VELS

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
ACCREDITED BY NAAC WITH 'A' GRADE
Marching Beyond 25 Years Successfully

M.Sc. Biotechnology

Curriculum and Syllabus

Regulations 2021

(Based on Choice Based Credit System (CBCS)

and

Learning Outcomes based Curriculum Framework (LOCF)

Effective from the Academic year

2021-2022

Department of Biotechnology

School of Life Sciences

VISION

- ✓ To develop as a department of eminence, by achieving high standards in both research and teaching, and to become a sought-after destination for highly motivated students and faculty. The Department aspires in delivering distinctive learning skills in biotechnology enabling excellence in professional competence and innovation for further betterment of society and mankind.

MISSION

- ✓ To maintain high standards of teaching by innovating pedagogy, instilling in students the ability to be lifelong learners, and continually upgrading the program curriculum with international standards of life sciences education and to meet the requirement of industry and research community.
- ✓ To adopt effective teaching methods to improve the learning process and impart knowledge of biology and technology.
- ✓ To provide a flexible curriculum that allows the students to study courses of his/her choice (through Elective courses) that will fulfill their aptitude and professional aspirations.
- ✓ To provide hands-on training and technical skills to transform students into technocrats and facilitate research and higher education in the fields of biotechnology.
- ✓ To create opportunities and a supporting infrastructure for students – through laboratory courses, projects, dissertations, and possible entrepreneurial ventures in biotechnology to achieve their aspirations. To pursue and promote cutting-edge research in selected fields of biotechnology

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO I: The post-graduates of Biotechnology will able to attain the in-depth knowledge of the basic and application-oriented subjects of Biotechnology and allied fields.

PEO II: The post-graduates of Biotechnology will able to gain the ability to use the concept of theories, practical skills and latest technological tools in solving any professional issues independently in a global and societal context.

PEO III: The post-graduates of Biotechnology are equipped to design, analyze, conduct and interpret the experiments and data for the development of process/product within the realistic constraints.

PEO IV: The Post graduates of Biotechnology will continue to learn and update knowledge to become an entrepreneur in a current competitive world of Science & technology and also contribute to society.

PROGRAMME OUTCOMES (POs)

- ✓ PO-1 Graduates will able to have knowledge on the basic and applied theories.
- ✓ PO-2 Handling of sophisticated instrumentations and interpretation and analysis of data.
- ✓ PO-3 Developing an interdisciplinary approach and a rational thinking.
- ✓ PO-4Designing of research projects that are cost effective, ecofriendly, potent and beneficial to mankind.
- ✓ PO-5making the graduates to demonstrate their communication effectively and scientifically in both verbal and written form as independent researcher.
- ✓ PO-6Providing a broad educational and analytical knowledge necessary to make the students for appearing in competitive examinations.
- ✓ PO-7Generating the graduates with an ability to identify, formulate and solve to deliver process/product with professional, societal and ethical responsibilities.
- ✓ PO-8Graduates will be able to recognize need for self-learning and lifelong learning.
- ✓ PO-9The student will be able design, solve the application-oriented problem in biotechnological field through project-based learning.
- ✓ PO-10 Demonstrate their ability to work effectively in team and Improvising the technical skills and implying them

PROGRAM SPECIFIC OUTCOME (PSO)

- ✓ The program specific objectives of M.Sc Biotechnology are to produce professionals who later take the role of academics, entrepreneurs and researchers with the following qualities:
- ✓ PSO1. Apply fundamental knowledge of biological sciences for the human Welfare and to have successful career as professional or a researcher through lifelong learning in the field of biotechnology.
- ✓ PSO2. Demonstrate the application of Biotechnological processes in industries that are of social and commercial importance.
- ✓ PSO3. Exhibit skills of handling microbial processes and biochemical analysis by making use of state of the art facilities and environment.

Vels Institute of Science, Technology and Advanced Studies
School of Life Sciences
Department of Biotechnology
M.Sc Biotechnology

S.No	BOARD OF STUDIES MEMBERS	
	Name	**Address**
BOARD CHAIRMAN		
1.	**Dr.B.Prakash** **Associate Professor & Head,**	Department of Biotechnology, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai.117.
BOARD MEMBER – External		
2.	**Dr. G. Vijaiyan Siva** **Associate Professor,**	Dept of Biotechnology, University of Madras. Chennai - 600025.
BOARD MEMBER – External (Industry Representative)		
3.	**Dr. R.Arunbabu** **Chief Operating Officer,**	Realgae Biopharma Solution Kovilampakkam, Chennai- 600129
BOARD MEMBER – External		
4.	**Dr. K. P.Girivasan** **Associate Professor,**	Dept of Plant Biology and Biotechnology, Government Arts College (Men's), Nandanam, Chennai- - 600035
BOARD MEMBER - Internal		
5.	**Dr. K.Ashok Kumar** **Associate Professor,**	Department of Biotechnology, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai-600117.
6	**Dr. M. Thenmozhi** Associate Professor	Department of Biotechnology, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai.600117.
STUDENT MEMBER – Student Representative		
7	**Ms. Monisha** Student	Department of Biotechnology, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai- 600117.

VELS INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)

CHENNAI - 600 117

CHOICE BASED CREDIT SYSTEM (CBCS)

&

LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF)

PG REGULATIONS 2021

M.Sc. Biotechnology

Common to All Post Graduate Full-Time Programmes

(Applicable to all the candidates admitted from the academic year 2021-22 onwards)

1. DURATION OF THE PROGRAMME

1.1. Two years (Four semesters)

1.2. Each academic year shall be divided into two semesters. The odd semesters shall consist of the period from July to November of each year and the even semesters from January to May of each year.

1.3. There shall be not less than 90 working days for each semester.

2. ELIGIBILITY FOR ADMISSION

2.1. A candidate with a Bachelor's Degree in Science in the disciplinary of Biotechnology, Genetics, Biochemistry, Microbiology, Botany, Zoology, Biology, Chemistry, Agriculture, B.E./B. Tech (Biotech), B.V.Sc, B.F.Sc., MBBS, BDS, B. Pharm, BPT from the University, or an examination of some other University, accepted by the Syndicate as equivalent thereto, shall be permitted to appear and qualify for the M.Sc. Biotechnology Degree examination of this University after a course of two academic years in an affiliated college of this University.

3. MEDIUM OF INSTRUCTION

The medium of instruction for all PG programmes is English excluding Tamil, Hindi and French Language Papers

4. CREDIT REQUIRMENTS AND ELIGIBILITY FOR AWARD OF DEGREE

Candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than three academic years and passed the examinations of all the Four Semesters prescribed earning a minimum of 90 credits as per the distribution given in for Part I, II & III and also fulfilled such other conditions as have been prescribed thereof.

5. COURSE

Each course / subject is to be designed under lectures / tutorials / laboratory or field work / seminar / practical training / Assignments / Term paper or Report writing etc., to meet effective teaching and

learning needs.

6. COURSE OF STUDY AND CREDITS

The Course Components and Credit Distribution shall consist Part I, II & III: (Minimum number of Credits to be obtained) Credit Assignment Each course is assigned certain number of credits based on the following:

Contact period per week CREDITS

1 Lecture Period - 1 Credit

1Tutorial Period - 1 Credit

2 Practical Periods - 1 Credit
(Laboratory / Seminar / Project Work / etc.)

7. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER

7.1. Eligibility: Students shall be eligible to go to subsequent semester only if they earn sufficient attendance as prescribed therefor by the Board of Management from time to time.

7.2. Attendance: All Students must earn 75% and above of attendance for appearing for the University Examination. (Theory/Practical)

7.3. Condonation of shortage of attendance: If a Student fails to earn the minimum attendance (Percentage stipulated), the HODs shall condone the shortage of attendance up to a maximum limit of 10% (i.e. between 65% and above and less than 75%) after collecting the prescribed fee towards the condonation of shortage of attendance. Such fees collected and should be remitted to the University.

7.4. Non-eligibility for condonation of shortage of attendance: Students who have secured less than 65 % but more than 50 % of attendance are NOT ELIGIBLE for condonation of shortage of attendance and such Students will not be permitted to appear for the regular examination, but will be allowed to proceed to the next year/next semester of the program

7.5. Detained students for want of attendance: Students who have earned less than 50% of attendance shall be permitted to proceed to the next semester and to complete the Program of study. Such Students shall have to repeat the semester, which they have missed by rejoining after completion of final semester of the course, by paying the fee for the break of study as prescribed by the University from time to time.

7.6. Condonation of shortage of attendance for married women students: In respect of married women students undergoing PG programs, the minimum attendance for condonation (Theory/Practical)

shall be relaxed and prescribed as 55% instead of 65% if they conceive during their academic career. Medical certificate from the Doctor together with the attendance details shall be forwarded to the university to consider the condonation of attendance mentioning the category.

7.7. Zero Percent (0%) Attendance: The Students, who have earned 0% of attendance, have to repeat the program (by rejoining) without proceeding to succeeding semester and they have to obtain prior permission from the University immediately to rejoin the program.

7.8. Transfer of Students and Credits: The strength of the credits system is that it permits inter Institutional transfer of students. By providing mobility, it enables individual students to develop their capabilities fully by permitting them to move from one Institution to another in accordance with their aptitude and abilities.

7.8.1. Transfer of Students is permitted from one Institution to another Institution for the same program with same nomenclature. Provided, there is a vacancy in the respective program of Study in the Institution where the transfer is requested. Provided the Student should have passed all the courses in the Institution from where the transfer is requested.

7.8.2. The marks obtained in the courses will be converted and grades will be assigned as per the University norms.

7.8.3. The transfer students are not eligible for classification.

7.8.4. The transfer students are not eligible for Ranking, Prizes and Medals.

7.8.5. Students who want to go to foreign Universities up to two semesters or Project Work with the prior approval of the Departmental / College Committee are allowed to get transfer of credits and marks which will be converted into Grades as per the University norms and are eligible to get CGPA and Classification; they are not eligible for Ranking, Prizes and Medals.

8. EXAMINATION AND EVALUATION

8.1. EXAMINATION:

i) There shall be examinations at the end of each semester, for odd semesters in the month of October / November, for even semesters in April / May. A candidate who does not pass the examination in any course(s) shall be permitted to appear in such failed courses in the subsequent examinations to be held in October / November or April / May.

ii) A candidate should get registered for the first semester examination. If registration is not possible owing to shortage of attendance beyond condonation limit / regulations prescribed OR belated joining

OR on medical grounds, the candidates are permitted to move to the next semester. Such candidates shall re-do the missed semester after completion of the programme.

iii) The results of all the examinations will be published through University Website. In the case of passed out candidates, their arrear results, will be published through University Website.

8.2 **To Register for all subjects**: Students shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination, except for the shortage of attendance programs. For this purpose, Students shall register for all the arrear subjects of earlier semesters along with the current (subsequent) Semester Subjects.

8.3. Marks for Continuous Internal Assessment (CIA) Examinations and End Semester Examinations (ESE) for PART I, II, III

8.3.1 There shall be no passing minimum for Continuous Internal Assessment (CIA) Examinations.

8.3.2 For End Semester examination, passing minimum shall be 40% (Forty Percentage) ofthe maximum marks prescribed for the Course/Practical/Project and Viva-Voce.

8.3.3 In the aggregate (CIA and ESE) the passing minimum shall be of 40%.

8.3.4. He/She shall be declared to have passed the whole examination, if he/she passes in all the courses wherever prescribed in the curriculum by earning 140 CREDITS in Part I, II, III.

9. Question Paper Pattern for End Semester Examination

APPENDIX – A- PATTERN OF QUESTION PAPER

PART – A (50 words) Answer 10 questions without choice	10 × 3 = 30 marks
PART – B (200 words) Answer 5 questions out of 8 questions	5 × 8 = 40 marks
PART – C (500 words) Answer 2 questions out of 5 questions	2 × 15 = 30 marks
	Total = 100 marks

QUESTION PAPER FOR PRACTICALS

The External examiner will prepare a question paper on the spot from the syllabus prescribed and supplied by the Controller's Office.

10. SUPPLEMENTARY EXAMINATION: Supplementary Examinations are conducted for the students who appeared in the final semester examinations. Eligible criteria for appearing in the Supplementary Examinations are as follows:

10.1 Eligibility: A Student who is having a maximum of two arrear papers is eligible to appear for the Supplementary Examination.

10.2 Non-eligibility for those completed the program: Students who have completed their Program duration but having arrears are not eligible to appear for Supplementary Examinations.

11. RETOTALLING, REVALUATION AND PHOTOCOPY OF THE ANSWER SCRIPTS:

11.1 Re-totaling: All PG Students who appeared for their Semester Examinations are eligible for applying for re-totaling of their answer scripts.

11.2 Revaluation: All current batch Students who have appeared for their Semester Examinations are eligible for Revaluation of their answer scripts. Passed out candidates are not eligible for Revaluation.

11.3 Photocopy of the answer scripts: Students who have applied for revaluation can download their answer

scripts from the University Website after fifteen days from the date of publication of the results.

12. The examination and evaluation for MOOCs will be as per the requirements of the regulatory bodies and will be specified at the beginning of the Semester and notified by the university NPTEL-SWAYAM Coordinator (SPOC).

13. CLASSIFICATION OF SUCCESSFUL STUDENTS

13.1. PART I TAMIL / OTHER LANGUAGES; PART II ENGLISH AND PART III CORE SUBJECTS, ALLIED, ELECTIVES COURSES AND PROJECT: Successful Students passing the Examinations for the Part I, Part II and Part III courses and securing the marks

a) CGPA 9.00 to 10.00 shall be declared to have passed the examination in **First class with Outstanding**.

b) CGPA 7.50 to 8.99 shall be declared to have passed the examination in **First class with distinction**.

c) CGPA 6.00 to 7.49 shall be declared to have passed the examination in **First Class**.

d) CGPA 5.00 to 5.99 in the aggregate shall be declared to have passed the examination in the **SECOND** Class.

e) CGPA 4.00 to 4.99 shall be declared to have passed the examination in the **THIRD** Class.

14. MARKS AND GRADES: The following table shows the marks, grade points, letter grades and classification to indicate the performance of the Student:

14.1. Computation of Grade Point Average (GPA) in a Semester, Cumulative Grade Point Average (CGPA) and Classification

GPA for a Semester: = ∑iCiGi ÷ ∑iCi That is, GPA is the sum of the multiplication of grade points by the credits of the courses divided by the sum of the credits of the courses in a semester.

Where, Ci= Credits earned for course i in any semester,

Gi = Grade Points obtained for course i in any semester

n = Semester in which such courses were credited.

CGPA for the entire programme: = ∑n∑iCniGni ÷∑n∑iCni That is, CGPA is the sum of the multiplication of grade points by the credits of the entire programme divided by the sum of the credits of the courses of the entire programme.

Grade Conversion Table – PG			
Range of Marks	**Grade Points**	**Letter Grade**	**Description**
90 - 100	10	O	Outstanding
82 - 89	9	A+	Excellent
75 - 81	8	A	Very Good
67 - 74	7	B+	Good
60 - 66	6	B	Above Average
50 - 59	5	C	Average
40 - 49	4	D	Minimum for pass
0 - 39	0	RA	Reappear
		AAA	Absent

14.2. Letter Grade and Class CGPA

Overall Performance - PG		
CGPA	**GRADE**	**CLASS**
4.00 - 4.99	D	Third Class
5.00 - 5.99	C	Second Class
6.00 - 6.69	B	First Class
6.70 - 7.49	B+	
7.50 - 8.19	A	First Class with Distinction*
8.20 - 8.99	A+	
9.00 - 10.00	O	First Class - Outstanding*

The Students who have passed in the first appearance and within the prescribed semester of the PG Programme (Major, Allied and Elective courses only) are eligible.

15. RANKING

- Students who pass all the examinations prescribed for the Program in the FIRST APPEARANCE ITSELF ALONE are eligible for Ranking / Distinction.
- In the case of Students who pass all the examinations prescribed for the Program with a break in the First Appearance are only eligible for Classification.
- Students qualifying during the extended period shall not be eligible for RANKING.

16. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMS TO QUALIFY FOR A DEGREE

16.1. A Student who for whatever reasons is not able to complete the programs within the normal period (N) or the Minimum duration prescribed for the programme, may be allowed two years period beyond the normal period to clear the backlog to be qualified for the degree. (Time Span = N + 2 years for the completion of programme)

16.2. In exceptional cases like major accidents and child birth an extension of one year considered

beyond maximum span of time (Time Span=N + 2 + 1 years for the completion of programme).

17. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The University may from time-to-time revise, amend or change the Regulations, Curriculum, Syllabus and Scheme of examinations through the Academic Council with the approval of the Board of Management.

Vels Institute of Science and Technology and Advanced studies (VISTAS)

M.Sc Biotechnology

Overall credit distribution / Course Components with credits

(Minimum Credits to be earned: 90)
M.Sc, Biotechnology (Common Template)
M.Sc. Course Components

Component	**I Sem**	**II Sem**	**III Sem**	**IV Sem**	**Total Credits**
Program Core & Languages	14	16	14	14	60
Discipline Specific Elective (DSE) & Generic Elective (GEC)	8	4	8	4	22
Skill enhancement Course (SEC)	2	2+2	2	-	8
Total Credits	**24**	**24**	**24**	**18**	**90**

Learning Outcome based Curriculum Framework

Preamble

Completion of a graduation course in biosciences basically delivers a platform for basic understanding of the subject. Inventions, innovations and technology have revolutionized and enriched the biological sciences. The demand for skilled manpower requires thorough knowledge of the subject. It also demands for incorporating latest knowledge and advanced technologies to fulfill the changing needs of society. The public private sector prefers the experienced manpower. Considering this, M.Sc. in any biological science course is designed to provide through and updated knowledge of the subject which makes easy entry of the students in public private sector. Uniqueness of the course is of having 6 months mandatory research projects. During the period students are getting an opportunity to work in nationally and internationally acclaimed research institutes and industries. This generates skilled human resources as per the demands of the society. The course has other research elements including scientific writing, writing research projects, preparing publications, preparing research posters for the conferences and the entire process also generates innovative minds to work in the capacity of scientists.

1. Introduction:

In the increasingly globalized society, it is important that the younger generation especially the students are equipped with knowledge, skills, mindsets and behaviors which may enable them to perform their duties in a manner so that they become important contributors to the development of the society. This will also help them to fully utilize their educational training for learning a decent living so that the overall standard of their families and surroundings improve leading to development of welfare human societies. To achieve this goal, it is imperative that their educational training is improved such that it incorporates the use of newer technologies, use of newer assessment tools for mid-course corrections to make sure that they become competitive individuals to shoulder newer social responsibilities and are capable of undertaking novel innovations in their areas of expertise. In the face of the developing knowledge society, they are well aware about the resources of self-development using on-line resources of learning which is going to be a major component of learning in the future. The learning should also be a continuous process so that the students are able to re-skill themselves so as to make themselves relevant to the changing needs of the society. In the face of this need, the educational curricula, teaching learning processes, training, assessment methods all need to be improved or even re-invented.

2. Learning Outcomes based approach to Curriculum Planning: (LOCF)

Learning Outcome based approach to curriculum planning (LOCF) is almost a paradigm shift in the whole gamut of higher education such that it is based on first and foremost identifying the outcomes of the learning required for a particular subject of study, and then planning all components of higher education so as to achieve these outcomes. The learning outcomes are the focal point of the reference to which all planning and evaluation of the end learning is compared and further modifications are made to fully optimize the education of the individuals in a particular subject. For the subject of bio science the outcomes are defined in terms of the understanding and knowledge of the students in biology and computer application in biology and the practical skills the students are required to have to be competitive biologist. So, that they are able to play their role as Biologist.The curriculum developed and the teaching and the evaluation tasks are such that the students are able to apply their knowledge and training of Biotechnology to solve the problems of Biotechnology as these exist or appear from time to time in the society.

3. Aim & Objectives of the course:

The aim and objectives of the M.Sc. Biotechnology course program essentially focus to develop skills of student for a successful career.

1. The course structure emphasizes to put enough efforts in theory as well as laboratory work so as to gain thorough knowledge of the subject.
2. The course includes project work that would develop and nourish the scientific approach and research attitude of the students.
3. Genetic engineering, Biotechnology, Bioinformatics, Immunotherapy are the new horizons of the interdisciplinary subject in biology which might provide solutions to various problems of the society. The course work is essentially framed to acquaint the students with all the recent advances in this field.
4. It is compulsory & essential for the students to read research papers, publications and deliver seminars that would better help them to know the recent advances in the subject and also develop the communication skills.
5. The program is designed in such a way that it is essential for the students to read original publications, put enough efforts in laboratory work for practical and project, be acquainted with all the recent advances in the field like Bioinformatics, drug designing and develop all the skills for a successful career

4. Postgraduate attributes in life science:

Broaden the outlook and attitude, develop the current skills and abilities, and learn

1. New one to do extremely well in studies and career, grow into responsible global citizens. Contour the academic career of the students, make them employable, enhances
2. To shape one's life and also that of colleagues and peers. Demonstrate behavioral attributes for the enhancement of soft skills, socialistic
3. Research insight and support the participation in co-curricular and extracurricular activities. Instill skills and abilities to develop a positive approach and be self-contained
4. Approach and leadership qualities for successful career and nurture responsible human being. Provide highly skilled and knowledgeable human resources for agricultural Sector, food industry, dairy industry, medical and paramedical field, pharmaceutical and research institutes

5. Qualification Descriptors:

The following may serve as the important qualification descriptors for a PG degree in Biochemistry/Biotechnology/Microbiology/Bioinformatics:

1. Knowledge of the diverse places where biological science is involved.
2. Understanding of diverse biological processes.
3. Advanced skills and safety issues related to handling of Microbes, Animals and Plants Good laboratory practices etc.
4. Advanced skills in working with microbes such as pilot scale culturing, downstream processes, diagnostics etc.
5. Generation of new knowledge through research projects
6. Ability to participate in team work through biological projects.
7. Ability to present and articulate their knowledge of biology.
8. Knowledge of recent developments in the area of biology.
9. Analysis of data collected through study and projects / dissertations / reviews / research surveys.
10. Ability to innovate so as to generate new knowledge.
11. Awareness how some biology leads may be developed into enterprise.
12. Awareness of requirements for fruition of a biology-related enterprise.
13. Ability to acquire intellectual property rights.

6. Programme Learning Outcome

1. An advanced and systematic or coherent understanding of the academic field of Science, its different learning areas and applications, and its linkages with related disciplinary areas/subjects.
2. The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This can be utilized in modeling and solving real life problems.
3. Procedural knowledge that creates different types of professionals related to the disciplinary including professionals engaged in research and development, teaching and government/public service
4. Skills in areas related to one's specialisation area within the disciplinary and current and emerging developments in the field of Science
5. Demonstrate relevant generic skills and global competencies such as (i) problem solving skills that are required to solve different types of problems with well-defined solutions, and tackle open-ended problems that may cross disciplinary-area boundaries;
6. Communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences
7. Analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language
8. ICT skills
9. Personal skills such as the ability to work both independently and in a group.

7. Teaching learning processes:

The teaching learning processes incorporate a variety of modes and a regular use of ICT. These are listed below:

1. Classroom Teaching for topics which are intensely information-based. This a very regular feature of all the courses in Biotechnology
2. Power Point slides for topics which involve information related to intricate biological pathways such as metabolic pathways in Plant, Animal and Microorganisms. Use of

Power Point presentations are also made whenever the lectures are to be summarized in a crisp and pointwise manner to highlight salient / important conclusions from the topics.

3. Classroom Discussions are a regular feature while teaching. The students are drawn into impromptu discussions by the teacher during the process of teaching.
4. Video Displaying, both real-time and animations, are used for topics which require 3D dimensional viewing of the biological mechanisms to drive the point home. These have proved to be very helpful while teaching concepts of molecular biology like DNA replication, transcription and translation. These are also used to convey complexities of antigen-antibody interactions and generation of antibody diversity during the teaching of Immunology.
5. Model Making is also used especially for understanding and building a perception of the students for the structures of viruses which cannot be seen by a light microscope and can be seen only under expensive equipment like electron microscopes.
6. Laboratory Practical are an integral part of every course included in PG programme in Biotechnology. The is also a daily affair for PG students of Biotechnology
7. Problem Solving is encouraged during the laboratory work.
8. Group Activity as well as discussions with the laboratory supervisor/ among the students themselves/ Mentor is also encouraged during laboratory work.
9. Project Work is included in the programme where students work individually or in groups to design experiments to solve/answer a problem suggested by the Mentor or identified by the students in consultation with the Mentor. The students are mentored regularly during the duration the project is in progress.
10. Presentations by the Students are regularly done. The students are mentored in presentation of data, interpretation of data and articulation with the students/teachers/Research Scholars during their presentation.
11. Presentation by Experts in different specialties of Biotechnology are arranged to broaden the horizons of the students.
12. Interaction with Experts is also encouraged during/after presentations to satisfy/ignite curiosities of the students related to developments in the different ares of Biotechnology.
13. Visit to Industries/Laboratories related to Biotechnology like fermentation, food, diagnostics etc. are organized to acquaint the students with real-life working

environments of the professional Biotechnology with a view to broaden their perspective of the subject of Biotechnology

8. Assessment Methods:

It is important that the students of PG Biotechnology program achieve the desired results in terms of the learning outcomes to be professionally sound and competitive in a global society. Achieving the desired learning outcomes is also imperative in terms of job employment leading to a happy and prosperous individual further leading to a happy and prosperous family and thereby a happy and prosperous society or nation. The assessments tasks are pivotal to get an authentic feedback for the teaching learning process and for mid-course corrections and further improvements in future. The assessment tasks are carried out at various stages of the duration of the PG Biotechnology programme like Mid-term assessments, End-term assessments, Semester examinations, Regular assessments, viva-voce etc. The assessment tasks are listed below:

1. Multiple Choice Questions (MCQ) are one of the predominant forms of assessment tasks. This task is used during all kinds of term and semester examinations.
2. Short-Answer Questions during term and semester examinations are used to assess the ability of the student to convey his thoughts in a coherent way where prioritization of the information in terms of their significance is tested.
3. Surprise Quizzes are regularly used during continuous assessment while the teaching learning process is continuing which prepares the student to quickly recall information or quickly analyze a problem and come up with proper solutions.
4. Visual/Pictorial Quizzes are used to sharpen the comprehension of the students after looking at all the components of a system.
5. Impromptu Opinions on microbiological problems are sought from student during regular teaching learning which help them to think quickly in a given context. This help build their ability to come up with solutions to problems which the students might not have confronted previously.
6. Problem Solving question are generally given during the laboratory work.
7. Data Interpretation is also another assessment task which is used to develop analytical skills of the students. This assessment is used during laboratory work as

well as during conduction of project work.

8. Analytical Skills are assessed during work related to several experiments like enzyme kinetics, growth of bacteria and bacteriophages, mutation frequencies.
9. Paper/ Project presentations are used to assess the articulation skills of the student. These are carried out both during the duration of the teaching learning processes as well as during end-Semester examinations.
10. Report Writing is used to assess the keenness of the students for details related to microbiology while visiting laboratories / industries as students invariably are required to submit a report after such visits.
11. Assignment Writing are used to assess the writing abilities of the students during midterm vacations.
12. Viva-voce during the laboratory working hours and during laboratory examination are used to assess the over-all knowledge and intelligence of the students.

M.Sc. BIOTECHNOLOGY CURRICULUM

Total number of Credits: 90

Code No.	Course	Hours/Week			Credits	Maximum Marks		
		Lecture	Tutorial	Practical		CA	SEE	Total
SEMESTER 1								
Core	Core 1 Cell and Developmental Biology	3	0	2	4	40	60	100
Core	Core 2 Microbiology	4	0	0	4	40	60	100
Core	Core 3 Biochemistry	4	0	0	4	40	60	100
Core	Core 4 Biochemistry and Microbiology Practical	0	0	4	2	40	60	100
DSE	DSE 1 Molecular Genetics	4	0	0	4	40	60	100
DSE	DSE 2 Bioinstrumentation	4	0	0	4	40	60	100
SEC	Soft Skill 1/ Sector Skill Course	2	0	0	2	40	60	100
		21	**0**	6	**24**			
SEMESTER II								
Core	Core 5 Genetic Engineering	4	0	0	4	40	60	100
Core	Core 6 Bioprocess Technology	4	0	0	4	40	60	100
Core	Core 7 Immunotechnology	4	0	0	4	40	60	100
Core	Core 8 Genetic Engineering & Bioprocess Technology Practical	0	0	4	2	40	60	100
Core	Core 9 Immunotechnology Practical	0	0	4	2	40	60	100
DSE	DSE 3 Genomics and Proteomics	4	0	0	4	40	60	100
SI	Internship	0	0	4	2	40	60	100
SEC	Soft Skill 2/ Sector Skill Course	2	0	0	2	40	60	100
		18	**0**	**12**	**24**			

SEMESTER III								
Core	Core 10 Plant Biotechnology	4	0	0	4	40	60	100
Core	Core 11 Animal Biotechnology	4	0	0	4	40	60	100
Core	Core 12 Environmental and Nanobiotechnology	4	0	0	4	40	60	100
Core	Core 13 Plant and Animal Biotechnology Practical	0	0	4	2	40	60	100
DSE	DSE 4 Pharmaceutical Biotechnology	4	0	0	4	40	60	100
DSE	DSE 5 Bioinformatics and IPR, & Bioethics	4	0	0	4	40	60	100
SEC	Soft Skill 3/ Sector Skill Course	2	0	0	2	40	60	100
		22	**0**	4	**24**			
SEMESTER IV								
Core	Core 14 Research Methodology and Biostatistics	4	0	0	4	40	60	100
GE	---------	4	0	0	4	40	60	100
Core	Project Work	0	0	20	10	40	60	100
		8	**0**	**20**	**18**			

CA - Continuous Assessment , SEE - Semester End Examination

List of Discipline Specific Elective Courses

1. Molecular genetics
2. Bioinstrumentation
3. Tissue Engineering and Stem Cell Biology
4. Genomics & Proteomics
5. Fermentation Technology
6. Medical and Herbal Biotechnology
7. Pharmaceutical Biotechnology
8. Bioinformatics, IPR & Bioethics
9. Project Management and Biotech products Entrepreneurship

List of Generic Elective Course

1. Biomedical Waste Management
2. Biotechnology and Human Welfare
3. Environmental Biotechnology
4. Mushroom Cultivation and Medicinal Plant Gardening

List of Skill Enhancement Courses

1. Soft Skill I
2. Soft Skills II
3. Soft Skills III

Syllabus
Core Courses

CELL AND DEVELOPMENTAL BIOLOGY 3 0 2 4

Course Objective: (Skill Development)

To understand the basics of cell and developmental biology such as cell organelles, cell cycle cell signals, fertilization, embryogenesis and developmental differentiation.

UNIT I Biomembrane and cell organelles 9

Membrane structure and function**:** structure of models membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, electrical properties of membranes. Structural organization and function of intracellular organelles: nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum**,** cell wall, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

UNIT II Nucleic acid, cell cycles and cell signals 9

Organization of genes and chromosomes**:** Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons. Cell division and cell cycle: mitosis, meiosis, their regulation, steps in cell cycle and their control cycle. Cell signaling**:** Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors signal transduction pathway, second messengers, regulation of signaling pathway, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

UNIT III Cell communication and Cancer biology 9

Cellular communication: regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Cancer: genetic rearrangement of progenitor cells, oncogenes, tumor suppressor genes, cancer and cell cycle, virus- induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

UNIT IV Developmental differentiation 9

Embryonic development, cellular differentiation, organogenesis, metamorphosis, genetic basis of development, stem cells, programmed cell death, aging and senescence. Concepts of

development**:** potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradient; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

UNIT V Fertilization and embryogenesis 9

Gametogenesis: fertilization and early development: production of gametes, cell surface molecule in sperm egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage blastula formation, embryonic fields, gastrulation and formation of germ layer in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Total: 45hrs

Course Outcomes:

- CO-1: List about basic cell biology, developmental biology principles and biomembarne and its functions
- CO-2: Explain about the various cell organelles and nucleic acid structure and functions.
- CO-3:Summarize on cell cycles of mitosis and meiosis with cell signaling and communications
- CO-4: Explain about cancer biology and oncogeness
- CO-5: Analyze on different aspects of embryo development and study about Gametogenesis of Male and female.

TEXT & REFERENCE BOOKS

1. Verma, P.S. and Agarwal, V.K. “Cell Biology”. S. Chand Publication.2008.
2. Arumugam N,“Cell Biology” ,Saras Publication, 2014
3. Arumugam N, R P Meyyan, “Cell Biology and Molecular Biology”, Saras publication, 2014.
4. Lodish, H. Berk, A., Kaiser, Krieger, Scott, Bretscher, Ploegh and Matsudaria, P. “Molecular Cell Biology”. Media connected, W. H. Freeman and company, 6th edition. 2008.
5. Cooper, G.M. and Hausman, R.E. “The Cell”. Molecular approach. A.S.M press. 4th edition. 2007.
6. Pollard, T.D. and Earnshaw, C. “Cell Biology”. 2nd Edition.2008.

7. Weaver, R.F. “Molecular Biology”. McGraqw Hill International. 2008.
8. Williams, L and Wilkins. “Cell and Molecular Biology”. B.I. Publication. 8th edition. 2005.
9. Davide, Sadava, “Organelle structure and function”. Panima publishing.2004.

CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY PRACTICAL 3 0 2 4

Course Objective: (Skill Development)

To educate and train the students for lab techniques of Cell Biology and Developmental Biology

List of Experiments

Cell Biology

1. Microscopy: Types and Application
2. Measurement of cell size by micrometry
3. Cell counting - RBC and WBC
4. Microtome, Fixation, Embedding, Sectioning, Staining.
5. Histochemical methods for proteins, carbohydrates, lipids and enzymes.
6. Mitosis and Meiosis. Preparation of metaphase chromosomes from cultured cells.

Developmental Biology

7. Culture of Drosophila
8. Culture of Drosophila result analysis
9. Chick embryo development (24hrs, 48hrs, 72hrs and 96hrs)
10. Demonstration on mouse embryo separation

Total: 15 hours

Course Outcome:

- CO-1: Understand cell biology lab practices and skilled in microscope operations
- CO-2: Illustrate on RBC and WBC count in blood
- CO-3: Examine on microtome tissue sectioning and histochemical analysis
- CO-4: Analyze the cell division of mitosis and meiosis in cultured cells
- CO-5: Explain the culturing Drosophila and its observations, know about embryo development using chick embryo and embryo separation techniques using mouse model.

TEXT &REFERENCE BOOKS

1. Gunasekar, . P. “Laboratory Manual in Microbiology”. New Age International Private Ltd. Publishers, New Delhi, Chennai. 1995
2. Jayaraman J,“Laboratory Manual in Biochemistry” (5th reprint) New Age
3. International Publishers Mumbai, Chennai, 1996.
4. M. Prakash, C.K. Arora, “Biochemical techniques”,Anmol Publications (I) Ltd New
5. Delhi. 1998.
6. Ian Freshney R. “Culture of Animal Cells: A Manual of Basic Technique”, Wiley-Liss, 2005.
7. David T. Plummer, “An Introduction to Practical Biochemistry”,Tata McGraw Hill Publishing Company Ltd. New Delhi. 3rd Edition, 2006.

MICROBIOLOGY 4 0 0 4

Course Objective: (Employability)

To provide detailed knowledge about taxonomy and diversity of microbes, growth, functions and diseases caused by them.

UNIT I **12**

Microbial Taxonomy, systematics, identification: Taxonomical hierarchy species-type strains: culture collections; binomial nomenclature; system of classification - phonetic, numerical taxonomy. General characteristics used in classification- five kingdoms, six kingdoms and eight kingdom systems. Classification of microbes using DNA analysis, proteins, rRNA analysis and phylogeny.

UNIT II **12**

Nutritional requirements and types of microorganisms, Uptake of nutrients by microorganisms. Photosynthetic microorganisms. Nitrate and sulfur oxidizing bacteria, Nitrate and sulfate reducing bacteria. Nitrogen fixation. Hydrocarbon transformation. Role of microorganism in agriculture, food and dairy industry.

UNIT III **12**

Host – parasite relationship, normal microflora. Infection types and mode of disease transmission. Causative agent, pathogenesis and control measures of typhoid, cholera, tuberculosis, AIDS, hepatitis, malaria and candidiasis. Antimicrobial agents and their mode of action – antibacterial, antiviral, antifungal, antiparasitic agents.

UNIT IV **12**

Mutation and Mutagenesis: UV and chemical mutagens; Types of mutation; Ames test for mutagenesis. Plasmids and Transposons. Methods of genetic analysis – Transformation, Conjugation, Transduction. Bacterial genetic maps with reference to E. coli, viruses and their genetic system – Phage life cycle, Genetic systems of yeast and Neurospora.

UNIT V **12**

Role of microorganisms in food production (SCP) dairy and non-dairy products. Fuel (ethanol), pharmaceuticals (antibiotics), biofertilizers (BGA), biopesticides (Bacillus thuringenesis), biopolymers, biosurfactants, vitaminB12, protease, glutamic acid. Secondary metabolites. Biogas

production, biocomposting and biotransformation

Total: 60 Hours

Course Outcome:

CO-1: Recallabout microscopy and Prokaryotic and eukaryotic cells and classification

CO-2: Demonstrate about the nutritional requirement for microbial growth and role of microbes in various fields.

CO-3: List about various microbial diseases and antimicrobial chemicals and its actions.

CO-4: Explain about mutation and various plasmids and gene transfer mechanism.

CO-5: Importance of microorganisms in food industry and various applications of microbes.

TEXT &REFERENCE BOOKS

1. Pelczar MJ, Chan ECS, and Krieg NR. Microbiology, Tata McGraw Hill Publishing Company, 5th Edition. 2006.

2. Prescott LM, Harley JP and Klein DA. Microbiology, McGraw Hill, 6th Edition,2005.

3. Talero KP and Talero A. Foundations in Microbiology, McGraw Hill, 4th Edition, 2002.

4. Benson HJ. Microbiological Applications: A Laboratory manual in General Microbiology, McGraw Hill. 7th Edition, 1999.

5. Salle AJ. Principles of bacteriology, Tata McGraw-Hill Publishing Company Ltd. New Delhi. 7th Edition, 1986.

6. Modi HA. Elementary Microbiology (Volume- 1 Fundamentals of Microbiology). Akta Prakashan Nadiad, Publication. 1995.

7. Freifelder D. Microbial Genetics, Narosa Publishing House. 1995

8. Maloy SR, Cronan JE and Freifelder D. Microbial Genetics, Jones Barlett Publishers.2nd Edition , 1994.

9. Cappuccino JG and Sherman N. Microbiology - A Laboratory Manual, , Editors: Wirth AE and Olsen L. nology: concepts, applications and perspectives, Wiley VCH publishers, 5th Edition

BIOCHEMISTRY 4 0 0 4

Course Objectives (Skill Development)

To develop understanding and provide scientific basics of the life processes at the molecular level and explain the structure, function and inter-relationships of biomolecules and their deviation from normal and their consequences for interpreting and solving clinical problems.

UNIT I Biochemical Organization and Bioenergetics 12

Bioenergetics - and biological oxidation – general concept of oxidation and reduction, electron transport chain, oxidative phosphorylation, uncouplers and theories of biological oxidation and oxidative phosphorylation. High energy compounds, ATP cycle, Calculation of ATP during oxidation of glucose and fatty acids.

UNIT II Biomolecules – Carbohydrates & Lipids 12

Carbohydrates – classification, properties. Starch, glycogen, dextrin, inulin, cellulose, metabolism of carbohydrates – gluconeogenesis, glycogenolysis, glycolysis. citric acid cycle, pentose phosphate pathway. Lipids – Classification, properties, Sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, metabolism of lipids, oxidation of fatty acids, α,β - oxidation and biosynthesis of ketone bodies, cholesterol, porphyrin biosynthesis, metabolism of bile pigments.

UNIT III Biomolecules – Proteins & Nucleic Acid 12

Proteins and amino acids – Classification, properties, biosynthesis of amino acids and proteins, essential amino acids, metabolism of amino acids and proteins, Nitrogen balance. Nucleic acids – genetic code, nucleic acids, and structure of DNA and RNA, purine biosynthesis and pyrimidine biosynthesis.

UNIT IV Vitamins, Hormones, Enzymes 12

Physical and chemical properties, structure of haemoglobin, immunoglobulins and nucleoprotein, classification and their properties, occurrence, functions, requirements, deficiency manifestations and role of vitamins as coenzyme, chemical nature and properties, hormones, Nomenclature, enzyme kinetics, classification and their properties, mechanism of action, enzyme induction and

inhibition, coenzyme significance and enzymes of clinical importance – Enzyme Markers.

UNIT V Biochemistry Of Clinical Diseases **12**

Scope of clinical biochemistry, Diabetes mellitus, atherosclerosis, fatty liver, and obesity, hormonal disorders, aging, inborn errors of metabolism organ function tests.

Total: 60 Hours

Course Outcomes

- CO-1: Understand the basis of the cell and its structure and importance Bioenergetics, ATP and other high energy compounds.
- CO-2: Illustrate the structure and Metabolism of carbohydrates and Lipids.
- CO-3: Summarise the structure and Metabolism of proteins and Nucleic acids.
- CO-4: List the function of hormones, vitamins, action and regulations of enzymes.
- CO-5: Explain the Scope of clinical biochemistry and clinical disorders.

TEXT& REFERENCE BOOKS:

1. Lehninger A.L., Nelson D.L. and Cox M.M. Principles of Biochemistry. CBS publishers and distributers, 7th edition, 2016
2. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. Harpers Biochemistry. Appleton and Lange, Stanford, 24th edition, 1996
3. Thomas M. Devlin.Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers, 7th edition, 2010
4. Burtis & Ashwood W.B. Tietz Textbook of Clinical chemistry. Saunders Company, 2nd Edition, 1993.
5. Lubert Stryer W.H. Biochemistry. Freeman and company, New york, 6th Edition, 2006
6. Donald Voet & Judith G. Voet. Biochemistry. John Wiley and Sons ,Inc.4th.edition, 2010
7. Rama Rao, Textbook of Biochemistry.UBS Publishers' Distributors Pvt. Limited, 9th edition 2006
8. Deb. Textbook of Biochemistry. New Central Book Agency (p) Ltd, 9th edition , 2001

BIOCHEMISTRY & MICROBIOLOGY LAB 0 0 4 2

Course Objectives: (Employability)

To enable the students to learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids and to learn about the microbial techniques Like culture techniques, Staining techniques and Biochemical analysis.

List of Experiments:

Biochemistry

1. Qualitative tests for carbohydrates.
2. Qualitative analysis of amino acids & proteins.
3. Quantitative estimation of protein using Lowry's Reagent.
4. Quantitative analysis of urea in serum.
5. Quantitative estimation of serum cholesterol by Libermann Burchard's method
6. Chromatography: Separation of amino acid by Thin Layer Chromatography.
7. Extraction and assay of acid phosphatase from potato.

Microbiology

1. Sterilization of glassware, media
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs.
4. Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram's Staining Capsule staining, Spore staining
5. Isolation of microbes from water, air, soil and plant surface
6. Growth curve, Optimization of microbial growth – PH, Temperature
7. Catalase test – Oxidase test – Urease test – IMViC test.

Total: 30 Hours

Course Outcomes:

Upon completion of the laboratory sessions, the students will be able to

- CO-1: Understand the basic principles of biochemical estimations and assays
- CO-2: Analyze various biomolecules both quantitatively and qualitatively.
- CO-3: Explain the various methods of enzyme assays needed for clinical research.
- CO-4: Examine of microbes from water, air, soil and plant surface.
- CO-5: Elaborateon microbial techniques like culture techniques, Staining techniques and Biochemical analysis.

TEXT & REFERENCE BOOKS

1. Jayaraman J., Laboratory Manual in Biochemistry, 2nd Edition, New Age International Private Limited, January 2011.
2. . Sawhney S. K, Randhir Singh Eds, Introductory Practical Biochemistry, 5th or later edition, Narosa Publishing House, New Delhi, 2014.
3. Gupta R.C. and Bhargavan S. Practical Biochemistry., CBS; 5th edition, 2018.
4. David T. Plummer, "An Introduction to Practical Biochemistry", Tata McGraw Hill Publishing Company Ltd. New Delhi. 3rd Edition, 2006
5. Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.
6. Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, Churchill Livingstone, 1996.

GENETIC ENGINEERING 4 0 0 4

Course Objective: (Employability)

To provide fundamental theoretical knowledge about Genetic Engineering, Cloning Vector, molecular techniques.

UNIT-I Introduction to genetic engineering **12**

Introduction to genetic engineering: Importance and outline of genetic engineering, organization of gene and genome, gene expression- Enzymes in genetic engineering- Endo and exonucleases - Restriction endonucleases- types, and mechanism of action, Ligases - types and mechanism of action, linker, adaptor, homopolymer tailing - Polymerases types and mechanism of action- other enzymes

UNIT-II Cloning Vectors and their applications **12**

E. coli Vectors - Plasmids (Properties, types, In vitro construction-pBR322, pUC), Bacteriophage- lambda and M13 (Biology, Classes, in vitro construction of cloning vectors), Cosmids and phagemids and its properties- vectors for gram positive and gram-negative bacteria -Plant viral vectors- animal viral vectors- Cloning in Yeast- Expression vectors.

UNIT-III Isolation and Transfer **12**

Plasmid isolation and purification method- nucleic acid and protein electrophoresis -nucleic acid staining and labelling - types of gene transfer- molecular probes - Selection and screening of recombinants – Blotting techniques - hybridization techniques – Autoradiography

UNIT-IV Modern Techniques

PCR technology – concept, types, primer design- DNA synthesis - DNA sequencing methods - DNA microarray technology - Molecular markers and types- Chromosome walking and jumping - DNA finger printing - DNA Foot printing- RNA interference.

UNIT V Applications **12**

Site directed mutagenesis- Protein engineering - Gene therapy – types- Application of genetic engineering in medicine and agriculture- antisense technology- Industrial applications of rDNA technology- recombinant vaccines- Genetically modified organism- Ethical, legal and social

issues

Total: 60 Hours

Course Outcomes:

- CO-1: Understand the basics of gene cloning, genetic engineering tools, nucleic acid manipulating enzymes and various modern techniques used in rDNA technology.
- CO-2: Summarize bout genetic engineering techniques, molecular probes and blotting techniques.
- CO –3: Make use of various molecular techniques and their application such as DNA sequencing and fingerprinting.
- CO –4: Explain about Gene transfer technologies and its application the Agriculture and Forensic science
- CO –5: Discuss About vaccines, protein engineering, GMOs organisms and Gene therapy

TEXT &REFERENCE BOOKS:

1. Old.R.W and Primrose S.B. Principles of Gene manipulation: An introduction to genetic engineering, Blackwell Sciences, U.K. 1998.
2. Brown T.A., Gene cloning and DNA analysis, Wiley Blackwell science. 6th edition, 2010.
3. Watson, Molecular Biology of the gene, Person education, Singapore.5th edition, 2004
4. Kreuzer-Massey, Recombinant DNA and Biotechnology, ASM Press, 2001
5. Alcamo, I. Edward. DNA Technology, Academic Press, 2001
6. Walker J.M. and R. Rapley, Molecular Biology and Biotechnology, 4th edition. 2006
7. Glick, B.R. and J.J. Pasternak, Molecular Biotechnology. Panima Publishing House, New Delhi, India. 2002.
8. Primrose, S.B. Molecular Biotechnology. Panima Publishing House, New Delhi, India. 2001.
9. Winnacker, E.L., Genes to Clones. Panima Publishing House, New Delhi, India. 2003.
10. Singh B.D., Molecular biology and Genetic Engineering, Kalyani publishers.2005

BIOPROCESS TECHNOLOGY 4 0 0 4

Course Objective (Employability)

To provide the students with the basics of bioprocess principles and bioreactor engineering. To develop bioengineering skills for the production of biochemical products using integrated biochemical processes.

UNIT I: Introduction to Bioprocess Technology 12

Scaling up of a Bioprocess, Upstream Processing, Downstream Processing, Fermentation- Types of Fermentation, Its significance in Industry, Submerged Fermentation and Solid-state fermentation, batch fermentation and continuous fermentation, Chemostat Fermentation.

UNIT II: Design of Fermentation Process 12

Kinetics of substrate utilization, biomass growth and product formation, inhibition on cell growth and product formation. Design and operation of continuous cultures, chemostat in series, batch and fed batch cultures, total cell retention cultivation.

UNIT III: Bioreactor Design & Construction 12

Basic configuration of Fermentor, Batch, continuous and fed batch cultivation, cell recycle cultivation, High cell density cultivation, two stage cultivation, packed bed reactor, airlift reactor, fluidized bed reactor and bubble column reactor. Media design and optimization for fermentation process, Thermal death kinetics of microorganism, Sterilization of liquid media and air, Design of batch and continuous sterilization, Biomass estimation - direct and indirect methods.

UNIT IV: Downstream Processing 12

Filtration, centrifugation, cell disruption, liquid/liquid extraction, dialysis, Purification, Drying, Packing and labelling. Good Manufacturing Practices, Biosafety - laws and concerns at different levels- individual, institution and society. Forms of IPR and process of patenting.

UNIT V: Fermentation Derived Products 12

Industrial production of Primary metabolites and secondary metabolites- shikimic acid, flavanoids Fermentative production of alcohol, citric acid; Amino acid – Phenylalanine; Vitamins – Riboflavin; Antibiotics – Penicillin; Microbial production of enzymes- amylase,

protease, cellulase; SCP production.

Total Hours: 60

Course Outcome:

- CO-1: Understand on operation modes and select appropriate bioreactor configurations based upon the nature of bioproducts and cell lines and other process criteria.
- CO-2Explain type of Bioprocess and standard Lab practices.
- CO-3: To Design bioreactor and control process of bioreactor.
- CO-4: List out different techniques involved in downstream processing.
- CO-5:Maximize Industrial production conditions through fermentation

TEXT & REFERENCE BOOKS

1. Stanbury P.F., A Whitaker and S.J.Hall , Principles of Fermentation Technology,. Elsevier. 2008.
2. Kalichelvan P.T. and I Arul Pandi, , Bioprocess Technology, MJP Publishers, Chennai, 2009.
3. Shuler M.& F.Kargi, Bioprocess Engineering, Prentice Hall (I) Ltd., N.Delhi. 2002.
4. Mansi E.M.T., C.F.A. Bryce. A.L..Dmain, A.R.Alliman. Fermentation Microbiology and Biotechnology, , Taylor and Francis. New York, 2009.
5. Cassida L.E, Industrial Microbiology,John Wiley and Sons Publishers. 1968.

GENETIC ENGINEERING AND BIOPROCESS TECHNOLOGY PRACTICALS 0 0 4 2

Course Objective: (Employability)

To educate and train the students for lab techniques of genetic engineering and gene cloning. To learn - microbial process fundamentals, enzyme catalysis. Bioreactor design and analysis.

List of Experiments:

Genetic Engineering

1. Isolation of genomic DNA and Plasmid DNA
2. Estimation and identification of nucleic acids and protein (AGE, SDS).
3. Transformation, selection of transformed colonies and preservation
4. Blotting Techniques – Southern, Northern
5. PCR and Manual DNA sequencing (Demo)

Bioprocess Technology

1. Growth optimization of Bacteria – Estimation of Biomass, calculation of specific growth rate, Yield coefficient.
2. Growth optimization of Algae - Estimation of Biomass, calculation of specific growth rate, Yield coefficient.
3. Effect of pH on enzyme activity
4. Effect of temperature on enzyme activity
5. Immobilization of enzymes – Entrapment Method
6. Effect of different substrate for the production of citric acid by *Aspergillus niger* by solid substrate fermentation and estimation of citric acid

Total : 30 Hours

Course Outcome

- CO-1: Demonstrateon training in isolation of Bacterial Culture.
- CO-2: Illustrategenomic and plasmid DNA isolation and Agarose gel electrophoresis and SDS-PAGE
- CO-3: Students will be given practical training in Purification and Quantization of

nucleic acids and about selection of transformed colonies and preservation.

- CO-4: Explain about biological and kinetic concepts underlying bioprocesses engineering
- CO-5: Elaborate theprocedures for the design and control of industrial scale fermentation and biological waste treatment processes.

TEXT &REFERENCE BOOKS:

1. Sambrook, J, E.F. Fritsch and T. Maniatis, Molecular Cloning, A Laboratory Manual, Cold Spring Harbor Laboratory Press, New York. 2000.
2. Glover, D.M. and B.D. Hames, DNA Cloning a Practical Approach. IRL Press, Oxford. 2000.
3. James, J.G. and V.B. Rao, Recombinant DNA Principles and Methodologies. Marcel Dekker Publications, NewYork. 2001.
4. Maliga, P., Methods in Plant Molecular Biology. A Laboratory Course Manual, Cold Spring Harbour Laboratory Press, NewYork. 2000.
5. Bailey and Ollis, ― Biochemical Engineering Fundamentals‖, McGraw Hill (2nd Ed.), 1986.
6. Shuler and Kargi, ― Bioprocess Engineering ―, Prentice Hall, 1992.
7. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications., 1995
8. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Butterworth-Heinemann., 3rd Edition, 2016.

IMMUNOTECHNOLOGY 4 0 0 4

Course Objectives (Skill Development)

To provide wider and global perspective of techniques involved as well as the genetic basis of the immunological diseases and their cure, with an ability to discriminate, evaluate, analyse and synthesis existing and new knowledge, and integration of the same for enhancement of knowledge

UNIT I Introduction to Immunotechnology 12

Brief history of Immunotechnology, immune system, components of immune system, Innate and adaptive immune system, external and internal barriers, phagocytosis. Antigen clearance mechanism.

UNIT II Antibodies & Immunodiagnosis 12

Monoclonal and polyclonal antibodies – their production and characterization – Western blot analysis – Immuno electrophoresis, SDS-PAGE – Purification and synthesis of antigens – ELISA principle and applications – Radio immuno assay (RIA) principles and applications – Non isotopic methods of detection of antigens – Enhanced chemilluminescence assay

UNIT III: Cellular Immunology 12

PBMC separation from the blood; identification of lymphocytes based on CD markers; FACS; Lympho -proliferation assay; Mixed lymphocyte reaction; Cr51 release assay; macrophage cultures; cytokine bioassays- IL2, gamma IFN, TNF alpha; HLA typing.

UNIT IV: Immunopathology 12

Preparation and storage of tissues, identification of various cell types and antigens in tissues – Isolation and characterization of cell types from inflammatory sites and infected tissues, functional studies on isolated cells – Immuno cytochemistry – Immuno fluorescence, Immuno-enzymatic and Immuno-ferrtin techniques, immuno-electron microscopy.

UNIT V: Molecular Immunology 12

Vaccines: Vaccine technology including DNA vaccines, identification of B and T epitopes for vaccine development. Immunodiagnosis of infectious diseases, immune screening of recombinant library.

Total: 60 Hours

Course Outcome

- CO-1: Summarize on techniques like developing diagnostic tests, characterization of lymphocytes, and purification of antigens.
- CO-2: Explain on the molecular events involved in immunological processes and their regulation
- CO-3: Illustrate health problems with an immunological background.
- CO-4: Analyze molecular immunology for diagnosis of disease.
- CO-5: Develop approaches of immune intervention

TEXT & REFERENCE BOOKS

1. Roitt, Ivan. Essential Immunology, Blackwell Scientific, 9th Ed, 1997.
2. Goldsby, R.A., Kindt, T.J., Osbome, B.A & Kerby, J. Immunology., W.H Freeman, 5th Ed, 2003.
3. Jenni, Punt, Sharon, Stanford, Patricia, Jones and Judith, A, Owen, "Kuby Immunology", WH Freeman & Co., 8th Edition, 2018.
4. Ashim K. Chakravarthy, "Immunology and Immunotechnology", Tata McGraw-Hill, 2006.
5. Weir, D.M & Stewart, J. Immunology, Churchill Livingstone, 8th Ed., 1997.

IMMUNOTECHNOLOGY LABORATORY 0 0 4 2

Course Objectives (Skill Development)

To teach advanced techniques and skills required in diagnosis, treatment and research in Immunotechnology. To acquire knowledge concerning the principles and applications of immunoassay procedure.

LIST OF EXPERIMENTS

1. Collection of Blood, Serum and Plasma
2. Methods of bleeding (Eg. Tail bleeding, Intravenous, intraorbital)
3. Collection of serum, storage and purification of total IgG (salt precipitation).
4. Blood smear identification of leucocytes by Giemsa stain
5. Identification of various types of immune cells in peripheral blood smear
6. Agglutination reactions: Determination of hemagglutination titer of IgM antibodies using human RBC
7. Double immunodiffusion (Ouchterlony Double Diffusion)
8. Radial immunodiffusion test
9. Antigen-antibody reaction-Haemagglutination, precipitation-Widal and VDRL
10. Affinity chromatography for antibody purification.
11. ELISA-DOT and plate ELISA
12. Western blotting

Total: 30 Hours

Course Outcome

- CO-1: Summarize on immune system cells and tissues.
- CO-2: Understand on immunological and clinical tests.
- CO-3: Illustrate on collection and storage of serum.

- CO-4: Explain on Immunodiffusion techniques.
- CO-5: Discuss on ELISA and Western blotting.

REFERENCE BOOKS

1. Edward A. Greenfield. Antibodies: A Laboratory Manual, Cold Spring Harbor Laboratory Press, 2nd Edition, 2014
2. John E. Coligan.et al. Current protocols in immunology, New York: Wiley Interscience, 2003.
3. Practical Immunology Frank C. Hay and Olwyn M.R. Westwood, Blackwell Science Ltd., 4th edition, 200

PLANT BIOTECHNOLOGY 4 0 0 4

Course Objectives (Employability)

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

UNIT I: History of plant tissue culture. 12

Concept of totipotency. Application of plant tissue culture- Agriculture, horticulture, forestry, cryopreservation, germplasm conservation. Design of Plant tissue culture laboratory. Nutritional requirements of plant tissue culture. Composition of MS media, Gamborg's media, Nitchs media, White's media and their preparation. Plant growth regulators. Sterilization techniques.

UNIT II: Plant micropropagation 12

Micro grafting, advantages of hairy root culture and culturing of meristem and shoot tip. Establishment and maintenance of callus and suspension culture. Somatic embryogenesis-Synthetic seeds.

UNIT III: Haploid plant production 12

Anther and microspore culture, triploid production, embryo culture and embryo rescue. In vitro pollination and fertilization. Protoplast isolation – fusion and culture regeneration. Somatic hybrids and cybrids. Somaclonal and gametoclonal variation.

UNIT IV: Plant genome organization. 12

Role of RFLP in plant breeding. DNA bar-coding in plants. Transposable elements in plant. Plant transformation technology: Ti and Ri plasmids, binary & co-integrated vector systems; viral vectors and their applications; 35S and other promoters; genetic markers; reporter genes; virulence genes; Cloning Strategies; Gene transfer methods in plants – Direct DNA transfer methods, Agrobacterium mediated gene transfer.

UNIT V: Application of gene transformation in plant 12

Insect resistance, fungus resistance, virus resistance, drought, cold resistance, saline resistance,

Transgenic plant with vitamin A, Gene silencing in crop plants, Terminator seed technology,

Production of therapeutic antibodies, edible vaccine. Extraction of secondary metabolites using plant tissue culture.

Total: 60 Hours

Course Outcome

Students will be able to

- CO-1: List the principles and processes in plant biotechnology.
- CO-2: Understand the concept of Plant Biotechnology.
- CO-3: Distinguish between different plant tissue culture techniques
- CO-4: Apply different techniques to produce better crop using the principles of biotechnology
- CO-5: Discuss on differentTransgenic andconcepts of Plant Metabolic Engineering

TEXT &REFERENCE BOOKS

1. Hammond J, McGarvey P and Yusibov V. Plant Biotechnology, Springer verlag.2000

2. Satyanarayana U. Biotechnology, Books and Allied (p) Ltd., 3rd revised edition, 2005

3. Bhojwani SS and Razdan MK. 2004. Tissue Culture Theory and Practice. 2004

4. Paul Christou and Harry Klee. 2004. Hand Book of Plant Biotechnology Vol.I & II, John Wiley & Sons. 2004

5. Guptha PK. Elements of Biotechnology, Rastogi and Co. Meerut.1996

6. Chawla. HS. Biotechnology in crop improvement, International Book. 1998

7. Slater, Scott and Fowler. Plant Biotechnology (The genetic manipulation of plants), Oxford University, UK, 2003.

PLANT AND ANIMAL BIOTECHNOLOGY PRACTICALS 0 0 4 2

Course Objective: (Employability)

To educate and train the students for lab techniques of plant tissue culture and its manipulation.

Plant Biotechnology

1. Sterilization techniques – Glass wares, media and laminar air flow chamber
2. Preparation of plant tissue culture media, Surface sterilization methods of explants and seed culture
3. Establishment of callus cultures
4. Micro propagation
5. Development plat root and shoot by varying hormonal concentration
6. Hardening and green house transfer

Animal Biotechnology

7. Sterilization Technique in Animal tissue culture.
8. Preparation of animal cell culture medium.
9. Preparation of single cell suspensions from animal tissue
10. Preparation of Animal cell monolayer and Trypsinization of monolayer
11. Sub culturing of cell lines
12. Cell counting and Cell viability assay
13. Embryonated egg inoculation.

Total: 30 Hours

Course Outcome:

- CO-1: Understand the maintenance of culture lines
- CO-2: Demonstrate on callus propagation of plants and Preparation of tissue culture medium

- CO-3: Summarize onmembrane filtration and preparation of single cell suspension from spleen
- CO-4: Elaborate onCryopreservation techniques for cell culture and gain practical training in the cell counting and viability assays.
- CO -5: Discuss on the organized preparation of the scientific reports for the experiments.

TEXT & REFERENCE BOOKS

1. ChawlaH.S.,"Plant biotechnologyLaboratory Manual for Plant Biotechnology", oxford & IBH Publishing Co. Pvt.Ltd., 2004.
2. Ritu Mahajan, Jitendra Sharma, R.K. Maharajan, "Practical Manual of Biotechnology", Vayu Education of India, 2010.
3. Michael R. Green, Joseph Sambrook, "Molecular Cloning: A Laboratory Manual", Fourth Edition, 2014.
4. Ian Freshney R. "Culture of Animal Cells: A Manual of Basic Technique", Wiley-Liss, 2005.
5. William Wu, Michael J. welshpeter B. KaufmanHelen H. Zhang, "Methods in Gene Biotechnology", CRC Press, New York., 1997
6. Melody S. Clark. "Plant Molecular Biology - A Laboratory Manual", Springer
7. Publication New York., 1997
8. Bruce A. White, "Methods in Molecular Biology", Chapman and Hall, London,
9. New York., 1997
10. Melody S. Clark. "Plant Molecular Biology - A Laboratory Manual", Springer, 1997

ENVIRONMENTAL AND NANOBIOTECHNOLOGY 4 0 0 4

Course Objective: (Employability)

Students will understand the importance of living beings and their role in Environment, and importance of Nanoscience in biotechnology.

UNIT I Introduction **12**

The scope of environmental biotechnology; Biodegradation of macromolecules; biodegradation of xenobiotics; Heavy metal pollution; bioremediation of metal contaminated soils; spilled oils and grease deposits and synthetic pesticides.

UNIT II Bioremediation **12**

Phyto-remediation. Degradation of pesticides and other toxic chemicals by microorganisms-degradation of aromatic and chlorinated hydrocarbons and petroleum products. Treatment of municipal waste and Industrial effluents.

UNIT III Biomining and biofertilizer **12**

Biomining, Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM).

UNIT IV Introduction to Nanotechnology **12**

History and Scope of nanotechnology. Nanostructures: Nanometer, Quantum dots, Fullerenes Nanorods, Nanotubes, Nanofibres. Properties of Nanomaterials. Carbon nanotubes and their properties. Nanocomposites and Nanomachines.

UNIT V Applications of bionanotechnology **12**

Nanobiotechnology and future perspectives. Biological nanostructures. Nanolithography. Application of nanobiotechnology in health and life sciences. DNA and Protein as Nanostructures. Nanoparticles in drug delivery and Biocompatibility.

Total: 60 Hours

COURSE OUTCOME:

On completion of the course, the student should be able to:

- CO-1: Understand on fundamentals of Environmental science and how the

macromolecules and gene modifying substances are degraded.

- CO-2: Outline how plants are used in remediation and how, Aromatic and Chlorinated Hydrocarbons are degraded
- CO-3: Explain how the microbes and plants are used in Biomining of minerals / metals and to know different types of Biofertilizers including bacteria, algae and fungi.
- CO-4: List the importance of Nanotechnology an Interdisciplinary science and able to identify different types of Nanostructures
- CO-5: ElaborateDNA and Protein as a Nanostructure and how the Nanomaterials are serving as drug delivering agents.

TEXT & REFERENCE BOOKS:

1. Kumaresan V, N Arumugam, Environmental Biotechnology ,Saras,2014
2. Sandhya Jadhav, A Text Book of Environmental Biology and Biotechnology 2nd Edition Vision, Publications 2012
3. Evans,G.M and Furlong J.C. Environmental biotechnology: theory and application.John Wiely and Sons. 2003.
4. Manahan, S.E. Environmental science and technology. Lewis, New York, 1997.
5. Metcalf and Eddy (eds). Wastewater engineering: treatment and reuse, Tata McGraw-Hill, New Delhi. 2003.
6. Pradipta Kumar Mohapatra, "Environmental Biotechnology", I.K. International Publishing House; 1st Ed. Edition,2007.
7. ManasiKarkare, Nanotechnology: Fundamentals and Applications, I K International Publishing House Pvt. Ltd ,2008.
8. Charles Poole, Frank Owens, Introduction to Nanotechnology, Wiley 2007.

ANIMAL BIOTECHNOLOGY. 4 0 0 4

Course Objective: (Employability)

The Wide scope for animal biotechnologists is there as they can be absorbed by the biotechnology industry, research organizations, food – processing units and pharmaceutical industry.

UNIT-I Animal cells **12**

Aseptic techniques, elements of aseptic environment, safety and risk assessment, biohazards. Culture media, types of media. Physical, chemical and metabolic functions of different constituents of culture medium; role of carbon dioxide, serum, growth factors, glutamine in cell culture; serum and protein free defined media and their applications.

UNIT-II Cell culture **12**

Primary cell culture: isolation of tissues from chick embryo, mouse and human biopsies. Methods of maintenance of tissues, continuous and established cell cultures. Organ culture: types and limitations, histotypic and organotypic cultures. Cell separation techniques, cryopreservation. Cell-cell interaction. cell death – apoptosis and its determination.

UNIT-III Cell techniques **12**

Gene transfer method in Animal, Cytotoxicity assays, characterization of cultured cells, molecular techniques in cell cultures: in situ hybridization, cell fusion methods, production of monoclonal antibodies, somatic cell hybridization and cell cloning and selection.

UNIT–IV Embryology **12**

Collection and preservation of embryos; culturing of embryos; gametogenesis and fertilization in animals, Artificial insemination, *In vitro* fertilization and stem cell research. Ethical issues in animal biotechnology.

UNIT–V Transgenics, Animal Husbandry and Dairy Science **12**

Transgenic animals; production and application; transgenic animals as models for human diseases; Breeding methods of Cattle and buffalo Milking methods and principles, Clean milk production, Feeds and feeding, Conservation of fodder, Housing for dairy animals and Common animal diseases .

Total: 60 Hours

Course Outcome:

- CO-1: Demonstrate on Animal tissue culture techniques and about Medium used in Animal Biotechnology
- CO-2: Understand the various cell culture technique and explain Gene transfer methods in animals
- CO-3: Explain about Artificial insemination and IVF and well versed with organ culture
- CO-4: Discuss and gain knowledge about Animal disease
- CO-5: Elaborate on Growth hormones and well versed with Transgenic Animal

TEXT &REFERENCE BOOKS

1. Ranga, M. M. Animal Biotechnology, Agrobios India, Jodhpur. India., 2nd Edition, 2003
2. Freshney, R.I.,Animal Cell Culture: A Practical Approach. John Wiley Publications, New York. 4th Edition, 2000
3. Glick, B.R. and J.J.Pasternack,. Molecular Biotechnology. Blackwell Science, U.K, 3rd Edition, 2003
4. Gordon, I., Laboratory Production of Cattle Embryos., CAB International. New Delhi. 2nd Edition ,2003
5. Houdebine, L.M., Transgenic Animals: Generation and Use., CRC Press, New york, 5th Edition, 1997
6. Jenkins, N., Animal Cell Biotechnology Methods and Protocol. Humana Press, Totowa, New Jersey and Panima Publishing Corporation, New Delhi., 1999
7. Yagasaki, K., Y. Miura, M. HatoriandY. Nomura,Animal Cell Technology: Basic and Applied Aspects. Vol. 13 .Springer-Verlag, New York., 2008
8. Primrose, S. B., R. M. Twyman and R. W. Old, Principles of Gene Manipulation., Blackwell Science Publishing Company, Germany., 4th Edition. 2001
9. Portner,R.,Animal Cell Biotechnology: Methods and Protocols. Vol. 24Springer-Verlag, New York, LLC, 2007

RESEARCH METHODOLOGY AND BIOSTATISTICS 4 0 0 4

Course objective: (Skill Development)

To provide fundamental theoretical knowledge about Research Methodology, and Biostatistics.

UNIT-I: Introduction **12**

Definition- Objectives- Types- Significance of Research- Steps in research process Criteria for good research. Defining and formulating a research problem- Literature survey- Development of working hypothesis.

UNIT-II: Research Design: **12**

Definition and related concepts, Basic principles of experimental designs- Informal and formal experimental designs; Sampling design: Steps in sample design, Non-probability sampling and Probability sampling -random sampling; Measurement and scaling techniques- Methods of data collection - Execution of project -Processing and analysis of data- Hypothesis testing - Interpretation and report writing- Steps and layout of research report- Types of report, review paper writing and presentation.

UNIT-III: Qualitative and Quantitative Research **12**

Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

UNIT-IV: Statistical Methods 12

Measures of Central tendency -Mean, Median, Mode– Measures of Dispersion- Range, Quartile Deviation, Standard Deviation and Coefficient of variation. Correlation and regression analysis: Correlation: Types of Correlation-Methods of studying correlation- Regression: Regression Lines and Regression equations - simple problems.

UNIT-V: Testing of Hypothesis **12**

Introduction-Tests of Significance for small samples: t-test -F-test (variance –Ratio test), Chi-Square tests - Analysis of Variance **:** One way and Two Way Classifications Basic Principles of Experimentation – Completed Randomized Design – Randomized Block Design- Latin Square

Design.

Total: 60 Hours

Course outcome:

- CO-1: Understand on fundamentals of research and learn about research problem
- CO-2: Analyse the data for research purpose
- CO-3: Explain on sampling and its importance and gain knowledge on Basics on Qualitative and Quantitative Research
- CO-4: Evaluate on merging the two approaches and apply statistics and interpretation in Biological studies
- CO-5: Explain on different statistical parameters in application in biology, Hypothesis and Analysis of Variance

TEXT &REFERENCE BOOKS

1. Kothari CR, Research Methodology: Methods and techniques, 2nd Edition, New age International Publishers, 2010
2. Gurumani N. Research Methodology for Biological Science, MJP Publishers, Chennai. 2006
3. S.P.Gupta, Statistical Methods. Sultan Chand & Sons, New Delhi, 2012
4. S.C. Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons, 3rd Edition, 2001.
5. P.R. Vital, Business Statistics, Margham Publications, Second Edition, 2012
6. Beri. G, Business Statistics, Tata McGraw Hill Publishing Company Limited, 2009.
7. S.P. Rajagopalan and R. Sattanathan, Business Statistics and Operations Research, Vijay Nicole Pvt. Ltd.2nd Edition, 2009.

PROJECT 0 0 20 10

Course objective:

Students should do research on their own interest or research guide interest on any biotechnology topic for 6 month in the university or any industries or laboratories. After the research, he/she should submit the detailed reports about the research in a dissertation and should present it to an external examiner.

- Students should do research on their own interest or research guide interest on any biotechnology topic for 6 month in the university or any industries or laboratories.

- The candidates shall undertake the major project work in the Sixth Semester either in the Department concerned or in industries, institutes or any other organizations and the project report shall be submitted at the end of the Sixth semester.

- In case the candidate undertakes the project work outside the Department, the Staff concerned within the Department shall be the Main guide and the Staff/scientist under whom the work is carried out will be the Co-guide. The candidate shall bring the attendance certificate from the place of project work carried out.

- After the research, he/she should submit the detailed reports about the research in a dissertation and should present it to an external examiner.

- Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

- The report will be evaluated by duly appointed teaching faculty from head of department

Syllabus

Discipline Specific Elective Courses

MOLECULAR GENETICS 4 0 0 4

Course Objective: (Skill Development)

To provide fundamental knowledge about Genetics, mutations, DNA repair, RNA and protein synthesis

UNIT-I: Introduction and theory **12**

Genetics: Principles of Mendelian inheritance, linkage, recombination, genetic mapping; extra chromosomal inheritance; prokaryotic and eukaryotic genome organization, regulation of gene expression, gene mutation and repair, chromosomal aberrations (numerical and structural), monopoly, polyphyly, & paraphyly taxon.

UNIT-II: Inheritance and Sex determination **12**

Development of genetics: gene versus allele concepts(pseudo alleles); quantitative genetics and multiple factors; incomplete dominance, polygenic inheritance, multiple alleles ; linkage and crossing over; methods of gene mapping, including molecular maps(idea of mapping functions)sex chromosomes and sex linked inheritance, sex determination and molecular basis of sex differentiation; mutations.

UNIT-III: Mutation and DNA repair **12**

Microbial genetics: Types of mutation; UV and chemical mutagens; selection of mutants; Ames test for mutagenesis; bacterial genetic system transformation, conjugation, transduction, recombination, plasmids, transposons; dna repair; regulation of gene expression; repression and induction; Operon model; bacterial genome with special reference to *E.coli*; phage λ and its life cycle RNA phages; RNA viruses; retroviruses; basic concept of microbial genomics.

UNIT-IV: Transcription **10**

Transcription factors and machinery , formation of initiation complex, transcription activators and repressors, RNA polymerase, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation structure and function of different types of RNA, RNA transport.

UNIT-V: Translation **14**

Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors

and their regulation, elongation and elongation factors termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proofreading, translation inhibitors, post-translational modification of proteins, role of chromatin in regulating gene expression and gene silencing.

Total: 60hrs

Course Outcome:

- CO-1: Recall on principles in genetics and genome organization in cells
- CO-2: Understand the inheritance of character and the sex determination
- CO-3: List on various types of mutation and it causes and its repair system
- CO-4: Explain about operon system in gene control and the transcription procedure
- CO-5: Discuss about different types of RNA and Student can able to explain translation procedure

TEXT & REFERENCE BOOKS

1. Phundan Singh, "Molecular genetics", IBDC Publishers,2010.
2. Sabyasachi Roychoudhuri, "A Textbook of Genetics and Molecular Biology", New Central Books Agency; 1st edition, 2011.
3. Sarin, "Genetics", - Tata McGraw hill, 1991.
4. Gardner, Simmons and Snustd,"Principles of Genetics", John Wiley & Sons; 8th Edition, 1991.
5. HartlD.L.G,"Basic genetics", Jones and publishers, 1991.
6. Date J.W. "Molecular Genetics of Bacteria", Wiley and sons, 1994.

BIOINSTRUMENTATION 4 0 0 4

Course Objective: (Employability)

To provide fundamental theoretical knowledge to the students about bioinstruments and bio methods, its principle and operation methods.

UNIT-I: **12**

Microscopic Techniques: Visualization of cell and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission electron microscope, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing method in microscopy.

UNIT-II: **12**

Biophysical method : Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy ,structure determination using x-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasmon resonance methods.

UNIT-III: **12**

Histochemical and immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry, in situ localization by techniques such as FISH and GISH, Separation techniques: Chromatography

UNIT-IV: **12**

Radio labeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioisotopes material, safety guidelines.

UNIT-V: **12**

Types of PCR, Introduction to Next generation sequencing techniques – Nanopore and Ion torrent, Applications - Personal Genomics, Metagenomics, Separation Techniques: types of Chromatography

Total Hours: 60

Course Outcome:

- CO-1: Understand on Basics of Microscopy, its operation and maintenance and learning advanced microscopes like SEM, TEM, STEM, FESEM etc and image processing for microscopical studies.
- CO-2: Illustrate about the analysis of biomolecules using spectroscopy and Applications of NMR and ESR in determination of biomolecules
- CO-3: Explain on antigen antibody reactions and detect molecules in living cells using FISH and GISH
- CO-4: Apply radio-isotopes in detection and measurement of biomolecules and to learn biological imaging of tissues using radio-isotopes
- CO-5: Explain on isolation and purification of genetic materials and sequencing genomes and RFLP, RAPD and ALP techniques

TEXT& REFERENCE BOOKS

1. Veerakumari L.,Bioinstrumentation, Publishers; 1st edition, 2011.
2. Webster, Bioinstrumentation ,Wiley India Private Limited , 2007.
3. John G Webster, Bioinstrumentation. John Wiley & Sons, New York, Physical John, 2004.
4. Robyt F., Bernard J. White, Biochemical Technique: Theory and Practice, - Waveland PrInc; Reprint edition, 1990.
5. Wilson,K., Walker, J. E. J. Wood, K., Walker, J, Principles and techniques of practical biochemistry Cambridge University Press, Cambridge, 5th Edition, 2000.
6. Michael R. Green, Joseph Sambrook, Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press,U.S, 4th Edition, 2014

TISSUE ENGINEERING AND STEM CELL BIOLOGY 4 0 0 4

Course Objective: (Employability)

To provide fundamental theoretical knowledge to the students about Tissue Engineering in animal cell and Stem Cell Biology.

UNIT I Basic biology of tissue engineering 12

Basic biology of tissue engineering; the basis of growth and differentiation – morphogenesis and tissue engineering. In vitro control of tissue developmental – Growth factors; Role of basic fibroblast growth factors and angiogenesis. Biomaterials in tissue engineering. Cell-Based Therapies, Tissue Morphogenesis.

UNIT II Biomaterials and bioreactors 12

Biomaterials Scaffolds, Scaffold Fabrication and Tailoring, Bioreactor technologies; Bioreactor modulation of Tissue formation, Bioreactor cultivation of functional tissues and its applications. Bio artificial pancreas, renal replacement devices. Structural tissue engineering – Bone regeneration through cellular engineering-Brain implants –Neural stem cell – Periodontal applications – Artificial womb. Synthetic.

UNIT III Introduction to stem cell 12

Stem cell – Definition, characterization, Pluripotent stem cells, Self renewal and differentiation, hierarchy, Stem cell niche, Niche specification - Drosophila germ line stem cells. Types of stem cells: Adult stem cell from amniotic fluid, cord blood and tooth primordial. Neural stem cells and its applications.

UNIT IV Cell signals and its pathways 12

Characteristics of stem cell – cell cycle, Ras/ Raf pathways, P13K cell signaling, p53 check points, Role of LIF pathways in cell cycle control. Stem cell communications – gap junctions, cell fusions, HOX genes, upstream transcriptional factors, Tran differentiation, cell fusion.

UNIT V Applications of stem cells 12

Therapeutics applications of embryonic stem cells, Bone marrow stem cells, Adipose derived stem cells and Hematopoietic stem cells in heart regeneration and neural defects. Ethics in human stem cell research; Controversy surrounding human embryonic stem cell research,

societal implications: women, low-income, Different religious views, Current Ethical Guidelines in India, Ethical views of other countries and how this affects advancement of science Policy.

Total : 60hrs

Course Outcome:

- CO–1: Understand on fundamentals of tissue engineering, tissue morphogenesis.
- CO–2: Illustrate about the Biomaterials Scaffolds, Scaffold Fabrication and Tailoring, Bioreactor technologies; Bioreactor modulation of Tissue formation and Structural tissue engineering – Bone regeneration through cellular engineering-Brain implants –Neural stem cell.
- CO–3: Explain on types of stem cells and characterizations.
- CO–4: Discuss about Ras/Raf pathways and stem cell communications.
- CO–5: Elaborate about therapeutics applications of embryonic stem cells and Bone marrow stem cells, Adipose derived stem cells and controversy surrounding human embryonic stem cell research.

TEXT & REFERENCE BOOKS

1. Jonathan Slack ,Stem cells- A Very Short Introduction, Oxford, 2012.
2. Bernhard O. Palsson ,Sangeeta N. Bhatia, Tissue Engineering, Prentice Hall; 1st edition, 2003
3. Robert P. Lanaza, Robert Langer and Joseph Vacanti. Principles of tissue engineering. Academic Press.4th edition, 2013
4. Micklem.H.S.,LoutitJohn.F., Tissue grafting and radiation, Academic Press, New York.2004.
5. Penson, Balducci.D.,Tissue cultures in biological research, Elsevier, Amsterdam.2004.
6. Robert Lanza, John earhart, Brigid Hogan, Douglas Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut, Essentials of Stem Cell Biology,Academic Press,2009.
7. Robert Lanza. “Essential of Stem Cell Biology” Academic Press, 2005.

8. James Thomson et al; “Handbooks of Stem Cells’ Embryonic / Adult and Fetal Stem Cells” Vol I and II, Academic Press 2004.

GENOMICS AND PROTEOMICS 4 0 0 4

Course Objective (Employability)

To provide the students a broader knowledge on the structure and function of genomes, the technologies developed for genomics, functional genomics and proteomics.

UNIT-I: Organization of genomes **12**

Introduction: Genome, Genomics, Omics and importance, General features, C-value paradox. Gene identification; gene prediction rules and software; Genome databases; Annotation of genome. Genome diversity: taxonomy and significance of genomes – bacteria, yeast, Caenorhabditis, Homo sapiens, Arabidopsis, etc.

UNIT-II: Mapping genomes **12**

Genetic mapping – i) Cross breeding and pedigree analysis, ii) DNA markers - RFLPs, SSLPs, SNPs Physical mapping - Restriction mapping, Fluorescent in situ hybridization, Radiation hybrid mapping and Sequence tagged site mapping.

UNIT-III: Genomics **12**

Genome projects: The Human genome project, HapMap Project, The 1000 genome project, and The ENCODE Project. Structural genomics: Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing Understanding a genome sequence: locating the genes in a genome sequence, determining the functions of individual genes and by studying the activity of a protein coded of an unknown gene

UNIT-IV: Technological Applications of Proteomics techniques **12**

Qualitative and quantitative proteome analysis; Proteome characterization techniques – 2D-gel electrophoresis, DIGE, Mass Spectrometry – Concepts, Ionization (MALDI, ESI, Nanospray, Mass Analyzers – Time of Flight, Magnetic sector, Quadrupole, Orbitrap; MS-MS approaches, Peptide Mass fingerprinting and Post Translational Modifications Interactomics

UNIT-V: Protein engineering **12**

Protein protein interaction assays - Two-hybrid methods, TAP/ GFP tags, Phage Display, Protein chips; Proteome-wide interaction maps, Proteomics workflows ; Protein Engineering; An

introduction to systems biology.

Total: 60 Hours

Course Outcome:

- CO-1: Understand the organization of genomes in multiple levels of taxanomy
- CO-2: Illustrate methodologies and approaches used for the study of structural and functional genomics.
- CO-3: List on various genome mapping and sequencing methods, genomic markers, microarray technology and methods for proteomics
- CO-4: Analyze on importance of milestone of genome project
- CO-5: Explain genome evolution and Synthetic genomes and their applications

TEXT & REFERENCE BOOKS

1. Brown T. A., Genomes 3. Garland Science Publishing, New York, 2007
2. Dunham, I., Genome Mapping and sequencing. Horizon Scientific, 2003
3. Graur, D and W H Li, Fundamentals of molecular evolution. Sinauer Associates. 2000
4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. Genetics from Genes to Genomes. McGraw Hill., 2004
5. Lewin B. Genes VIII. Oxford University Press. Oxford, 2003
6. The Human Genome, Nature Vol. 409, 2001.
7. The Drosophila Genome, Science Vol. 267, 2000.
8. The Caenorhabditis elegans genome, Science Vol. 282., 1998
9. The Arabidopsis Genome, Nature vol. 408, 2000
10. Primrose, S. B., and. Twyman. R M., Principles of gene manipulation and Genomics, Blackwell Publishing MA. USA, 7th Edition, 2006.

FERMENTATION TECHNOLOGY 4 0 0 4

Course Objective: (Employability)

To provide knowledge about the fermentation technological process for industrial importance.

UNIT-I: Introduction to fermentation technology 12

Introduction to fermentation technology; interaction between chemical engineering, microbiology and biochemistry. History of fermentation introduction to fermentation processes, microbial culture selection for fermentation processes. Media formulation and process optimization.

UNIT-II Bioreactors and its design 12

Bioreactors: Functions, design, aeration and agitation, sterilization instrumentation and control. Types of bioreactors, continuous and Fed-batch cultures, Garden's fermentation classification, design and operation of fermenters, basic concepts for selection of a reactor, packed bed reactor, fluidized bed reactor, trickle bed reactor, bubble column reactor and scale up of bioreactors.

UNIT III Industrial microbes 12

Production of industrial starters: isolation, maintenance and development of microorganisms. Starter utilization, immobilization of biocatalysts: kinetics effects, inactivation kinetics biocatalysts in non-conventional media (biphasic, organic, ionic liquids, supercritical fluids).

UNIT IV Downstream process 12

Downstream processing. Recovery of particulate matter, product isolation, distillation, centrifugation, whole broth processing, filtration, aqueous two – phase separation, solvent extraction, chromatography and electrophoresis.

UNIT V Monitoring data and analysis 12

Monitoring of bioprocesses – On-line data analysis for measurement of important physio-chemical and biochemical parameters. Computer based data acquisition, monitoring and control-LABVIEW software.

TOTAL : 60hrs

Course Outcome:

- CO–1 Understand the fundamentals of fermentation technology, interaction between chemical engineering, microbiology and biochemistry.
- CO–2: Summarize about different Bioreactors: Functions, design, aeration and agitation, sterilization instrumentation and control.
- CO–3: Explain about the production of industrial starters: isolation, maintenance and development of microorganisms and Starter utilization and immobilization of biocatalysts.
- CO–4: Illustrate on Downstream processing, Recovery of particulate matter, product isolation, distillation and Monitoring of bioprocesses
- CO–5: Analyze the On-line data for measurement of important physio-chemical and biochemical parameters, Computer based data acquisition and Monitoring and control-LABVIEW software.

TEXT & REFERENCE BOOKS

1. Kalaiselvan P T, I Arul Pandi, Bioprocess Technology (Volume 1), MJP Publishers; 1st edition, 2007.
2. Stanbury F, A Whitaker, Principles Of Fermentation Technology, Elsevier; 2 editions,2008
3. Mukhopadhyay, S.N. processes biotechnology fundamentals, Viva Books Pvt. Ltd., 2001.
4. Keith Wilson and john Walker, Practical Biochemistry-principles and Techniques, Cambridge, 5th Edition, 2000.
5. Coulson and Richardson JF, chemical engineering-volume 3 (Chemical and biochemical reactors and process controls ed. Richardson, J.F., Peacock, D.G., First Indian ed. Asian Bookss Pvt. Ltd., 1998.
6. Bailey and oils, Biochemical Engineering Fundamentals, McGraw-Hill, 1990.
7. Ho, W.S.W. and K.K. Sirkar, Membrane Handbooks, Van Nostrand Reinhold, N.Y.,

1992

MEDICAL AND HERBAL BIOTECHNOLOGY

4 0 0 4

Course Objective: (Skill Development)

To provide detailed knowledge about medicinal and herbal biotechnology and its products.

UNIT-I: Introduction to medical biotechnology **12**

Introduction to medical biotechnology and its scope. Disease Diagnosis and Therapy- ELISA and hybridoma technology,- DNA vaccine, - Gene Therapy,- Toxic genomics. DNA, RNA, Protein in Drug Development. Diagnosis of disease by Proteomics. Separation and identification techniques for protein analysis. Development of antibody based protein assay for diagnosis.

UNIT-II: Diagnosis and medical coding **12**

Diagnosis and Kit Development- Use of enzymes in clinical diagnosis, Use of biosensors for rapid clinical analysis.- Diagnostic kit development for microanalysis. Introductions to medical coding and transcription. Importance of ICD9 and ICD10.

UNIT-III: Introduction to Stem Cell Biology **12**

Introduction to Stem Cell Biology, Fate Mapping of Stem Cells, Stem Cell Pattern: Stem Cell Pattern of Cell type switching in Schizosaccharomyces pombe. The Notch/LIN-12 Communication System, Cell Cycle Control, Checkpoints, and Senescence of Dividing Somatic Cells. Drosophila Ovary: An In Vivo Stem Cell System, Male Germ-line Stem Cells, Primordial Germ Cells as Stem Cells, Embryonic Stem Cells, Trophoblast Stem Cells, Hematopoietic Stem Cells, Mesenchymal Stem Cells, Adult Bone Marrow stem cells, Epidermal Stem Cells: Liver Stem Cells, Pancreatic Stem Cells, Stem Cells in the Epithelium of the Small Intestine and Colon

UNIT-IV: Introduction to Herbal medicine **12**

Study of history and scope of herbals. Important medicinal herbs in treating diseases. . Phytochemistry of medicinal plants- alkaloids- flavones- flavonoids and xanthones - furocoumarins - glycosides - naphthoquinones - phenols and acylphloroglucinols - resins, oleoresins and gum resins. Saponins - sesquiterpene - sterols and steroid like compounds - tannins and terpenes. Introduction to analysis and quality controls of herbal products (TLC, HPLC, IR, NMR, and mass spectroscopy).

UNIT-V: Herbal biotechnology **12**

Biotechnological methods of plant propagation - Micropropagation– Somatic Embryogenesis and somaclonal variation. Herbal gardening and maintenance - Standardization of cultivation protocols of selected medicinal plants; in vitro production of secondary metabolites. Polyhouse technology. Important diseases of medicinal plants and their management. Alternative method of secondary metabolite production - Organ culture, Cell culture, Biotransformation (Microbial and Plant cells) - Scale up - Enhancement of product formation by elicitation.

Total : 60 hrs

Course Outcome:

- CO–1: Understand about medical biotechnology and its scope and about the disease diagnosis, therapy –ELISA, hybridoma, proteomics.
- CO–2: Demonstrate about diagnostic kit development for microanalysis and Importance of ICD9 and ICD10.
- CO–3: List out the basics of Stem Cell Biology, Fate Mapping of Stem Cells, Stem Cell Pattern: Stem Cell Pattern of Cell type switching in Schizosaccharomyces pombe, Trophoblast Stem Cells, Hematopoietic Stem Cells and Mesenchymal Stem Cells.
- CO–4: Apply the important medicinal herbs in treating diseases and phytochemistry of medicinal plants and methods of analysis and quality controls of herbal products (TLC, HPLC, IR, NMR, and mass spectroscopy).
- CO–5: Explain about Biotechnological methods of plant propagation. - Micropropagation – Somatic Embryogenesis and somoclonal variation. Herbal gardening and maintenance. Alternative method of secondary metabolite production

TEXT & REFERENCE BOOKS

1. Trivedi P. C., Herbal Drugs and Biotechnology ,Pointer Publishers , 2009.
2. KhadabadiS. S., B. A. Baviskar S. L. Deore, Pharmacognosy and Phytochemistry: A Comprehensive Approach (Pharmacognosy),PharmaMed Press; 1 edition2014.
3. Prathibha Nallari ,V.VenugopalRao,Medical Biotechnology, Oxford University Press ,2010.

4. Agrawal S.S. and M. Paridhavi, Herbal Drug Technology, University press 2007.
5. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (ed), Concepts in Biotechnology, University, Press, 1996.
6. Anderson, F.J Illustrated History of the Herbals. New York: Columbia University press. 2009.
7. Kayser, O,R.H. Muller. Pharmaceutical Biotechnology - Drug Discovery and clinical applications. Wiley - VCH.2004.
8. Garywalsh. Biopharmaceutical, biochemistry and biotechnology.2003.
9. Robert Lanza. "Essential of Stem Cell Biology" Academic Press, 2005.
10. James Thomson et al; "Handbooks of Stem Cells' Embryonic / Adult and Fetal Stem Cells" Vol I and II; Academic Press (2004).

PHARMACEUTICAL BIOTECHNOLOGY 4 0 0 4

Course Objective: (Employability)

To provide knowledge on principles of drug development, manufacturing, design and its importance in Pharmaceutical industry and Controlled Drug Delivery Systems.

UNIT 1: Basics Of Pharmacology, Drug Action & Metabolism 12

History and Principle of pharmacology. Drug names and Classification systems. Route of drug administration, pharmacodynamics, pharmacokinetics – Absorption, Distribution, Metabolism and Excretion of drugs / metabolites, prodrugs, protein binding of drugs

UNIT 2: Drug And Its Treatments 12

Chemo therapeutic drugs- Protein synthesis inhibitors, Anti mycobacterial, anti-fungal, anti-protozoal, antiviral, anticancer, anti-inflammatory drugs, Production of Ergot alkaloids, Probiotics. Human Insulin, Human Growth Hormone, Production of recombinant vaccines. Monoclonal antibodies.

UNIT 3: Controlled Drug Delivery Systems 12

Concepts, Route of delivery - design of oral controlled drug delivery - dissolution controlled release system, diffusion-controlled release system and oral osmotic pump. Parenteral controlled drug delivery – liposomes, osmotic pump (implants). Transdermal drug delivery.

UNIT 4: Principles of Drug Manufacture 12

Solid dosage forms – introduction to types of tablets, excipients, granulation techniques, compression machinery, processing problems, Coated tablets - types – enteric coated tablets, film coated tablets and sugar coated tablets. Evaluation of coated tablets. Production of hard and soft gelatin capsules, liquid dosage form – suspension and emulsion. Semisolid dosage form – ointment, GMP

UNIT 5: Biopharmaceuticals & Bioactivity 12

Various categories of therapeutics like Laxatives, Analgesics, Contraceptives, Antibiotics and Hormones. Biochips, Biofilms, Biosurfactants.

Total: 60 Hours

Course Outcomes:

- CO-1: Understand different pharmaceutical parameters for the current and future biotechnology related products on the market.
- CO-2: Illustrate on biotechnological and pharmaceutical products, current medicines and their applications in therapeutic and diagnostic fields.
- CO-3: Analyze different types of Controlled Drug Delivery Systems.
- CO-4: Explain on current topical and newly emerging aspects of pharmaceutical biotechnology.
- CO-5: Elaborate the progress on the new drug to market and grasping the current regulatory acts and safety norms of the modern pharmaceutical industries.

TEXT & REFERENCE BOOKS:

1. Sivakumar.S M, Pharmaceutical Biotechnology. 2003
2. Sambamurthy.K, Pharmaceutical Biotechnology. 2006
3. Pharmaceutical Biotechnology (PB) Vyas S.P. / Dixit V. ISBN : 9788123906140, 2011
4. Walsh, Biopharmaceuticals: Biochemistry and Biotechnology, 2e (PB) ISBN : 9788126530014, 2011
5. Agrawal S.S. and M. Paridhavi, Herbal Drug Technology, University press 2007.
6. Kayser O., R.H. Muller. Pharmaceutical Biotechnology - Drug Discovery and clinical applications. Wiley - VCH. 2004

BIOINFORMATICS, IPR, BIOETHICS AND BIOSAFETY 4 0 0 4

Course Objectives (Skill Development)

Students will understand the importance of Computing in Biological Sciences, Intellectual Property Rights (IPR), and Bioethics

UNIT I Biological Databases **12**

Nucleic Acid sequence Databases: Genbank, NCBI, EMBL, DDBJ; Protein Sequence Databases: Swiss Prot, PIR; Structural Databases: PDB, CATH, SCOP and specialized databases.

UNIT II Tools for Bioinformatics 12

Pairwise alignment –Dotplots –scoring matrices –Blosum Matrices –PAM Matrix –Gap Penalty Alignment Algorithms: Needleman –Wunsch Global Alignment Algorithm ; Smith –Waterman Local Alignment Algorithm. Genome aligners- BLAST, MUMmer, Avid, LAGAN and Multi LAGAN. Protein gene prediction method - ORF finder, restriction analysis, secondary structure prediction. Homology modeling and drug designing.

UNIT-III IPR – Types **12**

Introduction and the need for IPR, WTO, GATT, TRIPS, WIPO - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret, Indian patent act. IPR in current scenario with case studies.

UNIT-IV Bioethics **12**

Introduction to bioethics, ethical issues in preclinical (animal) studies, & clinical studies- Ethical principles, Ethical guidelines-ICMR, Institutional Ethics - Institutional Ethics committees, Institutional review board, SOPs, ethical issues based on methodology of clinical research. The ethics of clinical research in developing countries.

UNIT V Biosafety **12**

Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level, General guidelines for rDNA research. Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

Total: 60 Hours

Course Outcome:

On completion of the course, the student should be able to:

- CO-1: Define types of data and collection of data and basic statistics like mean, mode and median. Measuring central tendency, Kurtosis.
- CO-2: Understand about percentiles, variability, standard deviation and application of the same in the sample data and Sample distribution.
- CO-3: Summarize about the importance of IPR, Copyright and other Intellectual Property.
- CO-4: Explain about Patent law, International agreement and WHO's patent detail and importance of Bioethics in Science
- CO-5: Analyze about general Ethical guidelines and Understand Institutional Ethics committees, Institutional review board, SOPs in ethics.

TEXT & REFERENCE BOOKS:

1. Attwood T K, D J Parry-Smith, "Introduction to Bioinformatics", Pearson Education, 2005.
2. David W Mount, "Bioinformatics sequence and Genome analysis", Second Edition, Cold Spring Harbor Laboratory Press, 2013.
3. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
4. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
5. Tom L Beauchamp.Jerffry Khan,LeRoy Walters, Anna C Mastroanni.(2013) Contemporary issues in Bioethics.
6. Neil C. Jones and Pavel A. Pevzner, "An Introduction to Bioinformatics Algorithms", MIT Press, 2005.
7. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
8. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf

PROJECT MANAGEMENT AND BIOTECH PRODUCTS ENTREPRENEURSHIP

4 0 0 4

Course Objective: (Entrepreneurship)

To provide detailed knowledge about Project Management and Biotech products Entrepreneurship that motivates the students in industrial firms.

UNIT I Introduction to Project management 12

Project management – framework; concept of a project, capital expenditure, Importance & difficulties, Phase of capital budgeting, feasibility study: overview. Resource allocation: elementary investment strategy, portfolio planning tools, strategic position & action evaluation.

UNIT II Project formulations 12

Financial identification & formulation- scouting for project idea, preliminary screening and project rating index. Market & demands analysis- market survey, characterization of market, forecasting & planning, profit potential of industries; porter model. Technical analysis- analysis of inputs, technology, product mix, capacities, location, civil works, charts, lay outs, work schedule.

UNITIII Project management plans 12

The triple constraints in project management, project management activities, project management objective, project management documents, project control variables, project management & clinical trials, role of project management in clinical trials, major roles of a project manager in a CRO, ensuring project success.

UNIT IV Business plan 12

Business plan preparation- sources of product for business -pre feasibility study-criteria for selection of products- ownership-capital- budgeting project profile preparation- matching entrepreneur with the project- Feasibility report preparation and evaluation criteria.

UNIT V Business development and biotech companies 12

Introduction & stages of business development-start-up phase, growth phase, maturity phase, decline phase. Outsourcing in clinical research, reasons for outsourcing to contract research organization, the India advantage, scope and future of CRO, list of clinical research organizations in India, list of IT companies offering service in clinical research. role of business

development manager.

Total : 60hrs

Course Outcome:

- CO–1: Understand about the project management – framework; concept of a project, capital expenditure.
- CO–2: Demonstrate on ideas, preliminary screening and project rating index and Technical analysis- analysis of inputs, technology, product mix, capacities, location, civil works, charts, lay outs, work schedule.
- CO–3: Illustrate on triple constraints in project management and will have an idea about project management & clinical trials, role of project management in clinical trials.
- CO–4: List about Business plan preparation- sources of product for business and will have an idea about matching the entrepreneur with the project- Feasibility report preparation and evaluation criteria. .
- CO–5: Explain about stages of business development-start-up phase, growth phase, maturity phase, decline phase and Outsourcing in clinical research.

TEXT AND REFERENCE BOOKS

1. Hisrich "Entrepreneurship", Tata McGraw Hill, New Delhi, 2001.
2. Khanka S.S., Entrepreneurship development", S. Chand and company limited, New Delhi, 2001
3. Craig Shimasaki, Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies [Kindle Edition] Academic Press; 1 edition, 2014.
4. Kumawat, H. S.. Modern Entrepreneur And Entrepreneurship Theory Process PracticeNeha Publishers & Distributors, 2013.
5. Erik Larson (Author), Clifford Gray, Project Management: The Managerial Process with MS Project (The Mcgraw-Hill Series Operations and Decision Sciences) 6th Edition, 2013.
6. Meri Williams, The Principles of Project Management, SitePoint; 1 edition, 2008.

INTERNSHIP 0 0 4 2

Course objective: Students should go for training in any biotechnological industry or laboratories and learn their laboratory techniques by hands on training. After the training, students should submit detailed reports about the training in an assignment.

- For the benefit of the students, it has been mandatory to attend a minimum of one internship/ Mini project during semester vacation
- Students should go for Internship/ Mini projects in any biotechnological industry or laboratories and learn their laboratory techniques by hands-on training.
- After the Internship/ Mini project, students should submit detailed reports about the Internship/ Mini project in printed format.
- Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.
- The report will be evaluated by a duly appointed teaching faculty from the head of department.

Total: 30hrs

Syllabus

Generic Elective Courses

BIOMEDICAL WASTE MANAGEMENT

4 0 0 4

Course Objective: (Employability)

This course aims to provide knowledge about source, types, handling, collection, and disposal and also ensure the proper and safe management of biomedical waste.

UNIT-I: Introduction to biomedical waste **12**

Introduction, Definition, Scope and importance of biomedical waste. Categories of biomedical wastes (Human Anatomical Waste, Animal Waste, Microbiology & Biotechnology Waste , Waste sharps, Discarded Medicines and Cytotoxic drugs, Solid Waste, Liquid Waste, Incineration Ash and Chemical Waste).

UNIT-II: Health impacts biomedical waste **12**

Health impacts of biomedical wastes. Direct and Indirect hazards, Potential health hazards of BMW. Infectious agents in the biomedical wastes. Monitoring and controlling of cross infection (protective devices)

UNIT-III: Handling of biomedical waste **12**

Biomedical waste - Handling rules, segregation, collection, transportation, disposal-color coding and type of container for disposal of biomedical wastes. Disposal technologies (sharp disposal pit, deep burial pit and secured land fill).

UNIT IV Treatment and management of biomedical waste **12**

Treatment and management of biomedical wastes-on site - pretreatments, treatment-in-site and off-site (common treatment facilities).Liquid waste treatment by different technologies. Conventional treatment technologies (wet thermal and incineration)

UNIT V Legislation policies and rules of biomedical wastes **12**

Environment and legislation policies and rules for handling and management of biomedical wastes. CPCB guidelines. WHO guidelines for biomedical wastes.

Total: 60hrs

Course Outcome:

- CO–1: Understand of the basics, the Scope and importance of biomedical wastes and about types of wastes and composition.
- CO–2: List about Potential health hazards of biomedical wastes.
- CO–3: Summarize the principles and methods of disposal of biomedical wastes and secured land fill.
- CO–4: Assess on different technologies of treatment and management of biomedical wastes and Conventional treatment technologies
- CO–5: Explain about the rules, policies and guidelines of biomedical wastes and understand the WHO guidelines for biomedical wastes

TEXT AND REFERENCE BOOKS

1. Sharma – Holistic approach to Hospital Waste Management published by Dept. of

   Bhide A. D.and B.B.Sundaresan, "Solid Waste Management – Collection, Processing and disposal" Mudrashilpa Offset Printers, Nagpur, 2001.
2. GoelS. L, Health Care System and Hospital Administration, Balaji World of Books 2009.
3. Radhakrishnan R, Biomedical Waste Management, Neha Publishers & Distributors,2007.
4. .Behera P K, Sustainable Bio-Medical Waste Management (2 Vols.)Dominant Publishers And Distributors 1993
5. Hosetti, B. B. Prospects and perspective of solid waste management, 2006.
6. Glynn Henry J and Gary. W. Heinke, "Environmental Science and Engineering", PreticeHall of India, 2004.
7. BhideA. D and B.B.Sundaresan, "Solid Waste Management – Collection, Processing and disposal" Mudrashilpa Offset Printers, Nagpur, 2001.
8. Glynn Henry J and Gary. W. Heinke, "Environmental Science and Engineering", Pretice Hall of India, 2004.

BIOTECHNOLOGY AND HUMAN WELFARE

4 0 0 4

Course Objective: (Employability)

This course has been designed to introduce the various techniques in the modern era of biotechnology. It focuses on industrial biotechnology, agriculture and medical biotechnology and molecular techniques for forensic science.

UNIT I Industrial Biotechnology **12**

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

UNIT II Agricultural Biotechnology **12**

Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III Environmental Biotechnology **12**

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

UNIT IV Biotechnology in Forensic science **12**

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

UNIT V Biotechnology in medicine **12**

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.

Total: 60hrs

Course Outcome:

- CO –1: Remember about the products of industrial biotechnology and gain knowledge relevant to the applications of agriculture biotechnology.
- CO–2 Show interaction between plants and microbes and the various techniques involved

in environmental biotechnology.

- CO–3: Outline about the degradation of hydrocarbons and agricultural wastes
- CO–4: Darmejabout the molecular techniques of forensic science and various methods of DNA finger printing

- CO–5: Demonstrate Students about health care products, receive knowledge about human genome project and recombinant live vaccines

TEXT AND REFERENCE BOOKS

1. Patnaik, "Textbooks of Biotechnology", McGraw Hill Education (India) Private Limited.2012.
2. Satyanarayana, U, "A Textbooks of Biotechnology", Books and Allied (p) Limited, 2013.
3. Sateesh MK,"Bioethics and Biosafety", I. K. International Pvt Ltd, 2010.
4. Sree Krishna V,"Bioethics and Biosafety in Biotechnology", New age international publishers, 2007.
5. Purohit S.S. "Agricultural Biotechnology", Agrobios, 3rd edition, 2010.
6. Kumaresan V," Biotechnology P, Saras Publication, 2015
7. Kumaresan V, N Arumugam, Environmental Biotechnology ,Saras,2014
8. SandhyaJadhav ,A Text Book of Environmental Biology and Biotechnology, Vision, Publications, 2nd edition, 2012
9. Clark DP and Pazdernik NJ. "Biotechnology-Applying the Genetic Revolution". Elsevier Academic Press, USA.2009.
10. Alan Scragg,"Environmental Biotechnology", Oxford; Second edition, 2007.

ENVIRONMENTAL BIOTECHNOLOGY ` 4 0 0 4

Course Objective: (Employability)

The topic represents a stand-alone, progressive topic leading the student through the key aspects of environmental microbiology prior to its subsequent application within environmental biotechnology.

UNIT I Biofuels **12**

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

UNIT II Bioremediation **12**

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes.

UNIT III Phyto-remediation 12

Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms-degradation of aromatic and chlorinated hydrocarbons and petroleum products.

UNIT IV Wastewater treatment and biofertilizer **12**

Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

UNIT V Biomining **12**

Biomining, Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium).Environmental significance of genetically modified microbes, plants and animals.

Total : 60hrs

Course Outcome:

- CO–1: Understand the importance of conventional fuels and their environmental impacts
- CO–2: Apply the Bioremediation to the environment and degradation of lignin and cellulose using microbes and water contaminated with oil spills
- CO–3: List about the various techniques involved in Phyto-remediation

and about the degradation of pesticides and other toxic chemicals by micro-organisms.

- CO–4: Explain about the various methods in wastewater treatment and the Algal and fungal biofertilizers

- CO–5: Explain about Bioleaching and importance of Genetically modified microorganisms.

TEXT AND REFERENCE BOOKS

1. Pradipta Kumar Mohapatra,"Environmental Biotechnology",I.K. International Publishing House; 1st Edition,2007.
2. Satyanarayana, U, "A Textbook of Biotechnology", Books and Allied (p) Limited, 2013.
3. Purohit S.S. "Agricultural Biotechnology", Agrobios, 3rd edition, 2010.
4. Alan Scragg,"Environmental Biotechnology", Oxford; Second edition, 2007.
5. Hans-Joachim Jordening and Jesef Winter, "Environmental Biotechnology – Concepts and Applications",Wiley VCH, 2004.
6. Metcalf and Eddy, "Waste Water Engineering", Tata McGraw hill, 4th edition, 2003
7. Alicia L. Ragout De Spencer, JohnF.T. Spencer."Environmental Microbiology: Methods and Protocols", Humana Press, 2004.
8. Milton Wainwright, "AnIntroduction to Environmental Biotechnology", Springer, 1999.

MUSHROOM CULTIVATION AND MEDICINAL PLANT GARDENING

4 0 0 4

Course Objective: (Entrepreneurship)

To learn the cultivation of various mushrooms and to create self-employment for the students.

Unit 1: Introduction **12**

Introduction to Mushroom - History of Mushroom - Ecology of Mushroom -Life cycle of Mushroom. classification of mushrooms, nutritional and dietary values of mushrooms as source such as protein, carbohydrates, fibre, vitamins and minerals, therapeutic properties, mushroom collections from field

Unit 2: cultivation techniques **12**

Mushroom cultivation techniques- Erections of mushroom culture sheds and maintenance (tools, equipment and prerequisites). Fungal Isolation techniques, preparation of mother culture- pure culture, selection of stock, spawn production – mother spawn production. Basic elements for Mushroom growth and farm settings

Unit 3: Spawn Multiplication **12**

Multiplication of spawn - Precautions, characters, and storage of spawn; substrate production, culturing of mushrooms; harvesting, post-harvesting processes, and key machinery and equipment required.

Unit 4: Cultivation techniques for selected mushrooms **12**

Cultivation techniques for commercially viable mushrooms - paddy straw mushroom, button mushroom and milky mushroom – spawning, substrate preparation, growth, packing, and maintenance of suitable environmental conditions. Factors influencing mushroom cultivation and harvesting. Mushroom delights.

Unit 5: Medicinal Plant Gardening **12**

Types of medicinal plants, Secondary metabolites- Bioactive constituents, Medicinal plants cultivation methods and gardening.

Total : 60 hours

Course Outcome:

CO –1: Student will understand about mushroom and its classification

CO –2: Illustrate about the Mushroom cultivation techniques

CO –3: Student will plan to about: Spawn Multiplication

CO –4: Student will Demonstrate about the cultivation methods of Selected mushrooms

CO –5: Explain about types of medicinal plants and its cultivation and gardening

TEXT & REFERENCE BOOKS:

1. Suman, B.C and V. P. Sharma. Mushroom Cultivation in India, Daya Publishing House. 2007
2. Subrata Biswas, M. Datta, S.V. Ngachan. Mushrooms: A Manual for Cultivation. PHI Learning Private limited, New Delhi. 2012.
3. Singh, M., Vijay, B., and Kamal, S., and Wakchaure, G.C. Mushrooms: Cultivation, Marketing and Consumption. Directorate of Mushroom Research, Indian Council of Agricultural Research, Solan, India, p.266. 2011
4. Oei, P, and van Nieuwenhuijzen, B. Small-scale mushroom cultivation. Digigrafi, Wageningen, The Netherlands, p.86. 2005
5. Training Manual on Mushroom Cultivation Technology. United Nations - Economic And Social Commission for Asia and the Pacific, p.139.
6. Milan S. Stankovic. Medicinal Plants and Natural Product Research, MDPI publishers, Switzerland, 2020
7. M.C. Joshi. Hand Book of Indian Medicinal Plants, Scientific Publishers, 2019

SKILL ENHANCEMENT COURSE

SOFTSKILLS – I **- 2 0 0 2**

Course Objective: (Skill Development)

- To enable participants Business Communication Skills
- To enhance participants E-mail writing skills
- To impart Leadership and Team Bonding skills

Credit Hours

1. READING COMPREHENSION AND VOCABULARY **06**

Filling the blanks – Cloze Exercise – Vocabulary building – Reading and answering Questions.

2. LISTENING AND ANSWERING QUESTIONS. **06**

Listening and writing – Listening and sequencing sentences – Filling in the blanks – Listening and answering questions.

3. GROUP DISCUSSIONS **06**

Why GD part of a selection process – Structure of a GD – strategies in GD – Team Work – Body Language

4. CONVERSATION. **06**

Face to face Conversation and Telephone conversation.

5. SELF- INTRODUCTION AND ROLE PLAY **06**

Total **30 Hours**

Course Outcome

At the end of this course the students will be able to,

CO 1 Prioritize power of understanding and aids assimilation of vocables. Vocabulary to charge communication with educated words

CO 2 Develop comprehensive knowledge through listening leading to answering questions

CO 3 Build observation power and infuse self-confidence through group discussions

CO 4 Identify methodology for befitting constructional ability

CO 5 Experiments with inward looking and visualization of the 'otherness' of situations

Books Recommended

- Barun K. Mitra. Personality Development and Soft Skills. Oxford University Press. New Delhi.2011.

- S.P. Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009.
- Tiko, Champa & Jaya Sasikumar. Writing with a Purpose.OUP. New Delhi. 1979

Web Source:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://blog.smarp.com/top-5-communication-skills-and-how-to-improve-them
- https://blog.hubspot.com/service/phone-etiquette

SOFT SKILLS – II **- 2 0 0 2**

Course Objective: (Skill Development)

- To enable students to develop their communication skills effectively
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence through communication

Credit Hours

1. PRESENTATION SKILLS **06**

Elements of an effective presentation – structure of presentation – voice modulation – Audience analysis – Body language

2. SOFT SKILLS **06**

Time Management – Articulateness – Assertiveness – Stress management

3. RESUME / REPORT PREPARATION / LETTER WRITING **06**

Structuring the resume / Report – Business letters – E-Mail Communication

4. INTERVIEW SKILLS **06**

Kinds of Interviews – Required by Skills – Corporate Culture – Mock Interviews

5. 30 FREQUENTLY ASKED QUESTIONS **06**

Total **30 Hours**

Course Outcome

At the end of this course the students will be able to,

CO1 Illustrate the essential of presentation skills, thoughts, structure, voice modulation, audience analysis and body language

CO2 Utilize the psychological skills pertaining to time management, articulation, assertion and stress management

CO3 Construct methodology for preparation of resume, reports, business letters and email communication

CO4 Appraise learners with varied skills needed for expose to interviews

CO5 Categorize the nature of questions asked usually in interviews

Books Recommended

- Barun K.Mitra. Personality Development and soft skills. Oxford University Press. New

Delhi. 2011.

- S P Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.
- Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009

Web Sources:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://www.businessnewsdaily.com/5836-top-interviewing-skills.html
- https://gdpi.hitbullseye.com/Group-Discussion.php

SOFT SKILLS III **2 0 0 2**

Course Objective: (Skill Development)

- To enable students to develop their soft skills and Body Language
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence to excel at Interviews

	Credit Hours
UNIT–I	**06**
Powerful Presentation	
UNIT–II	**06**
Reinforcement	
UNIT–III	**06**
Using visual aids	
UNIT–IV	**06**
Types and Methods of Presentations	
UNIT–V	**06**
Obstacles to Presentation	
Total	**30 Hours**

Course Outcome:

CO1 To develop participants social and professional skills

CO2 To help participants manage time effectively

CO3 To build a strong resume to suit corporate requirements

CO4 To face interviews confidently

CO5 To enhance their aptitude abilities

Books Recommended:

- Roz Townsend: Presentation Skills for the Upwardly Mobile, Emerald, Chennai.
- Prasad, H. M. How to Prepare for Group Discussion and Interview. NewDelhi: Tata McGraw-Hill Publishing Company Limited, 2001.

- Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

Web Sources:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://venngage.com/blog/presentation-skills/
- https://gdpi.hitbullseye.com/Group-Discussion.php

SECTOR SKILL COURSE

CLINICAL RESEARCH 2 0 0 2

COURSE OBJECTIVE: (Employability)

To understand the fundamentals in clinical research

Unit I **7 hours**

Introduction to Clinical Research, Clinical Trial Terminologies, History of Clinical research, CPCSEA Guideline & Pre-clinical Trials, Drug Discovery & Development,

Unit II **7 hours**

Introduction to Toxicity Studies, Definition of clinical trial, Different Phases of clinical research: Subtypes of Phase 1,2,3, and 4, E –clinical trial, Bioavailability & Bioequivalence Studies [BA/BE]

Unit III **6 hours**

Drug Regulations & Ethics in Clinical Research: Background of ethics, Declaration of Helsinki, Belmont Report, Informed consent Process, Nuremberg code

Unit IV **5 hours**

History of Indian regulations, Schedule – Y- Appendices, ICMR (Indian Council of Medical Research) Guidelines, Indian GCP (Good Clinical Practice), ICH GCP (International Conference on Harmonisation)

Unit V **5 hours**

Drugs & magic remedies Act 1954, Drug prices control order, CTRI-Clinical trial registry of India, Regulations for AYUSH, An Introduction to Clinical Data Management, Data Management Standards.

TOTAL 30 HOURS

COURSE OUTCOMES

CO-1: To understand the basic the guidelines for conducting pre-clinical trial and research

CO-2: Will Know about various phases of clinical trials

CO-3: Knowledge about the ethics in clinical research

CO-4: To acquire knowledge Indian regulations in clinical research

CO-5: They would have studied in detail about Indian act for drug regulation

TEXT AND REFERENCE BOOKS

1. Spriet A., Dupin-Spriet T., Simon P. Methodology of Clinical Drug Trials, 2nd Edition. Publisher: Karger.
2. SheinChung Chow, Jen-Pei Liu. Design and Analysis of Clinical Trials: Concepts and Methodologies, 3rd Edition. Publisher: Wiley.
3. Lionel D. Edwards, Anthony W. Fox, Peter D. Stonier. Principles and Practice of Pharmaceutical Medicine, 3rd Edition. Publisher: Wiley-Blackwell.

MEDICAL CODING AND PHARMACOVIGILANCE & SAFETY MONITORING 2 0 0 2

Course Objective: (Employability)

The paper is designed to provide basics in medical coding and to learn importance pharmacovigilance for clinical research students.

UNIT-I INTRODUCTION TO MEDICAL CODING 12

Professional over view and specific responsibilities. Standardization of coding and coding over view.History ICD and CPT. ICD – 9, ICD – 9CM, ICD -10. ICD – 9 - CM versus ICD – 10 – CM. Coding accuracy.

UNIT-II CPT CODE 12

CPT – Medical coding, structure of CPT codes. Three categories of CPT codes.

Absence of codes and special cases. EM Coding.

UNIT-III PHARMACOVIGILANCE 12

Introduction, definition, aim and objective of Pharmacovigilance study. Method, Plans, procedures, scope of Pharmacovigilance study. Pharmacovigilance study in India.

UNIT-IV SAFETY MONITORING 12

Basics in pharmacogenomics process of monitoring. Safety monitoring boards. Monitoring of quality assurance. Introduction to GPP. Risk management, guidance, assessing adverse and serious adverse events. Reporting of AE & SAE.

UNIT-V PRACTICES AND SAFETY SIGNALS 12

Introduction to good reporting practices and safety signals. Case reports, Case series, data mining, and causality report. International drug monitoring procedures. Health care information for comprehensive Pharmacovigilance surveillance.

Total Hours 60

Course Outcome:

CO-1: Understand the basics in Medical Coding and transcription. Also introduced to ICD, CPT and Coding accuracy.

CO-2: Demonstrate the categories of CPT codes and coding rituals.

CO-3: Interpret the importance of Pharmacovigilance study for clinical researchers and Plans, procedures, scope of Pharmacovigilance study.
CO-4: Analyze how monitoring boards function and their responsibilities and basics of pharmacogenomics.
CO-5: Categorize the good reporting practices and safety signals and International drug monitoring procedures will also be learnt.

TEXT AND REFERENCE BOOKS:

1. Linda Campbell, Medical Transcription Fundamentals and Practice, Prentice Hall-Gale, 1993.
2. Gupta S.K, Textbook of Pharmacovigilance, Japee publications, India, 2011.
3. Ravi N Humbarwadi,Quick Learner's Pharmacovigilance,Amazon,2003.
4. Eric T Herfindel, Dick R. Gourley, Textbook of Therapeutics Drug and Disease management, 6^{th} edition, 2012.
5. Janet woodcock, Frederick Ognibene, john overbeke, Assuring data quality and validity in clinical trials for regulatory decision making, 2003.
6. Marilyn takahashi Fortney Otis Diehl, Medical transcription guide: do’s and dont’s, 2003.

ADVANCED MEDICAL LAB TECHNOLOGY 2 0 0 2

Course Objective: (Entrepreneurship)

- To provide the analytical knowledge of clinical laboratory testing and its diagnosis.

UNIT I HEMATOLOGY 14

Specimen –definition, types. Collection and transport of specimen.Specimen preservation and storage. Hematology - Blood and its constituents, collection of blood various anticoagulants and their uses. Total Leukocyte Count(TC), Differential count(DC), Erythrocyte Sedimentation Rate(ESR) Red blood cells count(RBC), Platelet count, Packed cell volume(PCV), Mean cell volume(MCV), Hb estimation Bleeding time(BT), Clotting time(CT).Blood bank -Blood grouping(ABO system & Rh system),Identification of malarial parasites.

UNIT II CLINICALPATHOLOGY 10

Complete urine routine examination –physical, chemical and microbiological examination of urine, Culture and sensitivity. Complete routine examination of sputum and feces. Semen analysis.Examination of CSF.

UNIT III CLINICAL SEROLOGY AND IMMUNOLOGY 12

Common serological tests - Rheumatoid arthritis, Pregnancy test, Widal (slide and tube test), VDRL, HBs antigen, carbohydrate reactive protein test. Clinical manifestations and lab immunological diagnosis of AIDS, MOTT, Legionellosis, Chicken guinea, Helicobacter pylori and SARS.

UNIT IV CLINICALMICROBIOLOGY 12

Clinical manifestation and laboratory diagnosis of bacterial pathogens-Enteric pathogens (E.coli, Shigella, Samonella and Vibrio), pyogenic organisms (Staphylococcus and Streptococcus), Spirochetes (Leptospira), Mycobacterium, B. anthracis and Rickettsia. Virology, Mycology and Parasitology - Clinical manifestation and laboratory diagnosis of Rabies and Poliomyelitis, Dermatophytes and E.histolytica.

UNIT-V MOLECULARDIAGNOSTICS TECHNOLOGY 12

Molecular techniques for analysis of biochemical disorders. Assays for the diagnosis of inherited diseases. Bioinformatics tools for molecular diagnosis. Antibody based diagnosis –monoclonal antibodies as diagnostic reagents. Diagnosis of diseases by using ELISA and Western blot. DNA

diagnostics – PCR and array-based diagnosis. Clinical proteomics - protein microarray for disease diagnosis. Ethics in molecular diagnosis.

Total Hours: 60

Course Outcome:

CO-1: Recall the principle and various methods of collection, transport and storage of different clinical samples and basics of hematology.

CO-2: Infer about diagnostic methods of clinical pathology specimens i.e.complete routine examination of blood, urine, sputum, feces ,CSF and semen.

CO-3: Understand the principles and procedures of different serological tests in Diagnosis.

CO-4: Summarize the interactions between bacteria, Virus, fungi and parasitic microorganisms and the humans and Clinical manifestation and laboratory diagnosis of bacterial, Viral, fungal and parasitic infections.

CO-5: Utilize the principles and techniques of molecular diagnosis and the ethics involved in molecular diagnosis.

TEXT & REFERENCE BOOKS:

1. Naigaonkar. A.V. and M.D.Burande, A manual of Medical Laboratory Technology, NiraliPrakasan, Pune, India, 3rd edition, 2004.
2. Praful.B.Godkar, Clinical Biochemistry Principles and Practice, Bhalani Publishing House, Bombay, India, 1994.
3. Anathanarayan R. and C K JayaramPaniker, Textbook of Microbiology, Ninth Edition, Jain publications, 9th edition, 2013.
4. Pradeep Kumar N.S., Manual of Practical Pathology, CBS Publishers and Distributors Pvt Ltd, New Delhi, 2011.
5. Geo. F. Brooks, Janet S. Butel and Stephen A, Medical Microbiology, Morse 23rd Edition, 2010.
6. Betty.A.F., Daniel.F.S and A.S.Weisfeld, Bailey and Scott's Diagnostic Microbiology, Mosby(Elsevier), 2002.
7. Prakash M, C.K. Arora, Biochemical techniques, Anmol publication (1) Ltd New Delhi, 1998.