HSNC UNIVERSITY, MUMBAI

Board of Faculty of Science & Technology

Board of Studies in the Subjects of Biotechnology Subject

1) **Name of Chairperson/Co-Chairperson/Coordinator:-**

a) **Dr. Sejal Rathod,** Head, Assistant Professor, Department of Microbiology, K. C college, HSNC University Churchgate, Mumbai –400 020. Email ID- sejal.rathod@kccollege.edu.in Mobile no- 9930082028

2) **Two to five teachers each having minimum five years teaching experience amongst the full time teachers of the Departments, in the relevant subject.**

a) **Dr. Pratibha Shah** Assistant Professor, Department of Microbiology, K.C college, Churchgate. Email ID- pratibha.shah@kccollege.edu.in Contact no- 9773321760

b) **Mrs. Rajitha Satish** Assistant Professor, Department of Microbiology, K.C college, Churchgate. Email ID rajitha.satish@kccollege.edu.in Contact no -9833716190

c) **Ms. Amina Dholkawala** Assistant Professor, Department of Microbiology, K. C college, Churchgate. Email ID- amina.dholkawala@kccollege.edu.in Contact no - 7208724194

3) **One Professor / Associate Professor from other Universities or professor / Associate Professor from colleges managed by Parent Body; nominated by Parent Body;-**

a) **Dr Bela Nabar** (Associate Professor, HOD of Microbiology, Department of Microbiology, CHM College, Ulhasnagar) Email ID- belamsn23@gmail.com Mobile no- 9322760417

b) **Dr. S. Raut** (Associate professor, Department of Microbiology, Bhavans college, Andheri West, Mumbai,) Email ID- svrmicro@yahoo.co.in Mobile no-9869053676

4) Four external experts from Industry / Research / eminent scholar in the field relevant to the subject nominated by the Parent Body;

a) **Mrs. Prabha Padmanabha** Former Associate Professor, Department of Microbiology, KC College Mumbai- 400 020) Email ID- prabhapadmanabha@hotmail.com 9820860049

b)**Dr. Sahayog Jamdar** (Scientific Officer G, Food and Technology Division BARC) snjam2@gmail.com 2225595375

c) **Dr. Mehul Rajpurkar** (Regional Medico Marketing Manager, SRL Diagnostics, Goregaon West) Email ID - mehul.rajpurkar@gmail.com 9819107505

d) **Dr. Surekha Zingde** (Former Dy. Director, Cancer Research Institute, ACTREC,) Tata Memorial Centre, Kharghar) Email ID - surekha.zingde@gmail.com 9820633284

5.) Top rankers of the Final Year Graduate and Final Year Post Graduate examination of previous year of the concerned subject as invitee members for discussions on framing or revision of syllabus of that subject or group of subjects for one year.

a) **Ms. Uzma Shaikh** (Undergraduate student- 18-19) Contact no- 9004718231 Mobile no- uzma25.shaikh@gmail.com

b.) **Ms. Soni Gupta** (Postgraduate student -18-19) Contact no- 9167147185 Mobile no- sonigupta445@gmail.com

Part –I

Outline of Choice Based Credit System as outlined by University Grants Commission:

R. ** : The Definitions Of The Key Terms Used In The Choice Based Credit System And Grading System Introduced From TheAcademicYear2020-2021AreAs Under:**

1. **Core Course:** Acourse, which should compulsorily be studied by a candidate as acorerequirement is termed as a Corecourse.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill iscalledan Elective Course.

   2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offerdiscipline related Elective courses of interdisciplinary nature (tobe offeredby main discipline/subject of study).

   2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of adiscipline specific elective paper.

   2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.
   P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Choice Base Credit System :** CBCS allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

4. **Honours Program :** To enhance employability and entrepreneurship abilities among the learners, through aligning Inter Disciplinary / Intra Disciplinary courses with Degree Program. Honours Program will have
40 additional credits to be undertaken by the learner across three years essentially in Inter / Intra Disciplinary course.

   A learner who joins Regular Undergraduate Program will have to opt for Honours Program in the first year of the Program. However, the credits for honours, though divided across three years can be completed within three years to become eligible for award of honours Degree.

5. **Program:** A Program is a set of course that are linked together in an academically meaningful way and generally ends with the award of a Degree Certificate depending on the level of knowledge attained and the total duration of study, B.Sc. Programs.

6. **Course:** A 'course' is essentially a constituent of a 'program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. All the learning topics included in a course must necessarily have academic coherence, i.e. there must be a common thread linking the various components of a course. A number of linked courses considered together are in practice, a 'program'.

7. **Bridge Course:** Bridge course is visualized as Pre semester preparation by the learner before commencement of regular lectures. For each semester the topics, whose knowledge is considered as essential for effective and seamless learning of topics of the Semester, will be specified. The Bridge Course can be conducted in online mode. The Online contentcanbecreated for the Bridge Course Topics.

8. **Module and Unit:** Acourse which is generally an independent entity having its own separate identity, is also often referred to as a 'Module' in today's parlance, especially when we refer to a 'modular curricular structure'. A module may be studied in conjunction with other learning modules or studied independently. A topic within acourseistreated asa Unit. Each course should haveexactly 3 Units.

9. **Self-Learning: 20% of the topics will be marked for Self-Learning.** Topics for Self-Learning are to be learned independently by the student, in a time-bound manner, using online and offline resources including online lectures, videos, library, discussionforums, fieldwork, internships etc.

   Evaluative sessions (physical/online), equivalent to the credit allocation of the Self Learning topics, shall be conducted, preferably, every week for each course. Learners are to be evaluated real time during evaluative sessions. The purpose of evaluative sessions is to assess the level of the students' learning achieved

in the topicsearmarked for Self-Learning.

The teacher's role in these evaluative sessions will be that of a Moderator and Mentor, who will guide and navigate the discussions in the sessions, and offer concluding remarks, with proper reasoning on the aspects which mayhave been missed by the students, in the course of the Self-Learning process.

The modes to evaluate self-learning can be a combination of the various methods such as written reports, handouts with gaps and MCQs, objective tests, case studies and Peer learning. Groups can be formed to present self-learning topics to peer groups, followed by Question and Answer sessions and open discussion. The marking scheme for Self Learning will be defined under Examination and Teaching.

The topics stipulated for self-learning can be increased or reduced as per the recommendations of the Board of Studies and Academic Council from time to time. All decisions regarding evaluation need to be taken and communicated to the stakeholders preferably before the commencement of a semester. Some exceptions may be made inexigencies, like the current situation arising from the lockdown, but such ad hoc decisions are tobe kept to the minimum possible.

10. **Credit Point:** Credit Point refers to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc. Credits assigned for a single course always pay attention to how many hours it would take for a learner to complete a single course successfully. A single course should have, by and large a course may be assigned anywhere between 2 to 8 credit points wherein 1 credit is construed as corresponding to approximately 30 to 40 learning hours.

11. **Credit Completion and Credit Accumulation:** Credit completion or Credit acquisition shall be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner who successfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. learner level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits as he completes successfully more and more courses. Thus the learner 'accumulates' course wise credits.

12. **Credit Bank:** A Credit Bank in simple terms refers to stored and dynamically updated information regarding the number of Credits obtained by any given learner along with details regarding the course/s for which Credit has been given, the course-level, nature, etc. In addition, all the information regarding the number of Credits transferred to different programs or credit exemptions given may also be stored with the individual's history.

13. **Credit Transfer:** (performance transfer) When a learner successfully completes a program, he/she is allowed to transfer his/her past performance to another academic program having some common courses and Performance transfer is said to have taken place.

14. **Course Exemption:** Occasionally, when two academic programs offered by a single university or by more than one university, may have some common or equivalent course-content, the learner who has already completed one of these academic programs is allowed to skip these 'equivalent' courses while registering for the new program. The Learner is 'exempted' from 'relearning' the common or equivalent content area and from re-appearing for the concerned examinations. It is thus taken for granted that the learner has already collected in the past the credits corresponding to the exempted courses.

Part-II

O*** The fees for transfer of credits or performance will be based on number of credits that a learner has to complete for award of the degree.**

The Scheme of Teaching and Examination:

The performance of the learners shall be evaluated in two components: Internal Assessment with 40% marks by way of continuous evaluation and by Semester End Examination with 60% marks by conducting the theory examination.

INTERNAL ASSESSMENT:- It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the credit based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

A). Internal Assessment – 40% **40 marks**

Practical's (internal Components of the Practical Course

1. For Theory Courses

Sr. No.	Particulars	Marks
1	**ONE** class test / online examination to be conducted in the given semester	15 Marks
2	One assignment based on curriculum (to be assessed by the teacher Concerned	10 Marks
3	Self-Learning Evaluation	10 Marks
4	Active participation in routine class instructional deliveries	05 Marks

2. For Courses with Practicals

Each practical course can be conducted out of 50 marks with 20 marks for internal and 30 marks for external

Practical's (Internal component of the Practical Course)

Sr. No	Evaluation type	Marks
1	Two Best Practicals /Assignments/Presentation /Preparation of models/ Exhibits **Or** One Assignment/ project/presentation to be assessed by teacher concerned	10
2	Journal	05
3	Viva	05

The semester end examination (external component) of 60 % for each course will be as follows:

i) **Duration** – **2 Hours** ii) **Theory Question Paper**

Pattern:-

1. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth one will be based on entire syllabus.
2. All questions shall be compulsory with internal choice within the questions. (Each question will be of 20 to 23 marks with options.)
3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depend on the weightage of the topic.

The marks will be given for all examinations and they will be converted into grade (quality) points. The semester-end, final grade sheets and transcripts will have only credits, grades, grade points, SGPA and CGPA.

3. Project and Assignment:

- Project or Assignment, which can in the following forms
  - Case Studies
  - Videos
  - Blogs
  - Research paper (Presented in Seminar/Conference)
  - Field Visit Report
  - Presentations related to the subject (Moot Court, Youth Parliament, etc.)
  - Internships (Exposition of theory into practice)
  - Open Book Test
  - any other innovative methods adopted with the prior approval of Director Board of Examination and Evaluation.

4.Self-Learning Evaluation

- **20% OF THE TOPICS OF CURRICULUM ARE LEARNED BY THE STUDENT THROUGH SELF LEARNING USING ONLINE / OFFLINE ACADEMIC RESOURSE SPECIFIED IN THE CURRICULUM.**

- **HENCE 20% OF THE LECTURES SHALL BE ALLOCATED FOR EVALUATION OF STUDENTS ON SELF LEARNING TOPICS**

- The identified topics in the syllabus shall be learnt independently by the students in a time bound manner preferably from online resources. Evaluative sessions shall be conducted by the teachers and will carry 10 Marks.

  CLUB The self-learning topics into 3-4 GROUPS OF TOPICS ONLY FOR EVALUATION.

- **PRESCRIBE TIME DURATION (IN DAYS) FOR COMPLETION OF EACH GROUP OF TOPIC AND EARMARK SELF LEARNING EVALUATION LECTURES IN THE TIMETABLE. HENCE EACH GROUP OF TOPIC CAN BE ASSIGNED 3 REGULAR LECTURES FOR THIS EVALUATION FOR ENTIRE CLASS**

3 Sub Topics
Each evaluative session shall carry 3 Marks (3 x 3 Units = 9 Marks). Students who participate in all evaluative sessions shall be awarded 1 additional Mark.
4 Sub Topics
Each evaluative session shall carry 2.5 Marks (2.5 x 4 Units = 10 Marks)

- **EVALUATION OF SELF LEARNING TOPICS CAN COMMENCE IN REGULAR LECTURES ASSIGNED FOR SELF LEARNING EVALUATION IN THE TIMETABLE**

3 Evaluative sessions

Each evaluative session shall carry 3 Marks (3 x 3 = 9 Marks). Students who

participate in all evaluative sessions shall be awarded 1 additional Mark.

4 Evaluative sessions

Each evaluative session shall carry 2.5 Marks (2.5 x 4 = 10 Marks).

Methods for Evaluation of Self-learning topics:

- Seminars/presentation (PPT or poster), followed by Q&A – Objective questions /Quiz / Framing of MCQ questions.
- Debates
- Group discussion
- You-Tube videos (Marks shall be based on the quality and viewership)
- Improvisation of videos
- Role Play followed by question-answers

TEACHERS CAN FRAME OTHER METHODS OF EVALUATION ALSO PROVIDED THAT THE METHOD, DULY APPROVED BY THE COLLEGE EXAMINATION COMMITTEE, IS NOTIFIED TO THE STUDENTS AT LEAST 7 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION AND IS FORWARDED FOR INFORMATION AND NECESSARY ACTION AT LEAT 3 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION

- Viva Voce
- Any other innovative method

SEMESTER END EXAMINATION: - It is defined as the examination of the learners on the basis of performance in the semester end theory / written examinations.

B. Semester End Examination- 60 % ***60 Marks***

1) Duration – These examinations shall be of 2 Hours duration.
2) Question Paper Pattern: -

i. There shall be four questions each of 15 marks. ii. All questions shall be compulsory with internal choice within the questions.

iii. Question may be sub-divided into sub-questions a, b, c, d & e only and the allocation of marks depends on the weightage of the topic.

THE MARKS OF THE INTERNAL ASSESSMENT SHOULD NOT BE DISCLOSED TO THE STUDENTS TILL THE RESULTS OF THE CORRESPONDING SEMESTER IS DECLARED.

HSNC University Mumbai

(2020-2021)

Ordinances and Regulations

With Respect to

Choice Based Credit System

(CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Microbiology

Curriculum – First Year Undergraduate Programmes

Semester-I and Semester -II

2020-2021

Microbiology
Part 1- Preamble

Microbiology is the study of microbes such as bacteria, viruses, fungi, algae, cyanobacteria, protozoa and many other microscopic organisms. They are very important as they carry out diverse activities ranging from causing diseases in humans, animals and plants to production of highly useful products like antibiotics, enzymes, alcohol, fermented foods, and recycling of dead and decaying organic matter in the environment. Microbiology is emerging as a key biological science as recognition of the ability of microorganisms to decompose materials such as herbicides, pesticides, and oils in oil spills; potential of microorganisms as food supplements; exploitation of microbial activity to produce energy such as methane gas for rural consumption; and the potential of new therapeutic substances by microorganisms.

Knowledge of different aspects of Microbiology has become crucial and indispensable to the society. Several discoveries in the last two to three decades, which significantly impact these areas, have put Microbiology on the centre stage of teaching, research and development all over the globe. In a country like ours, where fast and tremendous technological advancement and population growth happens, the demand and supply of trained man power is not on par. Introduction of a Microbiology program with an amalgamation of interdisciplinary aspects of the field is the remedy to this major skill gap in the country.

1. Course objective

The FYBSc Microbiology syllabus (FMB) is a Choice based credit system comprising of two papers having three units each in both the semesters. The course covers different disciplines like microbiology, immunology, biochemistry, healthcare, nutrition and diagnosis. The course will concentrate on the detection and identification of infectious agents in the clinical laboratory, followed by determination of susceptibility to antimicrobial agents. It will cover general principles of infectious diseases and laboratory diagnosis.

The understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

It is envisaged that the students trained under this curriculum will have the required attributes of knowledge, skills, temperament and ethics related to the subject of Microbiology, Diagnostics and healthcare to meet the increasing demand.

2. Process adopted for curriculum designing.

The curriculum was designed in a stepwise manner, firstly on the basis of feedback obtained from department teachers and students. Later several meetings were conducted with representatives from academia, industries and research institutions to assure that the syllabus is enriched in all the aspects.

3. Salient features, how it has been made more relevant.

While designing of the syllabus care has been taken to balance the fundamental techniques of Microbiology with some advance techniques of diagnostic and clinical microbiology.

The course would give students the opportunity to develop skills in areas which have direct relevance to employability in diagnostics, health, food and pharmaceutical industries, agriculture and environment-related job opportunities in Microbiology.

4. Learning Outcomes.

The curriculum is designed to educate the learner about various fields of Microbiology like Genetics, Medical Microbiology and Diagnostics, pharmaceutical industry, molecular, environmental and biotechnology. The course would help students to apply their microbiological concepts to summarize, analyze, and inculcate problem solving approach in the newer developments and innovations in the future. The curriculum design and the teaching and the evaluation patterns would help students to develop skills and competencies to build a progressive and successful career in the field of Microbiology.

- The learner will learn to prepare stained smears, culturing micro-organisms, conducting experiments, performing tests to identify bacteria and fungi, and studying microbial growth control.
- The learner will learn about evolution of microbes and new emerging and re-emerging diseases. The learner will learn the handling of various instruments which will help them to understand the principle and working of the same.
- The learner will understand the physiology of a microorganism with the details of its macromolecular structure.
- The learner will know the role of microbes in the fields of environment, medicine and industrial microbiology. The course will help them to study of ability of microbes as decomposers, food supplements, energy source and infectious agents.
- The learner will also acquire skills to cultivate and identify microorganisms, study growth characteristics and prevent contamination.
- The learner will learn the handling of various instruments which will help them to understand its component parts, principle and working.
- The learner will learn about the skills required to work in a basic diagnostic and clinical laboratory.

5. Input from stakeholders (Which Sections have been modified) with relevant introduction.

New topics were introduced at basic level which will be gradually included in more depth in second and third year B.Sc. Existing components were modified, practical applications of the fundamental techniques were incorporated as suggested by the industrial, research and academic experts.

The Missing links between different subtopics were introduced. Subtopics were more streamlined and made specific (depth of the content). Topics like Five kingdom classification – missing link between prokaryotes and eukaryotes (suggested by research expert) were introduced. Academic expert suggested streamline the fields of microbiology and be more specific regarding the content

mitosis and meiosis- cell cycle missing all throughout three year syllabi of microbiology. Introduction of clinical and diagnostic microbiology – suggested by academic and research experts was also done.

Molecular identification of microorganisms- suggested by industrial expert as these are currently used in research and R& D departments of industries like imaging techniques were added , Biostatistics and Bioinformatics were introduced - suggested by research and industrial expert .Preparation of solutions (normality and molarity) – research expert suggested as students find it difficult during research as they not much importance is given to this during early graduation years was also introduced.

Part 2- Scheme of Teaching and Examination:

First Year Semester – I
Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (**Microbiology**)			US-FMB-101, US-FMB- 102, US-FMB- P1	
2	Elective Course	Discipline Specific Elective (DSE) Course			
		2.1	Interdisciplinary Specific Elective (IDSE) Course		
		2.2	Dissertation/Project		
		2.3	Generic Elective (GE) Course		
3	Ability Enhancement Courses (AEC)				
	Skill Enhancement Courses (SEC)				

First Year Semester I Internal and External Detailed Evaluation Scheme

Sr. No.	Subject Code	Subject Title	Periods Per Week						Seasonal Evaluation Scheme				Total Marks
			Units	S. L.	L	T	P	Credit	S. L. E	CT+ AT= 15+5	PA	SEE	
1	US-FMB-101	Basics of Microbiology, Cell - structure and function	3	20% *	3	0	0	2	10	20	10	60	100
2	US-FMB-102	Diagnostic and Clinical Microbiology	3	20% *	3	0	0	2	10	20	10	60	100
3	US-FMB-P1	Practicals Based US-FMB--101 + Practicals Based US-FMB--102			0	0	6	2				100 (80+ 20)	100
	Total Hours / Credit							06	Total Marks				300

***One to two lectures to be taken for CONTINUOUS self -learning Evaluation.**

First Year Semester I - Units – Topics – Teaching Hours

Sr. No	Subject Code	Subject Unit Title		Hours /Lectures	Total No. of hours/lectures	Credit	Total Marks
1	US-FMB-101	1	Introduction to Microbiology and Prokaryotic Cell Structure	15	45 L	2	100 (60+40)
		2	Eukaryotic Cell Structure	15			
		3	Study of Macromolecules	15			
2	US-FMB-102	1	Diagnostic Microbiology I	15	45L	2	100 (60+40)
		2	Introduction to Clinical Microbiology	15			
		3	Cultivation of Microbes and Biocontainment	15			
3	US-FMB-P1	1	Practicals Based on Unit-I, II & III ofFMB-101)	3	45x2= 90L lectures per batch	2	100 (80+10+10)
		2	Practicals Based on Unit-I, II & III of FMB-102	3			
			TOTAL			6	300

- **Lecture Duration – 48 Minutes**
- **One Credit =16.87 hours equivalent to 17 Hours**

L: Lecture: Tutorials P: Practical Ct-Core Theory, Cp-Core Practical, SLE- Self learning evaluation CT-Commutative Test, SEE- Semester End Examination , PA-Project Assessment, AT- Attendance

Part 3: Detailed Scheme Theory

Curriculum Topics along with Self-Learning topics - to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective Unit

Course Code: US-FMB-101

Unit	Content	No. of Lectures
1	**Introduction to Microbiology and Prokaryotic Cell Structure** **1.1 Introduction to Microbiology** 1.1.1. Discovery of microorganisms 1.1.2 Five-kingdom system of classification 1.1.3 Biogenesis v/s Abiogenesis 1.1.4 Introduction to different fields of Microbiology i. Genetics and Virology ii. Medical iii. Immunology iv. Industrial 1.1.5 Scope of Microbiology **1.2 Prokaryotic Cell Structure** 1.1.6 1.2.1 Cell wall 1.1.7 1.2.2 Cell membrane 1.1.8 1.2.3. Components external to cell wall-Capsule, Slime layer, Flagella, Pili, Fimbriae 1.1.9 Cytoplasmic matrix-Inclusion bodies, magnetosomes, ribosomes, gas vesicles 1.1.10 Nucleoid, Plasmids **1.1.11** Bacterial endospores and their formation	15

2	**Eukaryotic Cell Structure** **1.1 Outline of Eukaryotic cell structure** **1.2 The plasma membrane and membrane Structure** **1.3 Cytoplasmic matrix and Cytoskeleton** **1.4 Organelles of the Biosynthetic, Secretory and Endocytic pathways** 1.4.1 Endoplasmic reticulum 1.4.2 Golgi apparatus 1.4.3 Definitions of Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome **1.5 Eukaryotic ribosomes** **1.6 Mitochondria** **1.7 Chloroplasts** **1.8 Nucleus –Nuclear Structure** **1.9 Eukaryotic chromosome condensation** **1.10 Cilia and Flagella** **1.11 Comparison of Prokaryotic and Eukaryotic Cells** **1.12 Multiplication and cell division** – Mitosis and Meiosis	**15**

3	**Study of Macromolecules** **3.1 Chemical Bonds in Macromolecules** 3.1.1Biomolecules as compounds of carbon with a variety of functional groups. 3.1.2 Universal set of small molecules. 3.1.3 Macromolecules as the major constituents of cells. 3.1.4 Configuration and Conformation with definitions and suitable examples only. 3.1.5 Types of Stereoisomers and importance of stereoisomerism in biology. 3.1.6 Types of bonds and their importance: Electrovalence, covalent, ester, phosphodiester, thioester, peptide, glycosidic. **3.2 Water - Structures and its Properties** **3.3 Carbohydrates** 3.3.1. Definition, Classification, Biological role. 3.3.2 Monosaccharides 3.3.3 Oligosaccharides (maltose, cellobiose, sucrose, lactose) 3.3.4 Polysaccharide (starch, glycogen, peptidoglycan, cellulose) **3.4 Lipids** 3.4.1 Fatty acids (as basic component of lipids and their classification). 3.4.2 Storage and structural lipids-Types of lipids with general structure of each and mention examples. **3.5 Nucleic acids** 3.5.1. Nitrogenous bases- Purines, Pyrimidines Pentoses-Ribose, Deoxyribose. 3.5.2. Nomenclature of Nucleosides and nucleotides, N-β-glycosidic bond, polynucleotide chain to show bonding between nucleotides (Phosphodiester bonds). 3.5.3. Basic structure of RNA and DNA. **3.6 Amino acids and proteins** 3.6.1 General structure and features of amino acids (emphasis on amphoteric nature). 3.6.2 Classification by R-group, Uncommon amino acids and their functions. 3.6.3 Peptides and proteins- Definition and general features and examples with biological role. 3.6.4 Primary, secondary, tertiary, quaternary structures of proteins-Brief outline	**15**

Self-Learning topics (Unit wise)

Sub-unit	Topics
1.1.1	. Discovery of microorganisms
1.1.4	Scope of Microbiology
2.11	Comparison of Prokaryotic and Eukaryotic Cells
2.12	Meiosis and mitosis
3.1.3	.Macromolecules as the major constituents of cells

Online Resources

Online module : Discovery of microorganism and scope (History and scope)
http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/44.

Online module: Comparison of Prokaryotic and Eukaryotic Cells
http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/44
Online module: Meiosis and mitosis
http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/41
Online module: Macromolecules as the major constituents of cells (Importance of macromolecules)
https://nptel.ac.in/courses/104/103/104103121/-

Course Code: US-FMB-102

Unit	Content	No. of Lectures
1	**Diagnostic Microbiology I**	**15**
	1.1 Microscopy 1.1.1. History of microscopy 1.1.2 Optical spectrum 1.1.3 Lenses and mirrors 1.1.4 Simple and compound light microscope 1.1.5 Dark field Microscopy 1.1.6 Phase contrast Microscopy **1.2 Stains** 1.2.1 Dyes and stains: Types, Physicochemical basis, Fixatives, Mordants, Intensifier, Decolorizers 1.2.2 Simple and differential staining 1.2.3 Vital staining 1.2.4 Special staining (Cell wall, Capsule, Lipid granules, Spores, Metachromatic granules, nucleus & Flagella)	
1	**Introduction to Clinical Microbiology**	**15**
	2.1 Laboratory analysis of clinical specimens Microscopic, cultural, biochemical and Genomic analysis **2.2 Introduction to Molecular identification of prokaryotes** –Nucleic acid extraction, Polymerase chain reaction (PCR), 16S r RNA **2.3 Biosafety in Microbiology:** 2.3.1 Means of laboratory infection 2.3.2 Potentially hazardous procedures 2.3.3 Responsibility 2.3.4 Risk Assessment 2.3.5 Restricted access 2.3.6 Safety equipment's 2.3.7 Immunization and medical records 2.3.8 Training of personnel 2.3.9 Laboratory procedure 2.3.10 Levels of Containment	
3	**Cultivation of Microbes and Biocontainment**	**15**
	3.1 Microbial Nutrition	

	3.1.1. Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors. 3.1.2. Nutritional types of microorganisms 3.1.3. Types of Culture media with examples 3.1.4. Isolation of microorganisms and pure culture techniques 3.1.5. Preservation of microorganisms **3.2 Control of Microorganism** **3.2.1** Definition of frequently used terms & Rate of microbial death, Factors affecting the effectiveness of antimicrobial agents & Properties of an ideal disinfectant **3.2.2** Physical methods of microbial control 1. Dry & moist heat – mechanisms, instruments used and their operations 2. Electromagnetic radiations – Ionizing radiations, mechanisms –advantages & disadvantages 3. Bacteria proof filters 4. Low temperature 5. Osmotic pressure 6. Desiccation **3.3 Chemical methods of microbial control** - mechanism & advantages & disadvantages (if any) applications. 3.3.1 Phenolics 3.3.2 Alcohols 3.3.3 Heavy metals and their compounds 3.3.4 Halogens 3.3.5 Quaternary ammonium compounds 3.3.6 Dyes 3.3.7 Surfaces active agents/Detergents 3.3.8 Aldehydes 3.3.9 Peroxygens 3.3.10 Sterilizing gases 3.3.11 Antibiotics - List types of antibiotics active against various groups & mention the site of action (Detailed mode of action not to be done	

Self-Learning topics (Unit wise)

Sub-unit	Topics
1.1.3	Lenses and mirrors
1.1.6	Phase contrast Microscopy
2.2	Polymerase chain reaction (PCR), 16S r RNA

3.1.1	Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors
3.2.1	Definition of frequently used terms & Rate of microbial death, Factors affecting the effectiveness of antimicrobial agents & Properties of an ideal disinfectant

Online Resources

Online module: Ray tracing with mirrors; basic optical systems: single lens magnifier, eyepiece, microscope.
https://nptel.ac.in/courses/102/107/102107028/
Online module: Phase contrast microscope
https://swayam.gov.in/nd1_noc20_mm14/preview

Online module: PCR https://nptel.ac.in/courses/104/103/104103121/
Online module:16srRNA sequencing https://swayam.gov.in/nd1_noc19_bt24/preview

Online module: Nutritional requirements
http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/44

Online module: Control of microorganism https://swayam.gov.in/nd2_cec19_bt11/preview

http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/44

Part 4: Detailed scheme Practicals

Course Code: US-FMB-P1

Basics of Microbiology, Cell - structure and function		
Unit	Content	Reference Books
I	1. Assignment: Applications of Microorganisms in Industries. 2. Special staining: i. Cell wall ii. Capsule iii. Endospore iv. Flagella (demonstration) v. Lipid vi. Metachromatic granules vii. Nucleus staining (demonstration)	Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company
II	3. Discard of highly infectious pathogenic samples like T.B, sputum etc. 4. Explain safety inoculation hood for infection inoculations and laminar air flow. 5. On accidental spillage of/ breakage of culture containers-precautions to be taken. 6. Demonstration of microbes in air, cough, on table surface, fingertips. 7. Permanent slides of Eukaryotes & its organelles: 8. Assignment: Eukaryotic organelles	Microbiology Laboratory Manual: Cappuccino and Sherman
III	9. Qualitative detection: i. Nucleic acid-DPA, Orcinol test ii. Carbohydrates- Benedicts, Molisch's test. iii. Proteins, amino acids- Biuret, Ninhydrin. 10.Handling corrosive chemical using rubber teat method for pipetting. Prevention of mouth pipetting and use of auto-pipettes.	Lehninger. Principles of Biochemistry. 4th Edition. D. Nelson and M. Cox. W.H. Freeman and Company. New York 2005

Paper-II-Practical: **Diagnostic and Clinical Microbiology**		
Unit	Content	Reference Books
I	1. Study of parts of a microscope 2. Micrometry 3. Dark field and Phase contrast: Demonstration	Prescott, Harley. Klein-Microbiology, 7th edition, International

	4. Monochrome and differential staining procedures, Gram staining& Negative Staining.	edition, McGraw Hill
II	5. Introduction to Laboratory equipment's, disinfection & discarding techniques in laboratory 6. Methods of preparation of glassware for Sterilization (Pipettes, Petri Plates, Plastic wares, Flasks, Micropipettes, microtiter plates) & Control of microorganisms using moist heat & dry heat sterilization (Sterilization of Dry powders, Rubber gloves, Bandages, Screw capped tubes, Sterilizable plastic wares) 7. Effect of UV Light, Desiccation, surface tension, Osmotic Pressure, heavy metals (Oligodynamic action) 8. Effect of dyes, phenolic compounds and chemotherapeutic agents (disc inhibition method) 9. Working of Laminar Air Flow and Biosafety Cabinets	Microbiology TMH 5th Edition by Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg
III	10. Preparation of Culture Media: i. Liquid medium (Nutrient Broth) ii. Solid Media (Nutrient agar, Sabouraud's agar) iii. Minimal media iv. Preparation of slant, butts & plates 11. Inoculation techniques and Study of Growth: i. Inoculation of Liquid Medium ii. Inoculation of Solid Media (Slants, Butts and Plates) iii. Study of Colony Characteristics of pigment & non - pigment producing bacteria. iv. Study of Motility (Hanging Drop Preparation) 12. Use of Differential & Selective Media 13. Determination of Optimum growth conditions: i. Temperature ii. pH 14.Methods of Preservation of culture 15. Preparation of solutions (Normality and Molarity)	A. J. Salle, Fundamental Principles of Bacteriology Conn E and Stumpf P. Outlines of biochemistry. John Wiley and Sons.

Part 5- Scheme of Teaching and Examination:

First Year Semester – II
Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (**Microbiology**)			US-FMB-201, US-FMB- 202, US-FMB- P2	
2	Elective Course	Discipline Specific Elective (DSE) Course			
		2.1	Interdisciplinary Specific Elective (IDSE) Course		
		2.2	Dissertation/Project		
		2.3	Generic Elective (GE) Course		
3	Ability Enhancement Courses (AEC)				
	Skill Enhancement Courses (SEC)				

Part 6: Detailed Scheme Theory

Sr. No.	Subject Code	Subject Title	Periods Per Week						Seasonal Evaluation Scheme				Total Marks
			Units	S. L.	L	T	P	Credit	S. L. E	CT+ AT= 15+5	PA	SEE	
1	US-FMB-201	Study of Microbial diversity, Growth, Bioinformatics and Biostatistics	3	20% *	3	0	0	2	10	20	10	60	100
2	US-FMB-202	Microbial interactions and Instrumentation	3	20% *	3	0	0	2	10	20	10	60	100
3	US-FMB-P2	Practicals Based US-FMB--201 + Practicals Based US-FMB--202			0	0	6	2				100 (80+ 20)	100
	Total Hours / Credit							06	Total Marks				300

***One to two lectures to be taken for self -learning Evaluation.**

Part 6: Detail Scheme Theory

I Year Semester – II Units – Topics – Teaching Hours

Curriculum Topics along with Self-Learning topics - to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective Unit

S.N	Subject Code	Subject Unit Title		Hours /Lectures	Total No. of hours/lectures	Credit	Tot al Marks
1	US-FMB-201	1	Microorganisms significant in environment, Industrial and Medical Microbiology - I	15	45	2	100 (60+40)
		2	Microorganisms significant in environment, Industrial and Medical Microbiology – II and Bioinformatics	15			
		3	Microbial Growth and Biostatistics	15			
2	US-FMB-202	1	Human Health and Microbial Interaction	15	45	2	100 (60+40)
		2	Microbial Ecology and Infections in humans	15			
		3	Diagnostic Microbiology II and Instrumentation	15			
3	US-FMB-P2	1	Practicals Based on Unit-I, II & III of US-FMB-201	3	45x2= 90 lectures per batch	2	100 (80+10+10)
		2	Practicals Based on Unit-I, II & III of US-FMB-202	3			
			TOTAL			6	300

L: Lecture: Tutorials P: Practical Ct-Core Theory, Cp-Core Practical, SLE- Self learning evaluation CT-Commutative Test, SEE- Semester End Examination , PA-Project Assessment, AT- Attendance

Course Code: US-FMB-201

Unit	Content	No. of Lectures
1	**Microorganisms significant in environment, Industrial and Medical Microbiology - I**	**15**
	1.1 Algae 1.1.1. Characteristics of algae: morphology, Pigments, reproduction 1.1.2 Cultivation of algae. 1.1.3 Major groups of Algae –an overview 1.1.4 Biological, Medical and Economic importance of Algae. 1.1.5 Differences between Algae and Cyanobacteria	

	1.2 Protozoa 1.2.1 Major Categories of Protozoa Based on motility, reproduction**.** Medical significance 1.2.2. Protozoa Life cycle of Entamoeba **1.3 Rickettsia, Coxiella, Chlamydia, Mycoplasma** 1.3.1 General features 1.3.2 Medical significance **1.4 Actinomycetes** 1.4.1 General features of Nocardia and Streptomyces 1.4.2 Importance: ecological, commercial and medical **1.5 Archaea** 1.5.1 Introduction- Major Archaeal physiological groups 1.5.2 Archaeal cell wall, lipids and membranes 1.5.3 Ecological importance 1.5.4 Genetic characters 1.5.5. Differences between Archaebacteria, Eubacteria and Eukaryotes	
2	**Microorganisms significant in environment, Industrial and Medical Microbiology - II and Bioinformatics**	**15**
	2.1 Viruses: 2.1.1 Historical highlights, 2.1.2 General properties of viruses, prions, viroid's 2.1.3 Structure of viruses 2.1.4 Bacteriophage, animal and plant virus 2.1.5 Life cycle of T4 and λ phage **2.2 Fungi and Yeast** 2.2.1 Characteristics: structure, Reproduction. 2.2.2 Cultivation of fungi and yeasts. 2.2.3 Major fungal divisions- overview. Life cycle of yeast 2.2.4 Biological and economical importance **2.3 Slime molds and Myxomycetes** **2.4 Overview of Bacterial classification** 2.4.1 Phenotypic- morphology and biochemical classification, concept of culture collections 2.4.2 Genotypic- sequence based techniques **2.5 Introduction to Bioinformatics** 2.5.1. Definition, aims, tasks and applications of Bioinformatics.	

	2.5.2 Importance, Types of databases	
3	**Microbial Growth and Biostatistics**	**15**
	3.1 Microbial Growth 3.1.1. Definition of growth 3.1.2 Mathematical Expression 3.1.3 Growth curve 3.1.4 Measurement of growth: Direct microscopic count – Breed's count, Petroff – Hausser counting chamber-Haemocytometer. 3.1.5 Viable count – Spread plate and Pour plate technique 3.1.6 Measurements of cell constituents. 3.1.7 Turbidity measurements – Nephelometer and spectrophotometer techniques 3.1.8 Synchronous growth, Continuous growth (Chemostat and Turbidostat) 3.1.9 Influence of environmental factors on growth. 3.1.10 Microbial growth in natural environment with examples. 3.1.11 Counting viable non-culturable organisms-Quorum sensing techniques 3.1.12 **3.2 Introduction to Biostatistics** – Types of data, data presentation, Measuring central tendencies, standard deviation	

Self-Learning topics (Unit wise)

Sub-unit	Topics
2.5.1	Definition, aims, tasks and applications of Bioinformatics
2.1.2	General properties of viruses
3.1.3	Growth curve

Online Resources

Online module: Concepts and importance of Bioinformatics https://nptel.ac.in/courses/102/106/102106065/

Online module: Virus – Introduction, Virus- host interaction, Lytic cycle of viruses, Lysogenic cycle of viruses https://swayam.gov.in/nd2_cec19_bt11/preview

https://www.swayamprabha.gov.in/index.php/program/archive/9 (https://www.youtube.com/embed/NFpCIc4AzGE)

Online module: Enumeration of bacteria and determination of growth phasehttp://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/78

Course Code: US-FMB-202

Unit	Content	No. of Lectures
1	**Human Health and Microbial Interaction**	**15**
	1.1 Host defense and basics of immunology 1.1.1 Difference between infection & disease. 1.1.2 Important terminology: Primary infection, secondary infection. Contagious infection, occupational infection, clinical infection, subclinical infection, Zoonosis, latent infection, Iatrogenic infection, vector borne infection. 1.1.3 Factors affecting infection: Microbial factors: adherence, invasion, role of virulence factors in invasion, colonization & its effects. Host factors: natural resistance, species resistance, racial resistance 1. Individual resistance: Factors influencing individual resistance: Age, nutrition, personal hygiene, stress, hormones, Addiction to drugs/ alcohol. Interaction between Microbes & host is dynamic. 2. Host defense against infection: Overview i. First line of Defense: for skin, respiratory tract, gastrointestinal tract, genitourinary tract, eyes. ii. Second line of defense: Biological barriers: Phagocytosis, Inflammation iii. Third line of defense: Brief introduction to antibody mediated & cell mediated immunity	
2	**Microbial Ecology and Infections in humans**	**15**
	2.1 Types of Microbial Interactions 2.1.1 Mutualism 2.1.2 Cooperation 2.1.3 Commensalisms 2.1.4 Predation 2.1.5 Parasitism 2.1.6 Amensalism 2.1.7 Competition **2.2 Human Microbe Interactions** 2.2.1 Normal flora of the human body: Skin, Nose & Nasopharynx, Oropharynx, Respiratory tract, Eye, External ear, Mouth, Stomach, Small intestine, Large intestine, Genitourinary tract. 2.2.2 Infections in humans with examples (TB, Typhoid, HIV, Swine Flu, Malaria) 2.2.3 Relationship between microbiota& the host	

	2.2.4 Gnotobiotic animals – Cultivation, Applications and examples **2.3 Microbial associations with vascular plants** 2.3.1 Phyllosphere 2.3.2 Rhizosphere & Rhizoplane 2.3.4 Mycorrhizae 2.3.5 Nitrogen fixation: Rhizobia, Actinorhizae, Stem Nodulating Rhizobia 2.3.5 Fungal & Bacterial endophytes 2.3.6 Agrobacterium & other plant pathogens 2.4 **Genetic Engineering** 2.4.1 Role of Ti plasmid 2.4.2 Genetically Modified crops- Bt Cotton	
3	**Diagnostic Microbiology II and Instrumentation**	**15**
	3.1Instrumentation 3.1.1.pH meter 3.1.2 Colorimeter 3.1.3 Spectrophotometer 3.1.4 Centrifuge 3.1.5 Weigh Balance and Anoxic gas chamber 3.1.6 Autoclave 3.1.7 Hot air Oven 3.1.8 Electron Microscope: TEM, SEM 3.1.9 Contrast enhancement for electron microscope 3.1.10 Fluorescent Microscope 3.1.11 Confocal Microscope 3.1.12 Application of electron microscopy in diagnostics 3.1.13 Applications Scanning probe Microscopy –Atomic force Microscope ,Significance of imaging in diagnostics – Role of computed tomography (CT), Magnetic resonance imaging (MRI) and positron emission tomography (PET) in bacterial detection. (Tabular format)	

Self-Learning topics (Unit wise)

Unit	Topics
1.1.5	Introduction to cell mediated immunity
2.1.2,2.1.3	Mutualism and Commensalism
3.1.2	Principle of colorimeter
3.1.11	Principle of Confocal Microscope

Online Resources

Online module: Introduction to cell mediated immunity

http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/46
Online module: Mutualism and Commensalism
http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/156
Online module: Principle of colorimeter
http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/141
Online module: Principle of Confocal Microscopy
http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/141

Part 7 : Detailed Scheme Practicals

Course Code: US-FMB-P2

Paper-I-Practical: **Study of Microbial diversity, Growth, Bioinformatics and Biostatistics**		
Unit	Content	Reference Books
1	1. Spot assay and plaque assay of Bacteriophage (Demonstration) 2. Slide Culture technique (Actinomycetes & Fungi)	A.J. Salle, Fundamental Principles of Bacteriology
2	3.Isolation of yeast and other fungi on Sabourauds agar 4. Study of microbial growth under Static & Shaker Cultures 5. Fungal Wet mounts & Study of Morphological Characteristics: Mucor, Rhizopus, Aspergillus, Penicillium. 6. Permanent slides of Algae, Protozoa	Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company
3	7. Growth curve (Demonstration) only in complex media. 8.Breed's Count 9.Haemocytometer 10.Viable count: Spread plate and pour plate 11. Viable count calculations with Mean, median and Mode 12. Brown's opacity 13.Effect of pH and temperature on growth 14.Measurement of cell dimensions-Micrometry 15. Calculation of central tendency 16. Introduction to Databases	Prescott, Harley. Klein-Microbiology, 7th edition, International edition, McGraw Hill

Paper-II-Practical: **Microbial interactions and Instrumentation**		
Unit	Content	Reference Books
1	1. Normal flora of the Skin & Saliva 2. Wet Mount of Lichen 3. Bacteroid Staining & Isolation of Rhizobium 4. Azotobacter isolation & staining	Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company
2	5.Study of virulence factors – Enzyme Coagulase 6.Study of virulence factors – Enzyme Hemolysin 7.Study of virulence factors – Enzyme Lecithinase	Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. Adisson Wesley Longman Inc. 1998.
3	8.Use of standard buffers for calibration and determination of pH of a given solution	An Introduction to Practical Biochemistry / Plummer

	9.Determination of ג max 10.Verification of Beer Lambert's law 11.Determination & efficiency of Autoclave, Hot air oven 12. DNA amplification using PCR (demonstration) 12.Writing of SOP's for Instruments 13.Visit to a Microbiology laboratory in a research Institute/Industrial visit	David (1979) TMH

REFERENCES

(US-FMB-101, US-FMB- 102)

1. Prescott ,Harley.Klein-Microbiology, 7th edition, International edition, McGraw Hill.
2. Kathleen Park Talaro& Arthur Talaro - Foundations in Microbiology International edition 2002 McGraw Hill.
3. Michael T.Madigan &J.M.Martin, Brock ,Biology of Microorganisms 12th Ed. International edition 2006 Pearson Prentice Hall.
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8. Outlines of Biochemistry 5/E, Conn P. Stumpf, G. Bruening and R. Doi. John Wiley & Sons. New York 1995
9. Lehninger. Principles of Biochemistry. 4th Edition. D. Nelson and M. Cox. W.H. Freeman andCompany. New York 2005
10. Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. AddsisonWeseley Longman Inc. 1998.
11. Microbiology Laboratory Manual: Cappuccino and Sherman

(US-FMB-201, US-FMB- 202)

1.Prescott ,Harley.Klein-Microbiology, 7th edition, International edition, McGraw Hill.
2. Kathleen Park Talaro& Arthur Talaro - Foundations in Microbiology International edition 2002| McGraw Hill.
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9. Biostatistics- Basic concepts and methodology for health sciences, Wayne Daniel, 10th edition
10. Teri Shors,.(2009), “Understanding viruses”, Jones and Bartlett publishers
11. S.Ignacimuthu, (2005), “Basic Bioinformatics”, Narosa publishing house.