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

HSNC University Mumbai

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Ordinances and Regulations

With Respect to

Choice Based Credit System

(CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Biotechnology

Curriculum – First Year Undergraduate Programmes

Semester-I and Semester -II

2020-2021

Revision I : 2022-2023

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 The Academic Year 2020-2021 Are as Under:

1. Core Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

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 is called an Elective Course.

2.1Discipline 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 offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2Dissertation/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 a discipline 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 content can be created for the Bridge Course Topics.

8. Module and Unit: A course, 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 a course is treated as a Unit. Each course should have exactly 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, discussion forums, 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 topics ear marked 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 may have 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 in exigencies, like the current situation arising from the lockdown, but such adhoc decisions are to be 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 four CP (Credit Point) course may be considered to have collected or acquired four 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%- 40marks

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 100 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

Practical examination:
Practical exam would be conducted over a period of 3 days; 100M for each practical paper.

Each student to perform 2 major and 2 minor practical for Sem V and 2 major and project presentation for Sem VI,

Viva would be conducted during the practical during Sem V; Sem VI would have ONLY project presentation.

Distribution of marks for the experiments carried out during the examination:
Sem V (50M/ paper): Major: 20M; Minor: 10M; Viva: 10M; Journal 10M.
Sem VI (50M/paper): Major (x2): 40M; Journal: 10M; Project 50M
The report could be around 25-30 pages with appropriate referencing and formatting.

Marks distribution for the project would be as follows:
25M documentation, 15M presentation, 10 M viva and interactions;

Students would undertake a project for 1-2 months during the last semester for 50 M.
The project should include either of the following:
1. One/ more major instrumentation OR
2. One / more major technique/s required in the field of interest OR
3. Bioinformatics OR
4. Biostatistics
The semester end examination (external component) of 60 % for each course will be as follows:

Duration – 2 Hours

Theory Question Paper Pattern:-

There shall be five questions each of 15 marks. On each unit there will be one question and the first and second one will be based on entire syllabus.
All questions shall be compulsory with internal choice within the questions. (Each question will be of 20 to 23 marks with options.)
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.

ii. 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.

Biotechnology

Part 1- Preamble

The world today is living and benefiting from the present 'Era of Biotechnology'. Biotechnology is one of the recent branches of Life Sciences, which has extended and built up as a progressed multidisciplinary applied science in most recent couple of years. Biotechnology at its heart conceives a far reaching investigation of the building blocks of life and this has prompted a novel status for Biotechnology in research and industry.

The financial capability of Biotechnology is settled which has nearly gotten synonymous with current improvement. Biotechnology has its applications in pretty much every field contacting basically every human action. Applied Biotechnology is presently a work in press finding applications in Industry, Agriculture, Health and Environment.

Biotechnology necessitates well trained and duly skilled individuals to constitute Industry and Research divisions. The field is novel and thus requests contributions to Infrastructure and Technology from all fields. The worldwide focus is now growing around inventions that can ease life and purpose. Biotechnology is destined to introduce a paradigm shift in the world's technologies and human perspective.

The interest for prepared workforce in Biotechnology is regularly developing in Fundamental Research and Industry Sector. Scholastic and Research Sectors likewise require interdisciplinary prepared labor to facilitate the Biotechnology Revolution.

The need of great importance is to configure a prospectus which keeps pace with changing occasions and innovation with stresses on applications while clarifying innovation top to bottom. The present syllabus is drafted foreseeing the future needs of Biotechnology Sector with more accentuation on granting hands-on aptitudes. The central purpose is laid on making schedule perfect with improvements in academics, research and commercial divisions. The theory and practical course introduced will prompt range of abilities to advance Biotechnology Sector.

The rebuilt prospectus consolidates fundamental knowledge of Physics, Chemistry and Biology considering headways in innovation. The educational program plans to grant essential information with accentuation on its applications to prepare the understudies business

To comply with the education policy of Government of India, we have included Online Courses (OLC) which is available on NPTEL or SWAYAM portals under MOOCS programme being developed by MHRD. The online courses would inculcate the habit of self-study at their own pace by the students and also acclimatize them to future technologies of learning processes.

1. Course Objectives:

Semester I

US-FBT-101
Biotechnology: Introduction and applications

The coursework provides an introduction to the fields of Biotechnology, its scope, and its application in the field of agriculture and food biotechnology.It helps in developing a good perspective of the field of Biotechnology and ethical issues related to biotechnology. The students are introduced to the concepts of Bioinformatics, fermentation and food processing.

US-FBT-102
Genetics and molecular biology

The objective of this course is to develop a firm foundation with concepts in heredity and variation. The coursework develops an understanding of the eukaryotic and prokaryotic genetics. It also discusses the structure of Chromosomes and types of Chromosomal Aberrations.

US-FBT-103
Ultra structure of cell and reproduction

The objective of this course to familiarize the students with ultra-structure of both prokaryotic and eukaryotic cells. The students will be able to differentiate between prokaryotes and eukaryotes. The coursework will help in development of an understanding of the reproduction in organisms.

US-FBT-104
Nutrition, growth and microscopy of microbes

The objective of this course is to impart skill in handling and culture of Microorganisms and acquaint them with various types of stains and staining methods to be used for visualization of specimens using a microscope
It also helps in development of laboratory skills viz. sterilization, microbial cell culture & cell lines techniques, microscopy and staining techniques to visualize specimens under a microscope.

US-FBT-105

Basic Chemistry

The objective of this course is to acquaint students with basic concepts of Chemistry like Classification and Nomenclature of organic compounds. It also helps to build concepts in Stereochemistry by providing an understanding of the relative spatial arrangement of atoms in molecules. Through the course work, the students will be able to understand Stereochemistry of organic molecules and their practical significance.

US-FBT-106
Bioorganic chemistry

The objective of this course is to provide a clear understanding of Classification, Structure and Characterization of Biomolecules. It helps to impart knowledge related to biological role of all major Biomolecules. The coursework develops an understanding of Carbohydrates, proteins, amino acids, lipids and nucleic acids with respect to biochemistry.

US-FBT-107
Foundation course-I : The Indian Constitution and personality development

The objective of this course is to acquaint the students with basic concepts associated with the Indian institution and Globalization. It also provides a basis for personality development of students.

Semester II

US-FBT-201
Tissue Culture

The objective of this course is to have an insight about the basic concepts in Plant and Animal Tissue Culture. It also develops basic skills required to carry out these techniques.

US-FBT-202
Genetic engineering

The objective of this course is to provide an understanding of the basic molecular processes of a cell at the level of its genome. It aids in developing an understanding of recombinant DNA technology and its applications. Additionally the coursework discusses the Model organisms and Bioethics in Recombinant DNA Technology.

US-FBT-203
Cell Physiology and Ecology

The objective of this course to acquaint students with Physiological Processes in Plants and Animals as well as to study the role of the ecosystem and the various interactions that sustains it. The coursework discusses the importance of the various interactions of the ecosystem. Students will become aware of advanced techniques like remote sensing that are used for animal and plant protection.

US-FBT-204
Genetics & immunology

The objective of this course is to offer an understanding of the concept of Population Genetics and to provide a basic understanding of antibodies, antigens and role of immune system. It helps to develop an understanding of various concepts of genetic variations in populations and the role of population genetics in Conservation Biology. Additionally the coursework teaches to understand identification and classifications of mutations in DNA followed by mechanism of DNA repair.

US-FBT-205
Analytical Chemistry

The objective of this course is to train the student in the principal, working and applications of basic Analytical Techniques like Chromatography and colorimetry. Students will learn how to make solutions, buffers and perform titrimetric analysis.

US-FBT-206
Physical Chemistry

The objective of this course to acquaint students with fundamentals in Oxidation and Reduction Reactions, reaction rates. The coursework helps to develop an understanding of kinetics involved in various types of chemical reactions. The students will be able to distinguish reactions involving oxidation and reduction processes.

US-FBT-207
Foundation course II: Ability enhancement course

The objective of this course is to acquaint the students with various professional skills. It also introduces communication and academic skills needed for better professional future.

2. Process adopted for curriculum designing:

The curriculum was designed in a stepwise manner, firstly based on 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 biotechnological techniques with entrepreneurship skills .The course would help the students to develop creativity in designing products, build research skills, and provide better employment opportunities in areas like health care, agriculture, industry and environment.

4. Learning Outcomes.

Our program is designed in a way to educate the learner about various fields of Biotechnology like Genetics, Medical Microbiology and Diagnostics, pharmaceutical industry, Industrial biotechnology, molecular, environmental and biotechnology. The program would help the learner to apply their biotechnological and microbiological skills to summarize, analyze, and instill problem-solving approach in the latest developments and innovations in the future. The program design, the teaching and the evaluation patterns would help the learner to develop analytical and critical thinking skills in biological problems through scientific methods to give the learner a solid foundation in the field of Biotechnology.

1. Learners shall analyze and solve process systems problems, particularly those related to equipment performance, fluid flow, and balance of material and energy.
2. The Program would enable the Students to communicate orally and in writing using suitable scientific terms.
3. During the Course of this Program Students will be able to design and conduct experiments, analyze and interpret data to address issues in biotechnology and related fields.
4. Students will be capable to understand the potential and impact of biotechnological innovations on the environment and their implementation in order to find a sustainable solution to environmental, health, agricultural and other issues.
5. The course will cater the students with essential concepts of different processes involved in development of animals, along with genetic control of development.
6. The course will acquaint the Students with Complete knowledge on how genes are transmitted in plants and animals from one generation to another will be imparted after completion of the course on genetics. The course shall also highlight the role of genetics / mutations in the breeding of animals and plants

7. The Program shall further build into the Learners the ability to develop, interpret, and critically evaluate modern scientific research approaches. As also Understanding the relationship between society and science and justifying plant, animal and microorganism biotechnological manipulation.

8. Students would be equipped with knowledge and understanding of basic skills in laboratory techniques viz. sterilization, microbial cell culture & cell lines techniques, microscopy and staining techniques to view specimens under a microscope

5. Input from stakeholders

New topics introduced at basic level which will be gradually included in more depth in second and third year B.Sc. Existing components were modified and shuffled from one semester to other on the basis of time frame required to complete the particular paper. As suggested by the industrial, research and academic experts, practical applications of the fundamental techniques were incorporated and missing links between different subtopics were introduced. Subtopics more streamlined and were made specific (depth of the content). Newly introduced concepts like IPR and Bioinformatics were suggested by industry expert. As suggested by academic experts, new topics such as Pedigree analysis, structure of chromosomes and variation in chromosome structure and number were introduced to the students at this basic level as they directly start studying in depth in second year B.Sc. Also, a missing section of molecular motor proteins,different PTC techniques, introduction to fundamental techniques in molecular biology and its application in molecular biology were added. As suggested by research and industrial expert, Industrial related techniques, Equipment, Instruments used in basic tissue culture were introduced. Also in recombinant DNA technology topic such as vectors, cDNA library, applications of rDNA technology were added as these are currently used in research and R&D departments of industries. To make students aware about the advance techniques used to protect plants and animals, a concept known as remote sensing was added as suggested by industrial expert plus a concept of professional and academic communications was added under applied component at basic level as the students can get an idea in the field of Marketing and broaden their horizons in respect to employment opportunities.

Part 2- The Scheme of Teaching and Examination is as under:

Semester – I
Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (**Biotechnology**)			US-FBT-101, US-FBT-102, US-FBT-1P1, US-FBT-103, US-FBT-104, US-FBT-1P2	
2	Elective Course	Discipline Specific Elective (DSE) Course			
		2.1	Interdisciplinary Specific Elective (IDSE) Course	US-FBT-105, US-FBT-1P3	
		2.2	Dissertation/Project		
		2.3	Generic Elective (GE) Course	US-FBT-106,US-FBT-1P3	
3	Ability Enhancement Courses (AEC)			US-FBT-107	
4	Skill Enhancement Courses (SEC)				

First Year Semester I Internal and External Detailed Evaluation Scheme

Sr. No.	Subject Code	Subject Title	Periods Per Week						Internals				Total Marks
			Units	S.L.	L	T	P	Credit	S.L.E.	CT+AT=15+5	PA	SEE	
1	US-FBT-101	Biotechnology : Introduction and Applications	3	20%*	3	0	0	2	10	20	10	60	100
2	US-FBT-102	Genetics and Molecular biology	3	20%*	3	0	0	2	10	20	10	60	100
3	US-FBT-103	Ultra structure of cell and reproduction	3	20%*	3	0	0	2	10	20	10	60	100
4	US-FBT-104	Nutrition , growth and microscopy of microbes	3	20%*	3	0	0	2	10	20	10	60	100
5	US-FBT-105	Basic Chemistry	3	20%*	3	0	0	2	10	20	10	60	100
6	US-FBT-106	Bioorganic chemistry	3	20%*	3	0	0	2	10	20	10	60	100
7	US-FBT-107	Foundation course: The Indian Constitution and personality development	3	20%*	3	0	0	2	10	20	10	60	100
8	US-FBT-1P1	Practicals Based US-FBT-101 + Practicals Based US-FBT-102			0		6	2				100 (80 +20)	100

9	US-FBT-1P2	Practicals Based US-FBT-103 + Practicals Based US-FBT-104			0		6	2				100 (80 +20)	100
10	US-FBT-1P3	Practicals Based US-FBT-105 + Practicals Based US-FBT-106			0		6	2				100 (80 +20)	100
	Total Hours / Credit							20	Total Marks				1000

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

First Year Semester I - Units – Topics – Teaching Hours

S. N	Subject Code	Subject Unit Title		Hours/Lectures	Total No. of hours/lectures	Credit	Total Marks
1	US-FBT-101	1	Introduction to Biotechnology and IPR	15	45 L	2	100 (60+40)
		2	Applications of Biotechnology I	15			
		3	Applications of Biotechnology II	15			
2	US-FBT-102	1	Mendelian Genetics	15	45L	2	100 (60+40)
		2	Chromosomes and Cell division	15			
		3	DNA replication and Recombination	15			
3	US-FBT-103	1	Origin of Life and Evolution	15	45L	2	100 (60+40)
		2	Ultra Structure of Cell	15			
		3	Reproduction	15			
4	US-FBT-104	1	Nutrition and Cultivation of Microorganisms	15	45L	2	100 (60+40)
		2	Sterilization Techniques	15			
		3	Microscopy and Stains	15			
5	US-FBT-105	1	Nomenclature and Classification	15	45L	2	100 (60+40)
		2	Chemical Bonds	15			
		3	Stereochemistry	15			
6	US-FBT-106	1	Biomolecule: Carbohydrates and Lipids	15	45L	2	100 (60+40)
		2	Biomolecule: Proteins and Amino Acids	15			
		3	Biomolecule: Nucleic Acids	15			
7	US-FBT-107	1	The Indian Constitution	15	45L	2	100 (60+40)
		2	Globalization and Human Rights	15			
		3	Personality Development	15			
8	US-FBT-1P1	1	Practicals based on US-FBT-101	3	45x2= 90 lectures per batch	2	100 (80+10 +10)
		2	Practicals based on US-FBT-102	3			
9	US-FBT-1P2	1	Practicals based on US-FBT-103	3	45x2= 90 lectures per batch	2	100 (80+10 +10)
		2	Practicals based on US-FBT-104	3			
10	US-FBT-1P3	1	Practicals based on US-FBT-105	3	45x2= 90 lectures per batch	2	100 (80+10 +10)
		2	Practicals based on US-FBT-106	3			
			TOTAL			20	1000

- **Lecture Duration – 45 Minutes = 0 .75 Hours. (45 Lectures equivalent to 33.75 hours)**
- **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-FBT-101 Biotechnology: Introduction and Applications

Unit	Content	No. of Lectures
1	**Introduction to Biotechnology and IPR** **1.1 History & Introduction to Biotechnology (2L)** 1.1.1. What is Biotechnology? 1.1.2. Definition of Biotechnology 1.1.3. Traditional and Modern Biotechnology **1.2 Branches of Biotechnology (5L)** 1.2.1. Plant Biotechnology 1.2.2. Animal Biotechnology 1.2.3. Marine Biotechnology 1.2.4. Agriculture 1.2.5. Healthcare 1.2.6. Industrial Biotechnology 1.2.7. Pharmaceutical Biotechnology 1.2.8. Environmental Biotechnology 1.2.9. Biotechnology Research in India, 1.2.10. Biotechnology Institutions in India (Public and Private Sector) **1.3 Ethics in Biotechnology(1L)** **1.4 Challenges in Biotechnology (2L)** **1.5 Intellectual Property Rights (IPR) and Protection (IPP)(5L)** 1.5.1. Basics of IPR (Patents, Copyright, Trademark, Trade Secrets, Plant Varieties Protection Act, Designs, Geographical Indications) 1.5.2. Biotechnology and IPR (Basmati and Turmeric case study), 1.5.3. Scientific Innovations Biotechnological Patents, 1.5.4. Plant Breeders Rights, farmers rights and privileges, breeders exemption	15
2	**Applications of Biotechnology I** **2.1 Applications of Biotechnology in Agriculture(5L)** 2.1.1. GM Food: GM Papaya, GM Tomato,	15

	2.1.2. Fungal and Insect Resistant Plants: BT Crops, BT Cotton, BT Brinjal 2.1.3. Modification in crops: Golden rice. Oilseed production, Starch quality improvement **2.2 Biotechnological applications for Human Welfare (5L)** 2.2.1. Insulin 2.2.2. Recombinant vaccines 2.2.3. Molecular farming 2.2.4. Edible vaccines 2.3. **Biotechnological applications for environmental protection (5L)** 2.3.1. Pollution abatement through GMO , 2.3.2. Algal technology, 2.3.3. Hydroponics	
3	**Applications of Biotechnology II** 3.1. **Food Biotechnology(5L)** 3.1.1. Biotechnological applications in enhancement of Food Quality 3.1.2. Unit Operation in Food Processing 3.1.3. Quality Factors in Preprocessed Food 3.1.4. Food Deterioration and its Control 3.2. **Microbial role in fermented food production(5L)** 3.2.1. Medicinal products (Single Cell Protein) 3.2.2. Food products (curd, yoghurt) 3.2.3. Alcoholic beverages (beer : lager and ale) 3.2.4. Citric acid 3.2.5. Sauerkraut 3.3. **Biocomposites(5L)** 3.3.1. Biocement 3.3.2. Bioplastics 3.3.3. Biolubricants 3.3.4. Bioprinting 3.3.5. Lignin based compounds	15

Self-Learning topics (Unit wise):

Sub- unit	Topic
1.1	Industrial Biotechnology,Copyrights
2.1	BT Brinjal , Plant Based Vaccines
3.1	Unit Operation in Food Processing , Medicinal products (Single Cell Protein, Penicillin), Food products (curd, cheese), Alcoholic Beverages (Wine),

3.3	Basics of Microbial Fermentations (Citric Acid, Ethanol)

Online Resources

https://nptel.ac.in/courses/102/103/102103016
https://nptel.ac.in/courses/102/105/102105058
https://nptel.ac.in/courses/109105112

Course Code: US-FBT-102 Genetics and Molecular biology

Unit	Content	No. of Lectures
1	**Mendelian genetics** **1.1. Introduction to Mendelian genetics (3L)** 1.1.1. Self-fertilization and cross fertilization, 1.1.2. Mendel's experimental design, 1.1.3. Genotype and Phenotype **1.2. Mendel's Laws of Heredity Monohybrid Cross(5L)** 1.2.1. Principle of Dominance and Segregation 1.2.2. Mendel's Laws of Heredity Dihybrid Cross 1.2.3. Principle of Independent Assortment (Punnett Square and Branch diagram for monohybrid and dihybrid cross) **1.3. Deviations from Mendelian Principles(5L)** 1.3.1. Incomplete Dominance 1.3.2. Co-dominance 1.3.3. Multiple Alleles 1.3.4. Epistasis 1.3.5. Environmental effect on the expression of the Human Genes and Epigenetics-Concept only **1.4. Pedigree analysis(2L)** -Autosomal dominant, autosomal recessive, X-linked dominant, X-linked recessive, Y-linked disease	15
2	**Chromosome and Cell division** **2.1. Discovery of Transforming Principle by Griffith, Avery and Chase experiment(1L)** **2.2. Structure of DNA by Watson and Crick (1L)** **2.3. Structure of chromosome (3L)** (Heterochromatin, Euchromatin, Polytene chromosomes) 2.3.1. Prokaryotes 2.3.2. Eukaryotes 2.3.3. Viral **2.4. Variations in Chromosomal Structure and Number(2L)** **2.5. Syndromes: Klinefelter, Turner, Cri-du-Chat, Trisomy -21, Trisomy 18 and Trisomy 13(2L)** **2.6. Mitosis and Meiosis(3L)** **2.7. Structure of chromosome (1L)** **2.8. Replication in Prokaryotes (2L)** 2.8.1. Semi-conservative DNA replication 2.8.2. DNA Polymerase and its role	15

3	**DNA Replication and Recombination** **3.1. Replication in Circular DNA(5L)** 3.1.1. Bidirectional Replication of Circular DNA molecules, 3.1.2. Rolling Circle Replication **3.2. Replication in Eukaryotes(4L)** **3.3. Gene Mapping and Genetic problems based on the following: (5L)** 3.3.1. Conjugation 3.3.2. Transformation 3.3.3. Transduction (Generalized Transduction and Specialized Transduction) **3.4. Holliday Model for Recombination- Transformation(1L)**	15

Self-Learning topics (Unit wise):

Sub- Unit	Topic
1.2	Mendel's Law of heredity
2.8	DNA replication in prokaryotes , Mitosis, human chromosome
3.2,	DNA replication in eukaryotes

Online Resources

https://nptel.ac.in/courses/102104052/
https://nptel.ac.in/courses/104103121/
http://www.digimat.in/nptel/courses/video/121106008/L17.html
http://www.digimat.in/nptel/courses/video/121106008/L18.html
https://nptel.ac.in/courses/102103012

Course Code: US-FBT-103 Ultra structure of cell and reproduction

Unit	Content	No. of Lectures
1	**Origin of Life and Evolution** **1.1 Origin of Life (2L)** 1.1.1. Special Creation theory 1.1.2. Theories of Spontaneous Generation 1.1.3. Hypothesis of Panspermia 1.1.4. Theory of Chemical Evolution and Spontaneous origin of life **1.2 Oparin's Hypothesis (2L)** 1.2.1. Urey and Miller's Experiment 1.2.2. Protenoid Microspheres **1.3 Process of Origin of Life (3L)** 1.3.1. Structure of Cosmos 1.3.2. Primitive Earth 1.3.3. Prebiotic Synthesis 1.3.4. Evolution of Progenote **1.4 Evolution of Eukaryotes (2L)** 1.4.1. Endosymbiotic hypothesis 1.4.2. Invagination of surface membrane hypothesis **1.5 Molecular Evolution (1L)** 1.5.1. Evolution of proteins **1.6 Theories of Organic Evolution (5L)** 1.6.1. Lamarckism, 1.6.2. Darwinism 1.6.3. Modern Synthetic Theory 1.6.4. Germplasm Theory 1.6.5. Mutation Theory	15
2	**Ultra Structure of Cell** **2.1 Introduction to Microbiology (1L)** **2.2 Bacteria - Classification, Types, Morphology(2L)** 2.2.1. Size 2.2.2. Shape 2.2.3. Arrangement **2.3 Ultra structure of Prokaryotic Cell (2L)** 2.3.1. Cell wall 2.3.2. Plasma membrane 2.3.3. Cytoskeleton 2.3.4. Nucleoid	15

	2.3.5. Plasmids 2.3.6. Ribosome 2.3.7. Inclusion bodies **2.4 External Cell components (3L)** 2.4.1. Capsule 2.4.2. Slime 2.4.3. S-layer 2.4.4. Pili 2.4.5. Fimbriae 2.4.6. Flagella **2.5 Ultra-structure of Eukaryotic Cell:** Plasma membrane **(1L)** **2.6 Cytoplasmic Matrix - Single Membrane Organelles (3L)** 2.6.1. Endoplasmic reticulum 2.6.2. Golgi complex 2.6.3. Lysosomes 2.6.4. Peroxisomes 2.6.5. Ribosomes **2.7 Cytoplasmic Matrix-Double Membrane Organelles (1L)** 2.7.1. Nucleus 2.7.2. Mitochondrion 2.7.3. Chloroplast **2.8 External Cell Coverings (1L)** 2.8.1. Cilia 2.8.2. Flagella **2.9 Comparison of Prokaryotic And Eukaryotic Cells(1L)**	
3	**Reproduction** **3.1 Reproduction in Prokaryotes(3L)** 3.1.1. Fission- Binary and Multiple 3.1.2. Endospore formation **3.2 Reproduction in Yeast (4L)** 3.2.1. Budding 3.2.2. Fission **3.3 Reproduction in Vertebrates (8L)** 3.3.1. Spermatogenesis 3.3.2. Oogenesis 3.3.3. Internal Fertilization 3.3.4. Cleavage 3.3.5. Morula Formation 3.3.6. Blastulation 3.3.7. Gastrulation	15

Self-Learning topics (Unit wise):

Sub-unit	Topic
1.1	Lamarckism, Oparin's Hypothesis
2.2,2.3	Plasma membrane,Chloroplast, Mitochondria
3.3	Internal Fertilization, Reproduction in fungi

Online Resources

https://nptel.ac.in/courses/1021032/01
https://nptel.ac.in/courses/102106025/
https://nptel.ac.in/courses/102103015/
https://nptel.ac.in/courses/122103039
https://www.ncbi.nlm.n books/NBK554394/ih.gov/
https://www.ncbi.nlm.nih.gov/books/NBK8099/

Course Code: US-FBT-104 Nutrition, growth and microscopy of microbes

Unit	Content	No. of Lectures
1	**Nutrition and Cultivation of Microorganisms** **1.1. Nutrition and Cultivation of Microorganisms (2L)** 1.1.1. Nutritional Requirements: Carbon, Oxygen, Hydrogen, Nitrogen, 1.1.2. Phosphorus, Sulphur and Growth Factors 1.1.3. Classification of Different Nutritional Types of Organisms **1.1. Design and Types of Culture Media (3L)** 1.2.1. Simple Medium (Nutrient agar and Sabouraud's agar) 1.2.2. Differential Medium (Xylose Lysine Deoxycholate agar) 1.2.3. Selective Medium (MacConkeys agar) 1.2.4. Enriched Media(Super Imposed Blood Agar) 1.2.5. Other media (Harrison et al media, Mueller-Hinton agar) 1.2. **Growth of microorganisms (5L)** 1.3.1. Growth curve 1.3.2. Measurement of growth 1.3.3. Batch culture 1.3.4. Continuous culture: Chemostat and turbidostat 1.3.5. Communication in microbial cells: quorum sensing (concept only) 1.3. **Concept of Isolation and Methods of Isolation (1L)**-Pure Culture Techniques 1.4. **Preservation of Culture (1L)** 1.5.1. Cryogenic Preservation -Principle and Methods, Advantages and Limitations 1.5. **Introduction to biostatics: Measurement of central tendency (3L)**	15
2	**Sterilization Techniques** **2.1 Definition (1L)** 1.2.1. Sterilization 1.2.2. Disinfection **2.2 Types and Applications of sterilization techniques (3L)** **2.3 Physical agents and their mode of action (5L)** 2.3.1. Dry Heat, 2.3.2. Steam under pressure 2.3.3. Gases 2.3.4. Radiation 2.3.5. Filtration **2.4 Chemical Agents and their mode of action (5L)** 2.4.1. Aldehydes 2.4.2. Halogens	15

	2.4.3. Quaternary ammonium compounds 2.4.4. Phenol and phenolic compounds 2.4.5. Heavy metals 2.4.6. Alcohol 2.4.7. Dyes 2.4.8. Detergents **2.5 Disinfectant (1L):** Evaluation of disinfectant (phenol coefficient)	
3	**Microscopy and Stains** **3.1 History of Microscopy(1L)** **3.2 Types of Microscope- Principle, Parts, Functions and Applications (7L)** 3.2.1. Simple and Compound Microscope 3.2.2. Dark Field Microscope 3.2.3. Phase Contrast Microscope 3.2.4. Fluorescence Microscopy 3.2.5. Electron Microscopy 3.2.6. Confocal Microscopy **3.3 Stains and Staining Solutions (8L)** 3.3.1. Definition of Dye and Chromogen 3.3.2. Structure of Dye and Chromophore 3.3.3. Functions of Mordant and Fixative 3.3.4. Natural and Synthetic Dyes 3.3.5. Simple Staining, Differential Staining 3.3.6. Acid Fast Staining with specific examples	15

Self-Learning topics (Unit wise):

Sub-unit	Topic
1.1,1.2	Microbial nutrition, History of microbiology
2.1	Staining techniques, Ideal Disinfectant, physical methods of sterilization
3.1	Disinfection, sterilization, Fluorescent microscopy, Dark field microscopy

Online Resources

https://www.studocu.com/in/document/amity-university/microbiology/microbial-nutrition/4680387
https://nptel.ac.in/courses/102103015
https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-02.pdf
https://www.youtube.com/watch?v=ilvthF0_3GI
https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-04.pdf
https://nptel.ac.in/courses/104104084
https://archive.nptel.ac.in/courses/113/106/113106064/
https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-04.pdf

Course code: US-FBT-105 Basic Chemistry

Unit	Content	No. of Lectures
1	**Nomenclature and Classification** 1.1 **Nomenclature and Classification of Inorganic Compounds: (7L)** 1.1.1. Oxides 1.1.2. Salts 1.1.3. Acids 1.1.4. Bases 1.1.5. Ionic 1.1.6. Molecular and Coordination Compounds 1.2 **Nomenclature and Classification of Organic Compounds: (8L)** 1.2.1. Alkanes, Alkenes, Alkynes, 1.2.2. Cyclic Hydrocarbons 1.2.3. Aromatic Compounds 1.2.4. Alcohols and Ethers 1.2.5. Aldehydes and Ketones 1.2.6. Carboxylic Acids and its derivatives 1.2.7. Amines, Amides 1.2.8. Alkyl Halides 1.2.9. Heterocyclic Compounds	15
2	**Chemical Bonds** **2.1 Ionic Bond (4L)** 2.1.1. Nature of Ionic Bond 2.1.2. Structure of NaCl 2.1.3. KCl and CsCl 2.1.4. Factors influencing the formation of Ionic Bond **2.2 Covalent Bond (4L)** 2.2.1. Nature of Covalent Bond 2.2.2. Structure of CH_4, NH_3, H_2O 2.2.3. Shapes of $BeCl_2$, BF_3 **2.3 Coordinate Bond (1L)** 2.3.1. Nature of Coordinate Bond **2.4 Non Covalent Bonds (3L)** 2.4.1. Van Der Waal‘s forces: dipole - dipole, dipole – induced dipole. **2.5 Hydrogen Bond (3L)** 2.5.1. Theory of Hydrogen Bonding 2.5.2. Types of Hydrogen Bonding (Examples of RCOOH, ROH,	15

	Salicylaldehyde, Amides and Polyamides).	
3	**Stereochemistry** **3.1 Isomerism (3L)-**Types of Isomerism: 3.1.1. Constitutional Isomerism (Chain, Position and Functional) 3.1.2. Stereoisomerism 3.1.3. Chirality **3.2 Geometric Isomerism and Optical Isomerism (4L)** 3.2.1. Enantiomers 3.2.2. Diastereomers 3.2.3. Racemic mixtures Cis-Trans, Threo, Erythro and Meso isomers 3.2.4. Diastereomerism (Cis-Trans Isomerism) in Alkenes and Cycloalkanes (3 and 4 membered ring) **3.3 Conformation (4L)** 3.3.1. Conformations of Ethane. 3.3.2. Difference between Configuration and Conformation 3.3.3. Representation of Configuration by ―Flying Wedge Formula **3.4 Projection formulae (4L)** 3.4.1. Fischer 3.4.2. Newman 3.4.3. Sawhorse 3.4.4. The Interconversion of the Formulae	15

Self-Learning topics (Unit wise):

Sub-Unit	Topic
1.1	Nomenclature of alkanes, Acids and Bases
2.1	Covalent bonding, Ionic bonding
3.1	Isomerism, Geometric Isomerism and Optical Isomerism, Conformation, Projection formulae

Online Resources

https://nptel.ac.in/courses/104/105/104105086/
https://nptel.ac.in/courses/104106119
https://www.nios.ac.in/media/documents/313courseE/L5.pdf

Course code: US-FBT-106 Bioorganic chemistry

Unit	Content	No. of Lectures
1	**Biomolecule: Carbohydrates and Lipids** **1.1 Carbohydrates (8L)** 1.1.1. Definition, muta-rotation, dextro-rotation, levo- rotation 1.1.2. Classification of carbohydrates 1.1.3. Structure of monosaccharides (3C, 4C, 5C, 6C and 7C) 1.1.4. Classification of carbohydrates on the basis of aldehyde and ketone group 1.1.5. Reaction of glucose with Bromine water, HNO3 and formation of glucuronic acid using glucuronic acid cycle. 1.1.6. Chemical reaction involved in osazones formation from glucose, Identification of fructose and sorbitol formation 1.1.7. Structure, occurrence and function of oligosaccharides like lactose, maltose, sucrose (reducing and non-reducing sugars) 1.1.8. Polysaccharides- storage polysaccharides (starch and glycogen) and structural polysaccharides (cellulose and glycogen) 1.1.9. Molisch test and Anthrone test for carbohydrates; Bial's test for pentose sugars **1.2 Lipids (7L)** 1.2.1. What are lipids, lipogenesis, lipolysis 1.2.2. Classification of lipids 1.2.3. Triacylglycerol structure and function 1.2.4. Definition of lipoproteins and their classification 1.2.5. What is cholesterol? 1.2.6. What are the different phospholipids 1.2.7. Derived lipids; classification of fatty acids (saturated and unsaturated) 1.2.8. Extraction of oil from plants and animals by Soxhlet method or simple chemical method 1.2.9. Analysis of lipids: Sudan B test, Emulsification test, Saponification test	15
2	**Biomolecule: Proteins and Amino Acids**	15

	2.1 Proteins and Amino Acids (15L) 2.1.1. Classification of proteins on the basis of solubility, shape, size and function 2.1.2. Classification of amino acids and their short forms 2.1.3. Amino acid reaction with Sanger's reagent, Edman's reagent and Ninhydrin 2.1.4. Action of pepsin, trypsin and chymotrypsin on proteins 2.1.5. Denaturation of proteins 2.1.6. Determination of pKa value of amino acid like glycine 2.1.7. Structure of protein- Primary structure of insulin (in detail), secondary, tertiary and quaternary structures 2.1.8. Definition- isoelectric pH, zwitterion, pKa values	
3	**Biomolecule: Nucleic Acids** **3.1. Nucleic Acids: (4L)** 3.1.1. Structure of Purines and Pyrimidines 3.1.2. Nucleic acid bases in DNA and RNA 3.1.3. Nucleotide- nucleoside; Ribose and Deoxyribose sugars **1.2. DNA structure by Watson and Crick model (Chargaff's rule, Tautomerism, Linking numbers) (5L)** **1.3. Analysis of nucleic acids (4L)** 3.1.1. DPA method 3.1.2. Orcinol method 3.1.3. Spectrophotometric analysis **1.2. RNA structure and types (2L)**	15

Self-Learning topics (Unit wise):

Unit	Topic
1.1	Definition, basic structure and stereoisomeric forms of carbohydrates, Classifications of Monosaccharides ,structure and functions of major monosaccharides, Disaccharides, Oligosaccharides and polysaccharides
2.1	Biomolecule, Amino acids-building blocks of proteins, Classification and Structure of Amino acids ,Definition- isoelectric pH, zwitterion
3.1	Nucleic Acids as genetic material, building blocks of nucleic acids, DNA &RNA structure and functions

Online Resources

https://archive.nptel.ac.in/content/storage2/courses/104103071/pdf/mod11.pdf https://nptel.ac.in/courses/104/105/104105040/ https://nptel.ac.in/courses/104103121

Course code: US-FBT-107 Foundation course: The Indian Constitution and personality development

Unit	Content	No. of Lectures
1	**The Indian Constitution** **1.1 The Indian Constitution (8L)** 1.1.1. Philosophy of the Constitution as set out in the Preamble; 1.1.2. The structure of the Constitution-The Preamble 1.1.3. Main Body and Schedules 1.1.4. Fundamental Duties of the Indian Citizen 1.1.5. tolerance, peace and communal harmony as crucial values in strengthening the social fabric of Indian society 1.1.6. Basic features of the Constitution 1.1.7. Basic laws (Civil, Criminal, trademark) 1.1.8. Infringement 1.1.9. Penalties **1.2 Significant Aspects of Political Processes (7L)** 1.2.1. The party system in Indian politics 1.2.2. Local self- government in urban and rural areas 1.2.3. The 73rd and 74th amendments and their implications for inclusive politics 1.2.4. Role and significance of women in politics	15
2	**Globalization and Human Rights** **2.1 Globalization (7L)** 2.1.1. Understanding the concepts of liberalization, 2.1.2. privatization and globalization; 2.1.3. Growth of information technology and communication and its impact manifested in everyday life; 2.1.4. Impact of globalization on industry: changes in employment and increasing migration; 2.1.5. Changes in agrarian sector due to globalization; 2.1.6. Rise in corporate farming and increase in farmers' suicides. **2.2 Human Rights (8L)** 2.2.1. Concept of Human Rights; 2.2.2. origin and evolution of the concept; 2.2.3. The Universal Declaration of Human Rights; 2.2.4. Human Rights constituents with special reference to Fundamental	15

	2.5.1. Rights stated in the Constitution	
3	**Personality Development** 3.1 **Introduction to Personality Development (5L)** 3.1.1. Positive thinking 3.1.2. Johari's Window 3.1.3. Soft skills 3.1.4. Physical fitness 3.2 **Emotional Intelligence (5L)** 3.2.1. Meaning & Definition 3.2.2. Need for Emotional Intelligence 3.2.3. Intelligence Quotient versus Emotional Intelligence 3.2.4. Components of Emotional Intelligence 3.2.5. Competencies of Emotional Intelligence 3.2.6. Skills to develop Emotional Intelligence **3.3.Managing Stress and Conflicts (5L)** 3.3.1. Types of conflicts and use of coping mechanisms for managing individual stress; 3.3.2. Maslow's theory of self-actualization 3.3.3. Different methods of responding to conflicts in society 3.3.4. Conflict-resolution and efforts towards building peace and harmony in society	15

Self-Learning topics (Unit wise):

Unit	Topic
1.1	The Indian constitution, Political process
2.1	Globalization, Human Rights
3.1	Emotional Intelligence, Personality development

Online Resources

https://nptel.ac.in/courses/129106003
https://onlinecourses.nptel.ac.in/noc22_hs14/preview
https://nptel.ac.in/courses/109105113
https://onlinecourses.swayam2.ac.in/cec20_hs24/preview
https://onlinecourses.nptel.ac.in/noc20_hs13/preview
https://onlinecourses.nptel.ac.in/noc20_hs43/preview

Part -4 Detailed Scheme Practicals

Course Code: US-FBT-1P1

Practical I	**Title of Paper: Biotechnology: Introduction and applications & DNA: Replication, Recombination and Mutations**	**Total Credits: 2**
Papers	**Content**	**No. of Lectures**
	1. Safety in Laboratory 2. DNA extraction by chloroform (DPA Estimation) 3. Study of Mitosis and meiosis 4. Study of normal and abnormal karyotype 5. Fermentative production of citric acid 6. Extraction of Casein from Milk 7. Isolation of organisms causing Food Spoilage 8. Aerobic and Anaerobic Microbial flora from Yoghurt 9. Alcohol fermentation and Estimation of Sugar Content by DNSA Method 10. Extraction of pectin from orange 11. Staining of Starch granules from potato 12. Meat tenderization using papain 13. Assignment- Study of any branch of Biotechnology and its application	90

Course Code: US-FBT-1P2

Practical I	**Title of Paper: Biotechnology: Introduction and applications & DNA: Replication, Recombination and Mutations**	**Total Credits: 2**
Papers	**Content**	**No. of Lectures**
	1. Study of Microscope a) Dark Field b) Fluorescent c) Phase Contrast d) Confocal Microscopy 2. Preparation of culture Media a) Liquid Medium (Nutrient Broth) b) Solid Medium (Nutrient Agar, Sabouraud's agar, MacConkey's agar) c) Preparation of Slants, Butts, Plates 3. Inoculation Techniques & Study of growth a) Liquid Medium (Nutrient Broth) b) Solid Medium (Nutrient Agar, Sabouraud's agar, Mac-Conkey's agar) c) Study of colony characteristics of Bacteria d) Study of Aseptic Transfer Technique 4. Enumeration of Microorganisms by Serial Dilution a) Pour Plate b) Spread Plate 5. Study of Sterilization of Laboratory Glassware, Media a) Autoclave b) Hot air oven c) Fumigation 6. Oligodynamic action of synthetic dyes on growth of microorganisms 7. Study of Photomicrographs of Cell Organelles 8. Staining techniques a) Gram Staining of organisms from Saliva b) Fungal staining c) Lipid staining d) Acid Fast staining e) Capsule staining f) Cell Wall staining g) Endospore Staining 9. Enumeration by Breed's Count 10. Visit to Biotechnology institute/Industry/Report Writing	90

Course Code: US-FBT-1P3

Practical I	**Title of Paper: Biotechnology: Introduction and applications & DNA: Replication, Recombination and Mutations**	**Total Credits: 2**
Papers	**Content**	**No. of Lectures**
	1. Safety Measures and Practices in Chemistry Laboratory, Working and use of a Digital Balance, Functioning and Standardization of pH Meter, Optical Activity of a Chemical Compounds by Polarimeter 2. Preparation of standard (Molar, Molal and Normal solutions) and Buffer Solutions Determination of strength of HCl in commercial sample 3. Qualitative Analysis of Inorganic Compounds - Three experiments 4. Characterization of Organic Compounds containing only C, H, O elements (no element test) - Compounds belonging to the following classes: Carboxylic Acid, Phenol, Aldehyde/Ketone, Ester, Alcohol, Hydrocarbon and Characterization of Organic Compounds containing C, H, O, N, S, Halogen Elements (element tests to be done) Compounds belonging to the following classes: Amine, Amide, Nitro Compounds, Thiamide, Haloalkane, Haloarene 5. To Standardize commercial sample of NaOH using KHP (Potassium hydrogen pthalate) and sample of HCl using borax 6. Spot test for Carbohydrates, Fats and Proteins and Amino Acids and Nucleic Acids 7. Estimation of Protein by Biuret method and Lowry method 8. Standardization of Colorimeter and Estimation of Reducing sugar by DNSA method	90

Part 5- The Scheme of Teaching and Examination is as under:

First Year Semester – II

Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (**Biotechnology**)			US-FBT-201, US-FBT-202, US-FBT-2P1, US-FBT-203, US-FBT-204, US-FBT-2P2	
2	Elective Course	Discipline Specific Elective (DSE) Course			
		2.1	Interdisciplinary Specific Elective (IDSE) Course	US-FBT-205 US-FBT-2P3	
		2.2	Dissertation/Project		
		2.3	Generic Elective (GE) Course	US-FBT-206, US-FBT-2P3	
3	Ability Enhancement Courses (AEC)			US-FBT-207	`
4	Skill Enhancement Courses (SEC)				

First Year Semester -II Internal and External Detailed Evaluation Scheme

Sr. No	Subject Code	Subject Title	Periods Per Week						Internals				Total Marks
			Units	S.L.	L	T	P	Credit	S.L.E.	CT+AT=15+5	PA	SEE	
1	US-FBT-201	Tissue Culture	3	20%*	3	0	0	2	10	20	10	60	100
2	US-FBT-202	Genetic Engineering	3	20%*	3	0	0	2	10	20	10	60	100
3	US-FBT-203	Cell Physiology and Ecology	3	20%*	3	0	0	2	10	20	10	60	100
4	US-FBT-204	Genetics & Immunology	3	20%*	3	0	0	2	10	20	10	60	100
5	US-FBT-205	Analytical Chemistry	3	20%*	3	0	0	2	10	20	10	60	100
6	US-FBT-206	Physical Chemistry	3	20%*	3	0	0	2	10	20	10	60	100
7	US-FBT-207	Foundation course II: Ability enhancement course	3	20%*	3	0	0	2	10	20	10	60	100
8	US-FBT-2P1	Practicals Based US-FBT-201 + Practicals Based US-FBT-202			0		6	2				100 (80+20)	100
9	US-FBT-2P2	Practicals Based US-FBT-203 + Practicals Based US-FBT-204			0		6	2				100 (80+20)	100
10	US-FBT-2P3	Practicals Based US-FBT-205 + Practicals Based US-FBT-206			0		6	2				100 (80+20)	100
	Total Hours / Credit							20	Total Marks				1000

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

First Year Semester – II Units – Topics – Teaching Hours

S.N	Subject Code	Subject Unit Title		Hours/Lectures	Total No. of hours/lectures	Credit	Total Marks
1	US-FBT-201	1	Plant Tissue Culture	15	45 L	2	100 (60+40)
		2	Animal Tissue Culture I	15			
		3	Animal Tissue Culture II	15			
2	US-FBT-202	1	Model organisms and Bioethics in Recombinant DNA Technology	15	45L	2	100 (60+40)
		2	Recombinant DNA technology and its application	15			
		3	Vectors used in genetic manipulation And recombinant DNA library	15			
3	US-FBT-203	1	Plant Physiology	15	45L	2	100 (60+40)
		2	Animal Physiology	15			
		3	Ecosystem and Interactions	15			
4	US-FBT-204	1	DNA Mutations and Repair	15	45L	2	100 (60+40)
		2	Population Genetics	15			
		3	Immunology	15			
5	US-FBT-205	1	Water and buffers	15	45L	2	100 (60+40)
		2	Titrimetry and Gravimetry	15			
		3	Analytical Techniques	15			
6	US-FBT-206	1	Thermodynamics	15	45L	2	100 (60+40)
		2	Chemical Kinetics	15			
		3	Oxidation Reduction Reactions	15			
7	US-FBT-207	1	Professional Skills	15	45L	2	100 (60+40)
		2	Introduction to Communication Skills	15			
		3	Academic Skills & Interview Understanding	15			
8	US-FBT-2P1	1	Practicals based on US-FBT-201	3	45x2= 90 lectures per batch	2	100 (80+10 +10)
		2	Practicals based on US-FBT-202	3			
9	US-FBT-2P2	1	Practicals based on US-FBT-203	3	45x2= 90 lectures per batch	2	100 (80+10 +10)
		2	Practicals based on US-FBT-204	3			
10	US-FBT-2P3	1	Practicals based on US-FBT-205	3	45x2= 90 lectures per batch	2	100 (80+10 +10)
		2	Practicals based on US-FBT-206	3			
			TOTAL			20	1000

- **Lecture Duration – 45 Minutes = 0 .75 Hours. (45 Lectures equivalent to 33.75 hours)**
- **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 -6 - 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-FBT-201 Tissue Culture

Unit	Content	No. of Lectures
1	**Plant Tissue Culture** **1.1. Introduction to Plant tissue culture (PTC) (1L)** 1.1.1. Cell culture Theory 1.1.2. Concept of Cell Culture 1.1.3. Cellular Totipotency **1.2. Design of PTC lab (2L)** **1.3. Culture Medium: Nutritional requirements of the explants (3L)** **1.4. Precautions to maintain Aseptic Conditions (1L)** **1.5. Crop improvement using PTC (8L)** 1.5.1. Callus Culture :Technique and suspension culture 1.5.2. Direct and Indirect Organogenesis 1.5.3. Micropropagation 1.5.4. Artificial seeds 1.5.5. Protoplast isolation culture and fusion 1.5.6. Somatic hybrids 1.5.7. Cybrids 1.5.8. Hairy root culture	15
2	**Animal Tissue Culture I** **2.1. Introduction to Animal Tissue Culture(ATC) (2L)** 2.1.1. Historical background 2.1.2. Advantages and Limitations of ATC 2.1.3. Types of tissue culture: Organ culture, Embryo culture, Explant culture **2.2. Biology of cultured cells (2L)** 2.2.1. Cell Adhesion 2.2.2. Cell Proliferation	15

	2.2.3. Cell differentiation **2.3. Lab layout of ATC lab (2L)** **2.4. Equipment and Instruments used in ATC Lab (2L)** **2.5. Aseptic Techniques in ATC lab (2L)** **2.6. ATC media (5L)** 2.6.1. Nutritional and physiological growth factors and parameters 2.6.2. General metabolism and growth kinetics of animal cells 2.6.3. Defined Media And Supplements	
	Animal Tissue Culture II **3.1. Cell culture techniques (4L)** 3.1.1. Primary, secondary and continuous cell lines, 3.1.2. Primary culture-Establishment **3.2. Maintenance of Cell Lines (4L) -** Primary Cell Cultures of Adherent and Non-Adherent Cell Lines with examples **3.3. Subculture and Propagation of cell lines (3L)** 3.3.1. Choosing a Cell Line, 3.3.2. Routine Maintenance 3.3.3. Subculture **3.4. Application of ATC (1L)** **3.5. Scale up, Cryopreservation, Culture Collections of animal tissues (2L)** **3.6. Ethical issues related to Animal Tissue Culture (1L)** -Passage limit, Permission and documentation	15

Self-Learning topics (Unit wise):

Sub-unit	Topic
1.1	Tissue Engineering, Tissue Culture
2.1	Cell culture, Types of Cell culture, Media
3.4	Applications of Tissue Culture, Scaffolds

Online Resources

https://nptel.ac.in/courses/102/106/102106081/
https://nptel.ac.in/courses/102/103/102103016/
https://nptel.ac.in/courses/102/104/102104059

Course Code: US-FBT-202 Genetic Engineering

Unit	Content	No. of Lectures
1	**Model organisms and Bioethics in Recombinant DNA Technology** **1.1. Model organisms (8L)** 1.1.1. In prokaryotes: *E.coli* 1.1.2. In Eukaryotes: 1.1.2.1. Fungus: *Neurospora crassa* 1.1.2.2. Yeast: *Saccharomyces cerevisiae* 1.1.2.3. Plants: *Arabidopsis thaliana* 1.1.2.4. Invertebrates: *Sea urchin* and *Drosophila melanogaster* 1.1.2.5. Animals: *Mus musculus* (mouse), *Cavia porcellus* (Guinea pig) and *Danio rerio* (zebrafish). **1.2. Livestock bioethics (2L)** **1.3. Regulating rDNA technology (5L)** 1.3.1. Deliberate release of the genetically modified organism 1.3.2. Genetically modified plants 1.3.3. Genetically engineered livestock	15
2	**Recombinant DNA technology and its application** **2.1. Enzymes used in genetic manipulation (5L)** 2.1.1. DNA polymerases 2.1.2. DNA ligases 2.1.3. Reverse transcriptase 2.1.4. Nucleases 2.1.5. Phosphatases 2.1.6. Terminal transferase **2.2. Recombinant DNA technology (3L)** 2.2.1. Introduction 2.2.2. Procedure of gene cloning 2.2.3. Application of recombinant DNA technology **2.3. Principle, working and applications (techniques in molecular biology) (5L)** 2.3.1. Western Blotting 2.3.2. Southern Blotting 2.3.3. Northern Blotting 2.3.4. Autoradiography 2.3.5. DNA fingerprinting **2.4. Overview of PCR (2L)** 2.4.1. Components of PCR 2.4.2. Steps of PCR	15
3	**Vectors used in genetic manipulation And recombinant DNA library** **3.1. Vectors - Features and applications (8L)** 3.1.1. pBR322 3.1.2. Phage vector	15

	3.1.3. Lambda phages 3.1.4. Cosmids 3.1.5. Phagemids 3.1.6. Shuttle vector 3.1.7. Expression vector 3.1.8. Transcribable vector 3.1.9. Artificial chromosomes- YAC, BAC **3.2. Restriction enzymes (3L)** 3.2.1. General properties of restriction enzymes. 3.2.2. Types of restriction enzymes. 3.2.3. Frequency of Occurrence of Restriction Sites in DNA. **3.3. DNA libraries (4L)** 3.3.1. cDNA library 3.3.2. Genomic library	

Self-Learning topics (Unit wise):

Sub-unit	Topic
1.1	Role of genes within cells, genetic code, genetic elements that control gene expression
2.1	rDNA technology, Genetic Engineering
3.1	Model organisms, Zebra fish as model organism, livestock bioethics

Online Resources

https://nptel.ac.in/courses/102/103/102103013/
https://nptel.ac.in/courses/102/103/102103074/
https://onlinecourses.nptel.ac.in/noc20_bt35/preview
https://onlinecourses.swayam2.ac.in/cec21_bt01/preview
https://www.ncbi.nlm.nih.gov/books/NBK500418/

Course Code: US-FBT-203 Cell Physiology and Ecology

Unit	Content	No. of Lectures
1	**Plant Physiology** **1.1 Photosynthesis (1L)** 1.1.1. Ultrastructure of Chloroplast 1.1.2. Fundamental Reactions of Photosynthesis **1.2 Photosynthetic Pigments (1L)** 1.2.1. Hill Reaction and its Significance **1.3 Light Reactions (2L)** 1.3.1. Cyclic and Non-Cyclic Photophosphorylation 1.3.2. Energetics of Photosynthesis **1.4 Dark Reactions (1L)** **1.5 Photorespiration (2L)** **1.6 CO2 fixation (3L)** 1.6.1. C3 cycle 1.6.2. C4 cycle 1.6.3. CAM pathways **1.7 Plant hormones (5L)** 1.7.1. Auxin 1.7.2. Gibbrellins 1.7.3. Cytokinins 1.7.4. Ethylene 1.7.5. Abscisic acid	15
2	**Animal Physiology** **2.1 Physiology of Digestion (3L)** 2.1.1. Movement of Food and Absorption 2.1.2. Secretary functions of Alimentary Canal 2.1.3. Digestion and Absorption 2.1.4. Assimilation in Gut of Human **2.2 Anatomy and physiology of Human Kidney (4L)** 2.2.1. Structure of Nephron 2.2.2. Physiology of Urine Formation 2.2.3. Role of Kidney in Excretion and Osmoregulation **2.3 Respiration (4L)** 2.3.1. Physiology of Respiration 2.3.2. Mechanism of Respiration 2.3.3. Principles of Gaseous Exchange in the Blood and Body Fluids **2.4 Blood and Circulation (4L)** 2.4.1. Blood Composition 2.4.2. Structure and Function of its Constituents 2.4.3. Blood Coagulation and Anticoagulants	15

	2.4.4. Hemoglobin and its Polymorphism 2.4.5. Regulation of the Circulation Mechanism 2.4.6. Working of Human Heart	
3	**Ecosystem and Interactions** **3.1 Ecosystem (5L)** 3.1.1. Ecosystems, Definition and Components 3.1.2. Structure and Function of Ecosystems 3.1.3. Aquatic and Terrestrial Ecosystems 3.1.4. Biotic and Abiotic Factors 3.1.5. Trophic Levels 3.1.6. Food Chain and Food Web **3.2 Ecological Pyramids (2L)** 3.2.1. Pyramid of Energy 3.2.2. Pyramid of Biomass 3.2.3. Pyramid of Number **3.3 Biogeochemical Cycles (5L)** 3.3.1. Water Cycle 3.3.2. Carbon Cycle 3.3.3. Oxygen Cycle 3.3.4. Nitrogen Cycle 3.3.5. Sulphur Cycle 3.3.6. Phosphorus Cycle **3.4 Population Interactions (1L)** **3.5 Remote sensing (1L)** **3.6 Advances in techniques used for animal or plant protection (1L)**	15

Self-Learning topics (Unit wise):

Sub-unit	Topic
1.1	Plant Cell Anatomy, Photosynthesis, Respiration
2.1	Cardiovascular system, Respiration and blood
3.1	Ecology, Components of Environment, Types of Environment, Biomass, Energy of the Ecosystem

Online Resources

https://nptel.ac.in/courses/102106080/
https://nptel.ac.in/courses/102104058
https://nptel.ac.in/courses/127106004

Course Code: US-FBT-204 Genetics & Immunology

Unit	Content	No. of Lectures
1	**DNA Mutations and Repair** **1.1. Mutation (4L)-**Definition and Types of Mutations **1.2. Mutagens and its types (3L)-**Physical, Chemical and Biological Mutagens **1.3. Luria Delbruck experiment (1L)** **1.4. AMES test (1L)** **1.5. Transposable elements (1L)** **1.6. DNA Repair (5L)** 1.6.1. Photoreversal, 1.6.2. Base Excision Repair, 1.6.3. Nucleotide Excision Repair, 1.6.4. Mismatch Repair, 1.6.5. SOS Repair 1.6.6. Recombination Repair	15
2	**Population Genetics** **2.1. Definitions (2L)** 2.1.1. Genotypic Frequencies 2.1.2. Allelic Frequencies 1.2. **Hardy- Weinberg Law (5L)** 2.1.1. Assumptions 2.1.2. Law 2.1.3. Problems **1.3. Genetic Variations in Populations (5L)** 2.3.1. Measuring Genetic Variation at Protein Level 2.3.2. Measuring Genetic Variations at DNA level 2.3.3. Natural Selection 2.3.4. Genetic Drift 2.3.5. Speciation **1.4. Role of Population Genetics in Conservation Biology (3L)**	15
3	**Immunology** **3.1. Definitions and terminologies: (7L)** 3.1.1. Cell and Organs involved 3.1.2. T and B cells 3.1.3. Innate Immunity 3.1.4. Acquired Immunity 3.1.5. Local and Herd Immunity 3.1.6. Humoral and Cellular Immunity **3.2. Antigens and Antibodies (8L)** 3.2.1. Types of Antigens 3.2.2. General Properties of Antigens 3.2.3. Haptens and Superantigen 3.2.4. Discovery and Structure of Antibodies (Framework region) 3.2.5. Classes of Immunoglobulins	15

	3.2.6. Antigenic Determinants. 3.2.7. Antigen-Antibody Interactions 3.2.8. Monoclonal Antibodies	

Self-Learning topics (Unit wise):

Sub-unit	Topic
1.2	Introduction to Mutations, Chemical Mutagens, Physical Mutagens
2.3	Genetic code, Genetic drift
3.2	Immunology, Cell Types, Antigens & Antibody structures

Online Resources

https://onlinecourses.nptel.ac.in/noc22_bt07/preview
https://archive.nptel.ac.in/content/storage2/courses/104103068/module1/lec1/1.html
https://nptel.ac.in/courses/102103038

Course Code: US-FBT-205 Analytical Chemistry

Unit	Content	No. of Lectures
1	**Water and buffers** **1.1 Chemistry of Water (3L)** 1.1.1. Properties of Water 1.1.2. Interaction of Water with Solutes (Polar, Non-Polar, Charged) 1.1.3. Non-Polar Compounds in Water – Change in its Structure and the Hydrophobic Effect 1.1.4. Role of Water in Biomolecule, Structure and Function and Water as a Medium for Life **1.2 Solutions (3L)** 1.2.1. Normality 1.2.2. Molarity 1.2.3. Molality 1.2.4. Mole fraction 1.2.5. Mole concept 1.2.6. Solubility 1.2.7. Weight ratio 1.2.8. Volume ratio 1.2.9. Weight to Volume ratio 1.2.10. ppb and ppm 1.2.11. Millimoles 1.2.12. Milliequivalents (Numericals expected) **1.3 Primary and Secondary Standards (3L)** 1.3.1. Preparation of Standard Solutions 1.3.2. Principle of Volumetric Analysis **1.4. Acids and Bases (3L)** 1.4.1. Lowry-Bronsted and Lewis Concepts 1.4.2. Strong and Weak Acids and Bases 1.4.3. Ionic Product of Water - *pH, pKa, pKb* 1.4.4. Hydrolysis of Salts **1.5. Buffer solutions (3L)** 1.5.1. Concept of Buffers 1.5.2. Types of Buffers 1.5.3. Derivation of Henderson equation for Acidic and Basic buffers	15

	1.5.4. Buffer action 1.5.5. Buffer capacity (Numericals expected) 1.5.6. pH of Buffer Solution	
2	**Titrimetry and Gravimetry** **2.1 Titrimetric Analysis (4L)** 2.1.1. Titration 2.1.2. Titrant 2.1.3. Titrand 2.1.4. End Point 2.1.5. Equivalence Point 2.1.6. Titration Error 2.1.7. Indicator 2.1.8. Primary and Secondary Standards 2.1.9. Characteristics and examples **2.2 Types of Titration (4L)** 2.2.1. Acid –Base 2.2.2. Redox 2.2.3. Precipitation 2.2.4. Complexometric Titration 2.2.5. Theory of Acid –Base Indicators 2.2.6. Choice and Suitability of Indicators **2.3 Gravimetric Analysis (4L)** 2.3.1. Solubility and Precipitation 2.3.2. Factors affecting Solubility 2.3.3. Washing 2.3.4. Drying and Ignition of Precipitate **2.4 Types of centrifuges (preparative and analytical) (3L)** 2.4.1. RCF 2.4.2. RPM 2.4.3. Define sedimentation velocity 2.4.4. Sedimentation co-efficient 2.4.5. Separation of liver cell organelles by differential centrifugation 2.4.6. Applications of analytical centrifuges (molecular weight determination)	15
3	**Analytical Techniques** **3.1. Methods of Separation (5L)** 3.1.1. Precipitation, 3.1.2. Filtration, 3.1.3. Distillation, 3.1.4. Solvent Extraction	15

	3.2. Analytical Techniques Chromatography (5L) 3.2.1. Definition, 3.2.2. Principles, 3.2.3. Types of chromatography: 3.2.3.1. Paper Chromatography, 3.2.3.2. Thin Layer Chromatography 3.2.3.3. Column Chromatography And Its Applications **3.3. Colorimetry (5L)** 3.3.1. Principle:Beer-Lambert‘s Law 3.3.2. Measurement of Extinction 3.3.3. Derivation of E = kcl, 3.3.4. Limitations of Beer-Lambert ‘s Law 3.3.5. Filter Selection	

Self-Learning topics (Unit wise):

Sub-unit	Topic
1.2	Normality, Molality, Acid Base Equilibrium, pH
2.4	Methods of chemical analysis, Centrifugation
3.1,3.3	Spectrochemical methods,Filtration

Online Resources

https://nptel.ac.in/courses/103105060
https://nptel.ac.in/courses/104106121/
https://nptel.ac.in/courses/104/105/104105084/
https://nptel.ac.in/courses/104/106/104106121/

Course Code: US-FBT-206 Physical Chemistry

Unit	Content	No. of Lectures
1	**Thermodynamics** **1.1. Thermodynamics (4L)** 1.1.1. System 1.1.2. Surrounding 1.1.3. Boundaries Sign Conventions 1.1.4. State Functions 1.1.5. Internal Energy and Enthalpy: Significance, examples, (Numericals expected) **1.2. Laws of Thermodynamics (4L)** 1.2.1. Laws of Thermodynamics and its Limitations 1.2.2. Mathematical expression. 1.2.3. Qualitative discussion of Carnot Cycle for ideal Gas 1.2.4. Mechanical Efficiency **1.3. Laws of Thermodynamics as applied to Biochemical Systems (4L)** **1.4. Concept of Entropy, Entropy for Isobaric, Isochoric and Isothermal Processes (3L)**	15
2	**Chemical Kinetics** **2.1. Reaction Kinetics (8L)** 2.1.1. Rate of Reaction 2.1.2. Rate Constant 2.1.3. Measurement of Reaction Rates, Order & Molecularity of Reaction, 2.1.4. Integrated Rate Equation of First and Second order reactions (with equal initial concentration of reactants) (Sums expected) **2.2. Determination of Order of Reaction by (7L)** 2.2.1. Integration Method 2.2.2. Graphical Method, 2.2.3. Ostwald‘s Isolation Method 2.2.4. Half Time Method (Sums expected)	15
3	**Oxidation Reduction Reactions** **1.1. Principles of Oxidation & Reduction Reactions (15L)** 1.1.1. Oxidising and Reducing Agents, 1.1.2. Oxidation Number, 1.1.3. Rules to assign Oxidation Numbers - examples ions :Oxalate, Permanganate and Dichromate 1.1.4. Balancing Redox Reactions by 1.1.5. Ion Electron Method 1.1.6. Oxidation	15

	1.1.7. Reduction 1.1.8. Addition 1.1.9. Substitution 1.1.10. Elimination Reaction	

Self-Learning topics (Unit wise):

Sub-unit	Topic
1.2	Thermodynamics, Fundamentals, Laws of thermodynamics
2.1	Elementary - rate law equations, chemical kinetics
3.1	Oxidation reactions, Reduction reactions

Online Resources

https://nptel.ac.in/courses/104/101/104101084/
https://nptel.ac.in/courses/104101128
https://nptel.ac.in/courses/103103153
https://archive.nptel.ac.in/courses/104/101/104101127/
https://archive.nptel.ac.in/courses/104/101/104101128/

Course Code: US-FBT-207 Foundation course II: Ability enhancement course

Unit	Content	No. of Lectures
1	**Professional Skills** **1.1 Creativity at workplace (4L)** 1.1.1. Current workplaces 1.1.2. Creativity & Motivation 1.1.3. Nurturing Hobbies at work 1.1.4. The six thinking Hat method **1.2 Ethical values (4L)** 1.2.1. Theories of Ethics 1.2.2. Correlation between values & behaviour 1.2.3. Nurturing Ethics 1.2.4. Importance of Work Ethics **1.3 Capacity Building (4L)** 1.3.1. Elements of Capacity Building 1.3.2. Zones of Learning ideas **1.4 Leadership & Teambuilding (1L)** **1.5 Decision making & Negotiation (1L)** **1.6 Time management (1L)**	15
2	**Introduction to Communication Skills** **2.1 The Sevens Cs of Effective Communication (5L)** 2.1.1. Completeness 2.1.2. Conciseness 2.1.3. Consideration 2.1.4. Concreteness 2.1.5. Clarity 2.1.6. Courtesy 2.1.7. Correctness **2.2. Components of Communication System (2L)** **2.3. Types of Communication System (2L)** **2.4. Writing Business Messages & Communication(3L)** 2.4.1. Report writing 2.4.2. Proposal writing 2.4.3. Career Building & Resume Writing **2.5 Developing Oral Communication skills (3L)** 2.5.1. Effective Listening 2.5.2. Public Speaking	15

3	**Academic & Interview Skills** **3.1. Essentials of Grammar (3L)** 3.1.1. Parts of Speech 3.1.2. Articles 3.1.3. Modals 3.1.4. Sentences & their types 3.1.5. Punctuation marks **3.2. Employment Communication (3L)** 3.2.1. Job Application or cover letter 3.2.2. E-mail writing 3.2.3. Difference in Resume and Curriculum Vitae **3.3. Interviews (3L)** 3.3.1. Definition of Interview 3.3.2. Types of Interview 3.3.3. Interview skills **3.4. Group Discussion(3L)** 3.4.1. Importance of Group Discussion 3.4.2. Difference between Group discussion /Panel Discussion/Debate 3.4.3. Types of Group Discussion 3.4.4. Topics based & cases based on group discussion **3.5. S.W.O.T Analysis (2L)** **3.6. Importance of vocational training (1L)**	15

Self-Learning topics (Unit wise):

Sub-unit	Topic
1.1	Time management
2.1	Verbal and non verbal communication
3.2	Resume writing

Online Resources:

http://www.nitttrc.edu.in/nptel/courses/video/109104115/lec7.pdf
https://onlinecourses.nptel.ac.in/noc20_hs43/preview
https://archive.nptel.ac.in/courses/109/105/109105144/

Part – 7- Detailed Scheme Practicals

Course Code: US-FBT-2P1

Practical I	Title of Paper: Tissue Culture techniques & Genetic Engineering	Total Credits: 2
Unit	**Content**	**No. of Lectures**
	1. Agarose Gel Electrophoresis 2. Working of PCR 3. Design of a plant tissue culture laboratory 4. Equipment in tissue culture; principle, working and applications a) CO2 incubator b) Inverted microscope c) Filter assembly and membrane filters d) Cold freezer e) Centrifuge 5. Explant sterilization and inoculation for callus culture 6. Preparation of synthetic seeds by alginate method 7. Media preparation and sterilization for animal tissue culture 8. Trypsinization of animal tissue and viability count assay 9. Enumeration of UV mutants 10. Review of 5 papers on genetic engineering 11. Visit to ATC laboratory	90

Course Code: US-FBT-2P2

Practical II	**Title of Paper: Cell: Physiology (Plants and animals) and Ecology & Genetics and Immunology**	**Total Credits: 2**
Unit	**Content**	**No. of Lectures**
	1. Problems on Population Genetics 2. Problems on Genetics-Map distance and gene order 3. Differential staining of blood 4. Study of Symbiotic and Synergistic activity 5. Enrichment, Isolation and Detection of Nitrosifiers and Nitrifiers 6. Enumeration of bacteria from soil 7. Colorimetric study of Absorption Spectrum of Photosynthetic Pigments from spinach and beetroot 8. Isolation of Chloroplast from spinach and demonstration of Hill's reaction 9. To perform immunoelectrophoresis of human serum proteins 10. Study of Antigen Antibody Interactions by Ouchterlony Method 11. Determination of human blood group by ABO and Rh antigen 12. Analysis of Urine a) Study of Normal and abnormal constituents b) Estimation of urea c) Estimation of uric acid d) Estimation of creatinine	90

Course Code: US-FBT-2P3

Practical III	**Title of Paper: Analytical chemistry & Physical Chemistry**	**Total Credits: 2**
Unit	**Content**	**No. of Lectures**
	1. Dissociation Constant of Weak Acids by Incomplete Titration Method using *pH* Meter and determination of Acetic acid in Vinegar by Titrimetric Method 2. Determination of the amount of Fe (II) present in the given solution Titrimetrically 3. Determination of amount of $NaHCO_3$ + $Na2CO_3$ in the given solid mixture Titrimetrically 4. Determination of the amount of Mg (II) present in the given solution complexometrically 5. Determination of percent composition of $BaSO_4$ and NH_4Cl in the given mixture Gravimetrically 6. Separation of Cu, Ni and Fe using Paper Chromatography and amino acids - paper chromatography 7. Determination of fluoride ion using Colorimetry and Fe (III) by using Salicylic Acid by Colorimetric Titration 8. Saponification of Fats, Saponification Value of Oil or Fat, Iodine value of Oil and determine the rate constant for the saponification reaction between ethyl acetate and NaOH by back titration method 9. To determine enthalpy of dissolution of salt like KNO_3 10. Determine the rate constant for hydrolysis of ester using HCl as a catalyst 11. Study the kinetics of reaction between Thiosulphate ion and HCl 12. Study reaction between potassium Persulphate and Potassium Iodide kinetically and hence to determine order of reaction 13. Study the reaction between $NaHSO_3$ and $KMnO_4$ and balancing the reaction in acidic, alkaline and neutral medium 14. Study transfer of electrons (Titration of sodium thiosulphate with potassium dichromate) 15. Determination of the volume strength of hydrogen peroxide solution by titration with standardized potassium permanganate solution 16. Determination of amount of K oxalate and oxalic acid in the given solution titrimetrically	90

Reference Books – Semester I

US-FBT-101 Paper I

1. Advanced Biotechnology- R.C. Dubey, S. Chand Publishing
2. Biotechnology-B.Sc. Edition B.D. Singh, Kalyani Publishers
3. Food Microbiology-William Frazier, 4th Edition, McGraw-Hill
4. Industrial Microbiology- A.H. Patel,2nd Edition
5. Microbiology- Pelczar, Reid, Chan 5th Edition, McGraw-Hill

US-FBT-102 Paper II

1. Genetics by Peter Russell, 5th edition, Pearson Education
2. iGenetics - A Mendelian Approach, Peter Russell
3. Genetics- B.D. Singh, Reprint edition 2010 Kalyani Publishers

US-FBT-103 Paper III

1. Microbiology- Pelczar, Reid, Chan 5th Edition, McGraw-Hill
2. Advanced Biotechnology- R.C. Dubey, S. Chand Publishing
3. Cell and Molecular Biology Gerald Karp6th edition,
4. The Cell, Cooper & Hausman4th edition
5. Microbiology by Prescott, Harley & Klein , 10th Edition
6. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology Biology by Verma&Agarwal 2005
7. Fundamentals of Microbiology by Frobisher 9th edition
8. Developmental Biology; Scott Gilbert; 9th Edition.

US-FBT-104 Paper IV

1. Fundamental Principles of Bacteriology by A.J. Salle 7thedition
2. Fundamentals of Microbiology by Frobisher 9th edition
3. Microbiology- Pelczar, Chan &Krieg 5th edition
4. Microbiology by Prescott, Harley & Klein 6th edition

US-FBT-105 Paper V

1. Organic Chemistry by Stanley Pine , 5th Edition
2. Organic Chemistry by Bahl&Bahl, 22nd Edition, S. Chand Publishers
3. Concise Inorganic Chemistry by J.D. Lee Ch. 3, 4 & 8,Wiley, 5th Edition

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1. Outlines of Biochemistry Conn and Stumpf, Wiley,5th Edition
2. Biochemistry Satyanarayan and Chakrapani, Elsevier3rd Edition
3. An Introduction to practical Biochemistry, David Plummer, 3rd edition McGraw Hill
4. Fundamentals of Biochemistry, S. Chand Publishers Jain, Jain and Jain 6thEdition;
5. Lehninger Principles of Biochemistry, Nelson & Cox Lehninger, 4th Edition
6. Textbook of Biochemistry, West, Todd, Mason and Bruggen, 4th Edition
7. Microbiology by Prescott, Harley & Klein 6th Edition
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1. Foundation Course-I , P.G. Shinde, Sheth Publications
2. Mitra, B. K. (2011). Personality development and soft skills (Vol. 156). Oxford University Press.

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1. Introduction to Plant Tissue Culture M.K. Razdan2nd Edition,Science publishers
2. Plant Tissue Culture Kalyan Kumar De, New Central Book Agency
3. Sant Saran Bhojwani, Prem Kumar Dantu (auth.) - Plant Tissue Culture_ An Introductory Text-Springer India (2013)
4. Principles and Practice of Animal Tissue Culture, SudhaGangal, Universities Press
5. Culture of animal Cells, R Ian Freshney, 5th Edition, Wiley

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1. Genetics – Peter Russell 5th edition
2. Genetic engineering – Sandhya Mitra,2nd Edition, McGraw Hill
3. A Textbook of Biotechnology – R.C. Dubey, S. Chand Publishing
4. Molecular Biology by Robert Weaver,5th Edition, McGraw Hill
5. Principles of gene manipulation and genomics by Primrose and Twyman, 7th Edition Blackwell Publishing
6. Molecular Biotechnology-Principles and application of recombinant DNA by Glick, Pasternak, 3rd Edition
7. Genetics: A conceptual approach by Pierce, Benjamin A. , 5th Edition , WH Freeman And Company
8. iGenetics, 3rd Edition Pearson Education
9. Principles and Techniques of Biochemistry and Molecular Biology by Wilson & Walker, 7th Edition, Cambridge University Press
10. Molecular Diagnostics: Fundamentals, methods and Clinical applications by Lela Buckingham & Maribeth Flaws, F.A. Davis, Wiley
11. Developmental Biology; Scott Gilbert; 9th Edition.
12. Glick, B. R., & Pasternak, J. J. (1998). Molecular biotechnology: Principles and applications of recombinant DNA. Washington, D.C: ASM Press.

US-FBT-203- Paper III

1. Textbook of Plant Physiology by V. Verma, Ane's Student edition
2. Medical Physiology by Guyton, Applegate Anatomy and Physiology learning system, 4th Edition, Elsevier
3. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology Biology by Verma& Agarwal, 2005, S. Chand Publishers

US-FBT-204- Paper IV

1. iGenetics – A Mendelian Approach Peter Russell, Pearson Education
2. Microbiology- Pelczar, Reid, Chan 5th Edition, McGraw-Hill
3. Medical Microbiology by Ananthnarayan, 7th edition, Orient Blackswan
4. Immunology by Janeway, 5th Edition, Garland Science
5. Immunology by C.V. Rao, Alpha Science
6. Immunology by Kuby, 6th Edition, W.H. Freeman

US-FBT-205- Paper V

1. Biochemistry Satyanarayan and Chakrapani, Elsevier3rd Edition
2. Textbook of Physical Chemistry (F.Y.B.Sc.)
3. XI STD Mah. State Board Textbook
4. Chemistry NCERT Pub (CBSE) XI Part-I
5. Fundamentals of Analytical Chemistry, Skoog, West, Holler and Crouch, 8th Edition, Thomson-Brooks/Cole
6. Vogel's Textbook of Quantitative Analysis by J. Mendham, R.c. Denney, J. D. Barnes, M. J. K. Thomas ,6thEdition, Prentice hall
7. Fundamentals of Analytical Chemistry, Skoog, West, Holler and Crouch, 8th Edition, Thomson-Brooks/Cole
8. Instrumental methods of Chemical analysis – Gurdeep Chatwal and Sham Anand, 13th reprint 1998,Himalaya Publishing House

US-FBT-206- Paper VI

1. Textbook of Physical Chemistry, F.Y.B.Sc
2. XII Std Mah. State Board Textbook
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US-FBT-207- Paper VII

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   Chauhan, G. S., Sharma, S. (2016). Soft Skills: An Intergrated Approach to Maximise Personality. India: Wiley.
   Mitra, B. K. (2011). Personality development and soft skills (Vol. 156). Oxford University Press.
2. Guffey, M. E., & Loewy, D. (2012). Essentials of business communication. Cengage Learning.
3. Rao, M. S. (2010). Soft skills-enhancing employability: connecting campus with corporate. IK International Pvt Ltd.
4. Sherfield, R. M. (2009). Cornerstone: Developing Soft Skills. Pearson Education India.