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. 2019-20 admitted batch)

Website: www.gitam.edu

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

REGULATIONS

(w.e.f. 2019-20 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 120 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.

B.Sc. (BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS)

SCHEME OF INSTRUCTION

I SEMESTER

Course Code	Subject	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	P		CE	SE	Total Marks
SFC101	English Communication Skills	AECC	3	-	2	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
SMB121	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: 20

II SEMESTER

B. Sc. BIOCHEMISTRY, MICROBIOLOGY AND 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

Total Credits: 20

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
SFC 203	English For Communication– II	CC	4	-	2	40	60	100
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: 20

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								
SMB 340	Microbial Physiology and Fermentation Technology	DSE	4	-	4	40	60	100
SMB 342@	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
Choose any one								
SSE 382	Pathology and Diagnosis of Cancer	SEC	2	-	2	100	--	100
SSE 384	PERL programming	SEC	2	-	2	100	--	100
SSE 386	Advanced Bioinformatics	SEC	2	-	2	100	--	100

Total Credits: 20

B.Sc. (BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS)
I SEMESTER
SFC:101 - ENGLISH – I
(BSc. & BSc. Hons)

No. of hours per week: 03 Credits: 02

UNIT- I

The eyes are not here – Ruskin Bond
Pronunciation: Consonants,**Grammar:** Nouns, **Vocabulary:**Roots forms of words**, Spelling:** Correcting wrong spelling, **Punctuation:**Capitalisation,
Conversation and Role Play: Introducing oneself in formal or social contexts,

UNIT- II

Work Brings Solace – APJ Abdul Kalam
Pronunciation: Monophthongs **Grammar:** Pronouns,
Vocabulary: Prefixes & Suffixes, **Spelling:** using 'un' and 'dis' to complete antonyms**,**
Punctuation: Capitalisation,
Conversation and Role Play: starting a conversation/controlling a conversation**,**

UNIT –III

Bangle Sellers – Sarojini Naidu
Pronunciation: Diphthongs **Grammar:** Helping verbs & auxiliary verbs, **Vocabulary:** Homophones, Homographs, Homonyms **Punctuation:** comma & full stop,
Conversation: Describing one's college and course of study, **Writing:** Paragraph writing/ Descriptive Writing,

UNIT -IV

The Merchant of Venice (Extract) – William Shakespeare
Pronunciation: varied pronunciation of some letters of the alphabet**Grammar:** Main verbs & Tenses, **Vocabulary:** Collocations, **Punctuation:** Question mark and Exclamation mark,
Conversation: Leaving a message and taking an appointment

UNIT- V

Vocabulary building: Synonyms, Antonyms, One Word Substitutes, Phrasal Verbs, Idiomatic Expressions, Foreign Phrases

Recommended Books:

1. Part – 1 (English for Enhanced Competence (by Sumit Roy, A.Karunakar, A.Aruna Priya)

Supplementary Reading:

1. Communicative skills for Technical Students, M. Faratullah. Orient Longman
2. Rizvi,MAshraf. ***Effective Technical Communication.*** McGraw - Hill.

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

SBC 101: BIOMOLECULES

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

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, Donnan membrane equilibrium. Significance of osmotic pressure in biological systems

UNIT – II

Carbohydrates: Classification, monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation, reactions of carbohydrates (specific to hydroxyl, aldehyde and ketonegroups). Structure and biological importance of disaccharides (sucrose, lactose, maltose), trisaccharides (raffinose), structural polysaccharides (cellulose) and storage polysaccharides (starch, glycogen).

UNIT – III

Lipids : Classification, saturated and unsaturated fatty acids, structure and properties of fats and oils (acid, saponification and iodine values, rancidity). General properties and structures of phospholipids, sphingolipids and cholesterol. Biomembranes - Behavior of amphipathic lipids in water. Formation of micelles, bilayers, vesicles, liposomes. Membrane composition and organization, Fluid mosaic model.

UNIT-IV

Amino Acids and Peptides: Classification, structure, stereochemistry, chemical reactions of amino acids due to carbonyl and amino groups. Essential and non-essential amino acids, Peptide bond - nature and conformation. Naturally occurring peptides – glutathione.

UNIT-V

Proteins: Classification based on solubility, shape and function. General properties of proteins, denaturation and renaturation of proteins. Structural organization of proteins- primary, secondary, tertiary and quaternary structures (Eg. Hemoglobin and Myoglobin), forces stabilizing the structure of protein.

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**

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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.

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).

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.

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.

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).

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**

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1. Microbiology Good Laboratory Practices and Biosafety.
2. Principle and applications of important instruments used in microbiology lab (biological safety cabinets, autoclave, bacteriological incubator, BOD incubator, hot air oven, light microscope, Ph meter and colony counter) used in the microbiology laboratory.
3. Studyof *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*
6. Simple staining
7. Negative staining

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**

UNIT – I

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

UNIT – II

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

UNIT – III

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

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.

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.

Recommended Books:

1. Computers Today, S.K Basandra Galgotia 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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

I SEMESTER

SBC 125: BASIC COMPUTERS LAB

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

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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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
II SEMESTER

SFC 102: ENVIRONMENTAL SCIENCE

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

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)

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.

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.

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.

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.

Books:

1. Text Book of Environmental studies for Undergraduate courses by Bharucha Erach Published by V.G.C
2. Environmental Science: A Global Concern by William P.Cunningham and Baraba Woodworth Saigo.
3. A text book of Environmental Science by P.C.Joshi
4. A text book of Environmental Science by Arvind Kumar

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**

UNIT-I

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

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.

UNIT-III

Physical methods - Dry heat – 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.

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.

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.

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**

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1. Demonstration of working principle of compound microscope
2. Sterilization of glassware using Hot Air Oven and assessment for sterility
3. Preparation and sterilization of media using Autoclave and assessment for sterility
4. Sterilization of heat sensitive material by membrane filtration and assessment for sterility (Demonstration)
5. Preparation of different media: synthetic media, Complex media-Nutrient agar, McConkey agar, EMB agar.
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. (glycerol stock method)

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
II SEMESTER

SBC 106: BASICS IN PROGRAMMING

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

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**

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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
III SEMESTER

SFC 203: ENGLISH FOR COMMUNICATION– II

No. of hrs/week: 03 Credits: 04

UNIT- I
The Open Window : Saki (H.H.Munro)
Pronunciation: Syllabification**, Grammar:** Non-infinite verbs, **Vocabulary:** Simile & Metaphor**, Spelling:** using 'ie' or 'ei', **Punctuation:** semi-colon, **Conversation:** Asking for advice/information,

UNIT- II
The Voice of Humanity – Rabindranath Tagore
Pronunciation: Word Stress, Grammar: Adjectives, Vocabulary: Oxymoron & Hyperbole, Spelling: using 'able' and 'ible', Punctuation: Colon & dash, Group Discussion

UNIT –III
If – Rudyard Kipling
Pronunciation: Sentence Stress, Grammar: Articles, Vocabulary: Portmanteau and loan words, Spelling: using suffixes, Punctuation:Hyphen & dash, Oral Presentation

UNIT -IV
Riders to the Sea – JM Synge
Pronunciation – Intonation, Grammar: Adverbs, Vocabulary: Palindromes, Spelling: completing tables with nouns, verbs, adjectives, adverbs Punctuation: Inverted comma, Conversation/Role play: Appearing for a job interview/conducting a job interview

UNIT- V
Academic Writing: Letter Writing, Paragraph Writing, Essay Writing, Resume Preparation, Dialogue Writing, Precis

Text Books:
Part – 2 (English for Enhanced Competence (by Sumit Roy, A.Karunakar, A.Aruna Priya)

Supplementary Reading:

1. Communicative skills for Technical Students, M. Faratullah. Orient Longman

2. Rizvi, M Ashraf. *Effective Technical Communication.* McGraw - Hill.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
III SEMESTER

SBC 201: BIOENERGITICS AND METABOLISM-I

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

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.

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.

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.

UNIT- IV

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

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.

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**

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.

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, regulation of copy number, curing of plasmids.

UNIT-III

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

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.

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

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

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
III SEMESTER

SMB 221: MICROBIAL GENETICS LAB

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

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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. Effect of UV exposure on survival of bacteria
5. Demonstration of Bacterial Conjugation
6. Demonstration of bacterial transformation and transduction
7. Isolation and enumeration of bacteriophages (PFU) from water / sewage sample using double agar layer technique

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
4. Cell and Molecular Biology Lab Manual (2011) by Dr. David A Thompson, CreateSpace Independent Publishing Platform
5. Cell and Molecular Biology: A Lab Manual (2013) by K. V. Chaitanya, PHI
6. A manual of laboratory techniques Raghu Ramulu et al 2003 NIN publications

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

III SEMESTER

SBC 205: COMPUTATIONAL BIOLOGY

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

UNIT – 1

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

UNIT – 2

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

UNIT – 3

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

UNIT – 4

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

UNIT – 5

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

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

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
III SEMESTER

SBC 225: COMPUTATIONAL BIOLOGY LAB

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

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

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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
IV SEMESTER

SBC 202: METABOLISM–II AND BIOCHEMICAL TECHNIQUES

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

UNIT- I

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

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.

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.

UNIT-IV

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

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.

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**

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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.

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**

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.

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.

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

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.

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.

Recommended Books:

1. Food Microbiology: An Introduction (2017) by Thomas J. Montville *et al.,* 4th Edition, 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. Determination of the efficiency of pasteurization of milk by Alkaline phosphatase test
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**

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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
IV SEMESTER

SBC 224: DBMS LAB

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

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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.

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**

UNIT-I

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

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.

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.

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.

UNIT-V

Immuno Techniques

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

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**

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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.

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**

UNIT -I

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

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*.

UNIT –III

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

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; protein synthesis; metabolism. Antibiotic resistance, MDR,MRSA.

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 EditionMcGraw-Hill Education

4. Microbiology: Principles and Explorations (2015) by Black *et al.,*9th Edition, Wiley Pulishers

5. Algae (2008) by James E. Graham (2nd Edition), Benjamin Cummings

6. The Fungi by Sarah C. Watkinson, Academic Press; 3 edition (2016)

7. Fungi: Experimental Methods in Biology by Ramesh Maheshwari, Second Edition, CRC Press

8. 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**

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1. Characterization of important bacterial species using morphological, staining, and biochemical methods
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
3. Study of bacterial flora of skin by swab method.
4. Perform antibacterial sensitivity by Kirby-Bauer method.

5.Determination of minimal inhibitory concentration (MIC) of an antibiotic. Determination of Dissolved Oxygen (DO) of waste water samples.

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
V SEMESTER
SMB 343: ECOLOGY AND AGRICULTURAL MICROBIOLOGY

No. of hrs/week: 04 Credits: 04

UNIT –I

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

UNIT –II

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

UNIT –III

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

UNIT –IV

Plant pathogens-fungal (white rusts of crucifers, early and late blight of potato, Fusarium wilt, powdery mildew), bacterial (Citrus canker) and viral (Tobacco mosaic virus, CaMV) disease symptoms, disease cycle, prevention and management.

UNIT –V

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

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. Brock Biology of Microorganisms (2015) by Michael T. Madigan (15th Edition), Pearson publishers
5. Handbook of Microbial Biofertilizers (2006) by Mahendra Rai 1st Edition, 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**

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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 of suspected subjects
7. VAM fungal observation of root samples
8. Analysis of characteristics of Biofertilizers

Recommended Books:

1. Miocrobiology: A laboratory manual by Cappuccino and Sherman, Pearson Education, 6th Ed.
2. Laboratory experiments in Microbiology by M.Gopal Reddy, M.N. Reddy, D.V.R.Saigopal and K.V.Mallaiah. Himalaya publishing house
3. Miocrobiology: A laboratory manual by S.M.Reddy and S.Ram Reddy 3rd Ed .Sri padmavathi publications

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 381: STRUCTURAL BIOINFORMATICS

No. of hrs/week: 04 Credits: 04

UNIT – I

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

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.

UNIT – III

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

UNIT – IV

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

UNIT – V

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

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

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 339: STRUCTURAL BIOINFORMATICS LAB

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

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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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 383: CONCEPTS OF GENOMICS AND PROTEOMICS

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

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.

UNIT – II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
V SEMESTER

SBC 341: GENOMICS & PROTEOMICS LAB

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

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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

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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
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**

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.

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.

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.

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.*

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.

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

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SBC 324: MOLECULAR BIOLOGY LAB

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

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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.

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**

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.

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.

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.

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.

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.

Recommended 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. Crueger's 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**

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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 with the 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 salts 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. Detection of amylase, lipase, and protease activities in bacterial cultures.
10. Isolation of Antibiotic producing organism for soil.

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
4. Industrial microbiology (2016) by Casida, New Age International Private Limited
5. Practical Manual on Fermentation Technology (2012) by S. Kulandaivelu, I K International Publishing 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**

UNIT-I

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

Unit-II

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

Unit III

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

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

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..

Recommended Books:

1.Immunology a short course by Benjamin 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).
6.Immunology-understanding of immune system by KlansD.Elgret (.Wiley-Liss.NY,)
7. 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**

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

Recommended Books:

1. Immunology methods manual - The comprehensive source book by Lefkovits. I6.Manual of clinical laboratory immunology by Rose NR.

2. The experimental foundations of modern immunology by Clark W.R.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

VI SEMESTER

SBC 382: DRUG DESIGNING

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

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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SBC 340: DRUG DESIGNING LAB

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

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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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS

VI SEMESTER

SBC 384: JAVA PROGRAMMING

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

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.

UNIT–II

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

UNIT–III

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

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.

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.

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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SBC 342: JAVA PROGRAMMING LAB

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

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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.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SSE 382: PATHOLOGY AND DIAGNOSIS OF CANCER

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

UNIT-I

Etiology - Characteristics of human cancer, causes of cancer. Prevalence of cancer. Benign and malignant tumors. Types of cancer - Carcinoma, Sarcoma, Lymphoma and Blastoma.

UNIT-II

Staging: staging types - Clinical and pathological staging, staging systems - TNM system. Grading – general and specific systems. Diagnosis - Blood Tests, Biopsy, Diagnostic Imaging - X-rays, CAT scan and MRI, Mammography.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SSE 384: PERL PROGRAMMING

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

UNIT-I:

Perl-Introduction, Data Types -Lists/Arrays and Hash, Scalar Functions, Quoting Basics, Functions/Subroutines, Operators and Control Structures, Data Types: Boolean, Pattern Matching and Regular Expressions, File Handling and File Manipulation, Error Handling, Variable Scope, Mathematical Functions, Special Variables, References, Aggregate data structures, Using Modules.

UNIT-II:

BioPerl Modules- Sequences and Strings, Motifs and Loops, flow control, String operators and Writing files, Subroutines-Scoping, Arguments, Command line arguments, Passing data to subroutines, Modules and Libraries, Debugging, CPAN – Comprehensive PERL archive network) Data Structures and Algorithms for Biology Restriction Maps and Restriction Enzyme Data, Working and Analyzing with GenBank and BLAST data Subroutines, Text and String Processing.

Recommended Books:

1.Beginning Perl for Bioinformatics, Tisdall, J.D., First Edition O'Reilly Publishers.

2.Programming Perl, Wall, W., Christiansen, T. and Orwant, J., Third Edition, O'Reilly Publishers.

B.Sc. BIOCHEMISTRY, MICROBIOLOGY AND BIOINFORMATICS
VI SEMESTER

SSE 386: ADVANCED BIOINFORMATICS

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

UNIT -1

Emerging Areas in Bioinformatics: Neuroinformatics, Glyco-bioinformatics, Lipidomics.

UNIT -2

Emerging Areas in Bioinformatics: Biodiversity informatics, Agroinformatics, Biomedical informatics.

Recommended Books:

1. Biological sequence analysis, Durbin, Eddy, Krogh and Mitchison, Eighth Edition, Cambridge University Press.
2. Introduction to Bioinformatics, Lesk, A.M., First Edition, Oxford University Press.
3. Database System Concepts – Abraham, Korth and Sudarshan, 6th Ed.