

# **ACADEMIC REGULATIONS COURSE STRUCTURE AND SYLLABI**

FOR

M. Tech. (BIOTECHNOLOGY)  
(with effect from 2009 – 10)



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**Kukatpally, Hyderabad – 500 085 AP.**

## **ACADEMIC REGULATIONS 2009 FOR M.TECH (REGULAR) DEGREE COURSE**

(Effective for the students admitted into first year from the academic year 2009-2010)

The M.Tech Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the program and fulfil all the requirements for the award of the Degree.

### **1.0 ELIGIBILITY FOR ADMISSIONS:**

Admission to the above program shall be made subject to the eligibility, qualifications and specialization prescribed by the University from time to time.

Admissions shall be made on the basis of merit rank obtained by the qualifying candidate at an Entrance Test conducted by the University or on the basis of any other order of merit approved by the University, subject to reservations prescribed by the university from time to time.

### **2.0 AWARD OF M. TECH. DEGREE:**

2.1 A student shall be declared eligible for the award of the M.Tech degree, if he pursues a course of study and completes it successfully for not less than two academic years and not more than four academic years.

2.2 A student, who fails to fulfil all the academic requirements for the award of the degree within four academic years from the year of his admission, shall forfeit his seat in M.Tech course.

2.3 **The minimum instruction for each semester 90 clear instruction days.**

### **3.0 A. COURSE OF STUDY:**

The following specializations are offered at present for the M.Tech course of study.

1. Advanced Manufacturing Systems
2. Aerospace Engineering
3. Bio-Technology
4. CAD/CAM
5. Chemical Engineering
6. Communication Systems
7. Computer Networks and Information Security
8. Computer Science
9. Computer Science and Engineering
10. Computers and Communication Engineering.
11. Control Systems
12. Design for Manufacturing/ Design and Manufacturing
13. Digital Electronics and Communication Engineering.

14. Digital Electronics and Communication Systems
15. Digital Systems and Computer Electronics
16. Electrical Power Engineering
17. Electrical Power Systems
18. Electronics and Communication Engineering
19. Embedded Systems
20. Embedded Systems and VLSI Design
21. Highway Engineering
22. Image Processing
23. Industrial Engineering and Management
24. Information Technology
25. Machine Design
26. Neural Networks
27. Parallel Computing
28. Power and Industrial Drives
29. Power Electronics
30. Power Electronics and Electrical Drives
31. Power Engineering and Energy Systems
32. Power System with Emphasis H.V. Engineering / H.V. Engineering
33. Real Time Systems
34. Software Engineering
35. VLSI
36. VLSI and Embedded Systems
37. VLSI Design
38. VLSI System Design
39. Web Technology
40. Wireless and Mobile Communication

and any other course as approved by the authorities of the University from time to time.

**3.0 B. Departments officering M.Tech Programmes with specializations mentioned below:**

<b>ECE</b>	Communication Systems Computers and Communication Engineering. Digital Electronics and Communication Engineering. Digital Electronics and Communication Systems Digital Systems and Computer Electronics Electronics and Communication Engineering Embedded Systems Embedded Systems and VLSI Design VLSI VLSI and Embedded Systems VLSI Design VLSI System Design Wireless and Mobile Communication
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<b>CSE</b>	Computer Networks and Information Security Computer Science Computer Science and Engineering Image Processing Information Technology Neural Networks Parallel Computing Real Time Systems Software Engineering Web Technology
<b>ME</b>	Advanced Manufacturing Systems CAD/CAM Design for Manufacturing/ Design and Manufacturing Industrial Engineering and Management Machine Design
<b>EEE</b>	Control Systems Electrical Power Engineering Electrical Power Systems Power and Industrial Drives Power Electronics Power Electronics and Electrical Drives Power Engineering and Energy Systems Power System with Emphasis H.V. Engineering/ H.V. Engineering
<b>Aeronautical Engg.</b>	Aerospace Engineering
<b>Bio-technology</b>	Bio-Technology
<b>Civil Engg.</b>	Highway Engineering
<b>Chemical Engg.</b>	Chemical Engineering

#### 4.0 ATTENDANCE:

The programs are offered on a unit basis with each subject being considered a unit.

- 4.1 A candidate shall be deemed to have eligibility to write end semester examinations in a subject if he has put in at least 75% of attendance in that subject.
- 4.2 Shortage of attendance up to 10% in any subject (i.e. 65% and above and below 75%) may be condoned by the College Academic Committee on genuine and valid reasons on representation by the candidate with supporting evidence.
- 4.3 A candidate shall get minimum required attendance at least in three (3) theory subjects in the present semester to get promoted to the next semester. In order to qualify for the award of the M.Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.
- 4.4 Shortage of attendance below 65% shall **in no case be condoned**.

4.5 A stipulated fee shall be payable towards condonation of shortage of attendance.

## **5.0 EVALUATION:**

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

- 5.1 For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination, 40 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the better of the marks secured in the two Mid Term-Examinations conducted one in the middle of the Semester and the other immediately after the completion of instruction. Each mid term examination shall be conducted for a duration of 120 minutes with 4 questions to be answered out of 6 questions.
- 5.2 For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations, 40 marks shall be awarded based on the day-to-day performance as Internal Marks.
- 5.3 There shall be two seminar presentations during I year I semester and II Semesters. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee. The Departmental Committee consists of Head of the Department, supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful.
- 5.4 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is aimed to assess the students' understanding in various subjects he/she studies during the M.Tech course of study. The Comprehensive Viva-Voce is valued for 100 marks by the Committee. There are no internal marks for the Comprehensive viva-Voce
- 5.5 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.
- 5.6 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to reappear for the End Examination in that subject. A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and he has failed in the end examination. In

such case candidate must re-register for the subject(s) and secure required minimum attendance. Attendance in the re-registered subject(s) has to be calculated separately to become eligible to write the end examination in the re-registered subject(s). The attendance of re-registered subject(s) shall be calculated separately to decide upon the eligibility for writing the end examination in those subject(s). In the event of taking another chance, the internal marks and end examination marks obtained in the previous attempt are nullified.

- 5.7 In case the candidate secures less than the required attendance in any subject(s), he shall not be permitted to appear for the End Examination in that subject(s). He shall re-register the subject when next offered.
- 5.8 Laboratory examination for M.Tech courses must be conducted with two Examiners, one of them being Laboratory Class Teacher and second examiner shall be other Laboratory Teacher.

## **6.0 EVALUATION OF PROJECT / DISSERTATION WORK:**

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Project Review Committee.

- 6.1 A Project Review Committee (PRC) shall be constituted with Principal as chair person Heads of all the Departments which are offering the M.Tech programs and two other senior faculty members.
- 6.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects (theory and practical subjects).
- 6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the Departmental Committee for its approval. Only after obtaining the approval of Departmental Committee the student can initiate the Project work.
- 6.4 If a candidate wishes to change his supervisor or topic of the project he can do so with approval of Departmental Committee. However, the Departmental Committee shall examine whether the change of topic/supervisor leads to a major change of his initial plans of project proposal. If so, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.
- 6.5 A candidate shall submit status report (in a bound-form) in two stages at least with a gap of 3 months between them.
- 6.6 The work on the project shall be initiated in the beginning of the second year and the duration of the project is for two semesters. A candidate is permitted to submit Project Thesis only after successful completion of theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Principal (through Head of the Department) and shall make an oral presentation before the PRC.

- 6.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College / School / Institute.
- 6.8 The thesis shall be adjudicated by one examiner selected by the University. For this, Principal of the College shall submit a panel of 5 examiners, who are eminent in that field with the help of the concerned guide and head of the department.
- 6.9 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis, in the time frame as described by PRC. If the report of the examiner is unfavourable again, the thesis shall be summarily rejected.
- 6.10 If the report of the examiner is favourable, viva-voce examination shall be conducted by a board consisting of the supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report candidates work as:

- A. Excellent
- B. Good
- C. Satisfactory
- D. Unsatisfactory

Head of the Department shall coordinate and make arrangements for the conduct of viva-voce examination.

If the report of the viva-voce is unsatisfactory, the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination, he will not be eligible for the award of the degree.

#### **7.0 AWARD OF DEGREE AND CLASS:**

**After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:**

Class Awarded	% of marks to be secured
<b>First Class with Distinction</b>	<b>70% and above</b>
<b>First Class</b>	<b>Below 70% but not less than 60%</b>
<b>Second Class</b>	<b>Below 60% but not less than 50%</b>
<b>Pass Class</b>	<b>Below 50% but not less than 40%</b>

**(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)**

#### **8.0 WITH-HOLDING OF RESULTS:**

If the candidate has not paid any dues to the university or if any case of in-discipline is pending against him, the result of the candidate will be withheld and he will not be allowed into the next higher semester. The issue of the degree is liable to be withheld in such cases.

## **9.0 TRANSITORY REGULATIONS:**

Candidate who have discontinued or have been detained for want of attendance or who have failed after having undergone the course are eligible for admission to the same or equivalent subjects as and when subjects are offered, subject to 5.5 and 2.0

## **10.0 GENERAL:**

- 10.1 The academic regulations should be read as a whole for purpose of any interpretation.
- 10.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
- 10.3 The University may change or amend the academic regulations and syllabus at any time and the changes and amendments made shall be applicable to all the students with effect from the date notified by the University.
- 10.4 Wherever the word he, him or his occur, it will also include she, her and hers.
- 10.5 There shall be no transfers within the constituent colleges of Jawaharlal Nehru Technological University.

## MALPRACTICES RULES

### DISCIPLINARY ACTION FOR IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
	<i>If the candidate:</i>	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining

		examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from classwork and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and projectwork and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from classwork and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that

		subject and all other subjects the candidate has already appeared including practical examinations and projectwork and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and projectwork and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.  Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and projectwork and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

### **Malpractices identified by squad or special invigilators**

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
  - (i) A show cause notice shall be issued to the college.
  - (ii) Impose a suitable fine on the college.
  - (iii) Shifting the examination center from the college to another college for a specific period of not less than one year.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.Tech. (Biotechnology)**  
**COURSE STRUCTURE AND SYLLABUS**

**I YEAR I SEMESTER**

Code	Group	Subject	L	P	Credit
		Microbial Engineering	3	0	3
		Molecular Biology & Virology	3	0	3
		Preparatory Core Course-I from unassigned course list	3	0	3
		Preparatory Core Course-II from unassigned course list	3	0	3
	Elective -I	from unassigned course list	3	0	3
	Elective -II	from unassigned course list	3	0	3
	Lab	Process engineering principle/ Microbiology & Biochemistry Lab	0	3	2
		Seminar	-	-	2
		Total Credits (6 Theory + 1 Lab.)			22

**I YEAR II SEMESTER**

Code	Group	Subject	L	P	Credit
		Bioreactor Engineering	3	0	3
		Genetic Engineering	3	0	3
		Downstream Processing	3	0	3
	Elective –III	from unassigned course list	3	0	3
	Elective –IV	from unassigned course list	3	0	3
	Elective -V	from unassigned course list	3	0	3
	Lab	Bioprocess Engineering / r-DNA Technology Lab	0	3	2
		Seminar	-	-	2
		Total Credits (6 Theory + 1 Lab.)			22

**II YEAR - I Semester**

Code	Group	Subject	L	P	Credit
		Comprehensive Viva	-	-	2
		Project Seminar	0	3	2
		Project work	-	-	18
		Total Credits			22

**II YEAR - II Semester**

Code	Group	Subject	L	P	Credit
		Project work and Seminar	-	-	22
		Total Credits			22

**LIST OF PREPARATORY CORE / ELECTIVES  
UNASSIGNED SUBJECTS/COURSES**

**I SEMESTER**

**PREPARATORY CORE SUBJECTS/COURSES:**

(Two of these are allotted to each student depending on the background)

BT-XX	General and Industrial Microbiology
BT-XX	Biochemistry and Metabolic Regulation
BT-XX	Process Engineering Principles
BT-XX	Basic Engineering Mathematics.

**ELECTIVE SUBJECTS/COURSES:** (Any Two of the following)

BT-XXX	Biochemical & Biophysical techniques
BT-XXX	Computer Applications and Biostatistics
BT-XXX	Biocatalysis and Enzyme Mechanisms.
BT-XXX	Enzyme Engineering & Technology
BT-XXX	Basic Immunology

**II SEMESTER**

**ELECTIVE SUBJECTS/COURSES:** (Any Three of the following)

BT-XXX	Environmental Biotechnology
BT-XXX	Advanced Immunology and Immunotechnology
BT-XXX	Plant Biotechnology
BT-XXX	Bioinformatics
BT-XXX	Advanced Animal cell science and Technology
BT-XXX	Nano Biotechnology and Nano Devices

**NOTE-XX:** Depending on the elective number and semester under which a particular course from the above given list is offered, it will be assigned the same number under elective as given in the course structure.

## **I Year - I Sem M.Tech. (Biotech)**

### **BT-101 MICROBIAL ENGINEERING**

#### **UNIT I**

Introduction to biotechnology and biochemical engineering, bioprocess techniques, biotechnology products. Raw materials used for Industrial fermentation and its processing. Chemical, physical and physiochemical treatment.

#### **UNIT II**

**Material balance:** Thermodynamic preliminaries, system and process, steady state and equilibrium, law of conservation of mass, types of material balance problem, material balances with recycle and bypass streams.

**Energy balance:** Basic energy concepts, intensive & extensive properties, Studies of enthalpy for reactive & non reactive processes. Heat of combustion, heat of reaction at Non standard conditions. Thermodynamics of microbial growth, energy balance equation for cell culture, unsteady state energy balance equations.

#### **UNIT III**

Medium optimization and Sterilization: Medium optimization techniques with special emphasize on statistical techniques, placket-Burman design, ANOVA, central; composite design, response surface methodology.

Sterilization: Media sterilization: kinetics of thermal death of cells & spores, design of batch and continuous thermal sterilization, coupling of Arrhenius equation and cell death kinetics, sterilization of air and filter design. Radiation and chemical sterilization.

#### **UNIT IV**

Stoichiometry of bioreaction and energetic of microbial growth, ATP and red ox potential balance, Yield coefficients, Growth stoichiometry and elemental balances, electron balances, productivity and their correlation with the stoichiometry.

Unstructured model for microbial growth. The development of different microbial growth kinetics like Malthus, Pearl and read, Monod Model, Konark Model. The limitation of Monod model and development of other constitutive models. Multisubstrate model, inhibition models for substrate, Product and toxic substances, development of logistic equation. Maintenance and endogenous metabolism kinetics.

#### **UNIT V**

Kinetics based on molecular mechanism, Model for Plasmid Structured models - a few examples, Single cell model, Product formation expression and replication, model of gene expression, Segregated model. Models of plasmid stability. Thermal death kinetics of cells and spores. Engineering and social considerations for the production of r-DNA products; Safety, Good Laboratory and manufacturing practices. Parameter estimation, Model validation and bioprocess optimization

#### **TEXT BOOKS**

- 1) Bailey JE, Ollis DF; Biochemical Engineering fundamentals Year of Publication 1986
- 2) Blanch HW and Clark DS: Biochemical Engineering Marcel Decker Year of Publication 1987
- 3) Introduction to Biochemical Engineering by D G Rao. Tata, Mc Graw Hill, New Delhi.

#### **REFERENCES:**

- 1) Biochemical Engineering Principles and functions by Syed Trnveer Ahmed Inamdar, PHI Learning Private limited.

- 2) Wiseman, A: Handbook of Enzyme Biotechnology, 3<sup>rd</sup> Edition, Ellis Horwood Publication, Year of Publication 1999
- 3) Moser, A; Bioprocess technology, kinetics and reactors; Springer Verlag, Year of Publication 1988
- 4) Schugerl K; Bellgardt K H (Eds); Bioreaction Engineering, Modeling and control; Springer – verlag, berlin Year of Publication 2000

**I Year - I Sem M.Tech. (Biotech)**

**BT-102 MOLECULAR BIOLOGY AND VIROLOGY**

**UNIT I:**

DNA Structure, Replication and repair. Genes arrangement. Eukaryotic chromosome Structure and replication. Repetitive DNA. CpG islands, Gene amplification. Different classes of RNA and their functions. RNA synthesis and other post transcriptional modifications.

**UNIT II:**

Protein synthesis and translational control.

Control of gene expression in prokaryotes. Transcriptional control in Eukaryotes.

**UNIT III:**

Plasmids, Transposable elements and TY elements.

Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping.

**UNIT IV:**

Biochemistry of ribozyme; hammer- head, hairpin and other ribozymes, strategies for designing ribozymes, Applications of antisense and ribozyme technologies.

**UNIT V:**

Structure and classification of viruses and Replication of bacteriophages.

Replication of animal viruses. A note on SV40 and Retroviruses in transformation.

**TEXT BOOKS :**

1. "Molecular Biology of the gene" by Waston et al 4th ed.
2. "Genes VI" by Benjamin Lewis
3. Biochemistry and Molecular biology, William H. Elliott and Daphne C. Elliott, Third Edition, Indian edition, Oxford University press, 2005.

**REFERENCES:**

1. "Genetics" by Ursula Goodenough
2. "Cytogenetics" by IGarl P. Swanson, Mertz & Young
3. "General Virology" by Luria & Darnell
4. "Biochemistry" by Stryer.

## **I Year - I Sem M.Tech. (Biotech)**

### **BT-XX GENERAL AND INDUSTRIAL MICROBIOLOGY**

#### **UNIT I: INTRODUCTION & METHODS IN MICROBIOLOGY**

Role of microorganisms in transformation of organic matter and in the causation of diseases, Development of pure culture methods; Enrichment culture methods. Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition Construction of culture media; Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms.

#### **UNIT II: MICROBIAL GROWTH**

The definition of growth, mathematical expression of growth, growth curve, availability of oxygen; Culture collection and maintenance of cultures.

Media formulation: Principles of microbial nutrition, formulation of culture media, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors & antifoam agents. Importance of pH. Basics of Response surface Methodology (RSM)

#### **UNIT III: HISTORY AND DEVELOPMENT OF FERMENTATION**

History and development of fermentation industry, Shake flask, batch and continuous operations and their applications merits and demerits. Solid state fermentation..

#### **UNIT IV: INDUSTRIALLY IMPORTANT METABOLITES**

Antibiotics: penicillin, streptomycin, tetracycline and other antibiotics; biological production considerations; large scale production. Primary and secondary metabolites. Organic acids: Lactic, citric, acetic, gluconic, fumaric and itaconic acids; process variables and large scale production.

Alcohols and alcoholic beverages: Ethanol production and purification, production of beer, wine and related beverages.

Industrial Enzymes, Vitamins: Their importance and role as coenzymes; production of B, C and A.

#### **UNIT V: FOOD & ALLIED PRODUCTS**

Food industry: Bakers yeast and bread making, rennet and other proteolytic enzymes in cheese making, production of different cheeses; other products from diary industry, sweeteners, single cell protein. Biofertilizers. Fuels: Methane generation, biological production of hydrogen. r-DNA proteins (EG. Hormones, vaccines, humanized antibody).

#### **TEXT BOOKS:**

1. "Principles of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press (1984).
2. Industrial Microbiology by A.H. Patel, Macmillan India Ltd.
3. Industrial Biotechnology by S.N. Jogdand, First edition, Himalaya Publishing House, 2006.

#### **REFERENCES:**

1. "General Microbiology" 5th Edition Stanier et al.
2. "Enzymes in food processing" by Gerald Reed, Academic press.
3. "Comprehensive Biotechnology" Vols III & IV, Editor M.Moo young.
4. "Industrial Microbiology" by Prescott
5. "Industrial Microbiology" by Casida.

**I Year - I Sem M.Tech. (Biotech)**

**BT-XX BIOCHEMISTRY AND METABOLIC REGULATION**

**UNIT I: METABOLISM AND REGULATION OF MACROMOLECULES**

**Carbohydrates-** Glycolysis, aerobic and anaerobic fate of pyruvate, Oxidative phosphorylation, Gluconogenesis, pentose phosphate pathway, glycogen metabolism.

**Nucleic acids-** Purine synthesis and catabolism. Pyrimidine synthesis and catabolism.

**Proteins-** Transamination, Deamination, Oxidative deamination, Urea cycle.

**Aminoacids-** Biosynthesis of non-essential aminoacids, catabolism of aminoacids.

**Lipids-** Fatty acid synthesis,  $\beta$ -oxidation of fatty acids

**UNIT II: PHOTOSYNTHESIS**

Light reaction and Dark reaction

**UNIT III: TRANSPORTATION IN BIOMEMBRANES, SIGNAL TRANSDUCTION**

Structure of plasma membranes. Transportation of molecules across plasma membrane.

Modes of cell signaling, Types of receptors used for cell signaling, pathway of intracellular signal transduction using secondary messengers, Apoptosis

**UNIT IV: PROTEIN TARGETING**

Protein synthesis, Cotranslation and post translation of proteins. Protein targeting

**UNIT V: ENZYMES**

Nomenclature and classification of enzymes. Factors affecting enzymes. Enzyme specificity. Enzymes assay. Enzyme inhibition. Applications

**TEXT BOOKS**

1. Biochemistry and Molecular Biology, Third Edition by William H. Elliott and Daphne C. Elliott, Oxford University press.
2. Biochemistry L.Stryer Third Edition

**REFERENCES:**

1. Biochemistry White, Handler and R.B.Smith 7th Ed. 1983
2. Principles of Biochemistry A.Lehninger 1987.
3. Fundamentals of Biochemistry by J.L. Jain, Sunjay Jain AND Nitin Jain, S. Chand and Company LTD

## **I Year - I Sem M.Tech. (Biotech)**

### **BT-XX PROCESS ENGINEERING PRINCIPLES**

#### **UNIT I**

**Fundamentals of chemical engineering** Brief overview, concepts of unit operation & unit process with examples, units and dimensions, dimensional analysis, Presentation and analysis of data, fluids vs solids, fluid statics- Pressure measurement –different types of manometers with simple numeric problems, steady flow –equation of continuity, Derivation of Bernoulli's equation for one dimensional flow, its limitation and corrections and applications in flow meters.

#### **UNIT II**

**Fluids mechanics** Introduction, Newton's law of viscosity, flow curves for non-Newtonian fluids with examples from biotechnology, flow patterns –laminar and turbulent, Reynolds experiment – Reynolds number, pressure drop due to friction, relating Reynolds number with friction factor, packed beds and pressure drop through packed beds, Fluidization – concept, significance in chemical industry, and pressure drop across fluidized beds.

#### **UNIT III**

**Heat transfer** Modes of heat transfer with examples, conduction, convection and radiation, definitions and governing laws, Thermal boundary layer and Prandtl number, conductivity and resistivity, compound resistances in series, heat transfer through cylindrical pipe, analogy between momentum and heat transfer, simple numerical problems on conduction.

**Heat transfer** Convection-Natural and forced convection, dimensionless numbers in heat transfer, concept of heat transfer coefficient and overall heat transfer coefficient, radiation, combined heat transfer by conduction, convection and radiation.

#### **UNIT IV**

**Heat exchanger equipment:** Heat exchangers Over view of heat exchangers-types and temperature area graphs, concept of LMTD, overview of other heat transfer operations.

**Boiling and evaporation;** Mechanisms of boiling, Film and nucleate boiling, single and multiple effect evaporators, economy and evaporators performance with various feeding patterns viz, forward, backward and parallel.

#### **UNIT V**

**Mass transfer** Definition, Fick's law of diffusion, Analogy with momentum and heat transfer, diffusivities of gases and liquids, fundamentals of mass transfer, theories of mass transfer, concept of mass transfer coefficients, dimensionless numbers, overview of separation operations with examples; ideal stage concept, mass transfer equipment-distillation, liquid extraction, gas absorption, drying.

#### **TEXT BOOKS:**

1. Unit operations of Chemical Engineering, (1993), by McCabe, Smith and Harriott, McGraw Hill publishers.
2. Introduction to Biochemical Engineering, Second edition, By D G Rao, Tata McGraw Hill Publications.

#### **REFERENCES:**

1. Bioprocess Engineering principles By Pauline M Doran, Academic Press.
2. Unit Operations-1, K. A. Gavhane, Nirali Prakashan Publication.

**I Year - I Sem M.Tech. (Biotech)**

**BT- XX BASIC ENGINEERING MATHEMATICS**

**UNIT I:**

Trigonometry- relations related to compound angles, multiple and sub-multiples, transformations, hyperbolic functions

**UNIT II:**

Concepts of limit, continuity, differentiation, product rule, quotient rule. Differentiation of trigonometric, logarithmic, exponential functions.

**UNIT III**

Applications of differentiation – problems on tangent, sub tangent normal, sub normal. Introduction to partial differentiation, Euler's theorem.

**UNIT IV:**

Introduction, Integration of different functions, methods of Integration, Integration by parts. Concept of definite integrals.

Applications of definite integrals – problems on areas.

**UNIT V:**

Forming of differential equation by eliminating arbitrary constants, first order and first degree – variables and separables, exact, homogeneous and linear.

**Textbooks:**

- |                            |   |                       |
|----------------------------|---|-----------------------|
| 1. Engineering Mathematics | - | N.P. Bali and others. |
| 2. Engineering mathematics | - | B.V. Ramana           |

**References:**

- |                          |   |                 |
|--------------------------|---|-----------------|
| 1. Differential Calculus | - | Shanthi Narayan |
| 2. Integral Calculus     | - | Shanthi Narayan |

## **I Year - I Sem M.Tech. (Biotech)**

### **BT-XXX BIOCHEMICAL AND BIOPHYSICAL TECHNIQUES**

#### **UNIT I:**

Colloidal solutions of biopolymers and their electrochemical properties. Hydrodynamic properties: Viscosity, diffusion etc of biopolymers; Molecular weight determination, osmotic pressure, reverse osmosis, and Donnan effect. Structure of Biomembranes and their electrochemical properties, membrane potential, action potential and propagation of impulses.

#### **UNIT II:**

Electrophoresis: Different methods of electrophoresis for protein, nucleic acids, small molecular weight compounds and immuno precipitates (Immuno electrophoresis). Peptide mapping and combination of electrofocussing and SDS-PAGE.

#### **UNIT III:**

Theory of centrifugation and application to biological systems. Rotors angle/vertical/zonal/continuous flow centrifuge, differential centrifugation density gradient centrifugation. Ultra centrifugation principle and application. Chromatography – adsorption, affinity, partition, Ion exchange, gel permeation, GLC, TLC, RPC, HPLC etc.

#### **UNIT IV:**

Introduction to principles and applications of (a) spectroscopic methods (UV, Vis, IR, Fluorescence, ORD, CD & PAS) (b) NMR, ESR & Mass spectrometry. Use of radioactive and stable isotopes and their detection in biological systems.

#### **UNIT V:**

Automatic analyzer for amino acids, protein sequenater, peptide synthesizer & nucleic acid synthesizer. Cell sorters and their applications. Theory of lyophilization and its applications to biological systems. Introduction to principles and working of light & Electron microscope.

#### **BOOKS:**

1. Introduction to Biophysics by Pranab Kumar Banerjee, S Chand and company, 2008.
2. Instrumental methods of chemical analysis by G. R Chatwal and S .K Anand, Himalaya publishing house, 2008.

#### **REFERENCE:**

1. Biotechnology Procedures and Experiments handbook by S. Harisha, Infinity Science Press LIC, 2008.

## **I Year - I Sem M.Tech. (Biotech)**

### **BT-XXX COMPUTER APPLICATIONS & BIOSTATISTICS**

#### **UNIT I:**

Introduction of digital computers: Organization; low-and high level languages; binary number system, Operating systems. Microsoft-Office packages (MS-Word, MS-Excel, MS-PowerPoint).

#### **UNIT II:**

Descriptive Statistics: Develop frequency distributions, Calculate measures of central tendency and Dispersion, Utilize Microsoft® Excel®'s graphic and tabular techniques to represent descriptive statistical data Probability Distribution Define terminology related to probability, Differentiate between probability and non probability sampling designs, Describe the probability distribution of a random variable, Explain the concept of a normal probability distribution

#### **UNIT III:**

Confidence Intervals: Explain the standard normal distribution, Describe the value of the central limit theorem, Calculate point and interval estimates, Evaluation of confidence Intervals using MS-Excel, Hypothesis Testing Assess circumstances when hypothesis testing is appropriate, Analyze research, which employs various hypothesis tests, Identify and assess when various inferential tests should be used, Hypothesis testing using MS-Excel

#### **UNIT IV:**

Simple linear regression and correlation

Apply correlation analysis to solve research issues, Apply linear regression analysis to solve research issues, Regression and correlation using MS-Excel

Flow charts and algorithms

#### **UNIT V:**

Introduction to programming - Fundamentals of 'C' Language - Typical structure of a C Program. Introduction to programming - Flow charts and algorithms - Fundamentals of 'C' Language - Typical structure of a C Program, Data Types - Variables - Constants - Arithmetic expressions –

Use of operators – program examples.

Decision making in C - relational operators - Logical operators - Precedence of operators - IF and IF ... ELSE statements - Looping concepts in C \_ WHILE loop - DO ... WHILE - and FOR loops - Programming examples.

Functions - User defined Functions - Local and Global variables - Parameters - Programming examples.

Arrays - BREAK statement - Strings and character arrays - examples.

Introduction to data structures and database concepts

Database architecture and concepts of Relational database management

System, SQL and PL/SQL ,Introduction to Oracle RDBMS

#### **TEXT BOOKS :**

1. "Computer Fundamentals" by B.Ram
2. "Fundamentals of Computers" by V.Rajaraman

#### **REFERENCE;**

1. "C Programming" by G.Kochan
2. "The Spirit of C" by Mullish Cooper

**I Year - I Sem M.Tech. (Biotech)**

**BT- XXX BIOCATALYSIS AND ENZYME MECHANISMS**

**UNIT I: BIOCATALYSIS**

Current Status, Advantages & disadvantages, Comparison with other Catalysts, Biocatalysts as a technology, Green Chemistry

**UNIT II: CHARACTERIZATION OF A BIOCATALYST**

Enzyme Kinetics, Basis of Enzyme Action, Theories of Enzyme Catalysis, Efficiency, Stability, Selectivity of Enzymes, Screening of New Enzyme Activity

**UNIT III: BIOCATALYTIC ASYMMETRIC SYNTHESIS**

Basic of stereochemistry; Enantiomerically pure amino acids, Hydroxy esters with carbonyl reductase, Alcohols with ADH, Penicillin G, Ephedrine, Chiral drugs, Anticholesterol drugs, Anti-infectives, Anti-AIDS drugs, Cardiovascular drugs, Applications of Lipases and Esterases in the Pharma industry, Steroids

**UNIT IV: BIOCATALYSIS IN NON-CONVENTIONAL MEDIA**

Enzymes in organic solvents, Advantages of Biocatalysis in organic media, Role of water in Enzyme reactions in Organic solvents, Substrate as solvent, Ionic liquids and Supercritical Solvents for enzymatic reactions

**UNIT V: INDUSTRIAL ENZYMES**

Enzymes in the food industry, Cell-wall degrading enzymes, Lipases, Proteases, Amylases, Xylanases, Enzymes in brewing, Fat splitting, Enzymes in the paper and pulp industry, Enzymes in the textile industry, Enzymes for preservation, The future of enzyme applications

**BOOKS:**

1. Biocatalysis: Fundamentals & Applications by Andreas Sebastian Bommarius , Bettina R. Riebel, VCH (02 April, 2004)
2. Biotransformations in Organic Chemistry by Kurt Faber, Springer Berlin 5<sup>th</sup> Edn, 2004

**REFERENCES:**

1. Enzymes by palmer,
2. Enzymes in Industry by Wolfgang Aehle, Wiley-VCH, 2004.

## **I Year - I Sem M.Tech. (Biotech)**

### **BT-XXX ENZYME ENGINEERING AND TECHNOLOGY**

#### **UNIT: I**

The enzyme, introduction, nomenclature and classification, applications in Industrial, Medical, Analytical, Chemical, Pharmaceutical and Food Sectors. specific activity, turnover number. Basis of enzymatic reaction, collision theory and transition state theory and role of entropy in catalysis

Enzyme kinetics, Michaelis-Menten equation, Brigg's-Haldane equation & estimation of constants using graphical technique,

#### **UNIT II:**

Hydrolytic, covalent, acid-base, electrostatic and metal ion involved catalysis. Energetics of substrate binding. The mechanism of action of chymotrypsin isoenzyme, glyceraldehyde 3 phosphate etc., Determination of the number of active sites of enzyme. Enzyme inhibition kinetics, substrate and product and toxic substance inhibition.

#### **UNIT III:**

Temperature dependence of rate constants of enzymatic reaction, thermal deactivation, pH effect on rate constants and protein structure. Stoichiometry of bioreaction and energetics of enzymatic reaction, ATP and redox potential balance. Yield coefficients and their correlation with the stoichiometry

#### **UNIT IV:**

Pre-steady-state kinetics, determination of rate constants, rapid mixing, stopped flow and relaxation technique. Enzyme kinetics at limiting condition, enzyme kinetics at interface and kinetics of multi substrate reactions.

#### **UNIT V:**

Immobilization of biocatalysts an introduction, Electrostatic Effect, effect of charged and uncharged support, Effect of external and internal mass transfer, Damkohler number, effectiveness factor, Intraparticle diffusion kinetics, Biot number

#### **TEXT BOOKS :**

1. Blanch HW and Clark DS: Biochemical Engineering Marcel Decker Year of Publication 1987.
2. Enzymes by palmer,
3. Prace and stevens,
4. Blanch HW and Clark DS: Biochemical Engineering, Marcel Decker

#### **REFERENCES:**

1. Bailey JE, Ollis, DF: Biochemical Engineering Fundamentals
2. Schugerl K., Bellgart KH (Eds): Biorection Engineering, modeling and control: Springer-Verlag, Berlin
3. Wiseman, A: Handbook of Enzyme Biotechnology, 3<sup>rd</sup> Edition, Ellis Horwood Publication
4. Moser, A: Bioprocess technology, kinetics and reactors: Springer Verlag
5. Biochemical Engineering Principles and functions by Syed Trnveer Ahmed Inamdar, PHI Learning Private limited.

**I Year - I Sem M.Tech. (Biotech)**

**BT-XXX BASIC IMMUNOLOGY**

**UNIT: I**

Types of immunity: innate and acquired, acute phase reactants. Acquired immunity: humoral and cell mediated immune response

**UNIT: II**

Immunogenicity; Immunochemistry: Immunogens, haptens, adjuvants, Immunoglobulin (antibody) structure and function, Monoclonal antibodies, recombinant and chimeric antibodies, Abzymes, Antigen-antibody interactions

**UNIT: III**

Cellular immunology: Lymphocytes- T and B, Macrophages- identification using CD markers, Lymphoid tissues, lymphocyte development, Antigen receptors on B and T cells

**UNIT: IV**

Antigen recognition, Role of MHC antigens, Lymphocyte activation, Antibody secretion and cell mediated immune responses, Cytokines, Immunological tolerance

**UNIT: V**

Transplantation and Immunosuppressive drugs; Vaccines: conventional, subunit and recombinant, Antiidiotypic vaccines; Tumor immunology: Immunotoxins.

**TEXT BOOKS:**

1. "Essential Immunology" by Ivan M. Roitt (1980). (Blackwell Scientific Publications, Oxford, London) fourth edition
2. "Immunology" by Ivan M. Roitt, Jonathan Brostoff and David K. Male (1985) (Glower Medical Publishing, London) first edition.
3. "Immunology Today".
4. Current topics in Microbiology & Immunology.

**I Year - I Sem M.Tech. (Biotech)**

**BT-107 TECHNIQUES IN MICROBIOLOGY AND BIOCHEMISTRY**

**LIST OF EXPERIMENTS:**

1. Basic techniques in handling microbes - sterilization, media preparation, precautions etc.,
2. Study of growth rate and the factors affecting it.
3. Chromatography - including Paper, TLC, GLC, Gel filtration chromatography (HPLC) and Ion exchange chromatography (FPLC)
4. Electrophoresis and Blotting Techniques - PAGE and SDS-PAGE. Determination of molecular weight. Western Blot Technique.
5. Quantitative determination of carbohydrate content: e.g. Preparation of Starch from various sources, starch hydrolysis and determination of carbohydrate content.
6. Estimation of proteins by Lowry's and Biuret methods e.g. in milk, legumes and pulses.
7. Isolation and Estimation of DNA by Diphenylamine reaction and UV spectroscopic method.

## **I Year -II Sem M.Tech. (Biotech)**

### **BT-201 BIOREACTOR ENGINEERING**

#### **UNIT I**

Introduction; Bioreactor function, utility, types of bioreactors. Modes of bioreactor operations, Main components of the bioreactor and their function.

Introduction Methods of Aeration, Surface aeration, Shake fasks, Mechanical stirred bioreactors, Enzyme catalysis in CSTR. Cell death in batch reactor, endogenous metabolism, maintenance, product and substrate inhibition on chemostat.

#### **UNIT II:**

Bioreactors and design features; Batch reactor, chemostat CSTR, Plug Flow Reactor, Fed batch reactor, Bubble column, bubble generation at an orifice, bubble coalescence and breakup, gas holdup, interfacial area, immobile and mobile gas liquid interface, regimes of bubbles, design of bubble columns, Cascade reactor, air lift reactor, Fluidized bed bioreactors, trickle bed reactors, Immobilized bioreactors, recycle bioreactors.

#### **UNIT III**

Gas-liquid mass transfer in cellular systems, basic mass transfer concepts, solubility of gases ( $O_2$ ,  $CO_2$ ) in biological media, mass balances for two –phase bioreactor.

Mass transfer –introduction to mass transfer between phases, mass transfer in porous solids, quantifying mass transfer, mass transfer & experimental design.

Oxygen transfer-introduction ,oxygen transfer process, factor effecting  $k_{LA}$  ,interfacial area and oxygen transfer, factors effecting the saturation concentration of oxygen, oxygen uptake.

#### **UNIT IV**

Mass transfer in agitated tanks, correlations with  $k_{LA}$  in Newtonian and non Newtonian liquid, Power number. Experimental determination of  $k_{LA}$ , static method, dynamic method, chemical method and electrochemical method. Power requirement for mixing in aerated and non aerated tanks, agitated and non agitated tanks for Newtonian and non Newtonian fluid. Mixing time in agitated reactor, residence time distribution , non ideal reactor and multiphase bioreactor.

#### **UNIT V**

**Aeration and Agitation in Animal cell Bioreactors;** Introduction,cell damage in animal cell bioreactors , shear damage ,bubble damage ,Methods of minimizing cell damage. Laminar & Turbulent flow in stirred tank bioreactors ,turbulent eddies,kolmogrov eddy size,Preventing vortex formation,Off centre impellers ,Baffles.

Control of bioreactor , strategy , online and offline monitoring of bioreactors; computerized bioprocess control.

Scaing up and scale down of mass transfer equipment and bioprocess, control of bioreactor, sensor used in the bioreactor, pH,  $O_2$ ,  $CO_2$  electrode. Online sensors for cell properties. Direct regulatory control and cascade control mechanism .

#### **TEXT BOOKS**

- 1) Bailey JE, Ollis DF; Biochemical Engineering fundamentals Year of Publication 1986
- 2) Blanch HW and Clark DS: Biochemical Engineering Marcel Decker Year of Publication 1987
- 3) Introduction to Biochemical Engineering by D G Rao, Tata Mc Graw Hill, New Delhi

**REFERENCE BOOKS:**

- 1) Wiseman, A: Handbook of Enzyme Biotechnology, 3<sup>rd</sup> Edition, Ellis Horwood Publication, Year of Publication 199
- 2) Moser, A; Bioprocess technology, kinetics and reactors; Springer Verlag, Year of Publication 1988
- 3) Schugerl K: Bellgardt K H (Eds); Bioreaction Engineering, Modeling and control; Springer – verlog, berlin Year of Publication 2000.
- 4) Biochemical Engineering Principles and functions by Syed Trnveer Ahmed Inamdar, PHI Learning Private limited

## **I Year -II Sem M.Tech. (Biotech)**

### **BT-202 GENETIC ENGINEERING**

#### **UNIT I:**

Scope of Genetic Engineering

Milestones In Genetic Engineering - Isolation of enzymes, DNA sequencing, synthesis and mutation, detection and separation, cloning, gene expression. Cloning and patenting of life forms. Genetic engineering guidelines.

#### **UNIT II:**

Molecular Tools in genetic engineering: Restriction enzymes, ligases, S1 nuclease, terminal deoxynucleotides, transferases, Poly A polymerases, Reverse Transcriptase, Alkaline phosphatase etc., modification enzymes, DNA, and RNA markers.

#### **UNIT III:**

Nucleic Acid Purification, Yield Analysis. Nucleic Acid Amplification and Its Applications.

Restriction Mapping of DNA Fragments and Map Construction. Nucleic Acid Sequencing.

Gene Cloning Vectors; Plasmids, bacteriophages, phagemids, cosmids, Artificial chromosomes.

cDNA Synthesis and cDNA library preparations. Cloning mRNA enrichment, reverse transcription, DNA primers, Linkers, adaptors and their chemical synthesis, Library construction and screening. Genomic libraries ( complete sequencing projects).

Alternative Strategies of Gene Cloning Cloning interacting genes- Two-and three hybrid systems, cloning differentially expressed genes. Site-directed Mutagenesis and Protein Engineering

#### **UNIT IV:**

How to Study Gene Regulation? DNA transfection, Northern blot, Primer extension, S1 mapping, RNase protection assay, Reporter assays. Nucleic acid microarrays.

Expression Strategies for Heterologous Genes Vector engineering and codon optimization, host engineering, In vitro transcription and translation, expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants. Processing of Recombinant Proteins Purification and refolding, characterization of recombinant proteins, stabilization of proteins.

#### **UNIT V:**

Phage Display

T-DNA and Transposon Tagging Role of gene tagging in gene analysis, T-DNA and transposon tagging, Identification and isolation of genes through T-DNA or transposon. Transgenic and Gene Knockout Technologies Targeted gene replacement, Chromosome engineering. Gene Therapy Vector engineering. Strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

#### **BOOKS**

1. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
2. DNA Cloning: a Practical Approach, .M. Glover and B.D. Hames, IRL Press, Oxford, 1995.

#### **REFERENCES:**

1. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu. D. Kim and L.J; Cseke, CRC Press, Florida, 1995.
2. Methods in Enzymology vol. 152, Guide to Molecular Cloning Techniques, S.L. Berger and A.R. Kimmel, Academic Press, Inc. San Diego, 1998
3. Methods in Enzymology Vol 185, Gene Expression Technology, D.V. Goeddel, Academic Press, Inc., San Diego, 1990
4. DNA Science. A First Course in Recombinant Technology, D,A. Mickloss and G.A. Froyer. Cold Spring Harbor Laboratory Press, New York, 1990.
5. Molecular Biotechnology (2nd Edn.), S.B. Primrose. Blackwell Scientific Publishers, Oxford, 1994
6. Milestones in Biotechnology. Classic papers on Genetic Engineering, J.A. Davies and W.S. Reznikoff, Butterworth-Heinemann, Boston, 1992.
7. Route Maps in Gene Technology, M.R. Walker and R. Rapley, Blackwell Science Ltd., Oxford, 1997.

## **I Year -II Sem M.Tech. (Biotech)**

### **M.Tech. (BIOTECHNOLOGY) - SECOND SEMESTER-COMMON SUBJECTS BT-203 DOWNSTREAM PROCESSING**

#### **UNIT I:**

##### **Scope of down stream processing:**

Importance of Down Stream Processing (DSP) in biotechnology, characteristics of products, criteria for selection of bio-separation techniques. Role of DSP methods in bioprocess economics

##### **Miscellaneous methods;**

Adsorption: Adsorption and adsorption processes, adsorption equilibria and isotherms, principles of adsorption, adsorption equipment, applications.

Precipitation: Principles of precipitation, precipitation equipment, applications in bio-processing.

Foaming: Principles of foaming, various foaming agents and their interaction with the products, applications in bioprocess.

Flocculation: Principles of flocculation various flocculating agents, applications in bio-processing.

Coagulation: Principles of coagulations and its applications in bio-processing.

#### **UNIT II:**

##### **Solid- Liquid separation;**

Filtration: Principles, filter aids, constant volume filtration, constant pressure filtration, specific cake resistance, equivalent cake thickness, filtration equipments viz; plate and frame filter press, vacuum filters, leaf filters.

Sedimentation: Principles of particle settling, batch sedimentation equipment viz ; thickener.

Centrifugation: Principles of centrifugation, centrifuge effect, g-number, sigma factor, various centrifuges viz; basket centrifuge, tubular centrifuge, disc-bowl centrifuge, scale-up of centrifuges.

#### **UNIT III:**

**Evaporation:** Theory of evaporation, BPR, single effect and multiple effect evaporation, steam economy, efficiency of evaporators, various evaporation equipments.

**Crystallization:** Principles of crystallization, crystallization equipment. Applications in bio-processing.

**Drying:** Various types of drying methods, principles of drying, EMC-RH data, drying curves, various types of industrial dryers and their criteria for choice. Freeze drying technique and its advantages over other methods. Applications in bio-processing.

#### **UNIT IV:**

Membrane separation processes: Basic principles of membrane separation, membrane characteristics, different types of membranes, criteria for selection of membranes.

**Chromatographic separation and electrophoresis methods;** Principles of chromatographic separation methods, different types of chromatographic methods, viz; adsorption chromatography, ion – exchange chromatography, gel chromatography, affinity chromatography etc. Applications in bio-processing.

Principles of electrophoresis and electrophoresis mobility, Potential electrophoresis units. Applications

#### **UNIT V:**

**Liquid-liquid extraction;** Extraction process and principles, phase equalitarian and distribution, batch and continuous extraction, co-current and counter current extraction processes, L-L-E equipment. Applications in bio-technology

**Cell disruption methods:** Various cell disruption methods, need for cell disruption for intracellular products, cell disruption equipment. Applications in bio-processing.

**TEXT BOOKS**

1. Bioseparations (Principles and Techniques) By Sivasanker, Prentice Hall of India Private Limited.
2. Principles of fermentation technology by Peter F Stan bury, Allan Whitaker and Stephen J Hall, Pergamon Publications.

**REFERENCES:**

1. Separation Process in Biotechnology edited by Juan A. Asenjo, Taylor & Francis Group
2. Comprehensive Biotechnology Vol 2 Ed: M.Moo –young (1985)
3. Product Recovery in Bioprocess technology, BIOTOL series, Butterworth – Heinemann.

**I Year -II Sem M.Tech. (Biotech)**

**BT-XXX ENVIRONMENTAL BIOTECHNOLOGY**

**UNIT I: BASIC CONCEPTS OF ENVIRONMENT AND ECOLOGY AND ENVIRONMENTAL POLLUTION AND CONTROL**

Ecosystem structure and functions: biotic and abiotic environmental factors – micro and macro nutrients, producers, consumers and decomposers – energy flow and material cycling.

Major ecosystems: terrestrial and aquatic ecosystems

Sustainable development.

Environmental pollution Air, water, soil pollution - their sources, effects and control through Biotechnology. Solid waste management.

Global environmental problems – climate change, green-house effect and global warming, acid rains and ozone depletion - their impact and biotechnological approaches for management.

**UNIT II: WASTE WATER TREATMENT TECHNOLOGIES AND HAZARDOUS WASTE MANAGEMENT**

Waste water definition and types, major contaminants in waste water.

Waste water treatment methods: physical, chemical, biological methods.

Aerobic Processes and Anaerobic processes.

Bioreactors: principles and their applications for waste water treatment.

Hazardous wastes – definition, classification, sources and characterization.

Physical and biological routes of transport of hazardous substances. Storage and disposal facilities – landfills, underground disposal and sea disposal.

Xenobiotic and recalcitrant compounds and their biodegradation.

Microbial transformations of hazardous chemicals.

Hazardous waste treatment and remediation technologies - waste recovery processes: solidification, stabilization, and encapsulation - biological processes - thermal processes

**UNIT III: BIOREMEDIATION**

Bioremediation definition and types of bioremediation, constraints and priorities of Bioremediation, factors affecting the use of bioremediation and applications of bioremediation.

Microbial systems for bioremediation.

In situ and Ex situ bioremediation techniques.

Liquid, solid and slurry phase bioremediation.

Bioremediation methods: physical, chemical, biological, solidification and thermal methods.

**UNIT IV: INDUSTRIAL POLLUTION AND BIOTECHNOLOGICAL APPROACHES AND NOVEL METHODS FOR POLLUTION CONTROL**

Process and Production technology - characteristics of effluents and treatment schemes for waste waters of Dairy, Distillery, Tannery, Sugar, Paper and Pulp, Pesticide and Antibiotic industries, Development of biodegradable and eco-friendly products – biopolymers, bioplastics, biofuels, biodiesel, biofertilisers and Biopesticides.

**UNIT V: ENVIRONMENTAL MANAGEMENT**

Concepts of Environmental Impact Assessment. Prediction and assessment of impact of air, water, biological, socio-economic environment.

Methodology for environmental management and Environmental management plan.  
Concepts of environmental audit.  
Integrated pest management,  
Vermitechnology, Phytoremediation.

**BOOKS:**

1. Environmental Biotechnology, Second edition by Alan Scragg, Oxford University press, 2005.
2. Environmental Biotechnology by Dilip Kumar Markandey and Neelima Rajvaidya, A P H Publishing corporation.

**REFERENCES:**

1. Global Pollution and Environmental Monitoring by H.V.Jadhav and S.H. Purohit, Himalaya Publishing House, First edition 2008.
  2. Text Book of Environmental Science and Technology by M.Anji Reddy, B.S. publications
- Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha

**I Year -II Sem M.Tech. (Biotech)**

**BT-XXX ADVANCED IMMUNOLOGY AND IMMUNOTECHNOLOGY**

**UNIT I: LYMPHOCYTE SUBSETS, ACTIVATION AND REGULATION**

Recall antigen presentation; introduce cross-presentation. Th1, Th2, Th 17 Treg subsets and their functions. Cytokines & Lymphokines in T-cell activation & function.

**UNIT II: IMMUNOLOGICAL MEMORY**

T cells memory, B cells memory, Central & peripheral memory. Relationship between memory and vaccines & infection.

**UNIT III: IMMUNOTECHNOLOGY**

Hybridoma technology, T cell cloning.

**UNIT IV: IMMUNOTHERAPY**

Antibodies-polyclonal, monoclonal; Cytokines, Cytoimmunotherapy, Immunomodulators in therapy, Immunotherapy of HIV infection.

**UNIT V: ADJUVANTS**

Function of adjuvants, Mechanism of action, New generation adjuvants, Plant based adjuvants.

**TEXT BOOKS:**

1. "Essential Immunology" by Ivan M.Roitt(1980). (Blackwell Scientific Publications, Oxford, London) fourth edition.
2. Essential Immunology – W.E. Paul
3. The Elements of Immunology by Fahim Halim Khan, Pearson Education, 2009.

**REFERENCES:**

1. Infection and immunity by John Playfair and Gregory Bancroft, third edition, Oxford University press. 2008.
2. "Monoclonal antibodies: Principles and practice" by J.W. Goding. Academic Press.
3. "Hybridoma Technology in the Biosciences and Medicine" T.A.Sringer (Editor) Plenum Press, N.Y.
4. "Hybridoma Techniques: A Laboratory Course" by VR. Muthukkaruppan, S. Baskar and F. Sinigaglia, Macmillan India Ltd.
5. "Basic and Clinical Immunology" by D.P. Stites, J.D.Stobo, H.H.Fudenberg J.V. Wells. 5th Edition Large medical publications.
6. "Isolation, Characterization and Utilization of T-lymphocyte clones" by C.Garrison Fathman , F.W. Fitch academic Press.

**I Year -II Sem M.Tech. (Biotech)**

**BT-XXX PLANT BIOTECHNOLOGY**

**UNIT I:**

Different areas and applications of plant tissue culture. Nutritional components of tissue culture media. Totipotency.

**UNIT II:**

Establishment of aseptic cultures, Initiation of callus and suspension cultures, Regeneration of plants, Organogenesis, Micropropagation with shoot apex cultures ( Clonal Propagation ), Somatic Embryogenesis.

Isolation and culture of protoplasts, protoplast fusion and somatic hybridization, Selection systems for somatic hybrids / Cybrids and their characterization .

**UNIT III:**

Anther Pollen culture, Production of haploids and their application.

Induction of mutation, Somoclonal variation.Storage of plant genetic resources (Cryopreservation )

**UNIT IV:**

Production of Secondary metabolites by plant cell cultures, commercial production of secondary metabolites. Technology for yield enhancement and bioreactor system and models for mass cultivation of plant cells. Biotransformations using plant cell cultures.

**UNIT V:**

Genetic Transformation methods for production of transgenic plants (Direct, Indirect)

Production of genetically modified (GM) plants for Agronomic traits.

Application of Plant Biotechnology for the production of quality oil, Industrial enzymes, therapeutic proteins (plantibodies, plantigens, edible vaccines etc.,)

**TEXT BOOKS:**

- 1.“Plant Cell, Tissue, and Organ culture” by J Reinert and Y P S Bajaj.
2. Plant Tissue Culture Theory and Applications Bhojwani SS and Razdan ,Elsevier Publication.

**REFERENCE BOOKS**

1. Plant Biotechnology New Products and Applications. Hammond PM and Yusibov V . Springer International Edition.
- 2.“Plant Tissue Culture” Thorpe, T.A. (Ed.).
3. “Handbook of Plant Cell Culture” Eds. Sharp et al.
4. “Plant Biotechnology” Eds. Mantell & Smith

**I Year -II Sem M.Tech. (Biotech)**

**BT-XXX BIOINFORMATICS**

**UNIT I : INTRODUCTION AND BIOINFORMATICS AND BIOLOGICAL DATABASES :**

Introduction to Bioinformatics- History, overview, Applications

Emerging areas of Genomics and Proteomics

Biological databases and their management – Protein Sequence databases, Protein structure databases, DNA databases, drug databases

**UNIT II : NUCLEOTIDE SEQUENCE ANALYSIS AND RNA STRUCTURES**

Nucleotide sequence analysis

DNA Sequence Analysis- Nucleic acid codes, Introduction to whole genome analysis, restriction site checks, Sequence assembly, finding overlaps and contigs, shotgun projects, walking primers, ORF analysis, Identification of transcription signals and other sequence patterns, Restriction enzyme databases, Coding region identification, EST analysis, SNP analysis,

RNA Sequence and structure Analysis - Different types of RNA, si-RNA design and development, micro RNA identification strategies, RNA secondary structure, RNA structure Prediction Methods, Introduction to Small nuclear RNAs, Applications of Small nuclear RNA

DNA/Protein Sequence alignments

**UNIT III: STATISTICAL METHODS IN BIOINFORMATICS:**

Dynamic programming methods- derivation and algorithms

Sequence Alignment concepts, Pair-wise alignment, Heuristic alignments, Multiple alignment, Matrices (PAM, BLOSUM)

Statistics and Scoring systems

**UNIT IV : STRUCTURE AND MODELING OF PROTEINS:**

Protein sequence analysis

Protein Physical properties- Molecular weight and amino acid composition, Iso-electric point, extinction coefft, Studies of protein hydrophobicity on kyte and Doolittle scale and other physico-chemical properties of primary protein sequences

Structural properties- Secondary structures, Hydrophobic patterns, structural motifs, Post translational modifications, Folding domain motifs, protein families

Principles of Protein Structure

Secondary Structure prediction methodologies, Threading methods

Protein Folds, protein domains, Tertiary structure prediction

Homology Modeling of proteins- methodology and applications

Ab initio protein structure prediction

Energy minimization - concept, applications and methodology

Molecular Dynamics simulations – concept and methodology

## **UNIT V: BIOINFORMATICS APPLICATIONS AND DRUG MODELLING.**

QSAR and Drug Designing Concepts

2D descriptors

3D descriptors

Drug Discovery

Drug Discovery Overview

Stages of drug discovery

Introduction to drug discovery tools– MoE and Accelrys suite

Bioinformatics applications in experimental biotechnology

Automatic 2D Gel analysis- Tools, Principles and methodology

Restriction analysis of DNA sequences

*Insilico* Primer Design

Micro-array image and data analysis

Protein Interaction Mapping (Yeast 2 Hybrids)

Functional genomics tools

Functional proteomics tools

### **TEXT BOOKS:**

1. Bioinformatics by Zoe Lacroix and Terence Critchlow, Morgan Kaufmann Publishers, 2003.
2. Bioinformatics by Orpita Bosu, Oxford University press, 2007.

### **REFERENCE BOOKS:**

1. Bioinformatics : Genome and sequence analysis by David W Mount.
2. Bioinformatics : A practical guide to analysis of genes and proteins by Baxevanis, Andreas D Wiley – Interscience publishers.
3. Computational Molecular Biology – An Introduction by Peter Clote Rolf Backofen, Jhon Wiley & Sons.
4. Essential Bioinformatics : by Jin Xiong, Cambridge University Press informatics in Proteomics by Srivasthava CRC Publishers.
5. Protein Structure Prediction: Bioinformatics approach by Igor F.Tsigelny International University Line.
6. An introduction to bioinformatics algorithms by Neil C.Jones, Pavel A Pevzner

**I Year -II Sem M.Tech. (Biotech)**

**BT – XXX ADVANCED ANIMAL CELL SCIENCE AND TECHNOLOGY**

**UNIT I:**

Media and components for growth, Constituents and their functions, Serum and protein – free media

**UNIT II:**

Generation of cell lines, Immortalization & transformation, Use of cellular/Viral oncogenes and oncoviruses, Use of telomerase.

**UNIT III:**

Cell cloning, Micromanipulation, synchronization.

**UNIT IV:**

Engineering cells, Somatic cell genetics, RNA silencing in cells, Complementary cells and their use.

**UNIT V:**

In vitro manipulation to generate knock-out or transgenic organisms

**TEXT BOOKS:**

1. Culture of Animal Cells, (3rd Edition), Fl. Ian Froshney. Wiley-Liss.
2. Animal Cell Culture - Practical Approach, Ed. John R.W. Masters, OXFORD,

**REFERENCES:**

1. Cell Growth and Division: A Practical Approach. Ed. R. Basega, IRL Press.
2. Cell Culture Lab Fax. Eds. M Butler & M. Dawson, Bios Scientific Publications Ltd..Oxford.
3. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
4. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Ed. Jenni P Mather and David Barnes. Academic Press.

**I Year -II Sem M.Tech. (Biotech)**

**BT – XXX NANO BIOTECHNOLOGY AND NANO DEVICES**

**UNIT I:**

Biological building blocks – sizes of building blocks and Nanostructures

**UNIT II:**

Polypeptide, Nanowire and protein Nanoparticle. Nucleic Acids – DNA

**UNIT III:**

Double Nano wire, Genetic code and protein synthesis. Biological Nanostructures: Bio sensors, Examples of proteins, Micelles and vesicles.

**UNIT IV:**

Multilayer films, Applications to NEMS, Bio and other applications to Nano devices.

**UNIT V:**

Nano technology for Immune system, clinical imaging, nano robots, Nano Fibres for Tissue Engineering.

**TEXT BOOKS:**

1. Bio Nano Technology by Good Sell – Wiley Liss
2. Biomedical Applications of Nanotechnology – Labhasetwar- Wiley-Interscience.
3. Introduction to Nano Technology by Charles. P.Poole Jr and Frank J. Owens. Wiley India Pvt Ltd.

**REFERENCE BOOKS:**

1. Hand book of Nano structured materials Vol I to V
2. Encyclopaedia of Nano Technology by M.Balakrishna rao and K.Krishna Reddy, Vol I to X Campus books.
3. Nano Technology, A gentle introduction to the next big idea by Mark Ranter, Daniel Ranter Pearson education.

Nanoelectronics and Nanosystems – Karl Goser – Springer Engineering series

**I Year -II Sem M.Tech. (Biotech)**

**BT-207 BIOPROCESS AND r-DNA TECHNOLOGY**

**LIST OF EXPERIMENTS:**

1. Immobilization of whole cells (Yeast) and enzymes (Amylase).
2. Various bioprocesses followed by product recovery e.g.
  - (I) Citric acid production from *A. niger*
  - (ii) Ethanol production from *S. cereviceae*
3. Isolation of plasmid, phage and human DNA
4. Agarose gel electrophoresis and visualization of DNA on gels.
5. Restriction enzyme digestion
6. Ligation
7. Transformation
  - a. Screening.
  - b. Enzyme kinetic studies: Determination of michaelis menton constant
  - c. Microbial kinetic studies: determination of monods model constants
  - d. Determination of volumetric mass transfer coefficient sodium sulphate oxidation method
  - e. caliculations for power number correlations
  - f. Media preparation for fermentation
  - g. Fermenter preparation
  - h. Fermenter testing
  - i. pH probe calibration
  - j. D.O.probe calibration
  - k. Pump calibration
  - l. Fermentor sterilization
  - m. Fermentor charging
  - n. Media sterilization
  - o. Inoculation methods for fermentor
  - p. Fermenttion – Batch, Fed Batch
  - q. Addition bottles: solution preparation
  - r. Sampling
  - s. Harvest the culture from the fermentor