biological data.
2. Understanding the use of Structured Query Language (SQL).
3. Data definition language.
4. Data manipulation language.
5. Understanding and writing SQL queries to create, report, and update data in a relational database.
6. Understanding views and forms.

Course Outcomes:

At the end of the course the students are able to:

- Apply the basic concepts of Database Systems and Applications.
- Use the basics of SQL and construct queries using SQL in database creation and interaction.
- Analyze and Select storage and recovery techniques of database system.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
IV SEMESTER

SSE 282: PURIFICATION TECHNIQUES

No. of hours per week: 02 **Credits: 02**

UNIT-I

Principle and applications of chromatographic techniques- paper, thin layer, gel filtration, ion- exchange and affinity chromatography.

UNIT-II

Electrophoresis- principles and applications of polyacrylamide (native and SDS) and agarose gel electrophoresis. Criteria of purity

Recommended Books:

1. Biochemical methods by Sadasivam and Manikam, Wiley Eastern Limited.
2. An introduction to practical Biochemistry by D. T. Plummer, McGraw Hill.
3. Laboratory manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited.
4. Introductory Practical Biochemistry by S. K. Sawhney and Randhir Singh, Narosa.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
IV SEMESTER

SSE 284: BIOSTASTICS

No. of hours per week: 03 **Credits: 02**

UNIT- I

Introduction to Mean, mode, median, mean deviation, Standard deviation, coefficient of variation. Correlation (Karl Passions, Co-efficient of correlation, Rank correlation) and Regression analysis, Regression equations, taking suitable examples from biological data.

UNIT- II

Probability: Theorems on probability, Binomial and normal distribution . Methods of Sampling of biological data and analysis using 't' and 'Z' and 'F' tests of significance for small and large samples.

Recommended Books

1. Basic statistics by A. L. Nagar and R. K. Das; 2nd Ed.; Oxford; 2002.
2. Biostatistics: a manual of statistical methods for use in health, nutrition and anthropology by K. Visweswara Rao; Jaypee Borthers, 1996.
3. Introductory statistics by Prem S. Mann; 5th Ed.; John Wiley; 2003.
4. Biostatistics: a foundation for analysis in the health sciences by Wayne W. Daniel; 8th Ed.; John Wiley; 2005.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 351: CLINICAL BIOCHEMISTRY AND IMMUNOLOGY

No. of hrs/week: 04 **Credits: 04**

Preamble:

ClinicalBiochemistry and Immunology has contributedenormously to the growth of modern medical and health science. They have applications in clinical diagnosis, understanding pathology of diseases,treatment of diseases, designing of drugs and understanding their metabolism. Keeping in pace with the developmental trends in various subareas of Biochemistry it isexpected that the students undertaking Clinical Biochemistry and Immunology course become conversant with the fundamentals and at the same time at the end ofthe programme they exhibit certain levels of learning outcomes.

Course Objectives:

To familiarize students with the specific characteristicfeatures of clinical biochemistry and immunology.

To understand the pathophysiology and molecular basis of the most prevalent diseases.

To understand the role of diagnostic enzymes and function tests in disease diagnosis.

To know how basic biochemistry and immunology can be applied to medical diagnosis, treatment and management of diseases.

UNIT-I

Blood and blood disorders**:** Plasma proteins in health and disease. Disorders of blood coagulation (haemophilia). Types of anemias, haemoglobinopathies and thalassemias.

Learning Outcomes:
By the end of this Unit, the student will be able to

- Understands the biochemical basis of blood related disorders (L1).
- Students will become aware with the variations in the levels of plasma proteins and their relationship with various diseases (L2).
- Understand the pathology and clinical manifestation associated with haemophilia(L1).
- Distinguish normal and abnormal hematological findings to predict the diagnosis of hematological disorders like anemias, hemoglobinopathies and Thalassemias (L2).

UNIT-II

Liver and Liver Functional tests: Structure and functions of the liver. Liver diseases- jaundice, hepatitis, cirrhosis. Liver function tests- conjugated and total bilurubin in serum, albumin: globulin ratio, hippuric acid and bromsulphthalein tests. Serum enzymes in liver diseases- SGPT, GGT and alkaline phosphatase.

Learning Outcomes:
By the end of this Unit, the student will be able to

- Describe and explain the role of liver function in bilirubin metabolism and identify the tests used for bilirubin analysis (L1).

- Students will get acquainted with the role of enzymes in diagnosis of various diseases. (L2).
- Relate laboratory results of SGOT, SGPT, GGT, ALPto clinical diagnosis(L3).
- Understands common disorders of liver (L2).

UNIT-III

Kidney and Kidney Functional tests**:**Kidneys-structure of nephron, urine formation, normal and abnormal constituents of urine. Biological buffers. Role of kidneys in maintaining acid-base and electrolyte balance in the body. Renal function tests- creatinine and urea clearance tests, phenol red test.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Students will learn about the formation, normal and abnormal constituents of urine and their significance inmaintaining good health(L1).
- Describe and explain the contributions of different buffer systems torespiratory and metabolic disorders of metabolism (L2).
- Explain that the renal compensation of altered [H+] involves alterationsin blood biochemistry to restore the blood pH (L3).
- Perform various biochemical tests to determine creatinine, urea clearance and albumin, ketone bodies, glucose in urine(L2).
- Understands common disorders of kidney (L2).

UNIT-IV

Immunology :Organization of immune system. Organs and cells of immune system.Innate and acquired immunity. Cell mediated and humoral immunity. Classification of immunoglobulins, structure of IgG. Epitopes / antigenic determinants. Concept of haptens. Adjuvants. Theories of antibody formation- clonal selection theory.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Students will gain an overview of the immune system including cells, organs and receptors (L1).
- Understand and the importance of humoral, cell-mediated and innate immune responsesincombating pathogens(L2).
- They will understand structure and functions of different classes of immunoglobulins, the basis of antibody diversity (L2).
- They will beacquainted with antigen, epitope, adjuvant and hapten (L1).
- Students willbe in a position to explainthe theories of antibody formation (L2).

UNIT-V

Immuno Techniques

Antigen-antibody reactions- agglutination, immunoprecipitation, immunodiffusion. Blood group antigens. Immunodiagnostics-RIA, ELISA. Vaccines and their classification. Outlines of hypersensitivity reactions.

Learning Outcomes:

By the end of this Unit, the student will be able to

- They will be acquainted with the importance of antigen-antibody interaction in disease diagnosis (L1).
- Students will be acquainted with immunodiagnostics like RIA and ELISA for diagnosis of various diseases (L2).
- They will also understand the importance of conventional vs recombinant vaccines and their classification (L2).
- They will also understand mechanisms involved in different types ofhypersensitivity (L2).

Course Outcomes:

- Students will be familiarizedwith the pathophysiology of various diseases related to blood (CO1).
- Understands the importance of function tests related to liver and kidney diseases(CO2).
- Will understand the organization and functioning of immune system (CO3).
- Understands the implications of basic clinical biochemistry and immunology in medical diagnosis, treatment and management of diseases (CO4).

Recommended Books

1. Biochemical aspects of human disease by RS Elkeles and AS.Tavil, Blackwell Scientific publications.
2. Textbook of Medical Biochemistry by M. N. Chatterjee, Jaypee, 6th Ed.
3. Textbook of Biochemistry with clinical corelationships by Devlin, JOHN publishers, 6th Ed.
4. Textbook of Biochemistry by S. Nagini, Scitech publishers.
5. Clinical biochemistry by S. Ramakrishna and Rajiswami.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 321: CLINICAL BIOCHEMISTRY AND IMMUNOLOGY LAB

No. of hrs/week: 03 **Credits: 02**

Preamble: Clinical Biochemistry and immunology has applications in clinical diagnosis, understanding pathology of lifestyle and other diseases. The practical knowledge of diagnostics in Clinical Biochemistry and immunologylab course equips the students with better learning outcomes in diagnosis and research.

Course Objectives:

- To learn about antigen antibody reactions and their use in diagnosis and identification of antigen/antibody.
- To acquires working knowledge of analytical methods commonly used in the clinical laboratory.

1. Determination of blood group and Rh typing.
2. Visualization of antigen antibody reactions (Ouchterlony technique).
3. Urine analysis for albumin, sugars and ketone bodies.
4. Estimation of serum creatinine.
5. Estimation of blood urea.
6. Estimation of serum SGPT.
7. Estimation of serum bilirubin.

Learning Outcomes:

- Will be able to clinically assess the laboratory indicators of physiologicconditions and diseases (L1).
- Relate laboratory results to clinical diagnosis of marker molecules in diseases pertaining to heart, liver, kidney, blood and urine (L2).
- Gain ability to apply knowledge of clinical biochemistryand immunology in health and diagnostic purposes (L3).

Course Outcomes:

- Obtains knowledge about antigen-antibody reactions and application in identification and quantification of antigens and antibodies in health and disease.
- Acquires working knowledge of analytical methods commonly used in the clinical laboratory.

Recommended Books

1. Practical Clinical Biochemistry by Harold Varley.
2. Experimental Biochemistry by BeeduSashidhar Rao and Vijay Deshpande, IKI Pvt. Ltd.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 353: HUMAN PHYSIOLOGY AND NUTRITION

No. of hrs/week: 04 **Credits: 04**

UNIT- I

Digestive and Respiratory System**:** Digestion and absorption of carbohydrates, lipids and proteins. Respiration and transportation of gases in blood (oxygen and CO_2), Bohr's effect.

UNIT-II

Circulatory and muscle physiology **:** Heart- structure of the heart, cardiac cycle, cardiac factors controlling blood pressure. Kinds of muscles, structure of myofibril, organization of contractile proteins and mechanism of muscle contraction.

UNIT-III

Endocrinology- organization of endocrine system. Outlines of chemistry, physiological role and disorders of hormones of pancreas, thyroid, parathyroid, gonads, adrenals, pituitary and hypothalamus. Mechanism of hormonal action- signal transduction pathways for adrenaline, glucocorticoids and insulin.

UNIT- IV

Nutrition**:** Balanced diet. BMR and factors affecting it.Specific dynamic action of foods. Recommended dietary allowance (RDA) for children, adults, pregnant and lactating women. Biological value of proteins. Sources of complete proteins. Malnutrition- Kwashiorkar, Marasmus and PEM. Role of essential fatty acids in human nutrition. Obesity and starvation.

UNIT – V

Nutritional aspects of Vitamins and Minerals **:** Vitamins- sources, structure, biochemical roles, deficiency disorders of water and fat soluble vitamins. Bulk and trace elements-Ca, Mg, Fe, I, Cu, Mo, Zn, Se and F. Introduction to neutraceutical and functional foods.

Recommended Books:

1. Textbook of human Physiology by Guyton, Elesvier,11thEd.
2. Essentials of Medical Physiology by K. Sembulingam, PremaSembulingam, Jaypee, 2nd Ed.
3. Textbook of Biochemistry & Human Biology by G.P.Talwar PHI, 3rd Ed.
4. Textbook of Medical Biochemistry by M.N.Chatterjee, Jaypee 6th Ed.
5. Molecular Endocrinology by Bolander, Elsevier 3rd Ed.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 323: HUMAN PHYSIOLOGY AND NUTRITION LAB

No. of hrs/week: 03 **Credits:02**

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1. Estimation of calcium by titrimetry
2. Estimation of iron in apple juice by phenanthroline method.
3. Estimation of vitamin C by 2, 6 -dichlorophenol indophenol method.
4. Determination of iodine value of oil.
5. Estimation of hemoglobin in blood.
6. Estimation of blood glucose.
7. Total count - RBC and WBC. Differential count.

Recommended Books:

1. Practical Clinical Biochemistry by Harold Varley.
2. Experimental Biochemistry by BeeduSashidhar Rao and Vijay Deshpande, IKI Pvt. Ltd.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

V SEMESTER

SMB 341: MEDICAL AND DIAGNOSTIC MICROBIOLOGY

No. of hrs/week: 04 **Credits: 04**

Preamble:

Microbiology is the study of the smallest living organisms (micro-organisms or microbes). Microorganisms play a critical role in the various biogeochemical cycles, as well as being a particularly important component of plant and soil ecosystems. They break down dead plant and animal tissues and make their nutrients, including carbon and nitrogen, available to support plant growth. Medical microbiology, the large subset of microbiology that is applied to medicine, is a branch of medical science concerned with the prevention, diagnosis and treatment of infectious diseases. In addition, this field of science studies various clinical applications of microbes for the improvement of health.Medical microbiologists provide services to aid the diagnosis and management of infectious diseases and help ensure the safety of those at risk of acquiring infectious diseases, both in hospitals and the community.

UNIT - I

Normal microflora of the human body- skin, throat, gastrointestinal tract, urogenital tract. Hostpathogen interaction: infection, invasion, pathogen, pathogenicity, virulence, toxigenicity,carriers and their types, opportunistic infections, nosocomial infections.Vertical and horizontaltransmission.

Learning Outcomes: By the end of this Unit, the student will be able to

- Learn the normal microflora of the human body
- Learn about hostpathogen interactions
- Study about opportunistic infections.
- Learn about nosocomial infections.
- Study about vertical and horizontaltransmission.

UNIT – II

Symptoms, mode of transmission, prophylaxis, diagnosis and control of – respiratory diseases: *Streptococcus pyogenes, Mycobacterium tuberculosis,* gastrointestinal diseases: *Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori,* disease caused by: *Staphylococcus aureus, Bacillus anthracis, Clostridium tetani*.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn about symptoms, mode of transmission, prophylaxis, diagnosis and control of various types of respiratory diseases.
- Learn about the disease and control of *Escherichia coli, Salmonella typhi, Vibrio cholerae*.
- Learn about *Helicobacter pylori*.
- Get insights into disease caused by *Staphylococcus aureus, Bacillus anthracis, Clostridium tetani*.

UNIT-III

Symptoms, mode of transmission, prophylaxis, diagnosis and control of-Polio, Herpes,hepatitis, HIV, Influenza, emerging and re-emerging viruses-Ebola, Zikavirus.Disease cycle, mode of transmission, treatment of *Plasmodium, Leishmania* and *Giardia*.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn about various symptoms, mode of transmission, prophylaxis, diagnosis and control of virus borne diseases .
- Learn about emerging and re-emerging viruses
- Learn about disease cycle, mode of transmission, treatment of *Plasmodium*
- Learn about disease cycle, mode of transmission, treatment of*Leishmania* and *Giardia*

UNIT-IV

Mycoses and types. Symptoms, mode of transmission, prophylaxis, diagnosis and control of-Cutaneous mycoses: Tinea pedis (Athlete'sfoot) Systemic mycoses: Histoplasmosis,Opportunistic mycoses: Candidiasis.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Study about various types of mycoses.
- Learn about symptoms, mode of transmission, prophylaxis, diagnosis and control of mycoses.
- Learn about systemic mycoses.
- Learn about Opportunistic infections
- Learn about candidiasis

UNIT-V

Collection, transport and culturing of clinical samples. Antimicrobial agents: mode of action:Inhibitors of – nucleic acid synthesis; cell wall synthesis; cell membrane function; proteinsynthesis; metabolism. Antibiotic resistance, MDR,MRSA.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn about collection, transport and culturing of clinical samples
- Learn about antimicrobial agents and their mode of action
- Learn about inhibitors of – nucleic acid synthesis
- Learn about inhibitors of metabolism.
- Study about antibiotic resistance.

Course Outcomes:

8. Learn the normal microflora of the human body
9. Learn about hostpathogen interactions
10. Learn about symptoms, mode of transmission, prophylaxis, diagnosis and control of various types of respiratory diseases.

11. Learn about various symptoms, mode of transmission, prophylaxis, diagnosis and control of virus borne diseases.
12. Learn about collection, transport and culturing of clinical samples
13. Learn about antimicrobial agents and their mode of action
14. Study about antibiotic resistance

Recommended Books:

6. Microbiology: An Introduction (2016) by Tortora et al., 12th Edition Pearson publishers
7. Prescott's Microbiology (2016) by Joanne Willey et al., 10th Edition McGraw-Hill Education
8. Sherris Medical Microbiology, (2018) by Kenneth J. Ryan et al.,7th EditionMcGraw-Hill Education
9. Microbiology: Principles and Explorations (2015) by Black et al.,9th Edition, Wiley Pulishers
10. Algae (2008) by James E. Graham (2nd Edition), Benjamin Cummings
11. The Fungi by Sarah C. Watkinson, Academic Press; 3 edition (2016)
12. Fungi: Experimental Methods in Biology by Ramesh Maheshwari, Second Edition, CRC Press
13. Understanding viruses (2016) by Teri shors, Jones and Bartlet Publishers

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SMB 321: MEDICAL AND DIAGNOSTIC MICROBIOLOGY LAB

No. of hrs/week: 03 **Credits: 02**

Course objectives:

The Medical Microbiology Lab is designed to give students an exposure to various laboratory techniquesdealing with microbial infections. Students would get an overall experience in identifying microbes, culturing them and understand their sensitivity to drugs

1. Identification of bacteria (E. coli, Pseudomonas, Staphylococcus, Bacillus) using laboratory strains based on cultural, morphological, and biochemical characteristics: IMViC, TSI,nitrate reduction, urease production and catalase tests.

2. Studyofcompositionanduseofimportantdifferentialmediaforidentifi

cationofbacteria: EMB Agar, McConkey agar, Mannitol salt agar,

Deoxycholate citrate agar, TCBS

3. Study of bacterial flora of skin by swabmethod.

4. Perform antibacterial sensitivity by Kirby-Bauermethod.

5. Determination of minimal inhibitory concentration (MIC) of an antibiotic.

Course outcomes:

By the end of the practical exercises, students would gain

- hands-on experience in identifying microbial pathogens, culturing them in laboratory and assay theirsensitivity to various available drugs.

RECOMMENDED BOOKS:

1.Laboratory Exercises in Microbiology (2016) by John Harley 8th Edition, McGraw-Hill Education 2.Microbiology: A Laboratory Manual (2016) by James G. Cappuccino 11th Edition Pearson publishers
3.Microbiology: Laboratory Theory and Application (2015) 4th Edition by Michael J. Leboffe, MortonPublishing Company

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER
SMB 343: ECOLOGY AND AGRICULTURAL MICROBIOLOGY

No. of hrs/week: 04 **Credits: 04**

Preamble:

This paper provides a base line understanding of Ecology and Agricultural Microbiology and has been designed to enrich students an insight in acquiring the fundamental knowledge on Microbial ecology and various microorganisms and their importance and applicability in different fields of Agricultural industry.

Course Objectives:

The objectives of this course are to introduce field of Agricultural microbiology with special emphasis on microbial diversity, host-microbe interactions. Also provide technological aspects related to the concept of ecosystem and its management, soil environment, Plant pathogens and biofertilizers.

UNIT –I

Microbial ecology-scope, positive microbial interactions- mutualism, protocooperation, commensalism. Negative microbial interactions – competition, antagonism, parasitism, predation, Microbial community development, r and k strategies.

Learning outcomes:

By the end of the course, the student will be able to:

- Learn and understand microbial ecology
- Acquire knowledge about various microbial interactions

UNIT –II

Air-borne transmission of microbes, air sampling principles and techniques. Aquatic microbiology- fresh water, marine habitats. Zonation of water ecosystems, eutrophication. Potability of water- Microbial assessment of water quality, water purification, major water-borne diseases, and their control measures.

Learning outcomes:

By the end of the course, the student will be able to:

- Gain basic knowledge of Airborne transmission of microbes and sampling techniques and waterecosystem.
- Understand procedures involved in Microbial assessment of water quality and purification
- Learn the methods of water borne diseases, and control measures.

UNIT –III

Soil environment soil profile. Physico-chemical conditions, sampling techniques, role of microorganisms in organic matter decomposition, biogeochemical cycles – nitrogen cycle, sulfur and phosphorous cycles.Rhizosphere, bio-chelators, siderophores.

Learning outcomes:

By the end of the course, the student will be able to:

- Acquire the knowledge on soil environment and learn the sampling techniques.
- Learn the concepts of various biogeochemical cycles.

UNIT –IV

Plant pathogens-fungal (white rusts of crucifers, early and late light of potato, Fusarium wilt, powdery

mildew), bacterial (Citrus canker) and viral (Tobacco mosaic virus, CaMV) disease symptoms, diseasecycle, prevention, and management.

Learning outcomes:

By the end of the course, the student will be able to:

- Develop knowledge on various Plant pathogens
- Acquire knowledge on various plant diseases affecting agricultural crops
- Understand the pathogenesis, prevention and management.

UNIT –V

PGPR Biofertilizers- nitrogen fixing microbes- Rhizobium, Azotobacter, blue green algae, Phosphate solubilizing microorganisms. Mycorrhiza. Biopesticides – Bacillus thuringiensis, Pseudomonas syringe and Beauveria bassiana, NPV. Mycophagy.

Learning outcomes:

By the end of the course, the student will be able to:

- Develop knowledge in Plant growth promoting microbes
- Learn the concepts of Nitrogen fixation using microbes
- Understand the role of various microbes as biofertilizers

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

- Acquire knowledge about various microbial interactions
- Gain basic knowledge of Airborne transmission of microbes and sampling techniques andwater ecosystem
- Appreciate the pathogenesis, prevention and management techniques
- Improve knowledge in Plant growth promoting microbes

RECOMMENDED BOOKS:

1.Microbiology: An Introduction (2016) by Tortora et al., 12thEdition Pearson publishers2.Microbiology: A Systems Approach (2017) by Kelly Cowan 5thEdition McGraw-Hill Education

3. Prescott's Microbiology (2016) by Joanne Willey et al., 10thEdition McGraw-HillEducation

4. Brock Biology of Microorganisms (2015) by Michael T. Madigan (15thEdition),Pearson publishers

5. Handbook of Microbial Biofertilizers (2006) by Mahendra Rai 1stEdition, CRC Press 6.Algae: An Introduction to Phycology (1996)

by Christiaan van den Hoek, 1st Edition,Cambridge University press
7.The Fungi by Sarah C. Watkinson, Academic Press; 3rd Edition (2016).

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SMB 323: ECOLOGY AND AGRICULTURAL MICROBIOLOGY LAB

No. of hrs/week: 03 **Credits: 02**

Preamble:

This paper has been designed to enrich students in learning the good laboratory practices used in Microbiology laboratory and provide practical skills in basic ecology and agricultural microbiology laboratory.

Course Objectives:

The objective of this laboratory course is to develop a detailed knowledge and practical skills in Ecology and Agricultural Microbiology. Students acquire sufficient level of knowledge and aptitude in all aspectsof agricultural microbiology.

1. Isolation of bacteria and fungi from soil using serial dilution method
2. Isolation of Rhizobium from root nodules
3. MPN test
4. DO and BOD
5. Observation of rust spots from local leafy vegetables
6. Observation of viral symptoms
7. VAM fungal observation
8. Observation and comparison of different Biofertilizers

Course outcomes:

By the end of the course, the student will be able to

- Learn the methods of isolation of bacteria and fungi from soil
- Acquire knowledge regarding water quality tests
- Understand the pathogenesis of fungal and viral diseases on agricultural crops
- Develop a detailed knowledge on use of biofertilizers

RECOMMENDED BOOKS:

1. Laboratory Exercises in Microbiology (2016) by John Harley 8th Edition, McGraw-HillEducation
2. Microbiology: A Laboratory Manual (2016) by James G. Cappuccino 11th Edition Pearsonpublishers
3. Microbiology: Laboratory Theory and Application (2015) 4th Edition by Michael J. Leboffe,Morton Publishing Company
4. Handbook of Microbial Biofertilizers (2006) by Mahendra Rai 1st Edition, CRC Press 5.Fungi: Experimental Methods in Biology (2019) by Ramesh Maheshwari, SecondEdition, CRC Press

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 381: STRUCTURAL BIOINFORMATICS

No. of hrs/week: 04 **Credits: 04**

Preamble:

This course provides exposure to wide range of techniques and applications in molecular modeling and structural bioinformatics, including molecular mechanics, energy minimization, molecular dynamics simulations, biomolecular structure prediction and analysis. Computational models help in better understanding of molecules and aid in quicker implementation of computer aided drug design approaches.

Course Objectives:

At the end of the course a student is expected to:

- To let students understand various methods of molecular modelingrepresentation of molecules in various formats.
- To understand the concept of energy minimization, molecular dynamics and monte carlosimulations of macromolecules
- To understand protein structure analysis at primary and secondary structure levels
- To understand the steps of protein modeling, structure validation and alignment studies.

UNIT – I

Introduction to Molecular Modelling: Representation of chemical compounds - Nomenclature, Line notations, Standard structure exchange formats.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the methods to model the molecules.
- Explain about various computer representations of molecules.
- Describe the formats of macromolecular structures.

UNIT – II

Molecular Mechanics and Simulations: Force Fields – Functional Forms – Bonded and Non-bonded interactions. Energy Minimization methods, Molecular dynamics and Monte Carlo simulation methods.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the concept of force field and its features.
- Explain about various interactions involving in computation of molecular energy.
- Describe the variety of force fields available for biomolecules.

- Explain the concept of minimization and need of simulation methods

UNIT – III

Protein Primary and Secondary Structure Analysis: Primary sequence analysis, Secondary structure prediction (Chou-Fasman, GOR, Neural Network) Conformational properties of Proteins.

Learning Outcomes:

By the end of this unit, the student will be able to

- Differentiate between protein primary and secondary structure analysis .
- Describe the various methods for secondary structure prediction of methods.
- Describe about conformational properties.

UNIT – IV

Protein Modeling& Evaluation: Homology modelling, Fold recognition and Abinitio. Error Estimation and Precision, Stereo Chemical Parameters.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the different approaches to model a protein molecule.
- Explain the steps involved in modeling of proteins and its validation.

UNIT – V

Structure Alignment and Comparison: Protein Structure Comparison and Alignment, Structural Alignment Methods - CE, VAST, DALI, SSAP, TM-align.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the different approaches to perform structural alignment and comparisons.
- Describe the various protein comparison and structure alignment methods.

Reference Books:

1. Molecular Modelling: Principles and Applications – A.R. Leach 2nd Ed
2. Chemoinformatics – Johann Gasteiger, Thomas Engel, Wiley.
3. Computational Biochemistry and Biophysics –O M. Becker.
4. Structural Bioinformatics – Jenny and Philip, 2nd Ed.

Course Outcomes:

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

- Apply concepts of molecular modeling, molecular mechanics in computation of various types of molecular interactions.
- Learn energy concepts and its importance with respect to force fields.
- Understand the concepts of simulations by molecular dynamics and Monte Carlo.

- Perform protein modelling, structural alignment and model validation studies.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 339: STRUCTURAL BIOINFORMATICS LAB

No. of hrs/week: 03 **Credits: 02**

Preamble:

The structural bioinformatics lab course, aimed for students working with latest tools available in the field and their usage for derivation of Biological insight. With the rise of computer power, in silico methods provide Biological insight on computational representation of molecules, structural properties computation, sequence-structure-function relationships including analysis and structure modeling.

Course Objectives

- To generate molecular representations and properties calculations.
- To perform protein primary, secondary and tertiary analysis.
- To model protein molecules by various methods and their validation studies.
- To perform energy evaluation and minimization of molecules.

Practical's Laboratory Sessions:

1. Generating 3D Representation from 2D Description of Small Molecules.
2. Computing Structural Properties of Small Molecules.
3. Protein Primary and Secondary Structure Analysis.
4. Protein Tertiary Structure Prediction by Homology Modeling.
5. Protein Tertiary Structure Prediction by Fold Recognition.
6. Protein Tertiary Structure Prediction by Ab-Initio.
7. Structure Alignment and Comparison.
8. Energy Evaluation and Geometry Optimization.

Learning outcomes:

By the end of this practical, the student will be able to

11. Generate various 3D representations of molecules and compute structural properties
12. Analyze primary, secondary and tertiary structures of protein.
13. Perform protein modeling using various methods and model validation.
14. Perform structural comparisons and alignments.
15. Compute energy properties and perform minimization of molecules.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 383: CONCEPTS OF GENOMICS AND PROTEOMICS

No. of hrs/week: 04 **Credits: 04**

Preamble:

Genomics and proteomics is the fast growing field of developing large data as a whole for particular organism to a particular condition and helps in dealing with complex condition in many case. The knowledge of genomics and proteomics help in narrow down the experimental procedures to achieve the reliable results faster and validating them.

Course Objectives

- To acquire knowledge on genome sequencing strategies and methods of assembly.
- To acquire knowledge on concept, tools and databases of comparative genomics.
- To identify different regions of genome sequence with predicting their functions using different methods.
- To understand different strategies and methods employed in protein separation and quantification for whole samples of proteins at a time.
- To understand different principles of protein-protein and protein-DNA interactions.

UNIT – I

Large scale genome sequencing strategies - combinatorial approach, shot gun, hierarchal, high throughput sequencing, NGS technology, Fragment and map assembly, Genome assembly and annotation, Tools for genome assembly.

Learning Outcomes:

By the end of this unit, the student will be able to

- Explain the strategies employed in genomics with their advantages and disadvantages (L2).
- Explain various NGS technologies employed in genomics with their advantages and disadvantages (L2).
- Understands fragment and map assembly which is required for genome assembly (L2).
- Describe about the genome assembly and annotating the genome (L1).
- Describe about the tools employed in genome assembly (L1).

UNIT – II

Basic concepts and applications of comparative genomics, Whole genome alignment, Tools and Databases for comparative genomics.

Learning Outcomes:

By the end of this unit, the student will be able to

- Describe the basic concepts of comparative genomics (L1).

- Explain various applications of comparative genomics (L3).
- Explain the strategy employed in whole genome alignment with the advantages and disadvantages (L2).
- Describe tools used for comparative genomics (L1).
- Describe databases used for comparative genomics (L1).

UNIT – III

Identification of genes, promoters, DNA motifs, splice sites, repetitive elements, CpG islands.

Learning Outcomes:

By the end of this unit, the student will be able to

- Describe the methods to employ to identify gene segments in prokaryotes and eukaryotes (like exons and introns) in genome sequence (L1).
- Explain the process of identification regulatory parts in genome sequence like promoters & DNA motifs (L2).
- Explain the process of identification regulatory parts in genome sequence like splice sites (L2).
- Explain the process of identification regulatory parts in genome sequence like repetitive elements (L2).
- Explain the process of identification regulatory parts in genome sequence like CpG islands (L2).

UNIT – IV

Protein sequence-structure-function relationship, Motifs and Domains, Protein expression analysis – 2D-gel electrophoresis and protein chip technology, Post translational modifications

Learning Outcomes:

By the end of this unit, the student will be able to

- Understands the relationship between protein sequence-structure-function (L2).
- Understand the concept of motifs and domains (L2).
- Understand the principle and method of 2DGE (L2).
- Understand the principle and method of protein chip technology (L2).
- Describe principles behind different post translational modifications (L2).

UNIT – V

Principles of Protein-Protein Interaction - Yeast Two-Hybrid system, STRING, Protein-DNA interactions.

Learning Outcomes:

By the end of this unit, the student will be able to

- Explain about the principles of protein-protein interactions (L2).
- Explain about the applications of protein-protein interactions (L3).
- Explain about the principles of Yeast Two-Hybrid system (L2).

- Explain about the principles of STRING (L2).
- Understand the protein-DNA interactions to solve biological problems (L2).

Recommended books:

1. Bioinformatics and Functional Genomics, Pevsner, J., John Wiley and Sons.
2. Principles of genome analysis and. Genomics, Primrose, S.B. and Twyman, R.M., Third Edition, Blackwell Publishing Company.
3. Essential Bioinformatics, Jinxiong, Cambridge University Press
4. Principles of Proteomics – RM. Twyman, Spl. Indian Ed.
5. Bioinformatics: Genes, Proteins and Computers – Orengo, Jones and Thornton
6. Introduction to protein science – AM. Lesk, 2nd Ed.

Course Outcomes:

By the end of course, the student will be able to

- Understand the concept of genomics and proteomics and its necessity to solve biological problems (CO1).
- Employ good strategies for sequencing genome of a particular sample. And use different methods and tools to assembly the gene fragments obtained in genome sequencing (CO2).
- Identify, predict and annotate the different sequences in the genome assembled, by employing suitable tools. And understand the concept, tools and databases of comparative genomics (CO3).
- Understand the basic principles of protein sequence-structure-function relationship. And the role of motifs and domains in structure-function of protein (CO4).
- Understand the basic principles of protein expression analysis, post translational modifications, protein-protein interactions, and protein-DNA interactions to solve biological problems (CO5).

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 341: GENOMICS & PROTEOMICS LAB

No. of hrs/week: 03 **Credits: 02**

Preamble:

Genomics and proteomics laboratory deals with understanding the principle's of acquaintance with genomic databases, prediction of ORF, post-translational modifications, function of proteins, and identification of interacting partners using various tools from biological data. It helps the student to analyse the genome and proteome content of an organism for better understanding of cellular life.

Course Objectives

- To understand the principle's of analyzing the genomic sequence data and the tools to predict the elements of the genome.
- To understand the principle's of analyzing the proteomic sequence data and the tools to predict the domains, post-translational modifications, and interacting partners of the protein.

Practical's Laboratory Sessions

1. Acquaintance with Genomic databases.
2. Prediction of ORF for genomic/DNA sequence.
3. Prediction of post-translational modifications using various tools.
4. Predicting function of proteins using domain databases.
5. Identification of interacting partners

Learning outcomes:

By the end of this practical, the student will be able to

1. Get acquainted with genomic databases (L3).
2. Predict ORF for genomic/DNA sequence (L3).
3. Predict function of proteins using domain databases, post-translational modifications using various tools, and interacting partners (L3).

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SSE 381: BASICS OF UNIX

No. of hours per week: 02 **Credits: 02**

UNIT - I

Introduction: Operating System, OS Types, Salient Features of UNIX, Various UNIX, History of Unix, Unix System, Unix for Dos Users.

UNIT - II

File and Directory Structure: Files, Type of Files, File Terminology, File Name Generation, File System, Directory, Path Name, Devices, Permission on Files and Directories. Editors: Stream Editor, Screen Editor, Line Editor.

UNIT - III

Unix Built In Commands: File Manipulation commands, Directory Manipulation Commands, Text Processing Commands, Networking and Communication Commands, General Purpose Commands, Day to Day Commands, Help commands, Terminal and Screen Commands, Processes Commands, Listing the Files.

Recommended Books:

1. Unix Concepts and Programming by Murugan Sethuraman, Denet and Company, 2006.

2. Unix Concepts by Sumitaba Das, TMH Publications, 4th edition, 2006.

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V SEMESTER

SSE 383: INDUSTRIAL BIOCHEMISTRY

No. of hr/ week: 02 **Credits: 02**

UNIT – I

Fermentation technology - surface, submerged and continuous culture techniques. Design and operation of fermentors, Agitation and Aeration, selection and growth of microorganisms in controlled environments, medium development.

UNIT – II

Production of fermented milks, cheese, alcoholic beverages and breads. Fermentative production of penicillin, citric acid, amylase.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SSE 385: INTRODUCTION TO ALGORITHMS – II

No. of hrs/week: 02 **Credits: 02**

UNIT-I

Searching and Sorting - Binary Search, Quick Sort, Merge Sort, KMP algorithm, Counting Sort, Data Structures: Binary Indexed Tree, Segment Tree, Tries.

UNIT-II

Graph algorithms: Dijkstra algorithms - Shortest Path from source to all vertices, Prim algorithms - Minimum Spanning tree, Kruskal algorithms - Minimum Spanning tree.

Recommended books:

1. An Introduction to Bioinformatics Algorithms, Pevsner, Neil C. Jones and Pavel A. Pevzner, MIT Press, 2004.
2. Introduction to Algorithms, Thomas H. Cormen, MIT Press; third edition edition.
3. Algorithms in Bioinformatics: A Practical Introduction, Wing-Kin Sung, Chapman and Hall/CRC.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SBC 352: APPLIED BIOCHEMISTRY

No. of hrs/week: 04 **Credits: 04**

UNIT-I

Enzyme Technology**:**Immobilization of enzymes and cells, different methods. Factors affecting immobilized enzymes. Industrial applications.

UNIT-II

Fingerprinting Techniques**:**Restriction Fragment Length Polymorphism (RFLP), Random Amplified Polymorphic DNA (RAPD), DNA Foot printing, Variable Number Tandem Repeats (VNTR), Single Nucleotide Polymorphism (SNP), Microsatellites.

UNIT-III

Molecular Biology Techniques**:**Mapping genes – chromosomal walking, chromosomal jumping. Isolation of gene fragments using restriction endonucleases,

UNIT-IV

Amplification of DNA:cDNA synthesis, Polymerase Chain Reaction, Rapid amplification of cDNA ends (RACE-PCR), Chemical synthesis of genes.

UNIT-V

Transgenic Methods**:**Methods involved in the Production of transgenic microbes, plants, animals and their applications.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SBC 322: APPLIED BIOCHEMISTRY LAB

No. of hrs/week: 03 **Credits: 02**

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1. DNA finger printing using RFLP techniques.
2. DNA finger printing using RAPD techniques.
3. Amplification of DNA using specific and random primers by PCR.
4. Quantification of cDNA using real time PCR.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

VI SEMESTER

SBC 354: MOLECULAR BIOLOGY

No. of hrs/week: 04 **Credits: 04**

Preamble:

Molecular Biology deals with the basics and understanding of the central dogma. It helps the student in knowing the organization of the genome, replication, transcription, translation and their regulation in both prokaryotes and eukaryotes. This knowledge can be employed in determining the function of various genes and proteins for better understanding of cellular life.

Course Objectives

- To understand the organization of nuclear genome and DNA replication in prokaryotes and eukaryotes.
- To gain the knowledge of genetic code, promoters, RNA polymerase, mechanism of transcription in both prokaryotes and eukaryotes.
- To gain the knowledge of ribosome, mechanism and inhibition of translation (protein synthesis), post translational modifications, and regulation of gene expression.
- To acquire the knowledge on recombinant DNA technology.
- To acquire the knowledge on applications of recombinant DNA technology.

UNIT- I

Genome Organization and Replication: Organization of genome in prokaryotes and eukaryotes. Experimental evidences to prove nucleic acids as genetic material. Nature and structure of the gene. DNA replication- models of replication, Meselson-Stahl's experimental proof for semi-conservative model.

Learning outcomes:

By the end of this unit, the student will be able to

- Understand the organization and the role of nuclear genome (prokaryotes and eukaryotes) (L2) and explain the differences between the genetic material in both prokaryotes and eukaryotes (L2).
- Explain experiments with evidences to prove nucleic acids as genetic material (L2). Describe the fine structure of gene (prokaryotes and eukaryotes) (L1).
- Explain the mechanism of DNA replication in both prokaryotes and eukaryotes (L2). Explain about the enzymes involved and their role in DNA replication (L2).
- Describe the role and types of DNA polymerases in both prokaryotes and eukaryotes (L1).List the differences between DNA polymerases in both prokaryotes and eukaryotes (L2).
- Describe the models of replication, and Meselson-Stahl's experimental as a proof for semi-conservative model (L2).

UNIT- II

Genetic code and Transcription: Genetic code, deciphering of genetic code, Nirenberg's and Khorana's experiments, wobble hypothesis, degeneracy of genetic code. Transcription - Role of RNA polymerase I, II and III of eukaryotes, Promoters. Initiation-Elongation- Termination.

Learning outcomes:

By the end of this unit, the student will be able to

- Understand the general features of genetic code (L1), with special emphasis on deciphering of genetic code, and Nirenberg's and Khorana's experiments (L2).
- Understand wobble hypothesis, and degeneracy of genetic code (L2).
- Explain the mechanism of transcription in both prokaryotes and eukaryotes (L2).
- Describe the role and types of RNA polymerases in both prokaryotes and eukaryotes (L2) and the role of promoters (L2).
- Compare and contrast RNA polymerases & promoters in both prokaryotes and eukaryotes (L2).

UNIT- III

Protein Synthesis and Regulation of Gene Expression: Introduction to protein synthesis, Ribosome structure, activation of amino acids (aminoacyl t-RNA synthetases). Initiation, elongation and termination of protein synthesis. Post- translational modifications. Inhibitors of protein synthesis. Regulation of gene expression - Tryptophan operon and attenuation.

Learning outcomes:

By the end of this unit, the student will be able to

- Learn the structural components of ribosomes in both prokaryotes and eukaryotes (L2).

- Understand the mechanism of protein synthesis in both prokaryotes and eukaryotes (L2)
- Study inhibitors of protein synthesis (L1) and use the knowledge to inhibit protein synthesis of various prokaryotes and eukaryotes (L3).
- Understand the concept of regulation of gene expression with reference to Trp operon (L2).

UNIT- IV

Recombinant DNA technology: Restriction endonucleases, ligase, phosphatases, reverse transcriptase, polynucleotide kinases, terminal transferase nucleases-S_1 and RNAase H. Restriction mapping. Cloning vectors- Plasmids, Ti plasmids, Cosmids, λ phages, shuttle vectors, expression vectors. Host- *E. coli*, *Sacchromycescereviciae, Agrobacterium tumifaciens.*

Learning outcomes:

By the end of this unit, the student will be able to

- Understand the concept of Recombinant DNA technology (L2)
- Learn the importance of enzymes ligase, phosphatases, reverse transcriptase, polynucleotide kinases, terminal transferase nucleases-S_1, RNAase H in Recombinant DNA technology (L2); and
- Learn the importance of restriction endonucleases (L2) and the concept of restriction mapping (L2).
- Explain cloning vectors (plasmids, Ti plasmids, Cosmids, λ phages), shuttle vectors, and expression vectors and their role in rDNA technology (L1).
- Understand the importance of Host - *E. coli*, *Sacchromyces cereviciae, Agrobacterium tumifaciens* (L1) and their role in rDNA technology (L1).

UNIT- V

Applications of Recombinant DNA technology: Outlines of blotting techniques-Southern, Northern and Western. Applications of rDNA technology in agriculture, industry and medicine. Production of insulin and human growth hormone, production of Bt cotton. Monoclonal antibodies.

Learning outcomes:

By the end of this unit, the student will be able to

- Understand the blotting techniques-Southern, Northern and Western (L2).
- Understand the applications of rDNA technology (L2), and apply the knowledge in agriculture, industry and medicine (L3).
- Study inhibitors of protein synthesis (L1) and use the knowledge to inhibit protein synthesis of various prokaryotes and eukaryotes (L3).
- Understand production of insulin, human growth hormone, and monoclonal antibodies (L2).
- Understand the concept of production of Bt cotton (L2).

Recommended Books:

1. Molecular Biology of the gene by Watson, Pearson, 5th Ed.
2. Molecular Biology of the cell by Alberts, Garland science, 4th Ed.
3. Biochemistry by Matthews, Pearson, 3rd Ed.
4. Biochemistry by Voet and Voet, John Wiley and sons, 3rd Ed.
5. Molecular cell Biology by Lodish, Freeman, 6th Ed.
6. Principles of Biochemistry by Nelson cox. PALG, 4th Ed.
7. Biochemistry by L.Stryer, Freeman, 5th Ed.
8. Molecular Biology by Robert F.Weaver, McGraw Hill

Course Outcomes

By the end of this course, the student will be able to

1. Understand the organization of nuclear genome (prokaryotes and eukaryotes), and DNA replication (prokaryotes and eukaryotes) along with enzymes involved in DNA (CO1).
2. Gain the knowledge of genetic code, promoters, RNA polymerase, mechanism of transcription in both prokaryotes and eukaryotes (CO2).
3. Gain the knowledge of ribosome, mechanism and inhibition of translation (protein synthesis), post translational modifications, and regulation of gene expression (CO3).
4. Understand the concept of rDNA technology; enzymes used in rDNA technology; restriction mapping; role of cloning vectors, shuttle vectors, and expression vectors and hosts in rDNA technology (CO4).
5. Gain the knowledge of blotting techniques, and applications of rDNA technology in agriculture, industry and medicine (CO5).

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SBC 324: MOLECULAR BIOLOGY LAB

No. of hrs/week: 03 **Credits: 02**

Preamble:

Molecular Biology laboratory deals with understanding the principle's of isolating DNA & RNA, determining the purity of isolated DNA & RNA, and quantifying the isolated DNA & RNA from different sources. It helps the student to analyse isolated DNA content for better understanding of cellular life.

Course Objectives

- To understand the principle's of isolating DNA and determining the purity of DNA.
- To understand the principle's of quantifying or estimating DNA & RNA.

Practical's Laboratory Sessions

1. Isolation of DNA from onion/liver/coconut endosperm.
2. Isolation of plasmids.
3. Determination of purity of nucleic acids by UV-spectrophotometric method.
4. Estimation of DNA by diphenylamine method.
5. Estimation of RNA by orcinol method.

Learning outcomes:

By the end of this practical, the student will be able to

1. Isolate DNA from onion/liver/coconut endosperm (L3), and determine its purity (L5).
2. Isolate plasmid DNA (L3) and determine its purity (L5).
3. Quantify the isolated plasmid DNA by spectrophotometeric method (L3).
4. Estimate the isolated DNA by DPA method (L3).
5. Estimate the isolated RNA by Orcinol method (L3).

Recommended Books:

1. Lab manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited.
2. Biochemistry – a lab course by J.M. Becker, Academic Press.
3. Experimental Biochemistry: A student companion by BeeduSashidhar Rao and Vijay Deshpande, I.K. International Pvt. Ltd., New Delhi.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SMB 340: MICROBIAL PHYSIOLOGY AND FERMENTATION TECHNOLOGY
No. of hrs/week: 04 **Credits: 04**

Preamble:

This course provides insights to the principles relevant to Microbial Physiology and Fermentation Technology. As per the course content, one can understand the basic principles of important physiological processes in microorganisms. Development of procedures for obtaining new microbial metabolites by rapid and reliable isolation and screening procedures. Understanding various principles of fermentation processes, selection of media, reactor designs, scale-up and downstream processing is primary and essential in large-scale production of various biologically active principles or products.

Course Objectives:

1.To study physiology of transportation of biomolecules and microbial growth in response to nutrition and energy.

2.To develop skills about the fermentation processes with respect to growth kinetics and fermenter design

3.To understand the production of various growth factors, organic solvents, nutraceuticals and therapeutic agents

UNIT –I

Passive and facilitated diffusion, Primary and secondary active transport, concept of uniport, symport and antiport, Group translocation, Iron uptake. Microbial growth in response to nutrition and energy, EMP pathway and EDP pathway.

Learning outcomes:

By the end of the unit, the student will be able to:

• Gain the knowledge about the concepts of physiological processes.
• Know the microbial growth response to nutrition and energey

UNIT-II

Fermenter design - basic functions of a fermenter for microbial cell culture – alternative vessel design, common measurements and control systems. aeration and agitation antifoaming reagents in fermentation. Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homo fermentative and hetero fermentative pathways), concept of linear and branched fermentation pathways.

Learning outcomes:

By the end of the unit, the student will be able to:

•Understand the basic functions and designs of fermenter for microbial cell cultures
•Gain knowledge on concepts of fermentative pathways

UNIT-III

Fermentation process: Definitions of growth, growth kinetics - measurement of microbial growth - generation time and specific growth rate, synchronous growth, diauxic growth curve. Batch culture, Continuous Culture, Fed -Batch culture. Major types of organisms used in fermentation.

Learning outcomes:

By the end of the unit, the student will be able to:

•Differentiate the various types of fermentation processes
•Gain knowledge on concept of growth kinetics

UNIT -IV

Media for industrial fermentation, types of media. Product recovery: In-situ recovery of products, ex-situ recovery of products: Production of enzymes used in food technology by microbial fermentation – amylase, proteases, lipases, glucose isomerase.

Learning outcomes:

By the end of the unit, the student will be able to:

•Differentiate the various types of fermentation media

•Understand the product recovery or purification from culture broth
•Give account on production of enzymes used in food technology

UNIT –V

Production of single cell proteins, organic acids - citric acid, vinegar, amino acids – glutamic acid and lysine. Vitamins - riboflavin, Vitamin B12. Antibiotics – penicillin and tetracycline. Acetone and butanol.

Learning outcomes:

By the end of the unit, the student will be able to:

•Gain knowledge on single cell proteins, organic acids & solvents production.
•Give account on vitamins and antibiotics production

Course outcomes:

By the end of the course, the students will be able to

•Be familiar with different methodologies involved in the downstream processing in removing the microbial cells and solid matter from the fermentation broth and finishing of product purification.
•Give an account of important microbial / industrial processes in industrial chemicals, solvents, insecticides etc
•Understand the production of therapeutic agents
•Be familiar with industrial processes and applications in pharma, medicine etc
•Understand the transformations and metabolic engineering of biologically active molecules.

REFERENCE BOOKS:

1 Principles of Fermentation Technology (2016) by Peter F Stanbury, 3rd Edition, Butterworth- Heinemann
2.Microbiology and Technology of Fermented Foods (Ift Press) (2006) by Robert W. Hutkins, 1st Edition, Wiley-Blackwell
3.Industrial Microbiology (2016) by KL Benson, CBS Publishers
4.Industrial microbiology (2016) by Casida, New Age International Private Limited
5.Cruegers Biotechnology: A Textbook of Industrial Microbiology (2017) by Wulf Crueger, Medtech Publishers

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SMB 320: MICROBIAL PHYSIOLOGY AND FERMENTATION TECHNOLOGY LAB

No. of hrs/week: 03 **Credits: 02**

Preamble: This course enables the learner to develop laboratory skills towards fermentation technology and microbial growth physiology. Able to demonstrate the effect of various physical and biochemical factors on growth rate and survival of microorganisms.

Course Objectives:

1. To train the students to demonstrate the production of organic solvents and enzymes throughfermentation.
2. To show the enzyme producing capability of microorganisms
3. To understand the effects of various physical and biochemical factors on growth rate of bacteria.

1. Study and plot the growth curve of *E. coli* by standard plate count methods.

2. Calculations of generation time and specific growth rate of bacteria from the graph plotted withthe given data.

3. Effect of temperature on growth of *E. coli.*

4. Effect of pH on growth of *E. coli.*

5. Effect of carbon and nitrogen sources on growth of *E. coli.*

6. Effect of salt on growth of *E. coli.*

7. Demonstration of alcoholic fermentation.

8. Demonstration of the thermal death time and decimal reduction time of *E. coli.*

9. Extracellular activities of microorganisms- amylase, lipase, caseinase.

10. Isolation of Antibiotic producing organism.

Course Outcomes: By the end of this practical course, the student will be able to

- Gain knowledge to investigate and analyze the effect of various factors on growth rate of bacteria.
- Calculate the generation time and specific growth rate of bacteria
- Be familiar with extracellular activities of microorganisms
- Demonstrate alcohol production

REFERENCE BOOKS:

1.Laboratory Exercises in Microbiology (2016) by John Harley 8th Edition, McGraw-HillEducation2.Microbiology: A Laboratory Manual (2016) by James G. Cappuccino 11th Edition Pearson publishers.
3.Microbiology: Laboratory Theory and Application (2015) 4th Edition by Michael J. Leboffe,Morton Publishing Company
4. Industrial microbiology (2016) by Casida, New Age International Private

Limited 5.Practical Manual on Fermentation Technology (2012) by S. Kulandaivelu, I K InternationalPublishing House
6.Practical Fermentation Technology (2008) by Brian McNeil, Wiley Publishers

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS VI SEMESTER

SMB 342: IMMUNOLOGY

No. of hrs/week: 04 **Credits: 04**

Preamble: This course deals about the structure and organization of cells and organs of the immune system and gives an idea about activation of different types of immune responses. The course explain how the immune system responds against transplantation. This course also helps in analyzing the response of the system against cancer. This course gives an comprehensive view on the tolerance, Autoimmunity and hypersensitivity. The course also helps to understand the principles and significanceof various immunological techniques and various diagnostic assays.

Course objectives:

1. Course helps students to get knowledge about different cells, organs, and other components of theimmune system
2. Student will understand the immune response manifested by different components.
3. Students will learn about the response of immune system in different pathologicalconditions and learns about different techniques based on antigen and antibody interactions

UNIT-I

Immune System-Characteristics of Innate and Adaptive immune systems. Anatomical and Physiologicalbarriers. Cells and Organs of the Immune System.Toll like receptors. Immunogen, Antigen, Hapten, adjuvants, Epitopes.

Learning Outcomes: Student will learn about

- Different cells of the immune system
- Various lymphoid organs
- Different types of antigens

Unit-II

B cells-Types. B cell receptor. General structure of antibodies. Structure and functions of different classesof antibodies. Genetic basis of antibody diversity, Affinity maturation. Complement system-Classical, alternate and MBL pathways. Functions of complement system and their regulation.

Learning Outcomes: Student will learn about

- Types of B cells, functions of different classes of antibodies and antibody diversity
- Biological function and regulation of complement system

Unit III

T cells-Types.T cell receptor.MHC restriction.General structure and types of MHC. Role of MHC in theImmune Response and antigen presentation, Cell mediated responses of different T cells.

Learning Outcomes: Student will learn about

- Types of T cell
- Significance of MHC in antigen processing and presentation cell mediated responses

Unit-IV

Immunological tolerance.Types, characteristics and examples of Hypersensitivity, Autoimmunity, Transplantation-Types of rejection, Graft versus host disease. Disorders of the Immune System, Basic immune response to cancer, Modern Antibody Therapy

Learning Outcomes: Student will

- Get an idea of types of T cell
- Understand the significance and physiology of tolerance, autoimmunity and hypersensitivity
- Learn about different disorders of immune system and immune response against cancer

Unit-V

Antigen-Antibody Interactions. Double immunodiffusion and single immunodiffusion. Principles of Western blotting and ELISA Principles of Diagnostic tests-VDRL, WIDAL, Pregnancy detection.Diagnostic methodologies and limitations in identifying HIV, Salmonella, and other infections.

Learning Outcomes: Student will

- Understand antigen and antibody interactions
- Analyze and critically examine various immunological techniques
- Learn about different Diagnostic assays.

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

• Provide sequential and conceptual thinking and paradigms of cellular and molecular basis ofimmune system and their applications
• Evaluate the usefulness of immunology in different fields like medicine, industry…etc.,
• Apply their knowledge and design molecular diagnostic kits for detection of diseases

REFERENCE BOOKS:

1.Immunology a short course byBenjamin E and Leskowitz S (Wiley

Liss NY) 2.Fundamental Immunology by William E. Paul, Paul, 4th ed.

(Garland Science publishers).3.Immunology by Roit et.al (Harper Row).

4.Kuby Immunology by Judy Owen *et al.*, 7th edition (NY:

WH Freeman and Co)5.Principles of Microbiology and

Immunology byDavis et.al.,(Harper).

7. Immunology-understanding of immune system by KlansD.Elgret (.Wiley-Liss.NY,)

8. Cellular and Molecular Immunology by Abul K. Abbas and Andrew H. Lichtman,, 5th ed. (W B. Saunders).

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER
SMB 322: IMMUNOLOGY LAB

No. of hrs/week:03 **Credits: 02**

Preamble:

This course is about different laboratory experiments designed basing on the antigen and antibody interactions. Experiments are helpful for identifying specificity between antigens and antibodies and qualitative and quantitative estimation of antigens or antibodies.

Course objectives:

This course objective is to make the student aware of the techniques, instrumentation, methods available with regard to the estimation of antigens and antibodies. Methods include both qualitative and quantitative estimations and limitations of certain diagnostic assays.

1. Identification of human blood groups.
2. Total Leukocyte Count of the given blood sample.
3. Differential Leukocyte Count of the given blood sample.
4. Separation of serum from the blood sample(demonstration).
5. VDRL and WIDAL
6. Immunodiffusion by Ouchterlony method.
7. ELISA
8. Immunoelectrophoresis

Course outcomes:

By the end of this practical course,
the student will be able to

- Identify blood group of the given sample
- Understand antigen and antibody reactions
- Perform various experiments to determine concentrations of antigens or antibodies
- Can perform diagnostic test for some infections

REFERENCE BOOKS:

1. Immunology methods manual - The comprehensive source book by
Lefkovits. I 6.Manual ofclinical laboratory immunology by Rose NR.
2. The experimental foundations of modern immunology by Clark W.R.

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VI SEMESTER

SBC 382: DRUG DESIGNING

No. of hrs/week: 04 **Credits: 04**

Preamble

The discovery of drug and developing new drug is a very long term process and very costly. Modern drug design and discovery involves the implementation of various computational approaches to discover and analyze biologically related active compounds. Methods such as virtual screening, ADMET profile studies, etc. speed up the development of new active biological compounds. Nanotechnology is the science of dealing with atoms with only a few nanometers in dimensions. Nanotechnology is considered more powerful than even the industrial revolution, with applications ranging from automobiles to medicine. This course helps in understanding the variety of methods for developing candidate drug for treatment of many disease types.

Course Objectives

1.To understand the use of informatics in drug design and development, finding new targets to treat disease; mechanism of drug designing
2.To learn about various drug targets and their mechanisms of action.
3.To acquire the knowledge in drug design by various approaches
4.To gain the knowledge of structure activity relationships and clinical trails
5.To study the concept of nanotechnology, methods and applications

UNIT – I

Introduction to Drugs: Drug discovery and Design – A historical outline, Leads and Analogues, Sources of leads and drugs, Methods and Routes of Administration, ADMET properties.

UNIT – II

Rational Drug Designing: Introduction, Target Identification, Lead Identification, Lead Optimization – Structure activity relationships (SAR), QSAR - Parameters, Descriptors, Analysis and Case study, Preclinical and Clinical trails, FDA registration.

UNIT –III

Drug Target Identification: Properties of Drug Targets, Target identification by In vivo and In vitro Methods.

UNIT – IV

Computational Drug Design: Concepts of Virtual screening, Structure based drug designing, Ligand based drug designing.

UNIT – V

Docking – Docking problem, Docking process, Various methods of docking, Scoring functions.

Recommended Books:

1. Medicinal Chemistry – Gareth Thomas, 2nd Ed.
2. Foye's Principles of Medicinal Chemistry – Lemke and Williams, 6th Ed.
3. Computatinal Drug Design – David C. Young.

Course Outcomes:

By the end of the course, the student will be able to

- Explain the sources of drugs, properties of drugs and drug targets and ADMET studies.
- Differentiate between each type of drug target, its function and role in drug targeting.
- Describe various approaches in target identification and validation methods.
- Perform drug designing studies based on structure, ligand or De novo, screening methods.

Understand the theory of QSAR, types of clinical trials and drug development methods.

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VI SEMESTER

SBC 340: DRUG DESIGNING LAB

No. of hrs/week: 03 **Credits: 02**

Preamble

This lab course provides detailed knowledge in implementing and demonstration of methods andtechniques in computer assisted drug design (CADD) where especially the needs ofpharmaceutical industry are considered. Its contents includes topics such as famous examples ofdocking, ligand-receptor interactions,virtual screening, etc.

Course Objectives

To learn various software and tools for computer-aided drug designing.

1. Target Prediction.
2. Binding Site Prediction.
3. Structure based Virtual Screening.
4. Ligand based Virtual Screening.
5. Protein-Ligand Docking.
6. Protein-Protein Docking.

Course Outcomes:

1. Learn and use various tools for in silico drug designing.

2. Analyze and provide solutions to new drug discovery by using modern CADD tools.

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VI SEMESTER

SBC 384: JAVA PROGRAMMING

No. of hrs/week: 04 **Credits: 04**

Preamble

Java programming exposes students to the depth of modern programming practice. This module makes students as best programmers with Java programming concepts.

Course Objectives

- To introduce the features of Java and understand the fundamentals of object-oriented programming in Java.
- To define classes, objects, etc in Java for good programming skills and software development.
- To introduce about packages, interfaces and exception handling in Java programming.
- To introduce multithreaded programming and string handling in Java programming.
- To understand applets and event handling in Java programming.

UNIT–I

The Primaries and Control Statements: Introduction to Java, Features of Java, Object Oriented Concepts, Lexical Issues, Data Types, Variables, Arrays, Operators, Control Statements.

Learning Outcomes:

By the end of this unit, the student will be able to

- Describes how to use primary and control statements in Java programming (L1).
- Understands the features of Java and concept of object oriented programming. (L2).
- Understands lexical Issues and data types in Java programming (L2).
- Explains the use of variables and operators in Java programming (L2).
- Explains the use of arrays, and control statements in Java programming (L2).

UNIT–II

Classes and Objects: Classes, Objects, Constructors, Overloading methods, Overloading constructors, Using Objects as Parameters, Understanding static, Introducing Inner Classes, Inheritance, Overriding methods, Dynamic Method Dispatch, Abstract class.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the use of classes, objects, constructors in Java programming and also the use of objects as parameters (L2).
- Understand how to use overloading methods, overloading constructors and overriding methods.
- Explain the use of static method and dynamic method dispatch (L2).
- Explain the use of objects as parameters, inner classes, and abstract class (L2).
- Describe the concept of inheritance in Java programming (L2).

UNIT–III

Packages, Interfaces and Exception Handling: Packages, Access Protection, Importing Packages, Interfaces, Exception Handling, Throw and Throws finally.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the use of packages, interfaces and exception handling in Java programming (L2).
- Understand the use of packages, importing packages, and interfaces (L2) and apply the principles in software development (L3).
- Understand the use of access protection in Java programming (L2).
- Understand the use of exception handling in Java programming (L1).

UNIT–IV

Multithreaded Programming and String Handling: The Java Thread Model, Main Thread, creating Thread, Extending Thread, Creating Multiple Threads, Using is Alive() and join(), Thread Priorities, String Handling, String Constructors, Special string operations, Character extractions, String comparisons, Modifying a string.

Learning Outcomes:

By the end of this unit, the student will be able to

- Explain the use of multithreaded programming and string handling in Java programming (L2).
- Explain Java thread model, main thread, creating thread, extending thread, and creating multiple threads in Java programming (L2).
- Understand the use of Alive() and join(), and thread priorities in Java programming (L2).
- Explain string handling, string constructors, and special string operations in Java programming (L1).
- Understand the use of character extractions, string comparisons, and modifying a string in Java programming (L1).

UNIT–V

Applets: Applet Basics, Applet Architecture, Applet Skeleton, Simple Applet display methods, Requesting Repainting, Simple Banner Applet, HTML Applet Tag.

Event Handling: Two Event Handling Mechanisms, Event Classes, Event Listener Interfaces, Adapter Classes.

Learning Outcomes:

By the end of this unit, the student will be able to

- Explain the use of applets and event handling in Java programming (L2).
- Explain the use of applet basics, applet architecture, applet skeleton, simple applet display methods (L2).
- Explain the use of requesting repainting, simple banner applet, HTML applet tag (L2).
- Understand the use of two event handling mechanisms, and event listener interfaces (L1).
- Understand the use of event classes, and adapter classes in Java programming (L1).

Recommended Books:

1. Java-2: The complete Reference, Naughton, P. and Schildt, H., Third Edition, McGraw Hill Publishers.

2.Computing Concepts with Java 2 Essentials"; Horstmann, C.S., Second Edition, John Wiley Publishers.

Course Outcomes:

By the end of course, the student will be able to

- Understand the features of Java and understand the fundamentals of object-oriented programming in Java (CO1).
- Define classes, and objects in Java for good programming skills and software development (CO2).
- Explain about packages, interfaces and exception handling and apply this knowledge in Java programming (CO3).
- Understands the use of multithreaded programming and string handling in Java programming (CO4)
- Understands the use of applets and event handling in Java programming (CO5).

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS VI SEMESTER

SBC 342: JAVA PROGRAMMING LAB

No. of hrs/week: 03 **Credits: 02**

Preamble:

Java programming laboratory exposes students to the depth of modern programming practice. This module makes students as best programmers with Java programming concepts.

Course Objectives

- To understand the principle's of using classes and objects, constructors, overloading constructors and different number of parameters passed to constructors, overloading methods, static variable and static class, single inheritance and multilevel inheritance, method of over-riding, dynamic method dispatch, abstract classes, packages, interfaces, and built in exceptions in Java programming.
- To understand the principle's of using BioJava for creating web-interface.

Practical's Laboratory Sessions

1. Program to demonstrate classes and objects.
2. Program to demonstrate constructors, overloading constructors and different number of parameters passed to constructors.
3. Program to demonstrate overloading methods.
4. Program to demonstrate static variable and static class.
5. Program to demonstrate single inheritance and multilevel inheritance.
6. Program to demonstrate method over riding.
7. Program to demonstrate dynamic method dispatch.
8. Program to demonstrate Abstract Classes.
9. Program to demonstrate packages.
10. Program to demonstrate Interfaces.
11. Program to demonstrate built in exceptions.
12. Use of BioJava for creating web-interface.

Learning outcomes:

By the end of this practical, the student will be able to

1. Understand the principle of using classes and objects, constructors, overloading constructors and different number of parameters passed to constructors, overloading methods, static variable and static class, single inheritance and multilevel inheritance, method of over-riding, dynamic method dispatch, abstract classes, packages, interfaces, and built in exceptions in Java programming.
2. Understand the principle's of using BioJava for creating web-interface.

Recommended Books:

1. Java-2: The complete Reference, Naughton, P. and Schildt, H., Third Edition, McGraw Hill Publishers.
   Computing Concepts with Java 2 Essentials"; Horstmann, C.S., Second Edition, John Wiley Publishers.

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VI SEMESTER

SBC 392: Minor Research Project