NOIDA INTERNATIONAL UNIVERSITY

DEPARTMENT OF BIOTECHNOLOGY & MICROBIOLOGY

SYLLABUS OF COURSES TO BE OFFERED

Core Courses, Elective Courses & Ability Enhancement Courses

UNDERGRADUATE PROGRAMME (BIOTECHNOLOGY)

Choice Based Credit System (CBCS)

Preamble

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching–learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students. Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades.

The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So, it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point

Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

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.
   - **2.1 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 offer discipline related Elective courses of interdisciplinary nature (to be offered by 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.
   - **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. **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course:** The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They ((i) Environmental Science, (ii) English/MIL Communication) are mandatory for all disciplines. AEEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.
   - **3.1** AE Compulsory Course (AECC): Environmental Science, English Communication/MIL Communication.
   - **3.2** AE Elective Course (AEEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real-life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Details of courses

	Theory+ Practical	Theory + Tutorial
I. Core Course		
(14 Papers)	14X4= 56	14X5=70
Core Course Practical / Tutorial*		
(14 Papers)	14X2=28	14X1=14
II. Elective Course		
(8 Papers)		
A.1. Discipline Specific Elective	4X4=16	4X5=20
(4 Papers)		
A.2. Discipline Specific Elective Practical/ Tutorial*	4 X 2=8	4X1=4
(4 Papers)		
B.1. Generic Elective/ Interdisciplinary	4X4=16	4X5=20
(4 Papers)		
B.2. Generic Elective Practical/ Tutorial*	4 X 2=8	4X1=4
(4 Papers)		

- **Optional Dissertation or project work in place of one Discipline Specific** Elective paper **(6 credits) in 6th Semester**

III. Ability Enhancement Courses

1. **Ability Enhancement Compulsory**

(2 Papers of 2 credit each)	2 X 2=4	2 X 2=4
Environmental Science		
English/MIL Communication		

2. **Ability Enhancement Elective** (Skill Based)

(Minimum 2)	2 X 2=4	2 X 2=4
(2 Papers of 2 credit each)		
Total credit	**140**	**140**

* Wherever there is a practical there will be no tutorial and vice-versa

B.Sc. (Hons) Biotechnology

Core Papers (C): (Credit: 06 each) (1 period/week for tutorials or 4 periods/week for practical)

1. STUGBT/C01: Bio instrumentation (4 + 4)
2. STUGBT/C02: Elementary Cell Biology (4 + 4)
3. STUGBT/C03: Fundamentals of Biochemistry (4 + 4)
4. STUGBT/C04: Basics of Immunology (4 + 4)
5. STUGBT/C05: Microbial Genetics (4 + 4)
6. STUGBT/C06: Cell & Tissue Culture Technology (4 + 4)
7. STUGBT/C07: Environmental Biotechnology (4 + 4)
8. STUGBT/C08: Microbiology (4 + 4)
9. STUGBT/C09: Food technology & Bioprocess technology (4 + 4)
10. STUGBT/C10: Recombinant DNA Technology (4 + 4)
11. STUGBT/C11: Principle of Genomics and Proteomics (4 + 4)
12. STUGBT/C12: Elementary Molecular Biology (4 + 4)
13. STUGBT/C13: Nanotechnology (4 + 4)
14. STUGBT/C14: Entrepreneurship (4 + 4)

Discipline Specific Elective Papers: (Credit: 06 each) - DSE 1-4
(4 papers to be selected: 02 each for Odd semester and Even semester as listed below)

1. STUGBT/DSE01: Plant Biotechnology (4) + Lab (4)
2. STUGBT/DSE02: Animal Biotechnology (4) + Lab (4)
3. STUGBT/DSE03: Microbial Biotechnology (4) + Lab (4)
4. STUGBT/DSE04: Industrial Microbiology (5) + Tutorial (1)
5. STUGBT/DSE05: Parasitology (4) + Lab (4)
6. STUGBT/DSE06: Clinical Research (4) + Lab (4)
7. STUGBT/DSE07: Host Pathogen interaction (4) + Lab (4)
8. STUGBT/DSE08: Biological physics (4) + Lab (4)
9. STUGBT/DSE09: Bio-pesticide & Bio-fertilizer (5) + Tutorial (1)
10. STUGBT/DSE12: Dissertation

Skill Enhancement Courses (02 to 04 papers) (Credit: 02 each)- SEC1 to SEC4

1. STUGBT/SEC01: Molecular Diagnostics
2. STUGBT/SEC02: Enzymology
3. STUGBT/SEC03: Industrial Fermentations
4. STUGBT/SEC04: Basic Instrumentation Skills
5. STUGBT/SEC05: Fermentation technology
6. STUGBT/SEC06: Drug Designing
7. STUGBT/SEC07: Basics of Forensic Science
8. STUGBT/SEC08: Food technology
9. STUGBT/SEC09: Bioprocess technology
10.

Generic Elective Papers (GE): (Credit: 06 each)

1. STUGBT/GE01: Fund. of Computer Applications (4) + Lab (4)
2. STUGBT/GE02: Operating system (4) + Lab (4)
3. STUGBT/GE03: Chemistry-1 (4) + Lab (4)
4. STUGBT/GE04: Bioinformatics (4) + Lab (4)
5. STUGBT/GE05: Recombinant DNA Technology (4) + Lab (4)
6. STUGBT/GE06: Bioethics, Biosafety and IPR (4) + Lab (4)
7. STUGBT/GE07: Plant Pathology (4) + Lab (4)

Assessment method:

Assessment method	Theory				Practical	
	Internal assessment	Mid-term examination	End-term examination	Maximum Mark	Practical examination	Maximum Mark
Mark	20	20	60	100	50 Mark	50 Mark
%	20%	20%	60%	100%	100%	100%

PEOs, POs & PSOs of B.Sc. Biotechnology Programme

Programme Educational Objectives (PEOs):

PEO1: To develop in our student competencies to pursue higher education and research in reputed institutes and industry at local and global level.

PEO2: To update, strengthen and deepen students 'knowledge using a flexible, research-intensive program in concord to academia and industry requirements.

PEO3: To develop a working knowledge of biotechnology product and processes

PEO4: To enable critical thinking and full-fledged grasp of essential aspects of bioethics inculcating a value system among students.

Programme Outcomes / Programme Specific Outcomes are attributes i.e. what students are expected to know or will be able to do when they graduate from a programme.

Programme Outcomes (POs): The POs of BSc Biotechnology are as follows:

PO1: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO2: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO3: Understand the impact of the professional biotechnological solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO4: Apply ethical principles and commit to professional ethics and responsibilities and norms of the science practice.

PO5: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change

Programme Specific Outcomes (PSOs):

PSO1: Students will be equipped to understand three fundamental aspects in biological phenomenon: a) what to seek; b) how to seek c) why to seek?

PSO2: Undergraduate students will be able to demonstrate and apply the principles of bioprocess engineering in the design, analysis, optimization and simulation of bioprocess operations.

PSO3: Empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology

PSO4: Detailed experience would enable them to begin a career in industry that engages in genetic engineering as well as in research laboratories conducting fundamental research

PSO5: Recognize the importance of Bioethics, IPR, entrepreneurship, Communication and management skills so as to usher next generation of Indian industrialists

PSO6: To impart in-depth practical oriented knowledge to students in various thrust areas of biotechnology, so as to meet the demands of industry and academia.

NOIDA INTERNATIONAL UNIVERSITY
SCHOOL OF SCIENCES
Study & Evaluation Scheme for B.Sc. (Biotechnology)

B.Sc. Biotechnology 1st Year
SEMESTER-I

S. No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit	CBCS
									External Exam			
			L	T	P	CA	TA	Total				
1	STUGBT1/ C01	Bio instrumentation	4	0	0	20	20	40	60	100	4	C1
2	STUGBT1/ C02	Elementary Cell Biology	4	0	0	20	20	40	60	100	4	C2
3	STUGBT1/ GE1	Fundamentals of Computer Applications	4	0	0	20	20	40	60	100	4	GE1
4	STUGBT1/ AECC1	Environmental Sciences	2	0	0	20	20	40	60	100	2	AECC 1
Practical												
1	SPUGBT1/ C01	Bio instrumentation Practical	0	0	2			25	25	50	2	C1
2	SPUGBT1/ C02	Elementary Cell Biology Practical	0	0	2			25	25	50	2	C2
3	SPUGBT1/ GE1	Fundamentals of Computer Applications Practical	0	0	2			25	25	50	2	GE1
Total										**550**	**20**	
Note: List of Practical will be supplied at the Start of every Semester												

C: Core Courses;
GE: Generic Elective;
AECC: Ability Enhancement Compulsory Course;
SEEC: Skill Enhancement Elective Courses;
DSE: Discipline Specific Elective

B.Sc. Biotechnology 1st Year
SEMESTER-II

S. No	Course Code	Subject	Period			Evaluation Scheme			External Exam	Subject Total	Credit	CBCS
			L	T	P	CA	TA	Total				
1	STUGBT2/ C03	Fundamentals of Biochemistry	4	0	0	20	20	40	60	100	4	C3
2	STUGBT2/ C04	Basics of Immunology	4	0	0	20	20	40	60	100	4	C4
5	STUGBT2/ GE02	Bioinformatics	4	0	0	20	20	40	60	100	4	GE2
6	STUGBT2/ AECC2	Technical Communication	2	0	0	20	20	40	60	100	2	AECC 2
Practical												
1	SPUGBT2/ C03	Fundamentals of Biochemistry Practical	0	0	2			25	25	50	2	C3
2	SPUGBT2/ C04	Basics of Immunology Practical	0	0	2			25	25	50	2	C4
3	SPUGCS2/ GE02	Bioinformatics Practical	0	0	2			25	25	50	2	AECC 2
Total										**550**	**20**	
Note: List of Practical will be supplied at the Start of every Semester												

C: Core Courses;
GE: Generic Elective;
AECC: Ability Enhancement Compulsory Course;
SEEC: Skill Enhancement Elective Courses;
DSE: Discipline Specific Elective

B.Sc. Biotechnology 2nd Year
SEMESTER-III

S. No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit	CBCS
									External Exam			
			L	T	P	CA	TA	Total				
1	STUGBT3/ C05	Genetics	4	0	0	20	20	40	60	100	4	C5
2	STUGBT3/ C06	Cell & Tissue Culture Technology	4	0	0	20	20	40	60	100	4	C6
3	STUGBT3/ C07	Environmental Biotechnology	4	0	0	20	20	40	60	100	4	C7
4	STUGBT3/ SEEC1	Fermentation Technology	2	0	0	20	20	40	60	100	2	SEC1
5	STUGBT3/ GE3	Bioethics, Biosafety and IPR	4	0	0	20	20	40	60	100	4	GE3
Practical												
1	SPUGBT3/ C05	Genetics Practical	0	0	2			25	25	50	2	C5
2	SPUGBT3/ C06	Cell & Tissue Culture Technology Practical	0	0	2			25	25	50	2	C6
3	SPUGBT3/ C07	Environmental Biotechnology Practical	0	0	2			25	25	50	2	C7
4	SPUGBT3/ GE3	Bioethics, Biosafety and IPR Seminar	0	2	0			25	25	50	2	GE3
Total										**700**	**26**	
Note: List of Practical will be supplied at the Start of every Semester												

C: Core Courses;
GE: Generic Elective;
AECC: Ability Enhancement Compulsory Course;
SEEC: Skill Enhancement Elective Courses;
DSE: Discipline Specific Elective

B.Sc. Biotechnology 2nd Year
SEMESTER-IV

S. No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit	CBCS
									External Exam			
			L	T	P	CA	TA	Total				
1	STUGBT4/ C08	Microbiology	4	0	0	20	20	40	60	100	4	C8
2	STUGBT4/ C09	Food Technology & Bioprocess technology	4	0	0	20	20	40	60	100	4	C9
3	STUGBT4/ C10	Basics of Genetic Engineering	4	0	0	20	20	40	60	100	4	C10
4	STUGBT4/ SEEC2	Basics of forensic science	2	0	0	20	20	40	60	100	2	SEC2
5	STUGBT4/ GE4	Plant Pathology	4	0	0	20	20	40	60	100	4	GE4
Practical												
1	SPUGBT4/ C08	Microbiology Practical	0	0	2			25	25	50	2	C8
2	SPUGBT4/ C09	Food technology & Bioprocess technology Practical	0	0	2			25	25	50	2	C9
3	SPUGBT4/ C10	Basics of Genetic Engineering Practical	0	0	2			25	25	50	2	C10
4	SPUGBT4/ GE4	Plant Pathology Practical	0	0	2			25	25	50	2	GE4
Total										**700**	**26**	
Note: List of Practical will be supplied at the Start of every Semester												

C: Core Courses;
GE: Generic Elective;
AECC: Ability Enhancement Compulsory Course;
SEEC: Skill Enhancement Elective Courses;
DSE: Discipline Specific Elective

B.Sc Biotechnology 3rd Year
SEMESTER-V

S. No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit	CBCS
									External Exam			
			L	T	P	CA	TA	Total				
1	STUGBT5/ C11	Principle of Genomics And Proteomics	4	0	0	20	20	40	60	100	4	C11
2	STUGBT5/ C12	Elementary Molecular Biology	4	0	0	20	20	40	60	100	4	C12
3	STUGBT5/ DSC1	Plant Biotechnology	4	0	0	20	20	40	60	100	4	DSC1
4	STUGBT5/ DSC2	Animal Biotechnology	4	0	0	20	20	40	60	100	4	DSC2
Practical												
1	SPUGBT5/ C11	Principle of Genomics and Proteomics Seminar	0	2	0			25	25	50	2	C11
2	SPUGBT5/ C12	Elementary Molecular Biology Practical	0	0	2			25	25	50	2	C12
3	SPUGBT5/ DSC1	Plant Biotechnology Practical	0	0	2			25	25	50	2	DSC1
4	SPUGBT5/ DSC2	Animal Biotechnology Practical	0	0	2			25	25	50	2	DSC2
Total										**600**	**24**	
Note: List of Practical will be supplied at the Start of every Semester												

C: Core Courses;
GE: Generic Elective;
AECC: Ability Enhancement Compulsory Course;
SEEC: Skill Enhancement Elective Courses;
DSE: Discipline Specific Elective

B.Sc Biotechnology 3rd Year
SEMESTER-VI

S. No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit	CBCS
									External Exam			
			L	T	P	CA	TA	Total				
1	STUGBT6 /C11	Nanotechnology	4	0	0	20	20	40	60	100	4	C13
2	STUGBT6 /C12	Entrepreneurship	4	0	0	20	20	40	60	100	4	C14
3	STUGBT6 /DSC3	Parasitology/ Transcriptomics and Metabolomics	4	0	0	20	20	40	60	100	4	DSC3
4	STUGBT6 /DSC4	Clinical Research	4	0	0	20	20	40	60	100	4	DSC4
Practical												
1	SPUGBT6 /C11	Nanotechnology Practical	0	0	2			25	25	50	2	C13
2	SPUGBT6 /C12	Entrepreneurship Seminar	0	2	0			25	25	50	2	C14
3	SPUGBT6 /DSC3	Parasitology/ Transcriptomics and Metabolomics Seminar	0	2	0			25	25	50	2	DSC3
4	SPUGBT6 /DSC4	Clinical Research Seminar	0	2	0			25	25	50	2	DSC4
Total										**600**	**24**	
Note: List of Practical will be supplied at the Start of every Semester												

C: Core Courses;
GE: Generic Elective;
AECC: Ability Enhancement Compulsory Course;
SEEC: Skill Enhancement Elective Courses;
DSE: Discipline Specific Elective

OVERALL CREDIT SCHEME

S. No.	SEMESTER	Theory Total	Practical Total	Subject Total	Total Credit
1	I	400	150	550	20
2	II	400	150	550	20
3	III	500	200	700	26
4	IV	500	200	700	26
5	V	400	200	600	24
6	VI	400	200	600	24
			Grand Total	**3700**	**140**

B.Sc. (H) Biotechnology 1st Year
SEMESTER-I

BIO INSTRUMENTATION (STUGBT1/C01)

L	T	P
4	0	2

Course Name: Bio Instrumentation **Course Code:** STUGBT1/C01
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

The students learn the physical principles of structure-function relationships in biological macromolecules such as proteins and nucleic acids, as well as the various approaches, techniques and instrumentation associated with structural biology.

Course Description:

This course presents the principles and applications of Biotechnology explaining the biomolecules and applications of biophysical methods. Students will be able to justify the need for buffers, describe how buffers are prepared, and calculate the amount of buffering agent needed when making a particular bufferOn successful completion of the course the students will be aware of Microscopic techniques, Electro physiological methods, Biomolecules structure determination using X-Ray diffraction.

Course Contents:

Unit I: General Biophysical methods: Measurement of pH, pOH, Buffer action, Isoelectric focusing.

Unit II: Separation & Identification of Materials: concept of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography); Electrophoresis (Gel Electrophoresis, Paper Electrophoresis).

Unit III: Centrifugation: Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation.

Unit IV: Microscopy: Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM.

Unit V: X-Ray Crystallography: X-ray diffraction, Bragg equation, Reciprocal lattice, Miller indices & Unit cell, Concept of different crystal structure, determination of crystal structure (concept of rotating crystal method, powder method). **Spectroscopy:** Basic concepts, principle, working, care &

maintenance and applications of Raman Spectroscopy, NMR Spectroscopy and Absorption Spectroscopy.

Course Learning Outcomes (CLOs):

CLO-1: Enable the student to get sufficient knowledge in principles and applications of bio instruments.

CLO-2. To enable the students to learn the immuno techniques and radio labelling techniques.

CLO-3. To differentiate and analyze the biomedical signal sources.

CLO4. Describe the Basic concept of microscopic techniques such as Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM.

CLO5. Explain the basic principle and application of X-Ray Crystallography and spectroscopy.

Text Books:

- Cromwell, L. and Weibell, F.J. and Pfeiffer, E.A., Biomedical Instrumentation and Measurement, Dorling Kingsley (2006) 2nd ed.
- Carr, J.J. and Brown, J.M., Introduction to Biomedical Equipment Technology, Prentice Hall (2000) 4th ed.
- Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.

Reference Books:

- Geddes, L.A., and Baker, L.E., Principles of Applied Biomedical Instrumentation, Wiley InterScience (1989) 3rd ed.
- Khandpur, R.S., Handbook of Biomedical Instrumentation, McGraw Hill (2003) 2nd ed.
- Webster, J.G., Medical Instrumentation Application and Design, John Wiley (2007) 3rd ed.
- Biophysical Techniques By Iain Campbell • 2012, 9780199642144, 0199642141, QUP Oxford.

Online links for study & reference materials:
https://microbenotes.com/category/instrumentation/
https://lecturenotes.in/download/material/18824-note-of-bioinstrumentation-by-nithya-biotech.
http://biomedikal.in/2009/12/lecture-notes-on-biomedical-instrumentation/

B.Sc. (H) Biotechnology 1st Year
SEMESTER-I

ELEMENTARY CELL BIOLOGY (STUGBT1/C02)

L	T	P
4	0	2

Course Name: Elementary Cell Biology
Course Code: STUGBT1/C02
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

To provide students the knowledge about cellular content, organization, structures and functions. To impart basic understanding of development biology and interaction of cell with environment.

Course Description:
It is an introductory cell biology course. Topics include the structure of the cell and cell components, both eukaryotic and prokaryotic. The processes of DNA replication and gene expression including protein processing and routing. Photosynthesis, respiration, and chemotrophy as means of energy production. The cell cycle and its regulation. These topics will be covered in one semester having four-hour lectures and one two-hour laboratory work per week.

Course Contents:

Unit I: Basics of Cell Biology (Structure & Function): Discovery of cell and Cell Theory; Comparison between plant and animal cells; Cell wall; Plasma membrane; Modification of plasma membrane and intracellular junctions; Cytoskeleton; Protoplasm; Mitochondria; Chloroplast; ER; Golgi complex; Lysosome, endosome and microbodies; Ribosome; Centriole; Nucleus; Chemical components of a cell; Catalysis and use of energy by cells.

Unit II: Biogenesis of Cellular organelles: Biosynthesis of mitochondria, chloroplast, ER, Golgi complex; Biosynthetic process in ER and Golgi apparatus; Protein synthesis and folding in the cytoplasm; Degradation of cellular components.

Unit III: Chromosomes: Chemical composition, structural organization of chromatids, centromeres, telomeres, chromatin, nucleosome organization, eu- and heterochromatin, special chromosomes (e.g. polytene and lampbrush chromosomes), banding patterns in human chromosomes.

Unit IV: Membrane Structure & Transport: Models of membrane structure, Membrane lipids, proteins and carbohydrates; Solute transport by Simple diffusion, Facilitated diffusion and Active transport; Cell adhesion

Unit V: Cell Cycle: An overview of cell cycle; Mitosis and meiosis; Components of cell cycle control system; Programmed cell death (Apoptosis), intrinsic & extrinsic pathways of cell death, Apoptosis in relation with Cancer, Viral disease (AIDS) & Organ transplant.

Course Learning Outcomes (CLOs):
After completion of the course, students will have a basic understanding of cell biology and will be able to demonstrate/explain:

CLO 1: To differentiate between animal as well as plant cells, to recognize and identify the function(s) of the following: centrioles, chromatin, Golgi apparatus, lysosome, microfilaments, microtubules, mitochondrion, nucleus, peroxisome, plasma membrane, rough and smooth endoplasmic reticulum, and ribosomes. An understanding of the ability of enzymes to facilitate chemical reactions. Explain how catalysts, including enzymes, affect and are affected by the chemical reactions in which they participate.

CLO 2: Protein sorting and transport of protein. Understanding of the biochemical processes of photosynthesis, glycolysis, citric acid cycle, and oxidative phosphorylation. Define cellular respiration and identify the cellular locations of the various stages of cellular respiration. Distinguish between the light reactions and the Calvin cycle of photosynthesis.

CLO 3: Chemical composition of nucleic acids (DNA/RNA). Structural Organization of DNA, chromatids, chromosome. Describe the various types of chromosomes on the basis of centromeric position. Chromosomal banding patterns and its application.

CLO 4: Cellular membrane structure and function. Various models of cellular membrane. Composition of cellular membranes. Transport across membrane by simple diffusion, facilitated diffusion and Active transport. Interaction between cells through cell adhesion molecules.

CLO 5: An understanding of how cells grow and divide. Describe the major events of each of the stages of the cell cycle (interphase, G1, G2, S, mitosis, prophase, prometaphase, metaphase, anaphase, telophase, mitotic phase, and cytokinesis). Cell Death and various process associated with cell death.

Text Books:

- Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith, Wayne M. Becker. Becker's World of the Cell, 8th edition, Benajmin Cummings, 9780321689634, 0321689631, (2012).
- EDP De Robertis and EMF De Robertis. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, 9780781734936, 0781734932, (2006)

Reference Books:

- Gerald Karp, Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc, 9780470483374, 0470483377 (2010)
- G.M. Cooper, and R.E. Hausman. The Cell: A Molecular Approach. 5th Edition. ASM Press 780878931064, 0878931066 (2009)

Online links for study and reference materials:

- http://www.open2study.com/cellbiology
- https://nptel.ac.in/courses/102103012/
- Cell Biology - Course (swayam2.ac.in)

B.Sc. (H) Biotechnology 1st Year
SEMESTER-I

FUNDAMENTALS OF COMPUTER APPLICATION (STUGBT1/GE1)

L	T	P
4	0	2

Course Name: Fundamentals of Computer Application **Course Code:** STUGBT1/GE1
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

It is intended to impart basic undergraduate-level knowledge in the area of computer application. This course will introduce the students with fundamentals of hardware, software and programming.

Course Contents:

Unit-I: Fundamental: H/W and S/W part of computer system, Computer Block Diagram, online processing, time sharing system, real time system, batch system, multiprogramming, multiprocessing, SPOOLING, distributed data processing. Element of computer file, types of files, file processing activities, file design factors, access methods, pros and cons of file organization.

Unit-II: MS office: Introduction to MS Office; Introduction to MSWord; Features & area of use. Working with MS Word.; Menus & Commands; Toolbars & Buttons; Shortcut Menus, Wizards & Templates; Creating a New Document; Different Page Views and layouts; Applying various Text Enhancements; Working with – Styles, Text Attributes; Paragraph and Page Formatting; Text Editing using various features ; Bullets, Numbering, Auto formatting, Printing & various print options.

Unit-III: MS Excel: Introduction and area of use; Working with MS Excel.; concepts of Workbook & Worksheets; Using Wizards; Various Data Types; Using different features with Data, Cell and Texts; Inserting, Removing & Resizing of Columns & Rows; Working with Data & Ranges; Column Freezing, Labels, Hiding, Splitting etc.; Using different features with Data and Text; Use of Formulas, Calculations & Functions; Cell Formatting including Borders & Shading; Working with Different Chart Types; Printing of Workbook.

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept immune system and its importance.
CLO2. Discuss Structure, Functions and Properties of different type of Immune Cells and immune organs.
CLO3. Describe the Basic characteristics of an antigen and Structure, Types, Functions and Properties of antibodies.
CLO4. Explain the Major Histocompatibility Complex I & II molecules, basics of Components of the Complement system.
CLO5. Discuss the basic concept of Generation of Immune Response, in particular Generation of Humoral Immune and Cell Mediated Immune Response.

Text Books:

- R. B. Patel, Fundamental of Computers and Programming in C, Khanna Book Publishing Company PVT.LTD. Delhi, India, 1st edition, 2008, ISBN: 13: 978-81-906988-7-0, pp. 1-962.
- Deitel & Deitel: C How to Program (Prentice Hall), 1996.
- Gottfried, Programming with C, Tata McGraw Hill.

Reference Books:

- Joe Habraken, Microsoft Office 2000, 8 in 1 by, Prentice Hall of India
- Yashwant Kanetker, Let us C, BPB Publications.
- Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, 2nd Ed., Prentice Hall of India.

Online links for study & reference materials:
https://microbenotes.com/category/instrumentation/
https://lecturenotes.in/download/material/18824-note-of-bioinstrumentation-by-nithya-biotech.
http://biomedikal.in/2009/12/lecture-notes-on-biomedical-instrumentation/

B.Sc. (H) Biotechnology 1st Year
SEMESTER-I

ENVIRONMENTAL SCIENCES- EVS (STUGBT1/AECC1)

L	T	P
2	0	0

Course Name: Environmental Sciences **Course Code:** STUGBT1/AECC1
Course Credit Hour: 2 hrs **Total Contact hour:** 30 hrs

Course Objective:

It is intended to impart basic undergraduate-level knowledge in the area of Environmental Sciences. People working in industries or elsewhere essentially require the knowledge of environmental science to enable them to work and produce the most efficient, economical and eco-friendly finished products.

Course Contents:

Unit I: Natural Resources: Forest resources: Use and over-exploitation, deforestation, case studies. Timberextraction, mining, dams and their effects on forests and tribal people, (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water,dams-benefits and problems. (c) Mineral resources: Use and exploitation, environmentaleffects of extracting and using mineral resources, case studies. (d) Food resources: Worldfood problems, changes caused by agriculture and overgrazing, effects of modernagriculture, fertilizer-pesticide problems, water logging salinity, case studies. (e) Energyresources: Growing energy needs, renewable and non- renewable energy sources, use ofalternate energy sources (f) Land resources: Land as a resource, landdegradation, man induced landslides, soil erosion and desertification.

Unit II: Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumersand decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, foodwebs and ecological pyramids, Introduction, types, characteristic features, structure andfunction of the following ecosystem :- (a) Forest ecosystem, (b) Grassland ecosystem, (c)Desert ecosystem, (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit III: Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social ethical, aesthetic and option values. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity : In-situ and Ex situ conservation of biodiversity.

Unit VI: Environmental Pollution: Definition, Causes, effects and control measures of: (a) Air pollution, (b) Water pollution,(c) Soil pollution, (d) Marine pollution (e) Noise pollution, (f) Thermal

pollution, (g) Nuclearhazards. Human health risks; Solid waste management: Control measures of urban and industrial waste. Pollution case studies.

Unit V: Environmental Policies & Practices: Sustainability and sustainable development; Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture; Environment Laws: Environment Protection Act; Air and Water Wildlife Protection Act; Forest Conservation Act.; Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept immune system and its importance.
CLO2. Discuss Structure, Functions and Properties of different type of Immune Cells and immune organs.
CLO3. Describe the Basic characteristics of an antigen and Structure, Types, Functions and Properties of antibodies.
CLO4. Explain the Major Histocompatibility Complex I & II molecules, basics of Components of the Complement system.
CLO5. Discuss the basic concept of Generation of Immune Response, in particular Generation of Humoral Immune and Cell Mediated Immune Response.

Text Books:

- S.C. Sharma & M.P. Poonia, Environmental Studies, Khanna Publishing House, New Delhi.
- C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011
- Reuse, Mc-Graw Hill Education India Pvt. Ltd., New York, 2007, ISBN:978-07-062099
- Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.

Reference Books:

- O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi
- Rao, C. S., Environmental Pollution Control and Engineering, New Age International Publication, 2007, ISBN: 81-224-1835-X.
- Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic press, 2011.

Online links for study & reference materials:
www.cpcp.nic.in
www.cpcp.gov.in
www.conserve-energy-future.com

B.Sc Biotechnology 1st Year
SEMESTER-II

FUNDAMENTALS OF BIOCHEMISTRY (STUGBT2/C03)

L	T	P
4	0	2

Course Name: Fundamentals of Biochemistry
Course Code: STUGBT2/C03
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

The **course aims** to provide an advanced understanding of the core principles and topics of **Biochemistry** and their experimental basis, and to enable students to acquire a specialised knowledge and understanding of selected aspects by means of a stem/branch lecture series and a research project.

Course Description:
This course introduces students to the general families of biomolecules that comprise the science of biochemistry and to the principles that integrate biochemistry with other chemical and biological disciplines. They acquire knowledge in the quantitative and qualitative estimation of biomolecules.

Course Contents:

Unit 1: Classification and Study of macromolecules: Introduction and classification of Carbohydrate. Lipids, amino acids and Nucleic acid. Interaction between protein-protein, protein-nucleic acid and nucleic acid- nucleic acid. Biochemistry and its scope. Structure, general properties and function of cellular macromolecules.

Unit 2: Carbohydrate metabolism: Glucose Metabolism: Glycolysis; fermentation; anaerobic fate of pyruvate; control of glycolysis; metabolism of hexoses other than glucose; pentose phosphate pathway. **Citric Acid Cycle**: Synthesis of acetyl-coenzyme A; enzymes of the citric acid cycle; regulation of the citric acid cycle; glyoxylate pathway; electron transport and oxidative phosphorylation. Glycogen Metabolism and Gluconeogenesis: Glycogen breakdown; glycogen synthesis; control of glycogen metabolism. Starch Metabolism: Starch synthesis; storage and degradation; abnormal carbohydrate metabolism.

Unit 3: Lipid Metabolism: Digestion; absorption and transport; fatty acid oxidation; ketone bodies; regulation of fatty acid metabolism; cholesterol biosynthesis; fatty acid biosynthesis.

Unit 4: Nitrogen Metabolism: Amino acid biosynthesis (L-Serine, L-Asparagine, L-Alanine, L-Tyrosine, L-Methionine); Nitrogen fixation in plants and microorganisms; nitrate reduction; inborn errors of L-Phenylalanine and L-Tyrosine metabolism; essential amino acids; glucogenic &ketogenic amino acids.

Unit 5: Nitrogen Excretion: The urea cycle; inborn errors involving urea synthesis; catabolism of purine and pyrimidine nucleotides; disorders involving purine metabolism.

Course Learning Outcomes:

C01: Understanding of Biochemistry as a discipline and milestone discoveries in life sciences that led to establishment of Biochemistry as separate discipline

C02: Fundamental properties of elements, their role in formation of biomolecules and in chemical reactions within living organisms

C03: Understanding of the concepts of mole, mole fraction, molarity, etc. and to apply them in preparations of solutions of desired strengths

C04: Unique property of water as a universal solvent and its importance in biological system

C05: Understanding of concepts of acids, bases, indicators, pKa values, etc. Acquiring skill to determine pKa value of amino acids.

Text Books:

- A.L., Lehninger, PRINCIPLES OF BIOCHEMISTRY (1982), Worth Publishers, Inc. New York, ISBN: 9780716743392, 0716743396
- L. Stryer, BIOCHEMISTRY (1995) W.H. Freeman Press, San Francisco, USA, ISBN: 9781319248086, 131924808X

Reference Books:

- Voet, D. and Voet, J.G., Biochemistry, (2004). 3rd Edition, John Wiley & Sons, Inc.USA,
- U. Sathyanarayana, Biochemistry by Books and Allied (P) Ltd. Kolkata, ISBN 0-87893-214-3, (2014), ISBN: 9788187134800, 8187134801

Online links for study & reference materials:

https://www.khanacademy.org/test-prep/mcat/biomolecules
https://nptel.ac.in/courses/104/105/104105076/

B.Sc Biotechnology 1st Year
SEMESTER-II

BASICS OF IMMUNOLOGY (STUGBT2/C04)

L	T	P
4	0	2

Course Name: Basics of Immunology
Course Code: STUGBT2/C04
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

It is intended to impart basic undergraduate-level knowledge in the area of Immunology. This course will introduce the students with basic principles of immunology and recent advancements in the field of host immunity, including innate and adaptive immunity.

Course Description:

This course is mainly focused on the host immune system which includes basic concept of immunology, Type of immune system, Classes of immune cells, Antigen-Antibody interaction immune cell tolerance, vaccine technology and other relevant topics.

Course Contents:

Unit 1: Introduction: Basic concepts of Innate and Adaptive immune system, Immune Cells and Immune Organs.

Unit 2: Structure, Functions and Properties of: Immune Cells: Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs: Bone Marrow, Thymus, Lymph Node, Spleen, etc.

Unit 3: Antigens and Antibodies: Antigen: Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens, Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants. **Antibodies:** Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; immunodiffusion, immunoelectrophoresis, ELISA, RIA, Monoclonal and Chimeric antibodies.

Unit 4: Major Histocompatibility Complex: Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocyticpathways), Complement System: Components of the Complement

system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement activation.

Unit 5: Generation of Immune Response: Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells), Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals), Killing Mechanisms by CTL and NK cells, Introduction to tolerance; Vaccines.

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept immune system and its importance.
CLO2. Discuss Structure, Functions and Properties of different type of Immune Cells and immune organs.
CLO3. Describe the Basic characteristics of an antigen and Structure, Types, Functions and Properties of antibodies.
CLO4. Explain the Major Histocompatibility Complex I & II molecules, basics of Components of the Complement system.
CLO5. Discuss the basic concept of Generation of Immune Response, in particular Generation of Humoral Immune and Cell Mediated Immune Response.

Text Books:

- Immunology, V Edition - Richard A.Goldsby, Thomas. J. Kindt, A. Osborne, JanisKuby, 2003. W.H. Freeman and company.
- Topley and Wilson principles of bacteriology, Virology and immunology, G. Wilson, A.Miles, M.T.Paker, 2004.
- Arnold, HeinemanAbbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
- Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition WileyBlackwellScientific Publication, Oxford.

Reference Books:

- Basic and Clinical Immunology, 2010, D.P. Stities and J.D. Stobo.
- Vaccines, New Approaches to immunization, F.Brown, KA Lerner, 1986. Cold spring Harborolab.Goldsby RA, Kindt TJ, Osborne BA. (2007).
- Kuby's Immunology. 6th edition W.H. Freeman andCompany, New York.
- Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

Online links for study & reference materials:

https://nptel.ac.in/courses/102103038/
https://nptel.ac.in/courses/102103041/18

B.Sc Biotechnology 1st Year
SEMESTER-II

BIOINFORMATICS (STUGBT2/GE2)

L	T	P
4	0	2

Course Name: Bioinformatics
Course Code: STUGBT2/GE2
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

This course is beneficial for students to understand the principles of analyzing biological data, building models and testing hypotheses using computer science algorithms. This course is a survey of algorithms and tools in biological sequence analysis, genome-wide disease association, and precision medicine. Basic concept machine learning and its application in the analysis of biological data are also included in this course.

Course Contents:

Unit 1: Introduction to Bioinformatics: Genomics and Proteomics. Bioinformatics – Online tools and offline tools. Biological databases. Types of data bases – Gen bank, Swiss port, EMBL, NCBL, and PDB. Database searching using BLAST and FASTA.

Unit 2: Sequence and Phylogeny analysis: Sequence Alignments, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

Unit 3: Dynamic programming: Gene and Genome annotation – Tools used. Physical map of genomes. Molecular phylogeny - Concept methods of tree construction.

Unit 4: Bioinformatics tools in proteomics: Introduction, strategies and methods. Bioinformatics tools in proteomics. Application of proteomics. Protein-protein interactions. Basic introduction of Proteomics technologies: 2D-electrophoresis, MALDI-TOF mass spectrometry. Biological Protein Databases: PDB, SWISSPROT, TREMBL. Protein secondary structure prediction. Protein 3D structure prediction.

Course Learning Outcomes (CLOs):
After successful completion of the course the students:

CLO1. Outlines the basic background of Bioinformatics, terminology, history and introduction to various databases

CLO2. Describe in detail the various mechanisms involved sequence similarity, algorithm matrices MSA and Phylogenetic analysis

CLO3. Introduces various programming and software tools involved in genome annotation, mol. Phylogeny.

CLO4. Discuss the basic background of proteomic and various tools and their application in understanding the proteome and its analysis

CLO5. Describes the mathematical tools involved in evaluation of the various dataset generated and their evaluation via statistics.

Text Books:

- D. Mount, Bioinformatics – Sequence and Genome Analysis, 2nd Ed. Cold Spring Harbor Laboratory Press, 9780879697129, 0879697121
- William Mendenhall, Robert J. Beaver, Barbara M. Beaver, Introduction to Probability & Statistics, 14th Edition, Cengage Learning,1133103758, 9781133103752,

Reference Books:

- Arthur M.Lesk, Introduction to Bioinformatics, 4th Ed. Oxford press, 9780199651566, 0199651566

Online links for study and reference materials:
https://nptel.ac.in/courses/102/106/102106065/
www.ncbi.nlm.gov

B.Sc Biotechnology 2nd Year
SEMESTER-III

GENETICS (STUGBT3/C05)

L	T	P
4	0	2

Course Name: Genetics
Course Code: STUGBT3/C05
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

The objective of this course is to build knowledge on the fundamentals of genetics, heredity, or inheritance. To build the foundation on the understanding of biological principles.

Course Description:
This course provides a detailed understanding of Mendelian and non-Mendelian inheritance; various techniques and methodologies that decipher genetic recombination, gene mapping and other relevant topics.

Course Contents:

Unit I: Prokaryotic Genomes - Physical organization of bacterial genomes; Structure of the bacterial nucleoid, Replication and partitioning of the bacterial genome and Genome of Archaea.

Unit II: Mechanism of genetic exchange: Plasmid and bacterial sex, Types of plasmids (F Plasmid: a Conjugate plasmid', Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid Copy number and incompatibility), Episomes. Transposable elements (Insertion sequence and transposons, Integrons and Antibiotic-Resistance cassettes, Multiple Antibiotic Resistant bacteria, Mu–virus); Bacterial Genetics (Mutant phenotype, DNA mediated Transformation; Conjugation (Cointegrate Formation and Hfr Cells, Time–of–Entry Mapping, F' Plasmid); Transduction (Generalized transduction, Specialized Transduction)-gene mapping.

Unit III: Molecular Mechanism of gene regulation in prokaryotes - Transcriptional regulation in prokaryotes (inducible and repressible system, positive regulation and negative regulation); Operon concept – lac, trp, Ara operons.

Unit IV: Bacteriophages: Stages in the Lytic Life Cycle of a typical phage, Properties of a phage infected bacterial culture, Specificity in phage infection, *E. coli* PhageT4, *E.coli* Phage T7, E.coli phage lambda, Immunity to infection, Prophage integration, Induction of prophage, Induction & Prophage excision, Repressor, Structure of the operator and binding of the

repressor and the Cro product, Decision between the lytic and lysogenic Cycles, Transducing phages, *E.coli* phage phiX174, The lysogenic Cycle.

Unit V: Bacteriophage Genetics: Plaque Formation and Phage Mutants, Genetic recombination in the lytic cycle, (concept of recon, muton, cistron)

Course Learning Outcomes (CLOs):
After successful completion of the course the students:

CLO 1. Will have knowledge of Mendelian, non- Mendelian inheritance and an insight of Gene concept and alleles

CLO 2. Will have an understanding of various methods employed in Gene mapping

CLO 3. Insight of differentiation of sex in plants and animals and various diseases associated with improper differentiation of sex. Evaluate difference between extra-chromosomal inheritances from chromosomal inheritance.

CLO 4. Biochemical changes that lead to difference in inheritance of characters & their expression

CLO 5. Various techniques involved in studying human genetics and their quantification

Text Books:
- P. K. Gupta, GENETICS. Rastogi Publication. 9788171338429, 8171338429
- Strickberger M. W., Genetics. Mac Millan Publishing Co., 9780024180902

Reference Books:
- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., "Molecular Biology of the Gene", 5th Ed., Pearson Education, 9780321762436, 0321762436

Online links for study and reference materials:
- www.biologydiscussion.com
- www.khanacademy.org
- https://www.ncbi.nlm.nih.gov/pmc

B.Sc Biotechnology 2nd Year
SEMESTER-III

CELL & TISSUE CULTURE TECHNOLOGY (STUGBT3/C06)

L	T	P
4	0	2

Course Name: Cell & Tissue Culture Technology
Course Code: STUGBT3/C06
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

The course intends to teach students about the traditional and new approaches used in crop improvement. This includes the conventional and marker assisted breeding approaches, plant tissue culture and its importance in generation of transgenic plants, methods to express large quantities of important proteins and modern tools for site directed mutagenesis in plants.

Course Description:

This course is mainly focused on the cell and tissue culture technology which includes basic concept of tissue culture laboratory, different culture media and culture methods, Basic techniques in plant and animal tissue culture.

Course Contents:

Unit 1: Tissue Culture Laboratory: Planning and organization of a Tissue Culture Laboratory

Unit 2: Plant and Animal Tissue Culture: Culture media and culture methods, Basic techniques in plant and animal tissue culture.

Unit 3: Culture Maintenance and Growth Measurement: Induction and maintenance of callus and suspension culture, Measurement of growth parameters.

Unit 4: Introduction to *in-vitro* Methods: Terms and definitions. Use of growth regulators, Ovary and Ovule culture, Embryo culture, Anther Culture, Embryo rescue after wide hybridization and its applications, Micropropagation- bud, shoot tip and meristem culture, Endosperm culture and production of triploids, *in-vitro* pollination & Fertilization.

Unit 5: Introduction to Protoplast Isolation: Principles and applications, Testing of viability of isolated protoplasts, Various steps in the regeneration of protoplasts, Somatic hybridization, Various methods for fusing protoplasts, chemical and electrical. Use of markers for selection of hybrid cells, Practical applications of somatic hybridizations, Cybridization.

Course Learning Outcomes (CLOs):

CLO1. be able to examine and analyze practical and theoretical principles of cell culture.
CLO2. be able to describe and explain the conditions under which cells can be cultured outside the body.
CLO3. be able to explain the advantages and limitations of cell culture in biomedical research.
CLO4. be able to carry out cell culture, and associated laboratory techniques.
CLO5. be able to carry out the most common analysis techniques associated with cell culture.

Text Books:

- Plant Tissue Culture: An Introductory Text, Sant Saran Bhojwani and Prem Kumar Dantu; Springer, India.
- Elements of Biotechnology, P.K.Gupta; Rastogi Publication, India
- Introduction to Plant Biotechnology, H.S.Chawla;Oxford and IBH

Reference Books:

- Introduction to Cell and Tissue Culture Theory and Technique, Jennie P. Mather and Penelope E. Roberts, Plenum Press, New York.

Online links for study & reference materials:
https://fenix.tecnico.ulisboa.pt/downloadFile/3779571815542/Lecture_30042008.pdf

B.Sc Biotechnology 2nd Year
SEMESTER-III

ENVIRONMENTAL BIOTECHNOLOGY (STUGBT3/C07)

L	T	P
4	0	2

Course Name: Environmental Biotechnology
Course Code: STUGBT3/C07
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

To offer insights on the basic ecological and evolutionary theories and their interrelationships in the environment. Evolution- Definition, scope and history, Darwinian view of life.

Course Description:

This course presents the Study and the Management of the Environment Goals: To make the student to understood Ecology and Conservation of the Environment Objectives: On successful completion of the subject the student should have understood Ecosystem, energy flow and Uses and values of Biodiversity

Course Contents:

Unit 1: Microorganisms and their Habitats: Structure and function of ecosystems; Terrestrial Environment: Soil profile and soil microflora; Aquatic Environment: Microflora of fresh water and marine habitats; Atmosphere: Aeromicroflora and dispersal of microbes; Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body.Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic& osmotic pressures, salinity, & low nutrient levels.Microbial succession in decomposition of plant organic matter

Unit 2: Microbial Interactions: Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism,predation, Microbe-Plant interaction: Symbiotic and non symbiotic interactions. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent
bacteria

Unit 3: Biogeochemical Cycling: Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin, Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction, Phosphorus cycle: Phosphate immobilization

and solubilisation, Sulphur cycle: Microbes involved in sulphur cycle, Other elemental cycles: Iron and manganese

Unit 4: Waste Management: Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill), Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary, sewage treatment

Unit 5: Microbial Bioremediation: Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants,

Course Learning Outcomes:

CLO1. Provides knowledge about basic terminologies used in environmental biotechnology

CLO2. Explain the microbial processes and growth requirements underlying the activated sludge process, nitrification, denitrification, enhanced phosphorus removal, and anaerobic digestion

CLO3. Role of biogeochemical cycle concept and its applications in ecological balance

CLO4.To understand the knowledge of microbial clean up the polluted environmental biotechnology

CLO5. Evaluate the potential for biodegradation of organic pollutants, taking microbial and physical/chemical environments, as well as the chemical structure of the compound itself, into consideration

Text Books

- Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition.Pearson/ Benjamin Cummings
- Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, AcademicPress

Reference Books:

- Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, AcademicPress
- Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA

Web References/ NPTEL:

http://freebookcentre.net/Biology/Ecology-Books.html
www.khanacademy.org
www.biologydiscussion.org

B.Sc Biotechnology 2nd Year
SEMESTER-III

FERMENTATION TECHNOLOGY (STUGBT3/SEEC1)

L	T	P
2	0	0

Course Name: Fermentation Technology
Course Code: STUGBT3/SEEC1
Course Credit Hour: 2 hrs
Total Contact hour: 30 hrs

Course Objective:

This course introduces various aspects of applied and industrial microbiology. The course helps the students to learn every important upstream and downstream components of fermentation process including strain selection, development, media design, formulation and recovery of products. Additionally, the course can educate the students about fermenter design, different types of fermentations and also the current trend of fermentation process in biotech-industry. Overall, the course helps in the student's exposure on industrial applications of bioprocesses.

Course Description:

To impact knowledge about biological and biochemical technology, with a focus on biological products, the design and operation of industrial practices

Course Contents:

Unit I: Introduction to Fermentation technology: History, Scope and Development of Fermentation technology; Isolation and screening of industrially important microorganisms − primary and secondary screening; Maintenance of Strains; Strain improvement: Mutant selection and Recombinant DNA technology.

Unit II: Fermentation media: Natural and Synthetic media; Basic components of an media (Carbon sources; Nitrogen sources; Vitamins; Minerals; Anti-foaming agents); Role of buffers in media; Process of aeration, and agitation.

Unit III: Fermenter design: Basic designs of Fermenter; Type of fermenters: Wald of, Tower, Deepjet, Cyclone column, Packed tower and airlift fermenter; Scale up study and Product development; Down-stream processing and Product recovery; Regulation and safety.

Unit IV: Production of Microbial Products: Production of alcohol; Organic acid − Citric acid; Antibiotic − Penicillin, Amino acid − Glutamic acid; Vitamin − B1; Single Cell Protein (SCP).

Course Learning Outcomes (CLOs):

CLO1. The students shall get an adequate knowledge on evaluate factors that contribute in enhancement of cell and product formation during fermentation process..
CLO2. Understand the kinetics of cell and product formation in batch, continuous and fed-batch cultures and different types of fermenters.
CLO3. Students should get enough information on Basic designs of Fermenter; Type of fermenters
LO4. Discuss the protocol of the production of alcohol, organic acid, antibiotic, amino acid and other biological materials

Text Books:

- PF Stanbery, A. Whitaker and Steve Hall, Principles of Fermentation Technology, Third Edition, Elesvier (2016), ISBN No. 9781483292915, 1483292916
- M Shuler and F. Kargi, Bioprocess Engineering Basic Concepts, Prentice Hall Press (2015), ISBN No. 9781292025995, 1292025999

Reference Books:

- H C. Vogel and C M. Todaro, Fermentation and Biochemical Engineering Handbook, 2nd Editions, Elesvier (2014), ISBN No. 9780815517139, 0815517130

Online links for study & reference materials:
https://www.khanacademy.org/test-prep/mcat/biomolecules
https://nptel.ac.in/courses/104/105/104105076/

B.Sc Biotechnology 2nd Year
SEMESTER-III

BIOETHICS, BIOSAFETY AND IPR (STUGBT3/GE3)

L	T	P
4	2	0

Course Name: Bioethics, Biosafety and IPR
Course Code: STUGBT3/SEC1
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

To apprise the students of the various societal, governance and regulatory issues in biotechnology with special emphasis on ethics, safety and intellectual property rights. Through this course, the students develop a perspective on the importance of these aspects in the success of biotechnology products and services in the market. At the end of the course, they should be able to apply this perspective and the specific principles, laws, regulations etc., in academic and industrial settings for regulatory oversight and enforcement.

Course Description:

This course is mainly focused on the Bioethics, Biosafety and Intellectual Property Rights which includes basic concept of patents, patent regime (in India and abroad) registration aspects and other details.

Course Contents:

Unit 1: Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms

Unit II: Biosafety Guidelines: Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol. **AERB/RSD/RES:** Guidelines for using radioisotopes in laboratories and precautions**.**

Unit III: Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR – patentable and non patentables – patenting life – legal

protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).

Unit IV: Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner. **Agreements and Treaties:** GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms; UPOV & Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recent amendments.

Course Learning Outcomes (CLOs):

CLO1. The students shall get an adequate knowledge on patent and copyright. This provide further way for developing their idea or innovations.
CLO2. Identify the role of regulatory committees in controlling the risk.
CLO3. Students should get enough information on ethical issues linked to research on animal models, transgenics, clinical trials.
CLO4. Students to consider Intellectual Property (IP) as a career option as IP Counsel/Patent Examiner/Patent agent.

Text Books:

- Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.
- Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.

Reference Books:

- Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
- Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
- V Sreekrishna, 2017. Bioethics and Biosafety in Biotechnology by New Age International publishers.

Online links for study & reference materials:

- http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
- https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

B.Sc. Biotechnology 2nd Year
SEMESTER-IV

MICROBIOLOGY (STUGBT4/C08)

L	T	P
4	0	2

Course Name: Microbiology
Course Code: STUGBT4/C08
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

This course focus on the basis of applied microbiology technology and their techniques. It basically covers the Air microbiology, sewage microbiology, water microbiology etc. It also covers the scope and importance of sources of contamination of milk, desirable and undesirable changes in milk, milk borne diseases, Microbial examination of water, Water borne diseases etc.

Course Description:

Microbiology course involves the study of microorganisms with particular emphasis on the biology of bacteria, viruses, fungi and protozoan parasites. You will also cover aspects of the biochemistry, physiology and genetics of microorganisms. Introduction to Microbiology is appropriate for students with some background in biology and chemistry whose career path intersects the study of microbes or simply have an interest in microbiology. This course introduces the basic principles of microbiology examining the microbes that inhabit our planet and their effect on the biosphere. Introduction to Microbiology explores this impact through the lens of all areas of microbiology.

Course Contents:

Unit I: Historical developments: Discovery of microorganisms, Spontaneous Generation Controversy, Germ theory of fermentation, Germ theory of disease.

Unit II: Air Microbiology: Definition and composition of air, sources of microorganisms in air, significance of microorganisms in air, droplet, droplet nuclei and droplet infection, air borne diseases, enumeration of microorganisms in air, control of microorganisms in air, air pollution.

Unit III: Water Microbiology: Types of water, Sources of microorganisms in water, Significance of microorganisms in water, Fecal contamination of water, Index of water pollution, Different indicator microorganisms, Coliform bacteria, Microbial examination of water, Water borne diseases

Unit IV: Sewage Microbiology: Definition of sewage, composition and strength of sewage (BOD and COD), Microbiology of sewage, Domestic sewage treatment, Municipal sewage treatment, Water purification, Water reclamation.

Unit V: Milk Microbiology: Definition and composition of milk, sources of contamination of milk, desirable and undesirable changes in milk, milk borne diseases, bacteriological examination of milk, reductase test, pasteurization of milk, application of microorganisms in dairy industry (examples and microflora).

Course Learning Outcomes: (CLOs):

CLO1. History of air microbiology and significance of microorganisms in air, water, sewage and soil.
CLO2. Micro-organisms in natural food products and their control.
CLO3. Scope and importance of Microbial examination of air, water and soil.
CLO4. Introduction to Water purification, Water reclamation.
CLO5. Objectives, importance and functions of Milk quality and milk borne diseases.

Text Books:

- Air Microbiology An environment And Health Prospective by Aithal, Wakte & Manwar. Cinnamonteal print and publishing Margao, Goa-403601
- Fundamental principles of bacteriology by A.J. Salle.

Reference Books:

- Fundamentals of Microbiology by Martin Frobisher
- General Microbiology by Stanier. Ingraham, Wheelis, Painter: Macmillan Press Ltd.

Online links for study & reference materials:
www.microbiologysummit.com
https://biopharmaceutics.pharmaceuticalconferences.com

B.Sc. Biotechnology 2nd Year
SEMESTER-IV

FOOD TECHNOLOGY & BIOPROCESS TECHNOLOGY (STUGBT4/C09)

L	T	P
4	0	2

Course Name: Food and bioprocess technology
Course Code: STUGBT4/C09
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

This course focus on the basis of bioprocess technology and their techniques. It basically covers the spoilage of food stuffs and food processing. It also covers the scope and importance of packaging and functions of quality control, the essential prerequisites for preservation of food stuffs and preserving techniques.

Course Description:

Food Technology is a science branch that deals with the techniques involved in production, processing, preservation, packaging, labeling, quality management, and distribution of food products. To impart knowledge on different configurations of bioreactors, optimization and fermentation process control, which are required for novel bioprocess applications such as in food, environment, pharmaceutics and tissue culture systems.

Course Contents:

Unit 1: Foods as a substrate for microorganisms: Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

Unit 2: Microbial spoilage of various foods: Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

Unit 3: Principles and methods of food preservation: Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene, oxide, antibiotics and bacteriocins.

Unit 4: Fermented foods: Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and

tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Unit 5: Food borne diseases (causative agents, foods involved, symptoms and preventive measures): Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Food infections: *Bacillus cereus*, *Vibrio parahaemolyticus*, *Escherichia coli*, *Salmonellosis*, *Shigellosis*, *Yersinia enterocolitica*, *Listeria monocytogenes* and *Campylobacter jejuni*. Cultural and rapid detection methods of food borne pathogens in foods.

Unit 6: Food sanitation and control: HACCP, Indices of food sanitary quality and sanitizers

Course Learning Outcomes (CLOs):

CLO1. Understand the basic background of microbiology of food stuffs.
CLO2. Discuss the Micro-organisms in natural food products and their control.
CLO3. Describe the Basic Scope and importance of food processing.
CLO4. Explain the basic concept of food packaging.
CLO5. Discuss the basic concept of food intoxications and infections. Explain the cultural and rapid detection methods of food borne pathogens in foods.

Text Books:

- Neeser JR & German BJ. 2004. Bioprocesses and Biotechnology for Nutraceuticals.
- Chapman & Hall. Robert EC. 2006. Handbook of Nutraceuticals and Functional Foods. 2nd Ed.
- Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional,London.

Reference Books:

- Wildman. Shi J. (Ed.). 2006. Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.
- Webb GP. 2006. Dietary Supplements and Functional Foods. Blackwell Publisher.
- Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBSPublishers and Distributors, Delhi, India.

Online links for study & reference materials:
www.bioprocessingsummit.com
https://biopharmaceutics.pharmaceuticalconferences.com

B.Sc. Biotechnology 2nd Year
SEMESTER-IV

BASICS OF GENETIC ENGINEERING (STUGBT4/C10)

L	T	P
4	0	2

Course Name: Basics of **Genetic Engineering** **Course Code:** STUGBT4/C10
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

It is intended to impart basic undergraduate-level knowledge in the area of genetic engineering. This course will make the students familiar about the translation machinery and concept of r-DNA technology and their application in advanced research.

Course Description:

This course is mainly focused on the basic concept of genetic engineering which includes basic knowledge in the area of molecular biology and recombinant DNA technology. The student would be able to understand the working details of the cloning of a gene. They would also be able to assimilate recent research findings, advancement and development in the relevant subject.

Course Contents:

Unit I: Molecular Tools: Restriction Enzymes: Types I, II and III; Linkers and adaptors; Sites of cleavage (Isoschizomers, neoschizomers; and isocaudomers); DNA modifying enzymes; End-modifying enzymes and theirapplications.

Unit II: Vectors: properties of vectors; Plasmid vectors; Viral vectors; Cosmids; Fosmids; YAC; PAC; shuttle vectors. Vectors for plants and Animals.

Unit III: Recombinant Screening: Selection of transformed cells; DNA introduction into host cells- bacterial cell (chemical method and electroporation) and plant cell (Direct gene transfer and vector mediated gene transfer); in animals (transduction and transfection).

Unit IV: Polymerase chain reaction: Primer designing; Reaction cycles; Modifications to PCR techniques (Asymmetric PCR, RT-PCR, Quantitative Real time PCR, Inverse PCR, RACE, RAPD, AFLP.

Unit V: Genetic Engineering in Animals: Primary and secondary cultures; cell lines; Culture media; Growth patterns. Applications of animal cell culture. **Genetic Engineering in Plants**: Gene transfer strategies; Ti plasmid; Strategies for production of transgenic plants; Applications; Molecular farming

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept of molecular tool such as restriction enzyme and its application.
CLO2. Discuss the concept of Plasmid vectors; Viral vectors; Cosmids; Fosmids; YAC; PAC; shuttle vectors
CLO3. Describe the preparation of transformed cells; DNA introduction into host cells-bacterial cell (chemical method and electroporation) and plant cell (Direct gene transfer and vector mediated gene transfer)
CLO4. Explain the major PCR techniques.
CLO5. Discuss the basic concept of genetic engineering n Animal and Plant cells.

Text Books:

- Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
- Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings
- Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

Reference Books:

- Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
- Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
- Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers

Online links for study & reference materials:
https://learn.genetics.utah.edu/
https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/

B.Sc. Biotechnology 2nd Year
SEMESTER-IV

BASICS OF FORENSIC SCIENCES (DNA) (STUGBT4/ SEEC2)

L	T	P
2	0	0

Course Name: Basics of Forensic Sciences (DNA) **Course Code:** STUGBT4/SEEC2
Course Credit Hour: 2 hrs **Total Contact hour:** 40 hrs

Course Objective:

It is intended to impart basic undergraduate-level knowledge in the area of DNA forensic sciences. This course will make the students familiar about the general information about forensic sciences focused on DNA based methods and their application in forensic research.

Course Description:

This course is mainly focused on the basic concept of forensic sciences which includes basic knowledge in the area of molecular biology techniques and associated tools. The student would be able to understand the working details of the biological blueprint of life. They would also be able to assimilate recent research findings, advancement and development in the relevant subject.

Course Contents:

Unit I: History of Development of Forensic Science in India: Functions of forensic science. Historical aspects of forensic science. Definitions and concepts in forensic science. Scope of forensic science. Need of forensic science. Basic principles of forensic science. Frye case and Daubert standard

Unit II: Organizational set up of Forensic Science Laboratories in India: Hierarchical set up of Central Forensic Science Laboratories, State Forensic Science Laboratories, Fingerprint Bureaus, Basic services and optional services.

Unit III: Basic Principles DNA as biological blueprint of life. Extraction of DNA for analysis. Quantitation of DNA – yield gel quantitation and slot blot quantitation. Forensic DNA Typing Collection of specimens. Polymerase chain reaction – historical perspective, sequence polymorphisms, individualization of evidence.

Unit IV: Basic tools used in DNA forensic science: Instrumentation Sample preparation for chromatographic and spectroscopic evidence. Chromatographic methods. Fundamental

principles and forensic applications of thin layer chromatography, gas chromatography and liquid chromatography. Spectroscopic methods. Fundamental principles and forensic applications of Ultravioletvisible spectroscopy. Colorimetric analysis and Lambert-Beer law.

Course Learning Outcomes (CLOs):

CLO1. Understand the fundamental principles, functions and significance of forensic science to human society.
CLO2. Describe the organizational set up of Forensic Science Laboratories in India.
CLO3. Describe the collection method of specimens, isolation of DNA from different specimens, and amplification of DNA using PCR.
CLO4. Explain the basic tools used in DNA forensic science.
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Text Books:

- Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
- Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings
- Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

Reference Books:

- Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
- Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
- Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers

Online links for study & reference materials:
https://learn.genetics.utah.edu/
https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/

B.Sc. Biotechnology 2nd Year
SEMESTER-IV

PLANT PATHOLOGY (STUGBT4/SEC2)

L	T	P
4	0	2

Course Name: Plant Pathology **Course Code:** STUGBT4/SEC2
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

It is intended to impart basic undergraduate-level knowledge in the area of Plant Pathology. This course will introduce the students with basic concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases.

Course Description:
This course is mainly focused on the host pathogen interaction. A study of the nature and causes of disease in plants, emphasizing the principal diseases in India. Practical hands on training for identification of disease symptoms at earliest stage. Making students aware about the ambience plants and related diseases and treatment if any, especially biological control.

Course Contents:

Unit I: Introduction and History of plant pathology: Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton DeBary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates. Contributions of eminent Indian plant pathologists.

Unit II: Stages in development of a disease: Infection, invasion, colonization, dissemination of pathogens and perennation.

Unit III: Plant disease epidemiology: Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases and its relevance in Indian context.

Unit IV: Host Pathogen Interaction: A. Microbial Pathogenicity Virulence factors of pathogens: enzymes, toxins (host specific and non-specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction).

Unit V: Control of Plant Diseases: Principles & practices involved in the management of plant diseases by different methods, viz. regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals.

Unit VI: Specific Plant diseases: Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control. Cucuta, Loranthuus, Orobanche and striga.

Course Learning Outcomes (CLOs):

CLO1. To introduce concepts and principles of plant pathology
CLO2. To acquaint with different strategies for management of plant diseases
CLO3. To acquaint with different strategies for management of higher yield from healthy soil.
CLO4. To impart knowledge on detection and diagnosis of plant diseases and their management.
CLO5. To study principles and application of ecofriendly and sustainable management strategies of plant diseases.

Text Books:

- Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. Blackwell Science, Oxford.
- Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.

Reference Books:

- Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,

Online links for study & reference materials:
http://ecoursesonline.iasri.res.in/
https://phytopath.ca/education/websites/
https://bsppjournals.onlinelibrary.wiley.com/journal/13653059

B.Sc. Biotechnology 3rd Year
SEMESTER-V

PRINCIPLE OF GENOMICS AND PROTEOMICS (STUGBT5/C11)

L	T	P
4	2	0

Course Name: Principle of Genomics and Proteomics
Course Code: STUGBT5/C11
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

It is intended to impart basic undergraduate-level knowledge in the area of Genomics and Proteomics. It also aims to familiarize them with the developments in the experimental approaches used by researchers to understand the complexity and diversity of genomes. Recent advances in genomics have transformed the way in which biologists study cells and biological systems. Furthermore, this course also provides knowledge of the use of high throughput techniques to study the entire range of proteins present in any cell/tissue/organism under specific conditions, to obtain a global view of cellular processes at the protein level.

Course Description:
This course is mainly focused on the Genomics and Proteomics and discuss the basic concept of genomics, such as origin, evolution and application of genomics and proteomics. This course also focuses to elaborates the Genomic and Proteomics techniques; from basic to advance level. It covers basic understanding of Genomics, Annotation of whole genome sequence & functional genomics, Pharmacogenomics and Proteomics.

Course Contents:

Unit I: Origin and Evolution of genomics: Study and Scope: Introduction, definition concepts and approaches of proteomics studies and activities. Origin of genomics, the first DNA genomes, microsatellite and SCOT, DNA based phylogenetic trees, genomes and human evolution, evolution of nuclear and organelle (mitochondrial and Chloroplast genome), Anticipated Benefits of Genome Research

Unit II: Molecular maps of genomes and comparative genomics: Genetic maps, physical maps, EST and transcript maps, functional maps, comparative genomics and collinearity/synteny in maps.

Unit III: Whole Genome sequencing: Whole genome shotgun sequencing, clone-by-clone or 'hierarchical shotgun' sequencing, microbial genomes, plant genomes and animal genomes.

Unit IV: Annotation of whole genome sequence and functional genomics: *In silico* methods, insertion mutagenesis (T-DNA and transport insertion), EST contigs and unigene sets, use of DNA chips and microarrays.

Unit V: Pharmacogenomics: Use in biomedicine involving diagnosis and treatment of diseases, genomics in medical practice, personalized medicine, DNA polymorphism and treatment of diseases, use of SNP in pharmacogenomics, pharmacogenomics and industry.

Course Learning Outcomes (CLOs):

CLO1. Gain an understanding of the basic concepts of genomics and its scope.
CLO2. Outline the fundamental of DNA based phylogenetic trees.
CLO3. Discuss the Annotation of whole genome sequence and functional genomics.
CLO4. Describe the basic concepts of pharmacogenomics and its future prospective.
CLO5. Explain the fundamentals of proteomics and advance molecular biology techniques.

Text Books:

- Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Campbell AM & Heyer LJ, Benjamin Cummings 2007; CSH Press, NY.
- Introduction to Proteomics: Tools for the New Biology. Daniel C. Liebler, 2002 Humana Press Inc.
- Primrose SB and Twyman RM. Genomics: Applications in human biology. Blackwell Publishing, 2008 Oxford, U.K

Reference Books:

- Genome III – T.A. Brown Garland Science Publ. June 08, 2006
- Bioinformatics and Functional Genomics – Jonathan Pevsner - 2nd edition, Wiley-Blackwell, 2009.
- Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press

Online links for study & reference materials:

http://www.genomenewsnetwork.org/resources
http://www.pss.co.jp/english/sc_bio/contents4.html
http://www.premierbiosoft.com/tech_notes/microarray.html

B.Sc. Biotechnology 3rd Year
SEMESTER-V

ELEMENTARY MOLECULAR BIOLOGY (STUGBT5/C12)

L	T	P
4	0	2

Course Name: Elementary Molecular Biology **Course Code:** STUGBT5/C12
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

It is intended to impart basic undergraduate-level knowledge in the area of Molecular Biology. This course will introduce the students with basic and advanced knowledge of molecular biology such as understand molecular Biological processes like DNA replication, transcription, repair systems and other relevant topics.

Course Description:

This course is mainly focused on the Elementary Molecular Biology which will provide the technical details and use of different gene expression systems for overexpression of recombinant proteins and protein complexes for different applications. The course will also provide details about the purification of proteins expressed in different expression systems..

Course Contents:

Unit I: Molecular of Life: An introduction experimental proof of DNA and RNA as genetic Material, Nucleic Acids, Structure and function of DNA and RNA, Watson and Crick model of DNA and other forms of DNA (A and Z), Functions of DNA and RNA including ribosome's.

Unit II: DNA Replication: Prokaryotic and Eukaryotic-Enzymes and proteins involved in replication, Theta model and Rolling circle model. Mechanism of DNA replication, replication origin and replication fork, DNA repair

Unit III: DNA Repair: Causes and mechanism –photo reactivation, excision repair, mismatch repair, SOS repair. Recombination in prokaryotes, Transformations, Conjugation and Transduction. Wobble hypothesis.

Unit IV: Transcription and Translation: Transcription in Prokaryotes and Eukaryotes, Mechanism, promoters and RNA polymerase, transcription factors, post transcriptional, modifications a eukaryotic mRNA. Translation: Mechanism of translation in Prokaryotes and

Eukaryotes. Ribosomes, mechanism of translation, post translational modification, translational inhibitors, and genetic code.

Unit V: Regulation of Gene expression: Regulation of Gene expression in Prokaryotes-Person concept (Lac and Trip), Regulation of Gene expression in Eukaryotes –transcriptional activation. Transposable elements in Maize and Drosophila, gene silencing.

Course Learning Outcomes (CLOs):

CLO1. Students who study the molecular biology re able to understand the central dogma

CLO2. Students who earn the plant pathology minor will integrate plant pathology principles into the understanding of their major discipline(s) through the study of agronomic diseases, horticultural diseases, turf diseases, entomology, applied microbiology, biotechnology and other relevant career fields**.**

CLO3. To learn to observe how mutation can cause the change in gene expression

CLO4. To learn various agents of DNA mutation and its repair

CLO5. Discuss the basic concept of Gene expression in Prokaryotes-Person concept (Lac and Trip), Regulation of Gene expression in Eukaryotes.

Text Books:

- Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
- Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco

Reference Books:

- De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
- Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.

Online links for study & reference materials:
https:// Biologynotes.com
https:// Easy biology class.com/

B.Sc. Biotechnology 3rd Year
SEMESTER-V

PLANT BIOTECHNOLOGY (STUGBT5/DSC1)

L	T	P
4	0	2

Course Name: Plant Biotechnology **Course Code:** STUGBT5/DSC1
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

The goal of this course is to introduce biotechnology methods in plants. The objective of the course is to give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production.

Course Description:

This course offers the train the students in techniques used in plant breeding and understanding of biotechnological processes that have applicative value in pharmaceutical and food industry, in agriculture and in ecology. Apart from organogenesis and embryogenesis of plants this course focus also explains the various methods of gene transfer in plants and production of transgenic plants for crop improvement and commercial purposes.

Course Contents:

Unit I: Introduction: Introduction to Plant Biotechnology and Plant Breeding, Methods used in plant breeding.

Unit II: Organogenesis & Embryogenesis: Micropropagation: bud,shoot tip and meristem culture. Haploids: their production &applications, Somaclonal variations and their applications. Practical applications and examples of tissue and organ culture. Somatic Embryogenesis and its practical applications. Single cell suspension culture and their applications in selection of variants/mutants with or without mutagen treatment.

Unit III: Delivery System for Gene Transfer in Pants: Direct delivery of genes, viz. electroporation, microprojectile transformation, Vector mediated gene transfer in plants. Introduction to *Agrobacterium* Tumour formation on plants using *Agrobacterium tumifaciens.* Root-formation using *Agrobacterium rhizogenes.* Practical application of genetic transformation.

Unit IV: Production &Practical applications of Transgenic Plants: production of human therapeutics &edible vaccines, production of herbicides and insecticide resistance, insect resistance, virus resistance, drought and salinity resistance plants, concepts and application of molecular farming.

Unit V: Genetic modification in Food industry: background, history, controversies over risks, future applications.

Course Learning Outcomes (CLOs):
After successful completion of the course the students:

CLO 1: will be able to explain plant breeding techniques and role of biotechnology in plant breeding.
CLO 2: can describe the methods and concept behind micropropagation of buds and shoots, somaclonal variation, tissue and organ culture, applications, somatic embryo genesis and their applications
CLO 3: use basic biotechnological techniques to explore molecular biology of plants. understand the processes involved in the planning, conduct and execution of plant biotechnology experiments. Production of transgenic crops- its merits and de-merits.
CLO 4: will have knowledge pertaining to plant based human therapeutics like edible vaccines, production of plants with herbicide, insecticide resistance, virus and draught resistance and molecular farming concepts and applications
CLO 5: can discuss the effect of genetic modifications on the food industry, its history, current controversies and risks and future applications.

Text Books:

- Chrispeels M.J., Sadava D.E. Plants, Genes and Crop Biotechnology, 2nd edition, Jones and Bartlett Publishers, ISBN: 0763715867
- Sarad R.Parekh (ed.). The GMO Handbook, Genetically Modified Animals, Microbes, and Plants in Biotechnology, Humana Press, ISBN: 1588293076.

Reference Books:

- Razdan M.K. Introduction to Plant Tissue Culture. 2nd edition Science Publishers Inc, ISBN: 1578082374.
- Heldt H.W. Plant Biochemistry and Molecular Biology, Oxford University Press, ISBN: 0198501803.
- Buchanan B.B., Gruissem W., Jones L.R. Biochemistry and Molecular Biology of Plants., 1 st edition, American Society of Plant Physiologists, ISBN: 0943088372.

Online links for study and reference materials:

1. https://nptel.ac.in/courses/102/103/102103016/

B.Sc. Biotechnology 3rd Year
SEMESTER-V

ANIMAL BIOTECHNOLOGY (STUGBT5/DSC2)

L	T	P
4	0	2

Course Name: Animal Biotechnology **Course Code:** STUGBT5/DSC2
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

The primary objective of the course is to provide students with the knowledge pertaining to techniques required for the generation of transgenic animals. Basic understanding of transgenic animals, their application and ethical issues pertaining the process of trans-genesis.

Course Description:

This course is a core subject of biotechnology undergrads and therefore will illustrate about methods that help in gene transfer in animals, scientifically and economically important transgenic animals- their production, application and drawbacks. Role of biotechnology in treating various diseases that affect animals. This course will also provide information to students about techniques used for animal propagation and conservation biology. And lastly it will provide appropriate knowledge regarding genetic modification in medicine.

Course Contents:

Unit I: Gene transfer methods in Animals: Microinjection, Embryonic Stem cell gene transfer, Retrovirus & Gene transfer.

Unit II: Transgenic Animals and Animal propagation: Mice, Cow, Pig, Sheep, Goat, Bird, Insects. Artificial insemination, Animal Clones

Unit III: Animal diseases need help of Biotechnology: Foot-and-mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

Unit IV: Conservation Biology: Embryo transfer techniques, Cryopreservation and transport of animal germplasm (i.e. semen, ova and embryos).

Unit V: Genetic modification in Medicine: Gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

Course Learning Outcomes (CLOs):
Successful students will be able to:

CLO 1: explain the various techniques used for gene transfer in animals their advantages and disadvantages, and difference between these techniques.

CLO 2: describe transgenic animals-their production, application of various established transgenic animals like mice, sheep, pig, fish, etc.

CLO 3: identify, diagnose, and know the treatment of various animal diseases and elucidate the role of biotechnology in management of these diseases.

CLO 4: describe techniques of animal propagation like artificial insemination, animal cloning, cryopreservation and maintenance and transport of animal germplasm to facilitate animal conservation.

CLO 5: discuss the role of biotechnology by gene therapy- its types, vectors used in gene therapy, molecular engineering, human genetic engineering, problems & ethics of human genetic engineering.

Text Books:
- B Singh, Textbook of Animal Biotechnology, 1st Edition, Energy and Resources Institute (TERI), 9788179933275, 817993327X (2013).
- MM Ranga, Animal Biotechnology, 3rd edition, Agrobios, 9788177543094, 8177543091 (2010).

Reference Books:
- Ashish Verma, Anchal Singh, Animal Biotechnology 1st Edition, Elsevier, 9780128117101, 0128117109, (2019).

Online links for study and reference materials:
1. https://nptel.ac.in/courses/102/103/102103013/#
2. www.ncbi.nlm.gov

B.Sc. Biotechnology 3rd Year
SEMESTER-VI

NANOTECHNOLOGY (STUGBT6/C13)

L	T	P
4	0	2

Course Name: Nanotechnology
Course Code: STUGBT6/C13
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

This course is designed to make students understand the intersection of nanotechnology and biology. It will also acquaint students with Nano devices of biomedical applications. Students will know about the use of nanotechnology in diagnostic biology and learn about the health and environmental impacts of nanotechnology.

Course Description:

This course is mainly focused on the nanotechnology which is an interdisciplinary and emerging area. The students are taught the basics of nanotechnology and their applications. The course introduces the students to the new and novel applications to solve biomedical problems through nanotechnology.

Course Contents:

Unit I: Introduction: The ascale dimension and paradigm. Definitions and historical evolution (colloids etc.) and current practice.

Unit II: Types of nanomaterials and their classifications (1D, 2D and 3D etc. Nanocrystal, Nanoparticle, Quantum dot, Quantum Wire and Quantum Well etc).

Unit III: Polymer, Carbon, Inorganic, Organic and Biomaterials – Structures and characteristics.

Unit IV: Physical, Chemical and Biological Fundamentals of Nanomaterials.

Unit V: Overview of synthetic methods Surfactants, polymers, emulsions. Micelles/reverse micelles and colloids Top-down and bottom up approaches Biological Methods Growth and stabilization Self-assembly.

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept and application of ascale dimension and paradigm.
CLO2. Discuss the different types of nanomaterials and their classifications.
CLO3. Describe the basic characteristics of Polymer, Carbon, Inorganic, Organic and Biomaterials.
CLO4. Explain the Physical, Chemical and Biological Fundamentals of Nanomaterials.
CLO5. Discuss the basic concept of synthetic methods Surfactants, polymers, emulsions. Micelles/reverse micelles and colloids Top-down and bottom up approaches Biological Methods Growth and stabilization Self-assembly.

Text Books:

- Introduction to Nanoscience and Nanotechnology, Chris Binns, 2010, Wiley, ISBN: 978-0471776475
- Introduction to Nanoscience, Stuart Lindsay, 2009, Oxford University Press, ISBN: 978-0199544219

Reference Books:

- Text book of Nanoscience and nanotechnology by Murthy, Shankar, raj, University press.
- Principles of Nanoscience and nanotechnology by MA Shah, Tokeer Ahmed

Online links for study & reference materials:
http://ethics.iit.edu/NanoEthicsBank/
https://www.nano.gov/nanotech-101/what/definition
http://web.mit.edu/research/topic/nano.html

B.Sc. Biotechnology 3rd Year
SEMESTER-VI

ENTREPRENEURSHIP (STUGBT6/C14)

L	T	P
4	2	0

Course Name: Entrepreneurship
Course Code: STUGBT6/C14
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

This course focus on the basis of Skills of bio-entrepreneur and biotechnology entrepreneurship. It basically covers the patenting, licensing and partnership in biotechnology industry It also covers the scope and importance of product development in biotech industries. It also includes about the marketing of the desired pharmaceutical drug.

Course Description:

This is a course to introduce the student to understanding creative abilities, recognizing their creative abilities, changing their way of viewing creativity, understanding who they are as a creative person, promoting innovation in themselves and others, and demonstrating productive thinking.

Course Contents:

Unit I: Introduction: Basic definition, history and scope of Biotechnology Entrepreneurship

Unit II: Biotechnology Marketing & Companies: Biotechnology in capital market; Initial Public Offering (IPO) in the capital market; examples of success and failure of biotechnology companies and the possible reasons; factors that influence success of company; product selection; failure of the product ; product development ; R&D with expertise ; cost of product development. Mergers and acquisitions of biotechnology companies: Celera Genomica and Axys Pharmaceutical; Monsanto and other companies (use other examples).

Unit III: Patenting, licensing and partnership in biotechnology industry: Patents on biological inventions, licensing revenue, selection of right partner; negotiations of the terms of the terms of the deal.

Unit IV: Entrepreneurship Skills: Entrepreneurship Skills of bio-entrepreneur, bio-entrepreneurial training; research experience, creativity, communication skills and other

attributes; participation in conferences, training and educational courses; institutes offering entrepreneurship courses.

Course Learning Outcomes (CLOs):

CLO1. Discuss the basic introduction of biotechnology entrepreneurship.
CLO2. Discuss the Biotechnology Marketing & industries.
CLO3. Describe the basic knowledge patenting, licensing and partnership in biotechnology industry.
CLO4. Explain the Major Entrepreneurship Skills.
CLO5. Discuss the Training, entrepreneurship courses, educational courses offered by various institutes.

Text Books:

- Entrepreneuship by P.F. Stanbury, W. Whitaker &S.J. Hall, Aditya Books (P) Ltd., New Delhi, 1997.
- Biotech Entrepreneur-to-Entrepreneur: http://www.bioe2e.org

Reference Books:

- Startup junkies http://www.startupjunkies.org/research.html by N. Okafer, Scientific Publishers, Enfield, USA., 2017.
- Biopreneur serves as a focal point for bringing together scientists, Businesspeople and investors, 2019

Online links for study & reference materials:

http://www.biopreneur.org/biotech-investment.htm
http://www.bioenterprise.com/assets/entrepreneurguide.pdf
http://www.bioe2e.org

B.Sc. Biotechnology 3rd Year
SEMESTER-VI

PARASITOLOGY (STUGBT6/DSC3)

L	T	P
4	2	0

Course Name: Parasitology
Course Code: STUGBT6/DSC3
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

This course will enable students to acquire knowledge on the fundamentals of Parasitology. It enables them to understand emerging and advanced concept in host pathogen interaction and this course also focuses on the host parasite interaction which include etiology, pathogenicity, life cycle, lab diagnosis and treatment. This program will facilitate the students to acquire knowledge in fields various aspects and molecular tools used in clinical application in alleviation of human disease.

Course Description:

This course is mainly focused to understand emerging and advanced concept in molecular pathogenesis of disease and role of biotechnology in diagnosis, prevention and therapeutics. An understanding of the basic biology and life cycles of human parasites; human parasitic infections, including epidemiology, clinical features, laboratory diagnosis, treatment and prevention.

Course Contents:

Unit I: Introduction: Parasites, Classification of Parasites, Host, Types of host, Relationships between host and parasites

Unit II: Protozoa: (introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment)
Entamoeba, Giardia, Plasmodium, Leishmania, Trypanosoma

Unit III: Platyhelminthes: (Introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment) Taenia, Echinococcus

Unit IV: Nemathelminthes: (introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment) Ascaris, Ancylostoma, Necator, Enterobius, Wuchereria

Unit V: Lab Diagnosis: Different specimens of parasitology, Collection & transportation. Processing of parasitological specimens

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept Parasitology and its importance.
CLO2. Discuss etiology, pathogenicity, life cycle, lab diagnosis and treatment of protozoan parasite.
CLO3. Discuss etiology, pathogenicity, life cycle, lab diagnosis and treatment of Platyhelminthes.
CLO4. Discuss etiology, pathogenicity, life cycle, lab diagnosis and treatment of Nemathelminthes.
CLO5. Explain the method for collection and processing of parasitological specimens.

Text Books:

- Textbook of Microbiology' by CP Baveja, 2nd edition, 1998, Arya longman Pvt. Ltd
- Textbook of Medical Lab Technology' 2010, by Praful Godkar
- Text book of Medical Laboratory' by Satish Gupta, Edition - latest, 2006, J.P. Bros.

Reference Books:

- Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.
- Medical parasitology' by Chatarjee, 3th edition
- Medical Microbiology and Immunology' by Warren Levinson, eighth Edition, Lange Medical books/ McGraw-Hill Publication

Online links for study & reference materials:

https://www.cdc.gov/parasites/about.html
http://www.onlinebiologynotes.com/
http://www.biologydiscussion.com/parasites/classification-of-parasites-parasitology/62036

B.Sc. Biotechnology 3rd Year
SEMESTER-VI

TRANSCRIPTOMICS AND METABOLOMICS (STUGBT6/DSC3)

L	T	P
4	2	0

Course Name: Basics of Immunology
Course Code: STUGBT6/DSC3
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

The primary objective of this course is to develop knowledge on the basics of omics and their versatile applications as well as integration of omics approaches for improvement of life. This subject will help in the development of technical skills and knowledge on versatile techniques in Omics.

Course Description:

An introduction to workflows for the resolution and characterization of complex mixtures of biomolecules, from DNA to small molecule metabolites. The course will emphasize the potential and challenges of omic approaches and will include data handling tasks and demonstration

Course Contents:

Unit I: Gene, Genome and Genomics: Online genomics databases and tools. Standalone bioinformatics analysis of genomic data. Applications of genomics.

Unit II: Proteomics: Aims, strategies and methods. Bioinformatics tools in proteomics. Application of proteomics. Proteomics technologies: 2D-electrophoresis, MALDI-TOF mass spectrometry, yeast 2-hybrid system. Protein-protein interactions: experimental and computational methods, databases.

Unit III: Proteomics and Generation of Interactomics: High-throughput proteomics, Construction of interactomics, Bioinformatics and data visualization software for proteomics

Unit IV: Transcriptomics: Microarrays, EST, SAGE. Bioinformatical methods in transcriptomics. Application of transcriptomics

Unit V: Metabolomics: Technologies in metabolomics, Nutrigenomics, Other omics, Nuclear Magnetic Resonance Spectroscopy and Mass Spectrometry in metabolomics.

Course Learning Outcomes:

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

CO1: Critically discuss information flow in biology, and evaluate the benefits of the different levels of omic data collection; discuss challenges to omic data collection;

CO2: Evaluate strategies to characterize a genome/transcriptome/proteome/metabolome;

CO3: Compare and contrast data from different "-omic" data collection approaches (genomics, transcriptomics, proteomics, metabolomics).

CO4: Identify appropriate applications for different omic approaches and Design an experimental strategy to exploit an omic analysis

CO5: Critically discuss the importance of controls and validation in 'omics strategies

Text Books:

- Barh D, Azevedo V, Omics Technologies and Bio-engineering: Towards Improving Quality of Life, Academic Press, ISBN: 9780128158708, 0128158700
- Wittmann, C, Lee SY, Systems Metabolic Engineering, Springer Science & Business Media, ISBN: 9789400745346, 9400745346
- Dunkler D, Sánchez-Cabo F, Heinze G. Statistical Analysis Principles for Omics Data. Methods in Molecular Biology. Totowa, NJ: Humana Press; 2011.

Reference Books:

- Pevsner J, Bioinformatics and Functional Genomics, Wiley-Blackwell , ISBN: 978-81-265-3834-8
- Kihara, D, Protein Function Prediction for Omics Era, Springer Science & Business Media, ISBN: 9789400708815, 9400708815
- Microbial Proteomics: Functional Biology of Whole Organisms by Ian Humphery-Smith and Michael Hecker (2006) Publisher: Wiley-Interscience; 1st edition ISBN-10: 0471699756, ISBN-13: 978-0471699750
- Microbial Genomics and Drug Discovery by Thomas J. Dougherty and Steven J. Projan(2003) Publisher: CRC; 1st ed. ISBN-10: 0824740416, ISBN-13: 978-0824740412

Online links for study & reference materials:
https://www.khanacademy.org/
https://nptel.ac.in/

B.Sc. Biotechnology 3rd Year
SEMESTER-VI

CLINICAL RESEARCH (STUGBT6/DSC4)

L	T	P
4	2	0

Course Name: Clinical Research **Course Code:** STUGBT6/DSC4
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

This course focus on the basis of Drug development process. It basically covers the (Preclinical, clinical and toxicological studies). It also covers the scope and importance of product development in biotech industries. It also includes about the marketing of the desired pharmaceutical drug.

Course Description:

Clinical research is a study conducted to understand health and diseases in the particular human body. It is branch of healthcare that governs the safety and effectiveness of medications, diagnostic products, devices, and treatment procedures proposed for human use. Clinical research is a branch of healthcare sciences in which research is conducted to understand health and diseases in human beings.

Course Contents:

Unit I: Drug discovery: Introduction, conventional drug design approaches, irrational Vs Rational, subacute and chronic toxicity studies. Irwin profile test, Drug development process (Preclinical, clinical and toxicological studies).

Unit II: Clinical Research: Past, Present and future Importance, Mile stones of regulations. FDA, US, Indian clinical research, global scenario of clinical research, Regulatory agency. Designing clinical trials- History, principles, scheme for conducting clinical trials, planning defining, objectives, variables, study populations, testable hypothesis.

Unit III: Ethical Issues in clinical research: Introduction, codes, declaration and guidelines, informed concent, special issues, Roles and responsibilities of IRBS, issues with ethics review.

Unit IV: ICH-GCP: History of ICH, Objectives, ICH structure, Guidelines, Future of ICH.

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept of Drug development process.
CLO2. Discuss the drug discovery, rational drug design. Delivery of biopharmaceuticals, Pre-clinical trials, and clinical trials.
CLO3. Describe the international pharmacopoeia, guide to good manufacturing practice, Manufacturing facility,sources of pharmaceuticals, production and analysis of final product..
CLO4. Explain the History of ICH, Objectives, ICH structure, Guidelines, Future of ICH.

Text Books:

- Research in Education- John V. Best, John V. Kahn 7th edition.
- Presentation skills - Michael Hallon- Indian Society for Institute education.

Reference Books:

- Practical Introduction of copyright.- Gavin Mcfarlane
- R2. Reference book on Thesis projects in Science & Engineering – Richard M. Davi.

Online links for study & reference materials:

https://europe.microbiologyconferences.com
https://nptel.ac.in/courses/102141/18