ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

BIO-TECHNOLOGY

For

BIO-TECHNOLOGY FOUR DEGREE COURSE

(Applicable for batches admitted from 2013-2014)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA - 533 003, Andhra Pradesh, India

ACADEMIC REGULATIONS R13 FOR B. TECH. (REGULAR)

Applicable for the students of B. Tech. (Regular) from the Academic Year 2013-14 onwards

1. **Award of B. Tech. Degree**

A student will be declared eligible for the award of B. Tech. Degree if he fulfils the following academic regulations:

1.1 A student shall be declared eligible for the award of the B. Tech Degree, if he pursues a course of study in not less than four and not more than eight academic years

1.2 The candidate shall register for 180 credits and secure all the 180 credits.

2. **Courses of study**

The following courses of study are offered at present as specializations for the B. Tech. Course:

S. No	Branch
01	Electronics and Communication Engineering
02	Electrical and Electronics Engineering
03	Civil Engineering
04	Mechanical Engineering
05	Computer Science and Engineering
06	Petro Chemical Engineering
07	Information Technology
08	Chemical Engineering
09	Electronics and Instrumentation Engineering
10	Bio-Medical Engineering
11	Aeronautical Engineering
12	Automobile Engineering
13	Bio Technology
14	Electronics and Computer Engineering
15	Mining Engineering
16	Petroleum Engineering
17	Metallurgical Engineering
18	Agricultural Engineering

3. Distribution and Weightage of Marks

(i) The performance of a student in each semester shall be evaluated subject – wise with a maximum of 100 marks for theory and 75 marks for practical subject. The project work shall be evaluated for 200 marks.

(ii) For theory subjects the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End - Examinations.

(iii) Out of 30 internal marks – 20 marks are assigned for subjective (**Theory, Design, Analysis, Simulation, Algorithms, Drawing, etc.**) examination 10 marks for objective examination.

(iv.)For theory subjects, during the semester there shall be 2 tests. The weightage of Internal marks for 30 consists of Descriptive – 15, Assignment - 05 (Theory, Design, Analysis, Simulation, Algorithms, Drawing, etc. as the case may be) Objective -10 (Conducted at College level with 20 Multiple choice question with a weightage of ½ Mark each). The objective examination is for 20 minutes duration. The subjective examination is for 120 minutes duration conducted for 40 marks. Each subjective type test question paper shall contain **4 questions** and all questions need to be answered. The Objective examination marks scaled for 10 and subjective examination marks scaled for 15 are to be added to the assignment marks of 5 for getting

internal marks for 30. The best of the two tests will be taken for internal marks. As the syllabus is framed for 6 units, the 1st mid examination (both Objective and Subjective) is conducted in 1-3 units and second test in 4-6 units of each subject in a semester.

(v) The end semester examination is conducted covering the topics of all Units for 70 marks. Part – A contains a mandatory question (Brainstorming / Thought provoking / case study) for 22 marks. Part – B has 6 questions (One from each Unit). The student has to answer 3 out of 6 questions in Part – B and carries a weightage of 16 marks each.

(vi)For practical subjects there shall be continuous evaluation during the semester for 25 internal marks and 50 semester end examination marks. Of the 25 marks for internal, 15 marks shall be awarded as follows: day to day work 10 and Record-5, and 10 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the teacher concerned and external examiner.

(vii)For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (20 marks for day – to – day work, and 10 marks for internal tests) and 70 marks for end examination. There shall be two internal tests in a Semester and the better of the two shall be considered for the award of marks for internal tests.

(viii) For the seminar, the student shall collect the information on a specialized topic and prepare a technical report, showing his understanding over the topic, and submit to the department, which shall be evaluated by the Departmental committee consisting of Head of the department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for seminar.

(ix)Out of a total of 200 marks for the project work, 60 marks shall be for Internal Evaluation and 140 marks for the End Semester Examination. The End Semester Examination (Viva – Voce) shall be conducted by the committee. The committee consists of an external examiner, Head of the Department and Supervisor of the Project. The evaluation of project work shall be conducted at the end of the IV year. The Internal Evaluation shall be on the basis of two seminars given by each student on the topic of his project and evaluated by an internal committee.

(x) Laboratory marks and the internal marks awarded by the College are not final. The marks are subject to scrutiny and scaling by the University wherever felt desirable. The internal and laboratory marks awarded by the College will be referred to a Committee. The Committee shall arrive at scaling factor and the marks will be scaled as per the scaling factor. The recommendations of the Committee are final and binding. The laboratory records and internal test papers shall be preserved in the respective departments as per the University norms and shall be produced to the Committees of the University as and when they ask for.

4. <u>Attendance Requirements</u>

4.1 A student is eligible to write the University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee

4.3 Shortage of Attendance below 65% in aggregate shall not be condoned.

4.4 A student who is short of attendance in semester may seek re-admission into that semester when offered within 4 weeks from the date of the commencement of class work.

4.5 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.

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

4.7 A student will be promoted to the next semester if he satisfies the attendance requirement of the present semester.

4.8 If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

5. **Minimum Academic Requirements**

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.4.

5.1 A student is deemed to have satisfied the minimum academic requirements if he has **earned the credits allotted to each theory/practical design/drawing subject/project and secures not less than 35% of marks in the end semester exam, and minimum 40% of marks in the sum total of the internal marks and end semester examination marks.**

5.2 A student shall be promoted from first year to second year if he fulfills the minimum attendance requirement.

5.3 A student will be **promoted from II year to III year** if he fulfills the academic requirement **of 40% of the credits up to II year I semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.**

5.4 A student shall be **promoted from III year to IV year** only if he fulfils the academic requirements of **40% of the credits up to III year I semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.**

5.5 A student shall register and put up minimum attendance in all 180 credits and earn all 180 credits. **Marks obtained in the all 180 credits shall be considered for the calculation of percentage of marks.**

5.6 **Students who fail to earn 180 credits as indicated in the course structure within ten academic years (8 years of study + 2 years additionally for appearing for exams only) from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled.**

6 Course pattern

6.1 The entire course of study is for four academic years, all the years on semester pattern.

6.2 **A student is eligible to appear for the end semester examination in a subject, but absent from it or has failed in the end semester examination, may write the exam in that subject when conducted next.**

6.3 **When a student is detained for lack of credits/shortage of attendance, he may be re-admitted into the same semester / year in which he has been detained. However, the academic regulations under which he was first admitted, shall continues to be applicable to him.**

7 Award of Class

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

Class Awarded	% of marks to be secured	From the aggregate marks secured from 180 Credits.
First Class with Distinction	70% and above	
First Class	Below 70 but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	

The marks obtained in internal evaluation and end semester examination shall be shown separately in the memorandum of marks.

8 **Minimum Instruction Days**

The minimum instruction days for each semester shall be 90 working days.

9 There shall be no branch transfers after the completion of the admission process.

10 **There shall be no transfer from one college/stream to another within the Constituent Colleges and Units of Jawaharlal Nehru Technological University Kakinada.**

11 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the university or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.

12. TRANSITORY REGULATIONS

12.1 Discontinued, detained, or failed candidates are eligible for readmission as and when next offered.

12.2 After the revision of the regulations, the students of the previous batches will be given two chances for passing in their failed subjects, one supplementary and the other regular. If the students cannot clear the subjects in the given two chances, they shall be given equivalent subjects as per the revised regulations which they have to pass in order to obtain the required number of credits.

12.3 In case of transferred students from other Universities, the credits shall be transferred to JNTUK as per the academic regulations and course structure of the JNTUK**.**

13. General

13.1 Wherever the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

13.2 The academic regulation should be read as a whole for the purpose of any interpretation.

13.3 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

13.4 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

13.5 The students seeking transfer to colleges affiliated to JNTUK from various other Universities/ Institutions have to pass the failed subjects which are equivalent to the subjects of JNTUK, and also pass the subjects of JNTUK on their own without the right to sessional marks which the candidates have not studied at the earlier Institution.

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ACADEMIC REGULATIONS R13 FOR B. TECH. (LATERAL ENTRY SCHEME)

Applicable for the students admitted into II year B. Tech. (LES) from the Academic Year 2013-14 and onwards

1 **Award of B. Tech. Degree (LES)**

A student will be declared eligible for the award of B. Tech. Degree (LES) if he fulfils the following academic regulations:

1.1 A student shall be declared eligible for the award of the B. Tech Degree (LES), if he pursues a course of study in not less than three academic years and not more than six academic years.

1.2 The candidate shall register for 132 credits and secure all the 132 credits.

2. The students, who fail to fulfil the requirement for the award of the degree in 8 consecutive academic years (6 years of study + 2 years additionally for appearing exams only) from the year of admission, shall forfeit their seats.

3. The attendance regulations of B. Tech. (Regular) shall be applicable to B.Tech. (LES).

4. **Promotion Rule**

A student shall be promoted from second year to third year if he fulfills the minimum attendance requirement.

A student shall be promoted from III year to IV year only if he fulfils the academic requirements of **40% of the credits up to III year I semester from all the examinations. Whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.**

5. **Award of Class**

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

Class Awarded	% of marks to be secured	From the aggregate marks secured from 132 Credits from II year to IV year.
First Class with Distinction	70% and above	
First Class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	

The marks obtained in the internal evaluation and the end semester examination shall be shown separately in the marks memorandum.

6. All the other regulations as applicable to **B. Tech. 4-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme)**.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate:	
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 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.
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	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.

	the tendency to disrupt the orderly conduct of the examination.	
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 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 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.
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 project work 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 project work 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 project work 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 centre from the college to another college for a specific period of not less than one year.

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COURSE STRUCTURE

I Year – I SEMESTER

S. No.	Subject	T	P	Credits
1	English – I	3+1	--	3
2	Mathematics - I	3+1	--	3
3	Mathematics – II (Mathematical Methods)	3+1	--	3
4	Engineering Physics	3+1	--	3
5	Professional Ethics and Human Values	3+1	--	3
6	Engineering Drawing	3+1	--	3
7	English – Communication Skills Lab -1	--	3	2
8	Engineering Physics Laboratory	--	3	2
9	Engineering Physics – Virtual Labs - Assignments	--	2	--
10	Engineering Workshop& IT Workshop	--	3	2
Total Credits				**24**

I Year – II SEMESTER

S. No.	Subject	T	P	Credits
1	English – II	3+1	--	3
2	Mathematics – III	3+1	--	3
3	Engineering Chemistry-- II	3+1	--	3
4	Engineering Mechanics	3+1	--	3
5	Environmental Studies	3+1	--	3
6	Computer Programming	3+1	--	3
7	Engineering Chemistry Laboratory	--	3	2
8	English - Communication Skills Lab - II	--	3	2
9	C Programming Lab	--	3	2
Total Credits				**24**

II Year – I SEMESTER

S. No.	Subject	T	P	Credits
1	Biochemistry	3+1	--	3
2	Biochemical Thermodynamics	3+1	--	3
3	Cell Biology	3+1	--	3
4	Genetics	3+1	--	3
5	Basic Industrial Biotechnology*	3+1	--	3
6	Microbiology	3+1	--	3
7	Biochemistry Lab	--	3	2
8	Cell Biology and Microbiology Lab	--	3	2
Total Credits				**22**

II Year – II SEMESTER

S. No.	Subject	T	P	Credits
1	Heat Transfer in Bioprocess	3+1	--	3
2	Process Engineering Principles	3+1	--	3
3	Instrumental Methods of Analysis	3+1	--	3
4	Molecular Biology	3+1	--	3
5	Environmental Biotechnology*	3+1	--	3
6	Bioprocess Engineering	3+1	--	3
7	Bioprocess Engineering Lab	--	3	2
8	Instrumental methods of Analysis Lab	--	3	2
Total Credits				**22**

III Year – I SEMESTER

S. No.	Subject	T	P	Credits
1	MASS TRANSFER OPERATIONS	3+1		3
2	BiochemicalReaction Engineering–I	3+1		3
3	Plant Biotechnology	3+1		3
4	Genetic Engineering	3+1		3
5	Managerial Economics and Financial Analysis	3+1		3
6	IPR & PATENTS	2+1		2
7	Plant Bio-Technology Lab		3	2
8	Genetic Engineering Lab		3	2
9	Advanced English Communication Skills Lab		3	2
Total Credits				**23**

III Year – II SEMESTER

S. No.	Subject	T	P	Credits
1	Bioinformatics*	3+1		3
2	BiochemicalReaction Engineering-II	3+1		3
3	Transport Phenomena in Bioprocess	3+1		3
4	Enzyme Engineering	3+1		3
5	Immunology	3+1		3
6	Instrumentation and Bio Process Control	3+1		3
7	Biochemical Reaction Engineering Lab		3	2
8	Immunology Lab		3	2
Total Credits				**22**

IV Year – I SEMESTER

S. No.	Subject	T	P	Credits
1	Computational Molecular Biology	3+1	--	3
2	Bioethics, Bio Safety, Clinical Regulatory Affairs*	3+1	--	3
3	Downstream Processing	3+1	--	3
4	Bio sensors and Bioelectronics*	3+1	-	3
5	**Open Elective** All Subjects with *	3+1	-	3
6	**Elective – I**	3+1	--	3
7	Bioinformatics Lab	--	3	2
8	Downstream Processing Lab	--	3	2
Total Credits				**22**

IV Year – II SEMESTER

S. No.	Subject	T	P	Credits
1	Animal Cell Science Technology	3+1	--	3
2	**Elective – II**	3+1	--	3
3	**Elective – III**	3+1	--	3
4	**Elective – IV**	3+1	--	3
5	Project	--	--	9
Total Credits				**21**

Open Elective:
All Subjects with *

Elective – I:
1. Bio materials Science and Technology
2. Cell Signaling
3. Structural Biology
4. Cancer Biology

Elective – II:
1. Creativity Innovation and Product Development
2. Nano Biotechnology*
3. Metabolic Engineering

Elective – III:
1. Food Science Technology
2. Molecular Modeling and Drug Design
3. Bioprocess Economics and Plant Design

Elective – IV:
1. Biopharmaceutical Technology
2. Protein Engineering

3. Bioprocess Optimization

SYLLABUS

I Year – I SEMESTER

T	P	C
3+1	0	3

ENGLISH –I
(Common to All Branches)

DETAILED TEXT-I English Essentials: Recommended Topics:

1. **IN LONDON: M.K.GANDHI**
   OBJECTIVE: To apprise the learner how Gandhi spent a period of three years in London as a student.
   OUTCOME: The learner will understand how Gandhi grew in introspection and maturity.
2. **THE KNOWLEDGE SOCIETY- APJ KALAM**
   OBJECTIVE: To make the learners rediscover India as a land of Knowledge.
   OUTCOME: The learners will achieve a higher quality of life, strength and sovereignty of a developed nation.
3. **THE SCIENTIFIC POINT OF VIEW- J.B.S. HALDANE**
   OBJECTIVE: This essay discusses how scientific point of view seeks to arrive at the truth without being biased by emotion.
   OUTCOME: This develops in the student the scientific attitude to solve many problems which we find difficult to tackle.
4. **PRINCIPLES OF GOOD WRITING:**
   OBJECTIVE: To inform the learners how to write clearly and logically.
   OUTCOME: The learner will be able to think clearly and logically and write clearly and logically.
5. **MAN'S PERIL**
   OBJECTIVE: To inform the learner that all men are in peril.
   OUTCOME: The learner will understand that all men can come together and avert the peril.
6. **THE DYING SUN—SIR JAMES JEANS**
   OBJECTIVE: This excerpt from the book "The Mysterious Universe" presents the mysterious nature of the Universe and the stars which present numerous problems to the scientific mind. Sir James Jeans uses a poetic approach to discuss the scientific phenomena.
   OUTCOME: This provides the students to think about the scientific phenomena from a different angle and also exposes the readers to poetic expressions.
7. **LUCK—MARK TWAIN**
   OBJECTIVE: This is a short story about a man's public image and his true nature. The theme of the story is that luck can be a factor of life, so that even if one is incompetent but lucky, one can still succeed.
   OUTCOME: The story is humourous in that it contains a lot of irony. Thus this develops in the learner understand humourous texts and use of words for irony.

Text Book : 'English Essentials' by Ravindra Publications

NON-DETAILED TEXT:

(From Modern Trailblazers of Orient Blackswan)
(Common single Text book for two semesters)
(Semester I (1 to 4 lessons)/ Semester II (5 to 8 lessons)

1. **G.D.Naidu**
   OBJECTIVE: To inspire the learners by G.D.Naidu's example of inventions and contributions.
   OUTCOME: The learner will be in a position to emulate G.D.Naidu and take to practical applications.
2. **G.R.Gopinath**
   OBJECTIVE: To inspire the learners by his example of inventions.
   OUTCOME: Like G.R.Gopinath, the learners will be able to achieve much at a low cost and help the common man.
3. **Sudhamurthy**
   OBJECTIVE: To inspire the learners by the unique interests and contributions of Sudha Murthy.
   OUTCOME: The learner will take interest in multiple fields of knowledge and make life worthwhile through social service.
4. **Vijay Bhatkar**
   OBJECTIVE: To inspire the learner by his work and studies in different fields of engineering and science.
   OUTCOME: The learner will emulate him and produce memorable things.

Text Book : 'Trail Blazers' by Orient Black Swan Pvt. Ltd. Publishers

I Year – I SEMESTER

T	P	C
3+1	0	3

MATHEMATICS – I (DIFFERENTIAL EQUATIONS)
(Common to All Branches)

UNIT I: Differential equations of first order and first degree:
Linear-Bernoulli-Exact-Reducible to exact.
Applications : Newton's Law of cooling-Law of natural growth and decay-orthogonal trajectories.
Subject Category
ABET Learning Objectives a d e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT II: Linear differential equations of higher order:
Non-homogeneous equations of higher order with constant coefficients with RHS term of the type e^{ax}, Sin ax, cos ax, polynomials in x, e^{ax} V(x), xV(x).
Applications: LCR circuit, Simple Harmonic motion
Subject Category
ABET Learning Objectives a d e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT III Laplace transforms:
Laplace transforms of standard functions-ShiftingTheorems, Transforms of derivatives and integrals – Unit step function –Dirac's delta function- Inverse Laplace transforms– Convolution theorem (with out proof).
Application: Solutions of ordinary differential equations using Laplace transforms.
Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT IV Partial differentiation:
Introduction- Total derivative-Chain rule-Generalized Mean Value theorem for single variable (without proof)-Taylors and Mc Laurent's series for two variables– Functional dependence- Jacobian.
Applications: Maxima and Minima of functions of two variables with constraints and without constraints.
Subject Category
ABET Learning Objectives a c e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT V First order Partial differential equations:
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions –solutions of first order linear (Lagrange) equation and nonlinear (standard type) equations
Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT VI Higher order Partial differential equations:
Solutions of Linear Partial differential equations with constant coefficients- Method of separation of Variables
Applications: One- dimensional Wave, Heat equations - two-dimensional Laplace Equation.
Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation B E

Books:

1. **B.S.GREWAL,** Higher Engineering Mathematics, 42nd Edition, Khanna Publishers
2. **ERWIN KREYSZIG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India
3. **GREENBERG,** Advanced Engineering Mathematics, 2nd edition, Pearson edn
4. **DEAN G. DUFFY,** Advanced engineering mathematics with MATLAB, CRC Press
5. **PETER O'NEIL,** advanced Engineering Mathematics, Cengage Learning.

Subject Category	ABET Learning Objectives	ABET Internal Assessments	JNTUK External Evaluation	Remarks
Theory Design Analysis Algorithms Drawing Others	a) Apply knowledge of math, science, & engineering b) Design & conduct experiments, analyze & interpret data c) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints d) Function on multidisciplinary teams e) Identify, formulate, & solve engineering problems f) Understand professional & ethical responsibilities g) Communicate effectively h) Understand impact of engineering solutions in global, economic, environmental, & societal context i) Recognize need for & be able to engage in lifelong learning j) Know contemporary issues k) Use techniques, skills, modern tools for engineering practices	1. Objective tests 2. Essay questions tests 3. Peer tutoring based 4. Simulation based 5. Design oriented 6. Problem based 7. Experiential (project based) based 8. Lab work or field work based 9. Presentation based 10. Case Studies based 11. Role-play based 12. Portfolio based	A. Questions should have: B. Definitions, Principle of operation or philosophy of concept. C. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. D. Design oriented problems E. Trouble shooting type of questions F. Applications related questions G. Brain storming questions	

I Year – I SEMESTER

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MATHEMATICS – II
(MATHEMATICAL METHODS)

(Common to All Branches)

UNIT I Solution of Algebraic and Transcendental Equations:

Introduction- Bisection Method – Method of False Position – Iteration Method – Newton-Raphson Method (One variable and Simultaneous Equestions)

Subject Category
ABET Learning Objectives a e k
ABET internal assessments 1 2 4 6
JNTUK External Evaluation A B E

UNIT II Interpolation:

Introduction- Errors in Polynomial Interpolation – Finite differences- Forward Differences- Backward differences –Central differences – Symbolic relations and separation of symbols-Differences of a polynomial-Newton's formulae for interpolation – Interpolation with unevenly spaced points - Lagrange's Interpolation formula

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 4 6
JNTUK External Evaluation A B E

UNIT III Numerical solution of Ordinary Differential equations:

Solution by Taylor's series-Picard's Method of successive Approximations-Euler's Method-Runge-Kutta Methods

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 4 6
JNTUK External Evaluation A B E

UNIT IV Fourier Series:

Introduction- Determination of Fourier coefficients – even and odd functions –change of interval– Half-range sine and cosine series

application: Amplitude, spectrum of a periodic function

Subject Category
ABET Learning Objectives a e d
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT V Fourier Transforms:

Fourier integral theorem (only statement) – Fourier sine and cosine integrals - sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms

Subject Category
ABET Learning Objectives a d e k
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT VI Z-transform:

Introduction– properties – Damping rule – Shifting rule – Initial and final value theorems -Inverse z transform- -Convolution theorem – Solution of difference equation by Z -transforms.

Subject Category
ABET Learning Objectives a b e k
ABET internal assessments 1 2 6

JNTUK External Evaluation A B E

BOOKS:

1. **B.S. GREWAL,** Higher Engineering Mathematics, 42nd Edition, Khanna Publishers
2. **DEAN G. DUFFY,** Advanced Engineering Mathematics with MATLAB, CRC Press
3. **V.RAVINDRANATH and P. VIJAYALAXMI,** Mathematical Methods, Himalaya Publishing House
4. **ERWYN KREYSZIG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India

Subject Category	ABET Learning Objectives	ABET Internal Assessments	JNTUK External Evaluation	Remarks
Theory Design Analysis Algorithms Drawing Others	a) Apply knowledge of math, science, & engineering b) Design & conduct experiments, analyze & interpret data c) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints d) Function on multidisciplinary teams e) Identify, formulate, & solve engineering problems f) Understand professional & ethical responsibilities g) Communicate effectively h) Understand impact of engineering solutions in global, economic, environmental, & societal context i) Recognize need for & be able to engage in lifelong learning j) Know contemporary issues k) Use techniques, skills, modern tools for engineering practices	1. Objective tests 2. Essay questions tests 3. Peer tutoring based 4. Simulation based 5. Design oriented 6. Problem based 7. Experiential (project based) based 8. Lab work or field work based 9. Presentation based 10. Case Studies based 11. Role-play based 12. Portfolio based	A. Questions should have: B. Definitions, Principle of operation or philosophy of concept. C. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. D. Design oriented problems E. Trouble shooting type of questions F. Applications related questions G. Brain storming questions	

I Year – I SEMESTER

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ENGINEERING PHYSICS

UNIT-1

PHYSICAL OPTICS FOR INSTRUMENTS

"Objective Designing an instrument and enhancing the resolution for its operation would be effective as achieved through study of applicational aspects of physical Optics"

INTERFACE : Introduction – Interference in thin films by reflection – Newton's rings.

DIFFRECTION : Introduction – Fraunhofer diffraction - Fraunhofer diffraction at double slit (qualitative) – Diffraction grating – Grating spectrum – Resolving power of a grating – Rayleigh's criterion for resolving power.

POLARIZATION : Introduction – Types of Polarization – Double refraction – Quarter wave plate ad Half Wave plate.

UNIT-II

COHERENT OPTICS – COMMUNICATIONS AND STRUCTURE OF MATERIALS

Objectives while lasers are trusted Non-linear coherent sources established for the fitness of instrumentation, establishing a structure property relationship for materials requires allotment of an equivalent footing in convening the physics knowledge base.

LASERS: Introduction – coherent sources – Characteristics of lasers – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Three and Four level pumping schemes – Ruby laser – Helium Neon laser.

FIBER OPTICS : Introduction – Principle of Optical Fiber – Acceptance angle and acceptance cone – Numerical aperture.

CRYSTALLOGRAPHY : Introduction – Space lattice – Basis – Unit Cell – Lattice parameters – Bravais lattices – Crystal systems – Structures and packing fractions of SC,BCC and FCC

X-RAY DIFRACTION TECHNIQUES : Directions and planes in crystals – Miller indices – Separation between successive [h k l] planes – Bragg's law.

UNIT-III

MAGNETIC, ELECTRIC FIELD RESPONSE OF MATERIALS & SUPERCONDUCTIVITY

"Objective many of the Electrical or Electronic gadgets are designed basing on the response of naturally abundant and artificially made materials, while their response to E- or H- fields controls their performance.

MAGNETIC PROPERTIES : Magnetic permeability – Magnetization – Organ or magnetic moment – Classification of Magnetic materials – Dir, para, Ferro, anti ferro and ferri-magnetism – Hysteresis curve

DIELECTRIC PROPERTIES : Introduction – Dielectric constant – Electronic, ionic and orientational polarization – internal fields – Clausius – Mossotti equation – Dielectric loss, Breakdown and Strength.

SUPERCONDUCTIVITY : General properties – Meissner effect – Type I and Type II superconductors – BCS Theory Flux quantization London's equations – Penetration depth – DC and AC Josephson effects – SQUIDS.

UNIT – IV

ACQUSTICS AND EM – FIELDS:

Objective: The utility and nuances of ever pervading SHM and its consequences would be the first hand-on to as it clearly conveyed through the detailed studies of Acoustics of Buildings, while vectorial concepts of EM fields paves the student to gear – up for a deeper understanding.

ACQUSTICS:_ Sound absorption, absorption coefficient and its measurements, Reverberations time – Sabine's formula, Eyring's formula.

ELECTRO-MAGENTIC FIELDS: Gauss and stokes theorems (qualitative) – Fundamental laws of electromagnetism – Maxwell's Electromagnetic Equations (Calculus approach).

UNIT – V

QUANTUM MECHANICS FOR ELECTRONIC TRANSPORT

Objective: The discrepancy between classical estimates and laboratory observations of physical properties exhibited by materials would be lifted out through the understanding quantum picture of sub-atomic world dominated by electron and its presence.

QUANTUM MECHANICS: Introduction to matter waves – Schrodinger Time Independent and Time Dependent wave equations – Particle in a box.

FREE ELECTRON THEORY: Classical free electron theory – electrical conductivity – Mean free path – Relaxation time and drifty velocity – Quantum free electron theory – Fermi – Dirac (analytical) and its dependence on temperature – Fermi energy – density of states – derivations for current density.

BAND THEORY OF SOLIDS: Bloch theorem (qualitative) – Kronig – Penney model – Origin of energy band formation in solids – Classification of materials into conductors, semi – conductors & insulators – Concepts of effective mass of electron - concept of hole.

UNIT – VI

SEMICONDUCTOR PHYSICS:

Objective: In the wake of ever increasing demand for the space and power the watch word "small is beautiful", understanding the physics of electronic transport as underlying mechanism for appliances would provide a knowledge base.

Introduction – Intrinsic semiconductor and carrier concentration – Equation for conductivity – Extrinsic semiconductor and carrier concentration – Drift and diffusion – Einstein's equation – Hall Effect – direct & indirect band gap semiconductors – Electronic transport Mechanism for LEDs, Photo conductors and solar cells.

TEXT BOOKS

1. Solid state Physics by A.J. Dekker (Mc Millan India Ltd)
2. A text book of Engineering Physics by M.N. Avadhanulu & P.G. Kshirasagar (S. Chand publications)
3. Engineering Physics b;y M.R. Srinivasan (New Age international publishers)

REFERENCE BOOKS

1. 'Introduction to solid state physics' by Charles Kittle (Willey India Pvt.Ltd)
2. 'Applied Physics' by T. Bhimasenkaram (BSP BH Publications)
3. 'Applied Physics' by M.Arumugam (Anuradha Agencies)
4. 'Engineering Physics' by Palanisamy (Scitech Publishers)
5. 'Engineering Physics' by D.K.Bhattacharya (Oxford University press)
6. 'Engineering Physics' by Mani Naidu S (Pearson Publications)
7. 'Engineering Physics' by Sanjay D Jain and Girish G Sahasrabudhe (University Press)
8. 'Engineering Physics' by B.K.Pandey & S. Chaturvedi (Cengage Learning)

I Year – I SEMESTER

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Professional Ethics and Human Values

UNIT I: Human Values:
Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.

UNIT II : Engineering Ethics:
The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics-Consensus and Controversy –Professional and Professionalism –Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Types of Inquiry – Engineering and Ethics-Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma.

UNIT III : Engineering as Social Experimentation:
Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering.

UNIT IV : Engineers' Responsibility for Safety and Risk:
Safety and Risk, Concept of Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

UNIT V : Engineers' Responsibilities and Rights:
Collegiality-Techniques for Achieving Collegiality –Two Senses of Loyalty-obligations of Loyalty-misguided Loyalty – professionalism and Loyalty- Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict problems – Self-interest, Customs and Religion-Ethical egoism-Collective bargaining-Confidentiality-Acceptance of Bribes/Gifts-when is a Gift and a Bribe-examples of Gifts v/s Bribes-problem solving-interests in other companies-Occupational Crimes-industrial espionage-price fixing-endangering lives- Whistle Blowing-types of whistle blowing-when should it be attempted-preventing whistle blowing.

UNIT VI : Global Issues:
Globalization- Cross-culture Issues-Environmental Ethics-Computer Ethics-computers as the instrument of Unethical behaviour-computers as the object of Unethical Acts-autonomous computers-computer codes of Ethics-Weapons Development-Ethics and Research-Analysing Ethical Problems in Research-Intellectual Property Rights.

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Text Books:

1. "Engineering Ethics and Human Values" by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009
2. "Professional Ethics and Morals" by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications
3. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran-Laxmi Publications

4. “Professional Ethics and Human Values” by Prof.D.R.Kiran-
5. “Indian Culture, Values and Professional Ethics” by PSR Murthy-BS Publication
6. “Ethics in Engineering” by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.
7. “Engineering Ethics” by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

I Year – I SEMESTER

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ENGINEERING DRAWING

Objective: Engineering drawing being the principle method of communication for engineers, the objective to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

UNIT I

Objective: The objective is to introduce the use and the application of drawing instruments and to make the students construct the polygons, curves and various types of scales. The student will be able to understand the need to enlarge or reduce the size of objects in representing them.

Polygons, Construction of regular polygons using given length of a side; Ellipse, arcs of circles and Oblong methods; Scales – Vernier and Diagonal scales.

UNIT II

Objective: The objective is to introduce orthographic projections and to project the points and lines parallel to one plane and inclined to other.

Introduction to orthographic projections; projections of points; projections of straight lines parallel to both the planes; projections of straight lines – parallel to one plane and inclined to the other plane.

UNIT III

Objective: The objective is to make the students draw the projections of the lines inclined to both the planes.

Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclinations and traces.

UNIT IV

Objective: The objective is to make the students draw the projections of the plane inclined to both the planes.

Projections of planes: regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT V

Objective: The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes.

UNIT VI

Objective: The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers.
3. Engineering Graphics by PI Varghese, McGrawHill Publishers

REFERENCE BOOKS:

1. Engineering Graphics for Degree by K.C. John, PHI Publishers
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers
3. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

I Year – I SEMESTER **T P C**
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ENGLISH – COMMUNICATION SKILLS LAB – I

Suggested Lab Manuals:

OBJECTIVE: To impart to the learner the skills of grammar as well as communication through listening, speaking, reading, and writing including soft, that is life skills.

BASIC COMMUNICATION SKILLS

UNIT 1	A. Greeting and Introductions
	B. Pure Vowels
UNIT 2	A. Asking for information and Requests
	B. Diphthongs
UNIT 3	A. Invitations
	B. Consonants
UNIT 4	A. Commands and Instructions
	B. Accent and Rhythm
UNIT 5	A. Suggestions and Opinions
	B. Intonation

Text Book:

'Strengthen your Communication Skills' Part-A by Maruthi Publications

Reference Books:

1. INFOTECH English (Maruthi Publications)
2. Personality Development and Soft Skills (Oxford University Press, New Delhi)

I Year – I SEMESTER

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ENGINEERING PHYSICS LAB

List of Experiments

1. Determination of wavelength of a source-Diffraction Grating-Normal incidence
2. Newton's rings –Radius of Curvature of Plano_Convex Lens.
3. Determination of thickness of a thin object using parallel interference fringes.
4. Determination of Rigidity modulus of a material- Torsional Pendulum.
5. Determination of Acceleration due to Gravity and Radius of Gyration- Compound Pendulum.
6. Melde's experiment – Transverse and Longitudinal modes.
7. Verification of laws of stretched string – Sonometer.
8. Determination of velocity of sound – Volume resonator.
9. L C R Senes Resonance Circuit
10. Study of I/V Characteristics of Semiconductor diode
11. I/V characteristics of Zener diode
12. Thermistor characteristics – Temperature Coefficient
13. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
14. Energy Band gap of a Semiconductor p.n junction.
15. Hall Effect for semiconductor.

REFERENCE:

1. Engineering Physics Lab Manual by Dr.Y. Aparna & Dr.K.Venkateswarao (V.G.S.Book links)
2. Physics practical manual, Lorven Publications.

I Year – I SEMESTER

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Engineering Physics
Virtual Labs - Assignments

List of Experiments

1. Hall Effect
2. Crystal Structure
3. Hysteresis
4. Brewster's angle
5. Magnetic Levitation / SQUID
6. Numerical Aperture of Optical fiber
7. Photoelectric Effect
8. Simple Harmonic Motion
9. Damped Harmonic Motion
10. LASER – Beam Divergence and Spot size

URL: WWW.vlab.co.in

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ENGINEERING WORKSHOP & IT WORKSHOP

ENGINEERING WORKSHOP:

Course Objective: To impart hands-on practice on basic engineering trades and skills.
Note: At least two exercises to be done from each trade.

Trade:

Carpentry	1. T-Lap Joint
	2. Cross Lap Joint
	3. Dovetail Joint
	4. Mortise and Tennon Joint
Fitting	1. Vee Fit
	2. Square Fit
	3. Half Round Fit
	4. Dovetail Fit
Black Smithy	1. Round rod to Square
	2. S-Hook
	3. Round Rod to Flat Ring
	4. Round Rod to Square headed bolt
House Wiring	1. Parallel / Series Connection of three bulbs
	2. Stair Case wiring
	3. Florescent Lamp Fitting
	4. Measurement of Earth Resistance
Tin Smithy	1. Taper Tray
	2. Square Box without lid
	3. Open Scoop
	4. Funnel

IT WORKSHOP:

Objectives: Enabling the student to understand basic hardware and software tools through practical exposure

PC Hardware:
Identification of basic peripherals, assembling a PC, installation of system software like MS Windows, device drivers. Troubleshooting Hardware and software _ some tips and tricks.

Internet & World Wide Web:
Different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet, web browsers, email, newsgroups and discussion forums .Awareness of cyber hygiene(protecting the personal computer from getting infected with the viruses), worms and other cyber attacks .

Productivity tools Crafting professional word documents; excel spread sheets, power point presentations and personal web sites using the Microsoft suite of office tools

(Note: Student should be thoroughly exposed to minimum of 12 Tasks)

PC Hardware

Task 1: Identification of the peripherals of a computer.
To prepare a report containing the block diagram of the CPU along with the configuration of each peripheral and its functions. Description of various I/O Devices

Task 2(Optional) : A practice on disassembling the components of a PC and assembling them to back to working condition.

Task 3: Examples of Operating systems- DOS, MS Windows, Installation of MS windows on a PC.

Task 4: Introduction to Memory and Storage Devices , I/O Port, Device Drivers, Assemblers, Compilers, Interpreters , Linkers, Loaders.

Task 5:

Hardware Troubleshooting (Demonstration):

Identification of a problem and fixing a defective PC(improper assembly or defective peripherals).

Software Troubleshooting (Demonstration):. Identification of a problem and fixing the PC for any software issues

Internet & Networking Infrastructure

Task 6: Demonstrating Importance of Networking, Transmission Media, Networking Devices- Gateway, Routers, Hub, Bridge, NIC ,Bluetooth Technology, Wireless Technology, Modem, DSL, Dialup Connection.

Orientation & Connectivity Boot Camp and web browsing: Students are trained to configure the network settings to connect to the Internet. They are trained to demonstrate the same through web browsing (including all tool bar options) and email access.

Task 7: **Search Engines & Netiquette:**

Students are enabled to use search engines for simple search, academic search and any other context based search (Bing, Google etc). Students are acquainted to the principles of micro-blogging, wiki, collaboration using social networks, participating in online technology forums

Task 8: Cyber Hygiene (Demonstration): Awareness of various threats on the internet. Importance of security patch updates and anti-virus solutions. Ethical Hacking, Firewalls, Multi-factor authentication techniques including Smartcard, Biometrics are also practiced

Word

Task 9 : MS Word Orientation:

Accessing, overview of toolbars, saving files, Using help and resources, rulers, formatting ,Drop Cap , Applying Text effects, Using Character Spacing, OLE in Word, using templates, Borders and Colors, Inserting Header and Footer, Using Date and Time option, security features in word, converting documents while saving

Task 10: Creating project : Abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check , Track Changes, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs.

Excel

Task 11: Using spread sheet features of EXCEL including the macros, formulae, pivot tables, graphical representations

Creating a Scheduler - Features to be covered:- Gridlines, Format Cells, Summation, auto fill, Formatting Text

LOOKUP/VLOOKUP

Task 12: Performance Analysis - Features to be covered:- Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

Power Point

Task 13: Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes :- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting –Images, Clip Art, Tables and Charts in Powerpoint.

Task 14: Focusing on the power and potential of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topic covered during this week includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background, textures, Design Templates, Hidden slides, OLE in PPT.

TEXT BOOK:

Faculty to consolidate the workshop manuals using the following references

1. Computer Fundamentals, Anita Goel, Pearson
2. Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott. Mueller, QUE, Pearson,2008
3. Information Technology Workshop,3e, G Praveen Babu, M V Narayana BS Publications.
4. Comdex Information Technology , Vikas Gupta, dreamtech.

REFERENCE BOOK:

1. Essential Computer and IT Fundamentals for Engineering and Science Students, Dr. N.B. Venkateswarlu

I Year – II SEMESTER **T P C**
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ENGLISH –II
(Common to All Branches)

DETAILED TEXT-II: Sure Outcomes: English for Engineers and Technologists **Recommended Topics:**

1. **TECHNOLOGY WITH A HUMAN FACE**
   OBJECTIVE: To make the learner understand how modern life has been shaped by technology.
   OUTCOME: The proposed technology is people's technology. It serves the human person instead of making him the servant of machines.
2. **CLIMATE CHANGE AND HUMAN STRATEGY**
   OBJECTIVE: To make the learner understand how the unequal heating of earth's surface by the Sun, an atmospheric circulation pattern is developed and maintained.
   OUTCOME: The learner's understand that climate must be preserved.
3. **EMERGING TECHNOLOGIES**
   OBJECTIVE: To introduce the technologies of the 20th century and 21st centuries to the learners.
   OUTCOME: The learner will adopt the applications of modern technologies such as nanotechnology.
4. **WATER- THE ELIXIR OF LIFE**
   OBJECTIVE: To inform the learner of the various advantages and characteristics of water.
   OUTCOME: The learners will understand that water is the elixir of life.
5. **THE SECRET OF WORK**
   OBJECTIVE:**:** In this lesson, Swami Vivekananda highlights the importance of work for any development.
   OUTCOME: The students will learn to work hard with devotion and dedication.
6. **WORK BRINGS SOLACE**
   OBJECTIVE: In this lesson Abdul Kalam highlights the advantage of work.
   OUTCOME: The students will understand the advantages of work. They will overcome their personal problems and address themselves to national and other problems.

Text Book : 'Sure Outcomes' by Orient Black Swan Pvt. Ltd. Publishers

NON-DETAILED TEXT:

(From Modern Trailblazers of Orient Blackswan)
(Common single Text book for two semesters)
(Semester I (1 to 4 lessons)/ Semester II (5 to 8 lessons)

5. **J.C. Bose**
   OBJECTIVE: To apprise of J.C.Bose's original contributions.
   OUTCOME: The learner will be inspired by Bose's achievements so that he may start his own original work.
6. **Homi Jehangir Bhaba**
   OBJECTIVE: To show Bhabha as the originator of nuclear experiments in India.
   OUTCOME: The learner will be inspired by Bhabha's achievements so as to make his own experiments.
7. **Vikram Sarabhai**
   OBJECTIVE: To inform the learner of the pioneering experiments conducted by Sarabhai in nuclear energy and relevance of space programmes.
   OUTCOME: The learner will realize that development is impossible without scientific research.
8. **A Shadow- R.K.Narayan**
   OBJECTIVE: To expose the reader to the pleasure of the humorous story
   OUTCOME: The learner will be in a position to appreciate the art of writing a short story and try his hand at it.

Text Book : ‘Trail Blazers’ by Orient Black Swan Pvt. Ltd. Publishers

I Year – II SEMESTER

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MATHEMATICS – III
(LINEAR ALGEBRA & VECTOR CALCULUS)
(Common to All Branches)

UNIT I Linear systems of equations:

Rank-Echelon form, Normal form – Solution of Linear Systems – Direct Methods- Gauss Elimination - Gauss Jordon and Gauss Seidal Methods.

Application: Finding the current in a electrical circuit.

Subject Category
ABET Learning Objectives a e k
ABET internal assessments 1 2 6 4
JNTUK External Evaluation A B E

UNIT II Eigen values - Eigen vectors and Quadratic forms:

Eigen values - Eigen vectors– Properties – Cayley-Hamilton Theorem - Inverse and powers of a matrix by using Cayley-Hamilton theorem- Quadratic forms- Reduction of quadratic form to canonical form – Rank - Positive, negative definite - semi definite - index – signature.

Application: Free vibration of a two-mass system.

Subject Category
ABET Learning Objectives a d e k
ABET internal assessments 1 2 4 6
JNTUK External Evaluation A B E

UNIT III Multiple integrals:

Review concepts of Curve tracing (Cartesian - Polar and Parametric curves)-

Applications of Integration to Lengths, Volumes and Surface areas of revolution in Cartesian and Polar Coordinates.

Multiple integrals - double and triple integrals – change of variables – Change of order of Integration

Application: Moments of inertia

Subject Category
ABET Learning Objectives a e d
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT IV Special functions:

Beta and Gamma functions- Properties - Relation between Beta and Gamma functions- Evaluation of improper integrals

Application: Evaluation of integrals

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT V Vector Differentiation:

Gradient- Divergence- Curl - Laplacian and second order operators -Vector identities

Application: Equation of continuity, potential surfaces

Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

UNIT VI Vector Integration:

Line integral – work done – Potential function – area- surface and volume integrals Vector integral theorems: Greens, Stokes and Gauss Divergence Theorems (Without proof) and related problems.

application: work done, Force
Subject Category
ABET Learning Objectives a e
ABET internal assessments 1 2 6
JNTUK External Evaluation A B E

BOOKS:

1. **GREENBERG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India
2. **B.V. RAMANA,** Higher Engineering Mathematics, Tata McGrawhill
3. **ERWIN KREYSZIG,** Advanced Engineering Mathematics, 9th Edition, Wiley-India
4. **PETER O'NEIL,** Advanced Engineering Mathematics, Cengage Learning
5. **D.W. JORDAN AND T. SMITH,** Mathematical Techniques, Oxford University Press

Subject Category	ABET Learning Objectives	ABET Internal Assessments	JNTUK External Evaluation	Remarks
Theory Design Analysis Algorithms Drawing Others	a) Apply knowledge of math, science, & engineering b) Design & conduct experiments, analyze & interpret data c) Design a system/process to meet desired needs within economic, social, political, ethical, health/safety, manufacturability, & sustainability constraints d) Function on multidisciplinary teams e) Identify, formulate, & solve engineering problems f) Understand professional & ethical responsibilities g) Communicate effectively h) Understand impact of engineering solutions in global, economic, environmental, & societal context i) Recognize need for & be able to engage in lifelong learning j) Know contemporary issues k) Use techniques, skills, modern tools for engineering practices	1. Objective tests 2. Essay questions tests 3. Peer tutoring based 4. Simulation based 5. Design oriented 6. Problem based 7. Experiential (project based) based 8. Lab work or field work based 9. Presentation based 10. Case Studies based 11. Role-play based 12. Portfolio based	A. Questions should have: B. Definitions, Principle of operation or philosophy of concept. C. Mathematical treatment, derivations, analysis, synthesis, numerical problems with inference. D. Design oriented problems E. Trouble shooting type of questions F. Applications related questions G. Brain storming questions	

I Year – II SEMESTER

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ENGINEERING CHEMISTRY

UNIT-I: WATER TECHNOLOGY

Hard Water – Estimation of hardness by EDTA method – Potable water- Sterilization and Disinfection – Boiler feed water – Boiler troubles – Priming and foaming , scale formation, corrosion, caustic embrittlement, turbine deposits – Softening of water – Lime soda, Zeolite processes – Reverse osmosis – Electro Dialysis, Ion exchange process

Objectives : For prospective engineers knowledge about water used in industries (boilers etc.) and for drinking purposes is useful; hence chemistry of hard water, boiler troubles and modern methods of softening hard water is introduced.

UNIT-II : ELECTROCHEMISTRY

Concept of Ionic conductance – Ionic Mobilities – Applications of Kohlrausch law – Conductometric titrations – Galvanic cells – Electrode potentials – Nernst equation – Electrochemical series – Potentiometric titrations – Concentration cells – Ion selective electrode –Glass electrodes – Fluoride electrode; Batteries and Fuel cells

Objectives : Knowledge of galvanic cells, electrode potentials, concentration cells is necessary for engineers to understand corrosion problem and its control ; also this knowledge helps in understanding modern bio-sensors, fuel cells and improve them.

UNIT-III : CORROSION

Causes and effects of corrosion – theories of corrosion (dry, chemical and electrochemical corrosion) – Factors affecting corrosion – Corrosion control methods – Cathodic protection –Sacrificial Anodic, Impressed current methods – Surface coatings – Methods of application on metals (Hot dipping, Galvanizing, tinning , Cladding, Electroplating, Electroless plating) – Organic surface coatings – Paints – Their constituents and their functions.

Objectives : the problems associated with corrosion are well known and the engineers must be aware of these problems and also how to counter them

UNIT-IV : HIGH POLYMERS

Types of Polymerization – Stereo regular Polymers – Physical and Mechanical properties of polymers – Plastics – Thermoplastics and thermo setting plastics – Compounding and Fabrication of plastics – Preparation and properties of Polyethylene, PVC and Bakelite – Elastomers – Rubber and Vulcanization – Synthetic rubbers – Styrene butadiene rubber – Thiokol – applications.

Objectives : Plastics are materials used very widely as engineering materials. An understanding of properties particularly physical and mechanical properties of polymers / plastics / elastomers helps in selecting suitable materials for different purposes.

UNIT-V : FUELS

Coal – Proximate and ultimate analysis – Numerical problems based on analysis – Calorific vaule – HCV and LCV – Problems based on calorific values; petroleum – Refining – Cracking – Petrol – Diesel knocking; Gaseous fuels – Natural gas – LPG, CNG – Combustion – Problems on air requirements.

Objectives : A board understanding of the more important fuels employed on a large scale is necessary for all engineer to understand energy – related problems and solve them.

UNIT-VI : CHEMISTRY OF ADVANCED MATERIALS

Nanometerials (Preparation of carbon nanotubes and fullerenes – Properties of nanomaterials – Engineering applications) – Liquid crystals (Types – Application in LCD and Engineering Applications) – Fiber reinforced plastics – Biodegradable polymers – Conducting polymers – Solar cells (Solar heaters – Photo voltaic cells – Solar reflectors – Green house concepts – Green chemistry (Methods for green synthesis and Applications) – Cement – Hardening and setting – Deterioration of cement concrete

Objectives : With the knowledge available now, future engineers should know at least some of the advanced materials that are becoming available. Hence some of them are introduced here.

TEXT BOOKSS

1. Jain and Jain (Latest Edition), Engineering Chemistry, Dhanpat Rai Publishing company Ltd,
2. N.Y.S.Murthy, V.Anuradha, KRamaRao "A Text Book of Engineering Chemistry", Maruthi Publications
3. C.Parameswara Murthy, C.V.Agarwal, Adhra Naidu (2006) Text Book of Engineering Chemistry, B.S.Publications
4. B.Sivasankar (2010), Engineering Chemistry, McGraw-Hill companies.
5. Ch.Venkata Ramana Reddy and Ramadevi (2013) , Engineering Chemistry, Cengage Learning

REFERENCES

1. S.S. Dara (2013) Text Book of Engineering Chemistry, S.Chand Technical Series
2. K.Sesha Maheswaramma and Mridula Chugh (2013), Engineering Chemistry, Pearson Publications.
3. R.Gopalan, D.Venkatappayya, Sulochana Nagarajan (2011), Text Book of Engineering Chemistry, Vikas Publications.
4. B.Viswanathan and M.Aulice Scibioh (2009), Fuel Cells, Principals and applications, University Press.

I Year – II SEMESTER

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ENGINEERING MECHANICS

Objectives: The students completing this course are expected to understand the concepts of forces and its resolution in different planes ,resultant of force system, Forces acting on a body, their free body diagrams using graphical methods. They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analysis of frames and trusses, different types of motion, friction and application of work - energy method.

UNIT – I

Objectives: The students are to be exposed to the concepts of force and friction , direction and its application.

Introduction to Engg. Mechanics – Basic Concepts.

Systems of Forces : Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems. Introduction **,** limiting friction and impending motion, coulomb's laws of dry friction , coefficient of friction, cone of friction

UNIT II

Objectives: The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.

Equilibrium of Systems of Forces : Free Body Diagrams, Equations of Equilibrium of Coplanar Systems, Spatial Systems for concurrent forces. Lamis Theorm, Graphical method for the equilibrium of coplanar forces, Converse of the law of Triangle of forces, converse of the law of polygon of forces condition of equilibrium.

UNIT – III

Objectives : The students are to be exposed to concepts of centre of gravity.

Centroid : Centroids of simple figures (from basic principles) – Centroids of Composite Figures

Centre of Gravity : Centre of gravity of simple body (from basis principles), centre of gravity of composite bodies, pappus theorem.

UNIT IV

Objective: The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.

Area moments of Inertia : Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia :** Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT – V

Objectives : The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.

Kinematics : Rectilinear and Curvelinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion. **Kinetics :** Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

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UNIT – VI

Objectives: The students are to be exposed to concepts of work, energy and particle motion

Work – Energy Method : Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.

TEXT BOOKS:

1. Engg. Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw Hill publications.

2. Engineering Mechanics: Statics and Dynamics 3rd edition, Andrew Pytel and Jaan Kiusalaas; Cengage Learning publishers.

REFERENCES:

1. Engineering Mechanics statics and dynamics – R.C.Hibbeler, 11th Edn – Pearson Publ.
2. Engineering Mechanics , statics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
3. Engineering Mechanics , dynamics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
4. Engineering Mechanics , statics and dynamics – I.H.Shames, – Pearson Publ.
5. Mechanics For Engineers , statics - F.P.Beer & E.R.Johnston – 5th Edn Mc Graw Hill Publ.
6. Mechanics For Engineers, dynamics - F.P.Beer & E.R.Johnston – 5th Edn Mc Graw Hill Publ.
7. Theory & Problems of engineering mechanics, statics & dynamics – E.W.Nelson, C.L.Best & W.G. McLean, 5th Edn – Schaum's outline series - Mc Graw Hill Publ.
8. Engineering Mechanics , Fedinand . L. Singer , Harper – Collins.
9. Engineering Mechanics statics and dynamics , A Nelson, Mc Graw Hill publications
10. Engineering Mechanics, Tayal. Umesh Publ.

I Year – II SEMESTER	T	P	C
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ENVIRONMENTAL STUDIES

Course Learning Objectives:

The objectives of the course is to impart

1. Overall understanding of the natural resources
2. Basic understanding of the ecosystem and its diversity
3. Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities
4. An understanding of the environmental impact of developmental activities
5. Awareness on the social issues, environmental legislation and global treaties

Course Outcomes:

The student should have knowledge on

1. The natural resources and their importance for the sustenance of the life and recognise the need to conserve the natural resources
2. The concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web
3. The biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity
4. Various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management practices
5. Social issues both rural and urban environment and the possible means to combat the challenges
6. The environmental legislations of India and the first global initiatives towards sustainable development.
7. About environmental assessment and the stages involved in EIA and the environmental audit

Syllabus:

UNIT - I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance –Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information Technology in Environment and human health.

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

UNIT - II

Natural Resources: Natural resources and associated problems

Forest resources – Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people

Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources

Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT - III

Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity- classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

UNIT - IV

Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies.

Solid Waste Management: Sources, classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products.

UNIT - V

Social Issues and the Environment: Urban problems related to energy -Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.

UNIT - VI

Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism

The student should submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

Text Books:

1. Environmental Studies by R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
2. A Textbook of Environmental Studies by Shaashi Chawla, TMH, New Delhi
3. Environmental Studies by P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

Reference:

1. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada
3. Environmental Studies by Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Environmental Studies by Piyush Malaviya, Pratibha Singh, Anoop singh: Acme Learning, New Delhi

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I Year – II SEMESTER **T P C**
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COMPUTER PROGRAMMING

Objectives: Formulating algorithmic solutions to problems and implementing algorithms in C

UNIT I:
Unit objective: Notion of Operation of a CPU, Notion of an algorithm and computational procedure, editing and executing programs in Linux
Introduction: Computer systems, Hardware and Software Concepts**,**
Problem Solving: Algorithm / Pseudo code, flowchart, program development steps, computer languages: machine, symbolic and highlevel languages, Creating and Running Programs: Writing, Editing(vi/emacs editor), Compiling(gcc), Linking and Executing in under Linux.
BASICS OF C: Structure of a C program, identifiers, basic data types and sizes. Constants, Variables, Arthmetic , relational and logical operators, increment and decrement operators, conditional operator, assignment operator, expressions, type conversions, Conditional Expressions, precedence and order of evaluation, Sample Programs.

UNIT II:
Unit objective: understanding branching, iteration and data representation using arrays
SELECTION – MAKING DECISION: TWO WAY SELECTION: if-else, null else, nested if, examples, Multi-way selection: switch, else-if, examples**.**
ITERATIVE: loops- while, do-while and for statements , break, continue, initialization and updating, event and counter controlled loops, Looping applications: Summation, powers, smallest and largest.
ARRAYS: Arrays- concepts, declaration, definition, accessing elements, storing elements, Strings and String Manipulations, 1-D arrays, 2-D arrays and character arrays, string manipulations, Multidimensional arrays, array applications: Matrix operations, checking the symmetricity of a Matrix**.**
STRINGS: concepts, c strings.

UNIT III:
Objective: Modular programming and recursive solution formulation
FUNCTIONS- MODULAR PROGRAMMING: functions, basics, parameter passing, storage classes extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, Recursive solutions for fibonacci series, towers of Hanoi, header files, C Preprocessor, example c programs, Passing 1-D arrays, 2-D arrays to functions.

UNIT IV:
Objective: Understanding pointers and dynamic memory allocation
POINTERS: pointers- concepts, initialization of pointer variables, pointers and function arguments, passing by address- dangling memory, address arithmetic, character pointers and functions, pointers to pointers, pointers and multi-dimensional arrays, dynamic memory management functions, command line arguments

UNIT V:

Objective: Understanding miscellaneous aspects of C

ENUMERATED, STRUCTURE AND UNION TYPES: Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit-fields, program applications

BIT-WISE OPERATORS: logical, shift, rotation, masks.

UNIT VI:

Objective: Comprehension of file operations

FILE HANDLING: Input and output- concept of a file, text files and binary files, Formatted I/O, File I/O operations, example programs

Text Books:

1. Problem Solving and Program Design in C, Hanly, Koffman, 7th ed, PERSON
2. Programming in C, Second Edition Pradip Dey and Manas Ghosh, OXFORD Higher Education
3. Programming in C, A practical approach Ajay Mittal PEARSON
4. The C programming Language by Dennis Richie and Brian Kernighan
5. Programming in C, B. L. Juneja, Anith Seth, Cengage Learning.

Reference Books and web links:

1. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE
2. Programming with C, Bichkar, Universities Press
3. Programming in C, Reema Thareja, OXFORD
4. C by Example, Noel Kalicharan, Cambridge

I Year – II SEMESTER

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ENGINEERING CHEMISTRY LABORATORY

List of Experiments

1. Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Quantitative analysis etc.,
2. Trial experiment – Estimation of HCI using standard Na_2co_3 solutions
3. Estimation of $KMnO_4$ using standard Oxalic acid solution.
4. Estimation of Ferric iron using standard $K_2Cr_2O_7$ solution.
5. Estimation of Copper using standard $K_2Cr_2O_7$ solution.
6. Estimation of Total Hardness water using standard EDTA solution.
7. Estimation of Copper using standard EDTA solution.
8. Estimation of Copper using Colorimeter
9. Estimation of pH of the given sample solution using pH meter.
10. Conductometric Titrations between strong acid and strong base
11. Conductometric Titrations between strong acid and Weak base
12. Potentiometric Titrations between strong acid and strong base
13. Potentiometric Titrations between strong acid and Weak base
14. Estimatinog of Zinc using standard potassium ferrocyanide solution
15. Estimation of Vitamin – C

TEXT BOOKSS

1. Dr.Jyotsna Cherukuis(2012)Laboratory Manual of Engineering Chemistry-II, VGS Techno Series
2. Chemistry Practical Manual, Lorven Publications
3. K. Mukkanti (2009) Practical Engineering Chemistry, B.S.Publication

I Year – II SEMESTER	T	P	C
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ENGLISH – COMMUNICATION SKILLS LAB – II

Suggested Lab Manuals:

OBJECTIVE: To impart to the learner the skills of grammar as well as communication through listening, speaking, reading, and writing including soft, that is life skills.

ADVANCED COMMUNICATION SKILLS

UNIT 6	Body language
UNIT 7	Dialogues
UNIT 8	Interviews and Telephonic Interviews
UNIT 9	Group Discussions
UNIT 10	Presentation Skills
UNIT 11	Debates

Text Book:

'Strengthen your Communication Skills' Part-B by Maruthi Publications

Reference Books:

1. INFOTECH English (Maruthi Publications)
2. Personality Development and Soft Skills (Oxford University Press, New Delhi)

I Year – II SEMESTER **T P C**
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COMPUTER PROGRAMMING LAB

Exercise l

a) Write a C Program to calculate the area of triangle using the formula
area = (s (s-a) (s-b)(s-c))$^{1/2}$ where s= (a+b+c)/2

b) Write a C program to find the largest of three numbers using ternary operator.

c) Write a C Program to swap two numbers without using a temporary variable.

Exercise 2

a) 2's complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the 2's complement of a binary number.

b) Write a C program to find the roots of a quadratic equation.

c) Write a C program, which takes two integer operands and one operator form the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

Exercise 3

a) Write a C program to find the sum of individual digits of a positive integer and find the reverse of the given number.

b) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the

c) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Exercise 4

a) Write a C Program to print the multiplication table of a given number n up to a given value, where n is entered by the user.

b) Write a C Program to enter a decimal number, and calculate and display the binary equivalent of that number.

c) Write a C Program to check whether the given number is Armstrong number or not.

Exercise 5

a) Write a C program to interchange the largest and smallest numbers in the array.

b) Write a C program to implement a liner search.

c) Write a C program to implement binary search

Exercise 6

a) Write a C program to implement sorting of an array of elements .

b) Write a C program to input two m x n matrices, check the compatibility and perform addition and multiplication of them

Exercise 7

Write a C program that uses functions to perform the following operations:

i. To insert a sub-string in to given main string from a given position.
ii. To delete n Characters from a given position in a given string.
iii. To replace a character of string either from beginning or ending or at a specified location

Exercise 8

Write a C program that uses functions to perform the following operations using Structure:

i) Reading a complex number ii) Writing a complex number
iii) Addition of two complex numbers iv) Multiplication of two complex numbers

Exercise 9

Write C Programs for the following string operations without using the built in functions

- to concatenate two strings

- to append a string to another string
- to compare two strings

Exercise 10

Write C Programs for the following string operations without using the built in functions

- to find t he length of a string
- to find whether a given string is palindrome or not

Exercise 11

a) Write a C functions to find both the largest and smallest number of an array of integers.

b) Write C programs illustrating call by value and call by reference cncepts.

Exercise 12

Write C programs that use both recursive and non-recursive functions for the following

i) To find the factorial of a given integer.

ii) To find the GCD (greatest common divisor) of two given integers.

iii) To find Fibonacci sequence

Exercise 13

a) Write C Program to reverse a string using pointers

b) Write a C Program to compare two arrays using pointers

Exercise 14

a) Write a C program consisting of Pointer based function to exchange value of two integers using passing by address.

b) Write a C program to swap two numbers using pointers

Exercise 15

Examples which explores the use of structures, union and other user defined variables

Exercise 16

a) Write a C program which copies one file to another.

b) Write a C program to count the number of characters and number of lines in a file.

c) Write a C Program to merge two files into a third file. The names of the files must be entered using command line arguments.

II Year – I SEMESTER

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BIOCHEMISTRY

UNIT I: CARBOHYDRATES:

Structure, properties, classification and biological functions- Mono, Di, Oligo & polysaccharides, complex carbohydrates, Glycolysis, aerobic and anaerobic fate of pyruvate, respiratory chain, aerobic and anaerobic respiration.

LO: To demonstrate simple and complex carbohydrates along with their metabolic pathways.

LA: Assessment by differentiating between simple and complex carbohydrates & their pathways.

Unit II: AMINO ACIDS:

Structure, properties, classifications and biological functions, - nitrogen cycle, nitrogen balance, reductive amination and trans amination and urea cycle, bio synthesis of amino acids- glutamate, and shikimate pathway.

LO: To demonstrate different aminoacids structurally and their synthesis pathways.

LA: Assessment of different aminoacids structurally and different nitrogen pathways.

UNIT III: **PROTEINS:**

Structure, properties, classifications and biological functions, protein types (globular & fibrous), protein folding, protein degradation, protein targeting.

LO: To demonstrate different simple and complex proteins along with their properties.

LA: Assessment by identification of different proteins and their folding.

UNIT IV: ENZYMES:

Introduction, properties, classification, and biological functions, IUB & EC nomenclature, enzyme specificity, enzyme inhibition, Regulatory enzymes- allosteric enzymes, enzyme catalysis- acid- base catalysis, covalent catalysis, metal ion catalysis.

LO: To demonstrate enzyme classification and Michaelis-Menten kinetics derivatives and enzyme models.

LA: Numerical and theoretical ability of Michaelis-Menten kinetics.

UNITV: LIPIDS:

Structure, properties and Classifications and biological functions- sphingolipids, phospholipids, fatty acid metabolism, β – oxidation, steroids, cholesterol structure& function. Lipoproteins- classification & function, lipid profile assays, lipids as surfactants in industry.

LO: To demonstrate different simple and complex lipids along with the metabolic pathways of complex lipids.

LA: Assessment by structural identification of simple and complex lipids & pathways by different assays.

UNITVI: **NUCLEICACIDS**

Structure, Properties and biological functions, forms of DNA & RNA, overview of purine & pyrimidine metabolism.

LO: To demonstrate structure of DNA & RNA along with nitrogen bases synthesis pathways.

LA: Assessment by identification and differentiation of nitrogen bases.

TEXTBOOKS:

1. Lehninger A. L, NelsonO.'L, M.M.Cox, Principles of Biochemistry, 4th Edition, CBS Publications, 2004.,

2. J.L.Jain Fundamentals of Biochemistry 6th edition S.Chand Publishers 2004

REFERENCES:

1. Voet D,Voet J. G, Biochemistry,4th Edition, JohnCWileyand Sons,2010.
2. L. Stryer, J. M. Berg, JLTymockzo, Biochemistry, 5thedition,W H Freemen&Co, 2002.
3. K. Mathews, K.E.VanHolde, KevinGAhern Biochemistry 3rd edition, Pearson education, 2003.
4. Daviel Whitford John Protein's Structure and function,1st edition Wiley Publications, 2005
5. Mary K. Campbell and Shawn O. Farrell: Biochemistry, Thomson Brooks/Cole, Indian Edition, 5 th Edition, 2007.

II Year – I SEMESTER

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BIOCHEMICAL THERMODYNAMICS

UNITI: THERMODYNAMICS

First and Second law of thermodynamics; Calculation of Work, energy and property changes in reversible processes, Thermodynamics of flow processes; Power cycles and refrigeration cycles, Residual properties.

LO: To demonstrate the laws of thermodynamics & applications.

LA: Assessment by application of thermodynamic principles in Calculation of Work, energy & flow.

UNITII: MATERIAL BALANCE

Steady state and equilibrium, types of material balances, Factors effecting growth kinetics and product formation, Electron balance, Theoretical oxygen demand.

LO: To demonstrate the mechanism of growth formation.

LA: Assessment of growth kinetic & product formation analysis.

UNITIII : ENERGY BALANCES

Basic Energy concepts, Intensive and Extensive properties, general energy balance equations, Enthalpy calculations, State properties- reactive and non-reactive systems, Heat of solutions, Heat of combustion ,Heat of reaction in non-standard condition; Energy balance equation for cell culture with basic numerical calculations.

LO: Demonstration on general energy balance equation and enthalpy.

LA: Assessment by problems on heat combustion.

UNITIV: UNSTEADY-STATE MATERIAL AND ENERGY BALANCES

Unsteady state material balance and energy balance equations; solving unsteady equations for biological systems in CSTR, fed-batch and plug flow reactors.

LO: To demonstrate CSTR, fed-batch and plug flow reactors.

LA: Assessment on demonstration of operation of CSTR, fed-batch and plug flow reactors.

UNITV: THERMODYNAMIC PROPERTIES OF FLUIDS

Estimation of thermodynamic properties using equations of state; Maxwell relationships and their applications; calculation of flow processes based on actual property changes. Criteria for phase equilibrium; vapor- liquid equilibrium calculations for binary mixtures, liquid-Liquid equilibrium and Solid- liquid equilibrium.

LO: To demonstrate different types of phase equilibriums.

LA: Assessment by calculating the flow parameters of equilibrium constants.

UNITVI: CHEMICAL REACTION EQUILIBRIA

Equilibrium criteria for homogeneous chemical reactions; Evaluation of equilibrium constant and effect of pressure and temperature on equilibrium constant; Calculation of equilibrium conversions and yields for single and multiple chemical reactions.

LO: To demonstrate various homogenous chemical reactions along with their physical effects.

LA: Assessment by Calculation on equilibrium conversions and yields for single and multiple chemical reactions.

TEXTBOOKS:

1. J M. Smith, H.C.VanNessand M.M.Abbott. Introduction to Chemical Engineering Thermodynamics 7th edition McGraw-Hill 2005
2. P. M. Doaran, Bioprocess Engineering Principles, 2nd edition AcademicPress, 2012

REFERENCES:

1. M. D. Koretsky, Engineering and Chemical Thermodynamics, John Wileyandsons, 2004

II Year – I SEMESTER

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CELLBIOLOGY

UNITI: HISTORY AND MORPHOLOGY OF THECELL

Discovery of cells; Basic properties of cells; Cell theory; Cell complexity - cell size & shape; different classes of cells; prokaryotic & eukaryotic cells; structure and functions of nucleus, endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, chloroplast & mitochondria.

LO: Ability to identify and isolate cells & cell organelles.

LA: Assessment on identification by counting of cells.

UNIT II: CHEMISTRY OFTHECELL

Importance of carbon and water; plasma membrane-structure and function; cytoplasm; cytoskeleton-microtubules, microfilaments & intermediate filaments, cell motility– cilia & flagella.

LO: To study the integrity of components present in the cell.

LA: Assessment by identification under microscope.

UNITIII: CELL DIFFERENTIATION

General characteristics of cell differentiation, differentiation in unicellular & multicellular organism, cytoplasmic determinants, nucleoplasmic Interactions; embryonic and adult stem cells and its biological importance.

LO: To demonstrate various characteristics of cell differentiation.

LA: Assessment by theoretical analysis.

UNIT IV: CELL DIVISION

Overview of the Cell Cycle, Interphase, Mitosis, Cytokinesis & Meiosis. Animal Cell & Yeast Cell Division, Cell Cycle Control & Checkpoints.

LO: To demonstrate the various phases during cell division.

LA: Assessment by diagrammatic representation & microscopic analysis.

UNITV: TRANSPORT ACROSS CELL MEMBRANES

Passive and Active Transport, Uniport, Symport, Antiport, Permeases, P-Type & V-Type Pumps, Na+/K+ ATPase, Lysosomal & vacuolar membrane ATP dependent Proton Pumps, Endocytosis and Exocytosis, Transport into Prokaryotic Cells.

LO: To know the transport mechanisms across the cell membranes.

LA: Assessment written and objective test.

UNITVI: CELL SIGNALING-BASIC CONCEPTS

Intracellular signaling, types of signal receptors- Cytosolic, Nuclear & Membrane bound receptors, Chemo receptors of Bacteria (Attractants & Repellents), Signal Transduction by hormones- Steroid / Peptide hormones; Concept of Secondary messengers, c AMP, c GMP, Protein Kinases, G Proteins; Receptors & Non- receptors associated tyrosine kinases.

LO: To study the various intracellular signaling and cell messengers.

LA: Assessment on diagrammatic analysis.

TEXTBOOKS:

1) Cooper The Cell 5th edition Sinauer Associates, Inc 2009 .
2) DeRobertis and DeRobertis Cell and molecular biology Waverly Pvt. Ltd, – (2010)

REFERENCES:

1) Gerald Karp Cell & Molecular biology (6ndEd.)Wiley publishers 2010.

2) Becker, Reece, Poenie The World of the cell (7th edition)Benjamin Publishers 2008.
3) Bruce Alberts molecular biology of the cell 4th edition Garland Science 2002.
4) ErnstJ.M.Helmreich ThebiochemistryofCellSignalling-.1st Oxford Press 2003.
5) Rastogi S. C: Cell Biology, New age International publishers, 3rd Edition, 2005.
6) Thomas D. Pollard, William C. Earnshaw and Jennifer Lippincott-Schwartz: Cell Biology: With Studen Consult Online Access, 2nd Edition Saunders College Publishing, , 2007

II Year – I SEMESTER

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GENETICS

UNIT – I: PHYSICAL BASIS OF HEREDITY

Basic laws of inheritance, modification of Mendel's ratios, multiple factors of inheritance. Genes and environment, identification of genetic material - classical experiments, Hershey chase, Avery McLeod etc. Packing of DNA, organization of genetic material in prokaryotes and eukaryotes.

LO: To demonstrate Mendel's laws pictorially.

LA: Assessment of practical demonstration of Mendel's laws.

UNIT – II: LINKAGE AND RECOMBINATION

Chromosomal inheritance, Linkage and Crossing over, Mechanism of Recombination, Methods of Transduction - Generalized, Specialized and Abortive, Bacteriophages – Lytic and Lysogenic life cycle, Molecular mechanism of Transformation, Bacterial Conjugation.

LO: To study the various concepts of inheritance and recombination.

LA: Assessment by practical observation.

UNIT-III: FACTORS ASSOCIATED WITH SEX DETERMINATION

Mechanism of sex determination in Insect (Fruit Fly), plants (Melandrium), F and HFr transfer, Mechanism of transfer. Sex determination and developments in Humans, Dosage compensation, Maryleons Hypothesis, Sex linked disorders in Human beings – Fragile-X syndrome, Down's syndrome.

LO: To demonstrate sex determination in prokaryotes and eukaryotes and observation of genetic disorders in humans.

LA: Assessment by practical demonstration & patient's observation.

UNIT – IV: CHROMOSOME STRUCTURE, ORGANIZATION AND ABERRATIONS

Chromosome morphology, classification, Karyotyping, Special Chromosomes, Chromosome aberrations, Origin, types and Cytogenetic effects, Gene Mapping, Test Crosses.

LO: To demonstrate the chromosome structure and its organization.

LA: Assessment by practical observation of chromosomes of different tissues.

Unit :- V: MUTATIONS AND DISEASES:

Mutations, types of mutations, Snps and related diseases (Turner's syndrome, colour blindness,klinfelter's) genetic diseases- cystic fibrosis, hemophilia, sickle cell anemia . Gene silencing, knockout genes.

LO: To demonstrate diseases caused by mutations in humans and micro-organisms.

LA: Assessment of mutations by analysis, practical observations and essays.

UNIT – VI: EXTRACHROMOSOMAL INHERITANCE

Introduction to Extra Chromosomal Inheritance, Examples of Extra Chromosomal Inheritance, Petite Phenotypes in Yeast, Uniparental inheritance in Algae.

LO: To demonstrate extra chromosomal inheritance.

LA: Assessment by experimental demonstration.

TEXT BOOKS

1. E.J. Gardner, M.J. Simmons & DP Shustad. Principles of Genetics, 2001

REFERENCES

1. Goodenough U. Hold Genetics, International2010
2. Griffith Genetics 9th edition W. H. Freeman and Company 2007
3. Strickberger Genetics 8th edition TBS 2008

4. Essentials of Genetics (In genomics prospective), Hartwell, 2003
5. Robert H. Tamarin Principles of Genetics-, 7th edition Tata McGraw Hill 2001

II Year – I SEMESTER

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BASIC INDUSTRIAL BIOTECHNOLOGY

UNIT I: INTRODUCTION

A historical overview of industrial fermentation process–traditional and modern biotechnology.

LO: Basic understanding about Application of biotechnology for industrial purposes and practice of using cells or components of cells like enzymes to generate industrially useful products.

LA: Assessment by technical analysis.

UNIT II: PRODUCTION OF PRIMARY METABOLITES:-

A brief outline of processes for the production of some commercially important Organic acids (e.g. citric acid); Amino acid (Glutamic acid); and Alcohol (ethanol, 2, 3- butanediol).

LO: Basic understanding about processes for the production of primary metabolites like organic acids, amino acids, alcohols.

LA: Assessment by application of production strategies for compounds.

UNIT III: SECONDARY METABOLITES:-

Study of production processes for various classes of low molecular weight secondary metabolites: antibiotics – beta-lactams, penicillin's, and cephalosporin's ,amino -glycosides(streptomycin), macrolides (erythromycin).

LO: Basic understanding about processes for the production of mentioned antibiotics.

LA: Assessment by application of production strategies.

UNIT IV: PRODUCTION OF COMMERCIALLY IMPORTANT ENZYMES:-

Proteases, Lipases, Enzymes A brief survey of organisms, processes, products relating to modern biotechnology. Process flow sheeting – block diagrams, pictorial representation. Or the food & pharmaceutical industries.

LO: Basic understanding about Production of Commercially Important Enzymes like Proteases, Lipases and Enzymes for the food & pharmaceutical industries.

LA: Assessment by producing various commercially important enzymes.

UNIT V: RECOMBINANT PROTEINS AND MODERN BIOTECHNOLOGY PRODUCTS:-

Production of recombinant protein (Insulin), production of vaccines (Hepatitis-B). Production of monoclonal antibodies. products of plant and animal cell culture

LO: Basic understanding about Production of recombinant protein like Insulin, vaccines like Hepatitis-B and monoclonal antibodies.

LA: Assessment by application of these strategies in place of conventional methods

UNIT VI: BIO PRODUCTS AND OTHER PROCESSES:-

Natural Bio preservatives (Nisin), and Biopolymers(PHB); Single Cell Protein(spirulina),Steroid Bioconversions; High-Fructose Corn syrup; Bioconversion of Vegetable Oils, Bioleaching.

LO: Basic understanding about Production of Natural Bio preservatives, Biopolymers, Single Cell Protein, High-Fructose Corn syrup and Products of Bioconversion

LA: Assessment by application of new strategies

TEXT BOOKS

1. CasidaJr, L.E., "Industrial Microbiology", New Age International (P) Ltd 2007.
2. Prescott, Dunn, "Industrial Microbiology", Agrobios (India) 7th edition 2007.

REFERENCES

1. Wulf Cruger and Anneliese Crueger, “Biotechnology: A Textbook of Industrial Microbiology”, 7th edition Panima Publishing Corporation 2005.
2. Murrey Moo & Young, “Comprehensive Biotechnology”, Pergamon

II Year – I SEMESTER

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MICROBIOLOGY

UNIT I: INTRODUCTION TO MICROBIOLOGY

Discovery of microorganisms; Theory of spontaneous generation, Germ theory of diseases; Scope and relevance of microbiology Identification of Microorganisms- A general account .Microbial diversity General characteristics of Bacteria, Achaea and Eubacteria. Diversity classification by Woese

Classification systems- Phylogenetic, Phenetic, Taxonomic ranks, Major characteristics used in Taxonomy - Morphological, Physiological, ecological, Biochemical, Immunological, Genetical and Molecular.

LO: To demonstrate the isolation & identification of microorganism.

LA: Assessment by isolation experiments.

UNITII: VIRUSES

General properties of Virus , Structure of Viruses; Animal Viruses; plant Viruses; and Classification of Viruses and Applications of Viruses in Biotech Industry, Viral Replication- Bacterial, plant and animal viruses with1example each.

LO: To study the structure classification of virus.

LA: Assessment by written test.

UNIT III: ISOLATION, IDENTIFICATION AND CULTURING OF VIRUSES

Isolation, Identification and invitro cultivation of viruses . Assay of viruses (Both Bacterial and animal viruses) .

LO: To demonstrate virus and their isolation.

LA: Assessment by practical demonstration of viral isolation.

UNIT IV: NUTRITION AND CULTIVATION

Nutrition of microorganisms; Nutritional classes of microbes, Macro and micronutrients, their sources and physiological functions. Growth factors and their functions in metabolism .Aerobic and anaerobic metabolism. Cultivation of microorganisms; Culture media, synthetic, complex media, solidifying agents, types of media- selective, Differential and enrichment and enriched media, pure culture methods- spread plate, pour plate and streak plate, special techniques for cultivation of anaerobes.

LO: To demonstrate the different microbial culturing methods and their requirements.

LA: Assessment by practice demonstration of microbial culturing techniques and media preparation.

UNIT V: IDENTIFICATION AND PRESERVATION OF MICROBES

Preservation of Microganisms: Working and Primary Stock cultures –agar slants, agar stabs, spore preparation, use of sterile soil, cryopreservation, lyophilisation, Application and limitations of various methods. Influence of environmental factors on growth– solutes, water activity, pH, temperature, oxyzen, osomotic pressure, radiation. Colony characteristics, staining techniques; Fixation, Principle dyes, simple standing, differential staining spore staining flagellar staining. Biochemical tests –Sugar fermentations, IMVIC tests, Catalase production etc.

LO: To demonstrate various identification and preservation techniques of micro-organisms

LA: Assessment by demonstration of different techniques of preservation and maintenance of micro-organisms

UNITVI: MEDICAL BIOTECHNOLOGY

Disease causing microorganisms, Molecular Basis of pathogenecity and identification methods (AIDS, Hepatitis, Polio, Tuberculosis, Anthrax, Cholera).

LO: To study the pathogenesis of micro organism.

LA: Assessment by practices and case studies.

TEXTBOOKS:

1. Pelczar M.J.Chan ECE and Krieg Microbiology, NR.5th edition Tata Mc Graw Hill, 2004.

2. John. L. Ingraham, Catherine AL Ingraham Introduction to Micro Biology a case History approach 3rd edition, Thomson
Publications, 2000

REFERENCES:

1. BROCK Biology of Microorganism, 13th edition Prentice Hall, International Inc.2010
2. Hans. G. Schlege General Microbiology, 7th edition, Cambridge university press, 1993.
3. Roger Y stanier General Microbiology.,5th edition Macmillan.2009
4. Prescott and Dunn General Microbiology. 8th edition McGraw Hill Publishers. 2008

II Year – I SEMESTER

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BIOCHEMISTRY LAB

CYCLE I:

1. Units, Volume & Weight measurements. Concentration units, pH Measurement. Preparation of buffers.
2. Qualitative tests for carbohydrates. Estimation of reducing sugars by the Benedict's method.
3. Qualitative tests for Amino Acids, Quantitative method for Amino Acids, Ninhydrin method.
4. Protein estimation by Biuret/ Folin / Bradford method.
5. Extraction of lipids, Saponification of Fats.
6. Estimation of cholesterol.
8. Estimation of Nucleic Acids, Precipitation by sodium sulphate, Test for ribose and deoxyribose sugar.
9. Extraction of Caffeine from tea leaves.
10. Hydrolysis of ester using Papain.

CYCLEII:

1 Preparation of simple organic compounds involving the following reactions:
   a) Acetylation: Acetanilide from aniline and aspirin from salicyclic acid
   b) Nitration: p- Nitroacetanilide from acetanilide.
   c) Sulphonation: sulphanilic acid from aniline.
   d) Oxidation: p-benzoquinone one from hydroquinone.

2 Qualitative analysis:
   a) Carboxylic acids
   b) Phenols
   c) Aldehydes and ketones
   d) Esters

TEXTBOOK:

1. Laboratory Manaual in Biochemistry by J. Jayaraman New age International Publications, 2011.

2. K.Wilson &J.Walker, Principles & Techniques of Practical Biochemistry 5th edition. Cambridge University Press, 2000.

Equipment:

1. Refrigerator
2. Centrifuge.
3. Boiling water both.
4. Calorimeter.
5. pH Meter.
6. Weighing Balance.

II Year – I SEMESTER **T P C**
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CELLBIOLOGYAND MICROBIOLOGY LAB

1. Identification of Animal, Plant & Bacterial cells.
2. Micrometry.
3. Differential centrifugation and isolation of Chloroplast &Mitochondria.
4. Sterilization techniques (lecture/ demonstrations).
5. Preparation of culture media (a) Broth type of media (b) Solid media.
6. Culturing of microorganisms: (a) Broth (b) Pure culture techniques: Streak plate, pour plate.
7. Isolation and preservation of bacterial culture.
8. Identification of microorganisms (a) Staining technique (b) Biochemical testing.
9. Antibiotic test- Disc diffusion method, minimum inhibitory concentration.
10. Microbiological examination of water.
11. Biochemical tests IMVIC test Catalase test Coagulase test Gelatinase test Oxidase test.
12. Determination of Bacterial growth by turbidometry/ colorimetry.
13. Factors effecting the bacterial growth– effects of temperature of pH.

TEXTBOOKS:

1. Microbiological and applications, laboratory, Manual in General Microbiology by Benson, McGraw Publications. First edition 2007
2. Laboratory manual in microbiology by P. Gunasekharan, New age international Publishers 2009.
3 J. G. Cappuccino and N. Sherman, A Laboratory manual, 9thedition, Addison &weslay,2010.

EQUIPMENT:

1. Bright field microscope.
2. Ocular micrometer.
3. Stage micrometer.
4. Hot air oven.
5. Autoclave.
6. Antibiotic disc.
7. Laminar air flow chamber.
8. Bunsen burner.
9. Spectrophotometer.
10. Incubator and shaker.
11. pH Meter.
12. Compound microscope.

II Year – II SEMESTER

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HEATTRANSFER IN BIOPROCESSES

UNIT-I: BASICS OF HEAT TRANSFER

Various modes of heat transfers, conduction, convection and radiation. Mechanism of heat transfer by conduction, conductive heat transfer through a series of resistances.

LO: To understand the principles of heat transfer, conduction, convection and radiation.

LA: Assessment by practical analysis.

UNIT-II: CONDUCTIVE HEAT TRANSFER

Steady state and unsteady state heat transfer by conduction. Heat transfer through slab and cylinder. Concept of log mean radius for transfer through pipes. Extended surface heat transfer through fins etc.

LO: To understand the difference between steady state and unsteady state heat transfer in conduction and its applications.

LA: Assessment by practical demonstration in various surfaces.

UNIT-III: CONVECTION

Convection–Dimensional analysis, Forced convection in pipe and other
Geometries. Natural convection –various correlation for evaluating heat transfer coefficients.

LO: To demonstrate and derive the various convectional flows.

LA: Assessing by evaluating the correlations of heat transfer.

UNIT-IV: HEAT TRANSFER EQUIPMENTS

Boiling and condensations. Mechanism of boiling: Film and nucleate boiling. Double pipe heat exchangers, Shell and tube heat exchangers, pin fin heat exchangers- Overall transfer coefficient. Overview of various types of heat exchangers and concept of LMTD.

LO: To understand the principle of heat transfer equipment's and their working.

LA: Assessment by working mechanisms.

UNIT-V: EVAPORATOR

Single and Multiple effect evaporators and problems on evaporators. Steam economy, Steam capacity, evaporators performance with various feedings viz, forward, backward and parallel.

LO: To study the various effects on evaporator and its performance.

LA: Assessment by calculations of heat transfer area, steam economy.

UNIT-VI: TRANSFER

Analogy between heat, mass and momentum transfer. Applications of heat transfer in bioprocessing- batch sterilization and design of continuous sterilizer.

LO: To study the analogies of heat, mass and momentum transfer, sterilization.

LA: Assessment by design of a sterilizer.

*Relevant basic numerical problems should be dealt in the units.

TEXTBOOKS:

1. W.L. Mc Cabe and JC Smith, Unit Operations of Chemical Engineering, McGraw-Hill, 7th edition, 2004.
2. P.M. Doran, Bioprocess Engineering Principles,2nd edition Academic Press, 2012.

REFERENCEBOOKS:

1. BIOTOL Series: Transport phenomena in bioprocesses, verlag
2. D.G. Rao, Introduction to Biochemical Engineering, Tata Mc Graw Hill, 2005.
3. H.W. Blanch and DS Clark, Biochemical Engineering,3rd edition Marced Dekav Inc. New York.

II Year – II SEMESTER

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PROCESS ENGINEERING PRINCIPLES

UNIT-I INTRODUCTION TO UNIT OPERATIONS AND UNIT PROCESS

Application of engineering principles in biotech industries- Introduction to unit operations and unit process–application of transport phenomenon principles (momentum, mass and heat transfer) in bioprocessing.

LO: To study various parameters of transport phenomena.

LA: Assessment by application of unit operations.

UNIT-II UNITS AND DIMENSIONS

Units and dimensions, basic quantities and derived units, Conversion of units, Concept of mass and force, definition of go and its utility. Various equations of state including ideal gas law to evaluate P- V. T data, their application in process calculations by solving basics numerical problems.

LO: To study various gas laws, units & dimensions.

LA: Assessment by derivations and application of equation of state.

UNIT- III FLUID MECHANICS

Fluid mechanics– Properties of fluids, fluid statics energy balance in fluid flow through pipes and cond units, Bernoulli's equation and its application, calculation of power required for pumping fluids. Rheology of fluids–Newton's law of viscosity. Concept of Newtonian and non-Newtonian fluids– Different types of non-Newtonien fluids with examples in bioprocessing. Measurement of viscosity using extrusion rheometer, plate and coneviscometer, coaxial cylinder viscometer.

LO: To study various properties & mechanics of fluids.

LA: Assessment by derivations and calculations.

UNIT IV RHEOLOGY OF FLUIDS

Flow through pipes, average velocity, flow regimes, boundary layer concept. Laminar and turbulent flow – characterization by Reynolds's number, pressure drop due to Skin friction and form friction, friction factor chart, Hagen–Poiseuitle equation. Brief introduction to flow of compressible fluids.

LO: To understand the various properties of fluid behavior.

LA: Assessment by derivations and calculations.

UNIT- V FLOW PAST IMMERSED BODIES

Flow past immersed bodies: Definition of drag and drag coefficient. Friction in flow through beds of solids, derivation of friction factor equations and pressure drop expressions. Introduction of the concept of packedbeds. Motion of particles through fluids, terminal velocity.

LO: To study various parameters of fluid flow under friction.

LA: Assessment by calculations and applications.

UNIT-VI FLOW MEASURING AND MONITORING SYSTEMS

Flow measuring and monitoring systems–valves, bends, elbows, prevention of leaks, mechanical seals, stuffing box. Flow measuring devices– Manometers, orifice meter, venture meter and rotameter. Fluid transportation machinery: Different types of pumps, positive displacement pumps, reciprocating pumps, diaphragm pumps, peristaltic pumps. Calculation of pump horse power.

LO: To understand and monitor the measurement of fluid flow.

LA: Assessment by monitoring and calculations.

TEXTBOOKS:

1. D. G. Rao, Introduction to Biochemical Engineering Tata Mc Hill (2005)
2. Pauline M.Doran Bio-process Engineering Principles, 2nd edition Academic press (2012)

3. Mc Cabe, W.L, Smith J.C and Harriot P,Unit operations of chemical engineering Mc- graw Hill,3rdEd.(2003)

REFERENCES:

1. Earle, R.L Unit operation in Food processing, 2nd edition, Pergamon Press, Oxford, 1983.

II Year – II SEMESTER

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INSTRUMENTAL METHODS OF ANALYSIS

UNITI: INTRODUCTION

Types of Analytical Methods – Instruments for Analysis – Uncertainties in Instrumental measurements – Sensitivity and detection limit for instruments. **Microscopy**: Bright field, Dark field, Phase contrast, confocal microscopy, SEM & TEM Microscopy, Flow Cytometry.

LO: To understand the basic principles of microscope and their working.

LA: By correct adjustment of slides under different types of microscopes.

UNITII: CENTRIFUGATION

General Principals, Ultra Centrifugation, velocity Sedimentation & measurements, Equilibrium Ultracentrifugation – Density Gradient centrifugation.

LO: To demonstrate the types of centrifuge and principles.

LA: By separating various sampling using different types of centrifuges.

UNIT-III: SEPARATION EQUIPMENTS – PRINCIPLES AND OPERATION:

HPLC, Gas chromatography, Ion – exchange Chromatography, Gel filtration Chromatography, Affinity Chromatography, Membrane separations, Ultrafiltration, Reverse Osmosis.

LO: To understand the principle and operation of different types of separation equipment's.

LA: By separating various sampling using different types of chromatography.

UNIT IV : SPECTROSCOPY

General principles – Radiation, energy and atomic structure- types of spectra and their biochemical usefulness – basic Laws of light absorption. Electromagnetic radiation & Spectrum, Beer – lambert's law and apparent deviations; UV - VIS Spectrophotometer, Spectrofluorimetry, Atomic absorption & Atomic emission spectroscopy, Cirular Dichroism (CD)- principles, instrumentation and applications. Infra Red Spectroscopy. Mass spectroscopy-Introduction, analysis, applications in biology ESR principles - instrumentation-applications

LO: To study different types & principle spectrophotometers

LA: practical analysis of various samples by using different types of spectrophotometers

UNIT V: ONLINE MONITORING AND CONTROL DEVICES: pH, temperature, dissolved oxygen, agitation, sensors and their operation. Principle, Mode of Operation and Applications.

LO: To study different types & principle of monitoring devices.

LA: by measuring & monitoring of various samples using these devices

UNITVI: NMR

High resolution NMR– Chemical shift- Spin- spin coupling Frequency lock- double resonance-applications of proton NMR-quantitative analysis- qualitative analysis, application of NMR in biology and study of macromolecules

LO: To study the different principles in NMR.

LA: assessment by structure analysis.

TEXTBOOKS:

1. Keith Wilson, Kenneth H.Goulding A Biologist Guide to principles and techniques of practical Biochemistry. 7th edition.ELBS Series.2010
2. Skoog &West, Fundamentals of Analytical Chemistry,8th edition2004

REFERENCES:

1. Vogel, Text Book of Quantitative Inorganic Analysis, 6th Prentice Hall edition 2000

2. Ewing, Instrumental Methods of Analysis, 3rd Mcgraw-Hill College edition 2003
3. Hobert H Wil**LA**rd D.L. Merritt & J. R. J. A. Dean, Instrumental Methods of Analysis,7th edition CBS Publishers & Distributors,2003
4. F. Settle. Hand bookof Instrumental techniques for Analytical Chemistry, Prentice Hall.1997

II Year – II SEMESTER

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MOLECULAR BIOLOGY

UNITI: STRUCTURE OFDNA

Detailed structure of DNA, variation from Watson & Crick model, Z- DNA, A & B DNA, Denaturation & melting curves.

LO: To demonstrate the different of forms of DNA.

LA: Assessment by diagrammatic representation.

UNIT-II: DNA REPLICATION

Models of DNA replication: semi conservative Mechanism of DNA replication in *E. coli* (bi-directional). Mitochondrial (D-loop), Viral DNA (Rolling circle), Single stranded-DNA phages (M13, ØX174), Eukaryotic telomeres and its replication Inhibitors of DNA Replication. Enzymes involved in replication, step by step process.

LO: To study the models of DNA replication.

LA: Assessment on practical ability and diagrammatic representation.

UNIT III: RNA STRUCTURE AND BIOSYNTHESIS

m- RNA, r-RNA, t-RNA structures, Transcription apparatus, RNA polymerases and proteins involved in transcription (initiation, elongation and termination steps). Post transcriptional processing of RNA‘s t-RNA, r-RNA, m-RNA splicing. Inhibitors of transcription.

LO: To demonstrate the different types of genetic material and factors responsible for its duplication and translation.

LA: Assessment by assembly of transcription apparatus of and performing transcription and translation.

UNIT IV: PROTEIN BIOSYNTHESIS

The genetic code and Wobble Hypothesis, Codon usage, Protein synthesis in Prokaryotes.

LO: To study the methodologies involved in protein synthesis.

LA: Assessment by application of genetic code in analysis of proteins after translation.

UNITV: PROTEIN SYNTHESIS IN EUKARYOTES

Eukaryotic Protein synthesis, differences between prokaryotic and eukaryotic protein synthesis, Post translational modifications. Inhibitors of protein synthesis.

LO: To study the methods involved in synthesis of proteins in eukaryotes.

LA: Assessment by application of genetic code in analysis of proteins after translation.

UNITVI: MUTAGENESIS

Mutations, spontaneous, induced, lethal, mutagens their types and actions, classification of mutations and their applications. Site-directed mutagenesis and reverse genetics. DNA damage and repair mechanisms. Mutagenicity testing using microbial systems, Ames TEST.

LO: To study the different types of mutations.

LA: Assessment by theoretical ability.

TEXTBOOKS

1. , David Friefelder Molecular Biology,4th edition Jones and Bartlett Publishing Home, 2002.

2. Short Protocolsin Molecular Biology, 2nd edition T.M. Ausubel, Brent, R.E. Kingston, D.D. Moire, J. G. Seidman, J.A. Smith, K. Struhl Green Publication Associates and John Wiley and sons2006.

REFERENCES:

1. Lodish, H., Berk A., Zipursky, S. L. Matsudaria, P. Baltimore, D. and Darnell,J.Molecular Cell of

Biology,
4th edition, W.H. Freeman and Company, 1999.
2. William H. Elli OFF Biochemistry and Molecular biology.4th edition Oxford Publications2009.
3. Philip Sheeler Donald E. Bianchi Cell and Molecular biology 3rd edition Wiley Publishers.2007
4. . De Roberti's E.D. Pi and De Roberti's Cell and Molecular Biology 7th edition, Saunders college, 1980.

II Year – II SEMESTER

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ENVIRONMENTAL BIOTECHNOLOGY

UNIT I : FUNDAMENTALS OF MICROORGANISMS:

Microbial flora of soil, growth, ecological adaptations, Interactions among soil microorganisms, biogeochemical role of soil microorganisms.

LO: To demonstrate microbial flora of soil and interactions among soil microorganism.

LA: Assessment by analyzing the type of microorganism and interaction between them.

UNIT II: BIOLOGICAL TREATMENT OF WASTE WATER – AEROBIC AND ANAEROBIC SYSTEMS:

Biological processes for domestic and industrial waste water treatments; Aerobic systems - activated sludge process, trickling filters, biological filters, rotating biological contractors (RBC), Fluidized bed reactor (FBR),expanded bed reactor, Inverse fluidized bed biofilm reactor (IFBBR) packed bed reactors air- sparged reactors; Anaerobic Systems - contact digesters, packed column reactors, UASB.

LO: To demonstrate various water treatment methods.

LA: Assessment by treating various water samples by these methods.

UNIT III: BIOREMEDIATION:

Introduction, constraints and priorities of Bioremediation, Bio stimulation of naturally occurring microbial activities, Bio augmentation, in situ, ex situ, intrinsic & engineered bioremediation, Solid phase bioremediation - land farming, prepared beds, soil piles, Phytoremediation. Composting, Bioventing & Biosparging; Liquid phase bioremediation - suspended bioreactors, fixed biofilm reactors.

LO: To explain different process involved in bio remediation in other biological treatments.

LA: Assessment by degradation of various samples by these processes of waste materials.

UNIT IV: HAZARDOUS WASTE MANAGEMENT

Introduction - Xenobiotic compounds, recalcitrance, hazardous wastes - biodegradation of Xenobiotic: Simple, aromatics, chlorinated, polyaromatic, petroleum products pesticides and surfactants -biological detoxification –biotechnological Applications of hazardous waste management, Bio-hazard Monitoring and Control Risk assessment, hazard monitoring, remedial measures, techniques and control strategies.

LO: To demonstrate biological waste management of hazardous materials.

LA: Assessment by treating of hazardous waste materials by these above mentioned methods.

UNIT V: **EXPLAINING THE OIL RECOVERY PROCESS USING BIOTECHNOLOGY TECHNIQUES**

Biotechnology processes for oil recovery (microbial), toxic wastes treatment, petroleum waste treatment etc.

LO: To study various extraction methods biological oil recovery.

LA: Assessment by extraction of oils from various sources by the above mentioned methods.

UNIT VI: BIOFUELS

Giving outlines about various sources of Biofuels and their production) Waste as an energy core, energy recovery systems for urban waste, technology evaluation, concept of gasification of wastes with molten salt to produce low -BTU gas; pipeline gas from solid wastes by syngas recycling process; conversion of feedlot

wastes into pipeline gas; fuels and chemicals from crops, production of oil from wood waste, fuels from wood waste, methanol production from organic wastes.

LO: To demonstrate types in methods of preparation of bio fuels.

LA: Assessment by production of various biofuels.

TEXT BOOKS:

1. John E. Smith Biotechnology. 5th edition Cambridge low price editions.2009
2. S. K. Agarwal Environmental Biotechnology by.4th edition Ashish Publications 2005.

REFERENCES

1. Stanier R.Y., Ingraham J.L., Wheelis M.L., Painter R.R., General Microbiology, 5 Sub edition, Prentice Hall College, 1986.
2. Foster C.F., John Ware D.A., Environmental Biotechnology, 3rd edition Ellis Horwood Ltd., 2006.
3. Chakrabarty K.D., Omen G.S., Biotechnology And Biodegradation, Advances In Applied Biotechnology Series, Vol.1, Gulf Publications Co., London. 1984.
4. Bailey J.E. &Olli's, D.F. Biochemical Engineering Fundamentals, 2nd edition, McGraw-Hill, 1986.
5. Alan Scragg., Environmental Biotechnology,2nd edition Longman. 2005.

II Year – II SEMESTER

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BIOPROCESS ENGINEERING

UNITI: INTRODUCTION TO BIOPROCESSES

An overview of traditional and modern applications of biotechnology industry, outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets.

LO: To study the traditional and modern applications of various upstream and downstream unit operations.

LA: Assessment by demonstration of various samples by these bioprocess.

UNITII: FERMENTATION PROCESSES

General requirements of fermentation processes, Basic design and construction of fermenter and ancillaries, Main parameter stobe monitored and controlled in fermentation processes; An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry, solid- substrate, slurry fermentation and its applications, whole cell immobilization, behavior of microbes in different reactors (airlift, fluidized, batch, continuous fed batch condition).

LO: To demonstrate the various principles and parameters for designing fermentation.

LA: Assessment by designing customized fermenter based on requirement.

UNITIII: MEDIA DESIGN

Medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation for optimal growth and product formation, examples of simple and complex media, design and usage of various commercial media for industrial fermentations.

LO: To study the different requirement of media and its design.

LA: Assessment by practical and objective ability.

UNITIV: METABOLIC STOICHIOMETRY

Stoichiometry of Cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients.

LO: To study the Stoichiometry balancing of different metabolic reactions.

LA: Assessment by calculation of different types of cell growth.

UNITV: ENERGETICS

Energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

LO: To study the various microbial growth requirements in different cultures.

LA: Assessment by analysis of different types of energetic required for microbial growth.

UNITVI: KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

Phases of cell growth in batch cultures, Simple unstructured kinetic models for microbial growth, Monod model, Growth of filamentous organisms. Growth associated (primary) and non- growth associated (secondary) product formation Kinetics. Leudeking- Piret models, substrate and product inhibition on cell growth and product formation. Introduction to Structured Models for growth and product formation. Enzyme processes: Production of enzymes in submerged and solid-state processes, extraction and purification of enzymes, methods of characterization, specific activity and activity definitions.

LO: To study the kinetics of microbial growth and product formation.

LA: Assessment by analyzing and calculating various kinetic parameters of growth for different types of microbes.

All relevant units will have basic numerical problems.

TEXTBOOKS

1. D. G. Rao, Introduction to Biochemical Engineering, McGraw-Hill, 2005.
2. M. L. Shuler and F. Kargi Bioprocess engineering, 2nd edition Prentice Hall of India 2002.
3. P. M. Doran, Biochemical process principles,2nd edition Academic Press,2012..

REFERENCES

1. Harvey W. Blanch, DouglasS. Clark Biochemical Engineering, Marcecel, Dekker, 2007.
2. Bailey Olli's, Biochemical Engineering fundamentals, edition, McGraw-Hill, 1986.

II Year – II SEMESTER

T	P	C
0	3	2

BIOPROCESS ENGINEERING LAB

1. ENZYME ISOLATION AND ASSAYOF ENZYMATIC ACTIVITY

Extraction of commercially important enzymes from natural source Development of enzyme assays; quantification of
Enzyme activity and specific activity.

2. ENZYME KINETICS

Estimation of Michaelis- Menten parameters, Effect of pH and temperature on enzyme activity, kinetics of inhibition.

3. IMMOBILIZED ENZYME REACTION

Techniques of enzyme immobilization- matrix entrapment, ionic and cross linking; column packing; analysis of mass
Transfer effects on kinetics of immobilized enzyme reactions; bioconversion studies with immobilized-enzyme packed–
Bed reactors.

4. MICROBIAL CULTURE STUDIES

Growth of microorganisms, estimation of Monod's parameters.

5. SCREENING OF PROCESS VARIABLES

Plackett- Burman design practice.

6. DEMONSTRATION OF REACTOR STUDIES

Batch, fed- batch, and continuous flow reactor analysis and residence time distribution.

TEXTBOOKS

1. P. M. Doran, Biochemical process principles,2nd edition Academic Press,2012..

EQUIPMENTS

1. Autoclave.
2. pH Meter.
3. Laminar air Flow chamber.
4. Centrifuge.
5. Compound microscope.
6. Water bath.
7. Packed-bed reactor.
8. Shaker-incubator.
9. Lyophilizer.
10. Spectrofluorimeter.
11. U.V. Visible spectrophotometer.
12. Hot air oven.
13. Incubator.
14. Petri plates.
15. Micropipettes.
16. Bioreactor.

II Year – II SEMESTER

T	P	C
0	3	2

INSTRUMENTAL METHODS OF ANALYSIS LAB

1. Demonstration of viable cells using phase contrast microscopy.
2. Verification of Lambert– Beers Law by UV– VIS spectrophotometer, scanning.
3. Estimation of different macromolecules by visible spectrophotometer.
4. Estimation of turbidity using UV- VIS spectrophotometer.
5. Emission spectra of Anthracene using Spectrofluorimeter.
6. Estimation of proteins & nucleic acids by U.V.method.
7. Separation of different macromolecules by Paper, Thin Layer & HPLC Chromatography.
8. Membrane separation- dialysis and ultrafiltration.

TEXT BOOKS

1. I.D. Campbell and R.T.D wek, Biological Spectroscopy, Benjameer Cunmeib &Co., 2002.
2. F. Settle. Handbook of Instrumental Techniques for Analytical Chemistry, Prence Hall, 2007.
3. W. Botton, Instrumentation and Process Measurements, University Press.

EQUIPMENTS

1. U.V.Visible spectrophotometer.
2. Spectroflourimeter.
3. HPLC.
4. Chromatographic chamber.
5. Microscope.
6. Dialysis bags.
7. Magnetic stirrer with magnetic beads.

III Year – I SEMESTER

T	P	C
3+1	0	3

MASS TRANSFER OPERATIONS

UNIT I: INTRODUCTION TO MASS TRANSFER AND DIFFUSION

Introduction to Mass Transfer Operations: Fick's Law of Diffusion, Gas diffusion and Liquid diffusion (one component transferring to non- transferring component and equimolar counter diffusion.) Diffusivity estimation (Stefan's experiment); permeability, distribution of gas and liquid components through solid, diffusion of biological solutes in liquids, diffusion in biological gels.

LO: To study the basics mass transfer diffusion.

LA: Assessment by performing diffusion experiments with various states.

UNIT II: MASS TRANSFER CO-EFFICIENT

Definition of k , F-type, K-type coefficients, Dimensionless numbers, Sherwood number, Stanton number, Schmidt number, estimation of MTC for the case where mass is diffusing from solid wall to bulk liquid. (Flat plates, cylindrical tubes) and flow past single solids, Application of $k_L a$.
in Biological Systems.

LO: To demonstrate the calculation of mass transfer parameters.

LA: Assessment by application of these parameters for calculations.

UNIT III: INTERFACE OF MASS TRANSFER

Interface of mass transfer, gas phase controlling, and liquid phase controlling operations. Liquid-liquid mass transfer, gas-liquid mass transfer, solid-liquid mass transfer.

LO: To demonstrate mass transfer between different phases.

LA: Assessment by calculating the rate of different mass transfers.

UNIT IV: GAS LIQUID OPERATION

Absorption: Definition, Solubilities of gases in liquids, single stage (one component transferring) operation. Distillation: VLE, single stage equilibrium distillation, simple distillation and steam distillation operation; continuous distillation (McCabe Thiele method only).

LO: To demonstrate various types of distillation operations.

LA: Assessment by practical demonstration of distillation operations.

UNIT V: LIQUID – LIQUID AND SOLID –LIQUID OPERATIONS

Liquid-Liquid extraction: LLE, types of equilibrium system, Singe stage extraction, Multi stage cross and counter current operations. Solid-liquid operation: Leaching, SLE, Single stage leaching. Adsorption: Physical adsorption, Chemisorption, Adsorption hysteresis, adsorption isotherm, Single stage operation, fixed bed adsorption, Case Studies with immobilized cell/enzyme systems.

LO: To demonstrate various single & multistage liquid-liquid & liquid-solid operations.

LA: Assessment by derivations and calculations.

UNIT VI: MEMBRANE SEPARATION PROCESSES

Dialysis: Hemodialysis, Gas permeation process, introduction to types of flow in gas permeation, hollow–fiber separation assembly, reverse osmosis, application of reverse osmosis, introduction of ultrafiltration and microfiltration processes.

LO: To demonstrate various membrane separation processes.

LA: Assessment by application of membrane separations.

TEXT BOOKS:

1. Robert E. Treybal, Mass Transfer Operations 3rd Edition, McGraw Hill International**,** 1981.

2. Christi J. Geankoplis, Transport process & Unit operations, 3rd sub edition, Prentice Hall India Pvt. Ltd, 1993.

3. P. M. Doran Bioprocess Engineering Principles, 2nd edition, Academic Press 2012.

REFERENCES:

1. Judson King, Separation Processes, 2nd Re edition, McGraw Hill Chemical Engineering series, 1983.

2. Philip A. Schweitzer, Handbook of separation Techniques for chemical Engineering, 3rd edition, McGraw Hill, 1997.

3. Philip C. Wankat, Rate-Controlled separations, reprint edition, springer, 1994.

III Year – I SEMESTER

T	P	C
3+1	0	3

BIOCHEMICAL REACTION ENGINEERING - I

UNIT I: FUNDAMENTALS OF REACTION ENGINEERING

Concept of order, molecularity of a reaction, searching a mechanism for a reaction, evaluation of rate constants, factors affecting reaction rates - pH, temperature using Arrhenius equation.
LO: To understand the basics of rate of reaction.
LA: Assessment by evaluating the rate of different reactions.

UNIT II: REACTIONS INVOLVING CELLS - I

Growth Kinetics - batch, fed-batch and continuous mode of operation in reaction system, evaluation of kinetic parameters Monod's equation- parameters, death rate of cell-batch and continuous sterilization.
LO: To understand the growth kinetics in batch, fed batch, continuous systems.
LA: Assessment by deriving the kinetics.

UNIT III: REACTIONS INVOLVING CELLS -II

Stoichiometry of cell growth and product formation - elemental and available electron balances, degrees of reduction, maintenance coefficient, online data analysis for measurement of biochemical parameters, state and parameter estimation technique.
LO: To study Stoichiometry of cell growth and product formation.
LA: Assessment by Stoichiometry analysis.

UNITIV: MULTIPLE REACTIONS

Parallel series, series – parallel reactions, calculation of yield and selectivity, role of thermodynamic parameters, metabolic flux analysis, basic concepts of structured model and introduction to cybernetic models, Design principles-non isothermal reactions and pressure effects, concepts of residence time distribution, micro mixing and macro mixing.
LO: To demonstrate the thermodynamic properties & principles of various reactions
LA: Assessment by derivations and calculations.

UNIT V: MECHANISMS AND KINETICS OF ENZYME ACTION

Mechanisms of Enzyme Action: Concept of active site and energetics of enzyme Kinetics, substrate complex formation; Specificity of enzyme action: Kinetics of single substrate reactions, turnover number and estimation of Michaelis-Menten's parameters. Importance of K_M, Multi-substrate reaction mechanisms and kinetics. Types of Inhibition - kinetic models; Substrate and Product Inhibition, Allosteric regulation of enzymes, Deactivation kinetics.
LO: To study the various kinetics and inhibitions of enzymes.
LA: Assessment by deriving the kinetics and demonstrating the inhibitions of enzymes.

UNIT VI: MASS TRANSFER EFFECTS IN IMMOBILIZED ENZYME

Brief overview of immobilization techniques: Immobilization techniques, Influence of different parameters on Immobilized reaction kinetics. Analysis of Film and Pore Diffusion Effects on kinetics of Immobilized Enzyme Reactions, calculation of Effectiveness Factors, Thiele modulus.
LO: To demonstrate the Mass Transfer Effects in Immobilized Enzyme.
LA: Assessment by deriving the kinetics of diffusion.

NOTE: In all units relevant basic numerical problems should be practiced.

TEXT BOOKS:

1. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcecel Dekker, 2007.
2. O. Levenspiel, Chemical Reaction Engineering, 3rd edition, wiley, Newyork, 1998.
3. P. M. Doran Bioprocess Engineering principles, 2nd edition, academic Press, London, 2012.
4. D. G. Rao, Introduction to Biochemical Engineering, 2nd edition, McGraw-Hill, 2005
5. K. A. Gavhane, Chemical Reaction Engineering–I, 2nd edition, Nirali Prakashan, 2006.
6. J. Nielsen, J. Villadsen and G. Liden Bioreaction Engineering Principles, Springer International, 2nd edition, 2003.
7. G. Hammes, Thermodynamics and kinetics for the biological sciences, 2nd edition, Wiley – VCH, 2000

REFERENCES:

1. H. Scott Fogler, Elements of Chemical Reaction Engineering, 4th Edition, Prentice Hall of India Pvt. Ltd, 2005.
2. J. M. Smith, Chemical Engineering Kinetics, 3rd edition, McGraw Hill, 1981.
3. M. L. Shuler and F. Kargi Bioprocess Engineering: basic concepts, 2nd edition, TBS Publishers, 2001.
4. H. J. Fromm Initial rate Enzyme kinetics, reprint Springer-verlog, 1st edition, Berlin 2012.

III Year – I SEMESTER

T	P	C
3+1	0	3

PLANT BIOTECHNOLOGY

UNIT I: TISSUE CULTURE

Introduction to cell and tissue culture: Tissue culture media (composition, preparation), Initiation and maintenance of callus and cell suspension culture, Somatic embryogenesis, organogenesis, Protoplast isolation culture and fusion.

LO: To understand the basics of plant tissue culture

LA: Assessment by media preparation and maintenance.

UNIT II: TISSUE CULTURE APPLICATIONS

Production of haploids, Somaclonal variations, Germplasm conservation (Cryopreservation). Production of secondary metabolites from plant cell cultures, Processes for enhancing the production of secondary metabolites. Technology of plant cell culture for production of chemicals, bioreactors systems and models for mass cultivation of plant cells.

LO: To demonstrate the production and applications of secondary metabolites.

LA: Assessment by demonstration of different pathways.

UNIT III: PLANT TRANSFORMATION TECHNOLOGY

Agrobacterium mediated gene transfer; Agrobacterium based vectors, viral vectors and their application. Direct gene transfer methods; chemical methods, electroporation, microinjection, particle bombardment.

LO: To demonstrate the various gene transfer methodologies and applications

LA: Assessment by applying these gene transfer methods.

UNIT IV: PLANT GENETIC ENGINEERING FOR PRODUCTIVITY AND PERFORMANCE (BIOTIC STRESS & ABIOTIC STRESS)

Herbicide resistance, Insect resistance, Disease resistance, virus resistance. Abiotic stress tolerance; Drought, temperature, salt.

LO: To study the various biotic and abiotic stress.

LA: Assessment by analyzing and differentiating various types of stress.

UNIT V: MOLECULAR FARMING & INDUSTRIAL PRODUCTS

Application of Plant biotechnology for the production of quality oil, Industrial enzymes, Therapeutic Proteins, Antigens (edible vaccine) and plantibodies.

LO: To understand the applications of plant molecular farming techniques.

LA: Assessment by application of these principles in production of therapeutically important products.

UNIT VI: METABOLIC ENGINEERING

Metabolic engineering for plant primary metabolites and secondary metabolites.

LO: To demonstrate the primary & secondary metabolites and their synthesis from plants.

LA: Assessment by incorporating metabolic calculations in the production of various primary and secondary metabolites.

TEXT BOOKS:

1. Roberta Smith, Plant Tissue Culture: Techniques and Experiments. 2nd edition Academic Press, 2000.
2. Bhojwani, S.S. and Rajdan, Plant Tissue Culture: Theory and Practice, Elsevier 2004.

REFERENCES:

1. Crispeels, M.J. and Sadava, D.E., Plants, Genes and Crop Biotechnology, Jones and Bartlett Publishers 2nd Edition, 2003.
2. Charles Cunningham and Andrew J.R. Porter, Recombinant Proteins from Plants: Production and Isolation of Clinically Useful Compounds (Methods in Biotechnology), Humana Press, 1997.
3. Bernard R. Glick and John E. Thompson, Methods in Plant Molecular Biology and Biotechnology, CRC Press, 1993.

4. I. Potrykus and G. Spangenberg, Gene Transfer to Plants (Springer Lab Manual), Springer Verlag, 1997.

5. John Hammond, Peter McGarvey, Vidadi Yusibov, Plant Biotechnology: New Products and Applications, Springer Verlag, 1999.

III Year – I SEMESTER

T	P	C
3+1	0	3

GENETIC ENGINEERING

UNIT I: GENE REGULATION AND EXPRESSION IN PROKARYOTES & EUKARYOTIC SYSTEM

Structure and Functions of Lactose, Arabinose and Tryptophan operons, Sigma switch in *Bacillus subtilis*. Repressors and activator. Gene regulation in Eukaryotic system, Repetitive DNA, Gene rearrangement, Promoters, enhancer elements, gene amplification.

LO: To understand the Gene Regulation and Expression in Prokaryotes & Eukaryotic system.

LA: Assessment by interpretation of different gene regulations.

UNIT II: PLASMIDS, TRANSPOSONS / VECTORS FOR GENE TRANSFERS

Plasmids: Definition, types, Identification, classification and purifications and transfer of Plasmids. Host restriction in transfer. Transposable elements: Definition, detection of transposition in bacteria, types of bacterial transposons, mechanisms of transposition (Conservative & Replicative) and applications of transposons, Retrotransposons.

LO: To study types, Identification, classification and transfer of Plasmids, transposons.

LA: Assessment by demonstration of different plasmids and its applications.

UNIT III: r DNA TECHNOLOGY

Purification of genomic DNA from living cells, Manipulation of purified DNA; construction of prototype vector (pBR322), different types of cloning vectors (plasmid – pUC 19, M13, Lambda phage, cosmid,). Enzymes involved in genetic engineering: cloning strategies, Introduction of DNA into living cells. Methods of Gene transfer, Restriction mapping.

LO: To understand the cloning of DNA and gene transfer methods.

LA: Assessment by applying different cloning and gene transfer strategies.

UNIT IV: EXPRESSION AND DETECTION OF CLONES

Detection of clones and its expression: Expression of cloned genes in yeast & *E.* coli. Nucleic acid hybridization - Southern, Northern dot blot. DNA methylation. Genomic and cDNA library construction and application. DNA sequencing. Molecular markers: RFLP, RAPD, AFLP, 16s r-RNA typing, gene chip and micro array; SNPs.

LO: To study the Expression and Detection of clones and different molecular markers.

LA: Assessment by practically applying these markers for detection of clones.

UNIT V: PCR AND ITS APPLICATION

Principles, designing of primers, PCR methodology, Reverse Transcriptase PCR & Real Time PCR, multiplex PCR, identification of PCR product, application of PCR technology.

LO: To demonstrate the principle and methodologies of PCR.

LA: Assessment by amplifying different genes using PCR.

UNIT VI: APPLICATIONS OF r-DNA TECHNOLOGY

Gene cloning in medicine (Insulin, Human Growth Hormone) High level expression of proteins in different host systems (Insect, mammalian cells) Limitation and advantages and novel technologies - for generation of transgenic animals. Introduction to Gene therapy (Ex vivo & In vivo), case study of ADA as an example. Advantages and limitations of Gene therapy, gene silencing applications in Cancer.

LO: To study the various applications of gene cloning and gene therapy.

LA: Assessment by application of gene cloning and gene therapy principles in medicine.

TEXT BOOKS:

1. Old RW, Primrose SB, principles of Gene manipulation, An introduction to Genetic engineering, 6th edition Blackwell Scientific Publications, 2002.
2. T. A. Brown, Gene Cloning 6th edition, Wiley-Blackwell Publications, 2010.
3. David Frifielder Molecular Biology, 4th edition Jones and Bartlett Publishing Home, 2002.
4. Glick & Pastenick – Molecular Bio-Technology, 4th edition ASM Press, 2009.

REFERENCES:

1. Ansubel FM., Brent A, Kingston AE, Moore DO, Current protocols in Molecular Biology, Greene Publishing Associates,
   NY, 2006.
2. Berger SL, Kimmer AR, Methods in Enzymology, Vol 152, Academic Press, 1987.
3. Gerald Carp, Molecular Cell Biology, 6th edition Wiley publishers, 2010.

III Year – I SEMESTER

T	P	C
3+1	0	3

MANAGERIAL ECONOMICS AND FINANCIALANALYSIS

UNIT I INTRODUCTION TO MANAGERIAL ECONOMICS & DEMAND ANALYSIS

Definition of Managerial Economics, Characteristics and Scope – Managerial Economics and its relation with other subjects- Basic economic tools in Managerial Economics. Demand Analysis: Meaning- Demand distinctions- Demand determinants- Law of Demand and its exceptions.

LO: To understand basics of Managerial Economics.

LA: Assessment by demonstration of tools in managerial economics.

UNIT-II ELASTICITY OF DEMAND & DEMAND FORECASTING

Definition -Types of Elasticity of demand - Measurement of price elasticity of demand: Total outlay method, Point method and Arc method- Significance of Elasticity of Demand. Demand Forecasting: Meaning - Factors governing demand forecasting - Methods of demand forecasting (survey of buyers' Intentions, Delphi method, Collective opinion, Analysis of Time series and Trend projections, Economic Indicators, Controlled experiments and Judgmental approach) - Forecasting demand for new products- Criteria of a good forecasting method.

LO: To understand various types of elasticity of demand and demand forecasting.

LA: Assessment by analyzing and applying different demand forecast parameters.

UNIT-III THEORY OF PRODUCTION AND COST ANALYSIS:

Production Function- Isoquants and Isocosts, MRTS, Law of variable proportions- Law of returns to scale- Least Cost Combination of Inputs, Cobb-Douglas Production function - Economies of Scale. Cost Analysis: Cost concepts, Opportunity cost, Fixed Vs Variable costs, Explicit costs Vs. Implicit costs, Out of pocket costs vs. Imputed costs. Determination of Break-Even Point (simple problems) - Managerial Significance and limitations of BEP.

LO: To explain the theory of production and different concepts of cost analysis including Break-Even analysis.

LA: Assessment by demonstrating and comparing different types of cost analysis.

UNIT-IV: INTRODUCTION TO MARKETS, MANAGERIAL THEORIES OF THE FIRM & PRICING POLICIES:

Market structures**:** Types of competition, Features of Perfect Competition, Monopoly and Monopolistic Competition. Price-Output Determination under Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly Managerial theories of the firm - Marris and Williamson's models. Pricing Policies: Methods of Pricing**-**Marginal Cost Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing, Bundling Pricing, and Peak Load Pricing. Internet Pricing Models: Flat rate pricing, Usage sensitive pricing, Transaction based pricing, Priority pricing, charging on the basis of social cost, Precedence model, Smart market mechanism model.

LO: To provide insight into the various types of competition, pricing strategies and models.

LA: Assessment by analyzing and studying various competitive and pricing strategies with reference to various firms.

UNIT-V TYPES OF INDUSTRIAL ORGANIZATION & INTRODUCTION TO BUSINESS CYCLES

Characteristic features of Industrial organization, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company, State/Public Enterprises and their types.

Introduction to business cycles: Meaning-Phases of business cycles- Features of business cycles.

LO: To understand the business cycle and industrial organizations.

LA: Assessment by comparing different types of industrial organizations and studying business cycles of different industries.

UNIT-VI INTRODUCTION TO FINANCIAL ACCOUNTING & FINANCIAL STATEMENT

Introduction to Double-entry system, Journal, Ledger, Trial Balance- Final Accounts (with simple adjustments)- Limitations of Financial Statements.

Ratio Analysis – Liquidity ratios, Profitability ratios and solvency ratios – Preparation of changes in working capital statement and fund flow statement. Capital and Capital Budgeting: Meaning of capital budgeting, Need for capital budgeting – Capital budgeting decisions (Examples of capital budgeting) - Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR), IRR and Net Present Value Method (simple problems)

LO: To learn financial accounting and budgeting nuances.

LA: Assessment by ability to prepare capital budget and financial statements.

TEXT BOOKS:

1. J. V. Prabhakar Rao: Managerial Economics and Financial Analysis, Maruthi Publications, 2011
2. N. Appa Rao. & P. Vijaya Kumar: 'Managerial Economics and Financial Analysis', Cengage Publications, New Delhi, 2011

REFERENCES:

1. A. R. Aryasri - Managerial Economics and Financial Analysis, TMH 2011
2. Suma damodaran- Managerial Economics, Oxford 2011
3. S. A. Siddiqui & A. S. Siddiqui, Mangerial Economics and Financial Analysis, New Age International Publishers, 2011.

III Year – I
SEMESTER

T	P	C
2+1	0	2

INTELLECTUAL PROPERTY RIGHTS AND PATENTS

Unit I

Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics - Types of Intellectual Property - Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement - Regulatory – Over use or Misuse of Intellectual Property Rights - Compliance and Liability Issues.

Unit II

Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of performers **–** Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law- Semiconductor Chip Protection Act.

Unit III

Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent Requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Double Patenting – Patent Searching – Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters.

Unit IV

Introduction to Trade Mark – Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law

Unit V

Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement – Trade Secret Law – Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law.

Unit VI

Introduction to Cyber Law – Information Technology Act - Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy - International aspects of Computer and Online Crime.

REFERENCE BOOKS:

1. Deborah E.Bouchoux: “Intellectual Property”. Cengage learning , New Delhi

2. Kompal Bansal & Parishit Bansal "Fundamentals of IPR for Engineers", BS Publications (Press)
3. Cyber Law. Texts & Cases, South-Western's Special Topics Collections
4. Prabhuddha Ganguli: ' Intellectual Property Rights" Tata Mc-Graw – Hill, New Delhi
5. Richard Stim: "Intellectual Property", Cengage Learning, New Delhi.
6. R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights", Excel Books. New Delhi.
7. M.Ashok Kumar and Mohd.Iqbal Ali: "Intellectual Property Right" Serials Pub.

III Year – I SEMESTER

T	P	C
0	3	2

PLANT BIOTECHNOLOGY LAB

1. Preparation of Media
2. Surface sterilization
3. Callus induction
4. Organ culture
5. Protoplast isolation
6. Protoplast Culture and Cytological examination
7. *Agrobacterium* mediated gene transfer
8. Selection of transformants
9. Reporter gene (GUS) assays.

TEXTBOOKS

1. Plant Biotechnology: Practical Manual, C. C. Giri & Archana Giri, IK International, 2007.

EQUIPMENTS:

1. Autoclave.
2. pH Meter.
3. Laminar air flow chamber.
4. B.O.D. Incubator.

III Year – I SEMESTER **T P C**
0 3 2

GENETIC ENGINEERING LAB

1. Isolation of Plant and Bacterial Genomic DNA
2. Isolation of Plasmid DNA.
3. Visualization of Genomic and plasmid DNA by Agarose gel Electrophoresis.
4. Restriction Enzyme digestion.
5. DNA Ligation.
6. Transformation, screening for recombinants.
7. Silver staining of protein gels.
8. Blotting Technique.
9. Gene Expression of Beta-galactosidase and assay.
10. Cloning of DNA into plasmid vector.

TEXTBOOKS

1. Maniatis, Current protocols in Molecular Biology, Wiley publications, 2013.

EQUIPMENTS

1. Autoclave.
2. Laminar air flow chamber. Water bath
3. Balance Microfuge. Micropipettes
4. Submarine gel electrophoresis unit with power pack. U. V. Transilluminator.
5. Vertical slab gel electrophoresis equipment.

III Year – I SEMESTER **T P C**
0 3 2

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

1. INTRODUCTION

The introduction of the English Language Lab is considered essential at
3rd year level. At this stage the students need to prepare themselves for their careers which may require them to listen, to read, speak and write in English both for their professional and interpersonal communication in the globalised context. The proposed course should be an integrated theory and lab course to enable students to use 'good' English and perform the following:

1. Gather ideas and information, to organise ideas relevantly and coherently.
2. Engage in debates.
3. Participate in group discussions.
4. Face interviews.
5. Write project/research reports/technical reports.
6. Make oral presentations.
7. Write formal letters.
8. Transfer information from non-verbal to verbal texts and vice versa.
9. To take part in social and professional communication.

2. OBJECTIVES:

This Lab focuses on using computer-aided multimedia instruction for language development to meet the following targets:

1. To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
2. Further, they would be required to communicate their ideas relevantly and coherently in writing.

3. SYLLABUS:

The following course content is prescribed for the Advanced

Communication Skills Lab:

1. Functional English - starting a conversation – responding appropriately and relevantly – using the right body language – role play in different situations.
2. Vocabulary building – synonyms and antonyms, word roots, one- word substitutes, prefixes and suffixes, study of word origin, analogy, idioms and phrases.
3. Group Discussion – dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.
4. Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele and video-conferencing.
5. Resume writing – structure and presentation, planning, defining the career objective, projecting ones strengths and skill-sets, summary, formats and styles, letter-writing.
6. Reading comprehension – reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading.

7. Technical Report writing – Types of formats and styles, subject matter – organization, clarity, coherence and style, planning, data- collection, tools, analysis.

4. MINIMUM REQUIREMENT:

The English Language Lab shall have two parts:

i) **The Computer aided Language Lab** for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.

ii) **The Communication Skills Lab** with movable chairs and audio- visual aids with a P.A System, a T. V., a digital stereo audio & video system and camcorder etc.

System Requirement (Hardware component):

Computer network with LAN with minimum 60 multimedia systems with the following specifications:

iii) P – IV Processor

a) Speed – 2.8 GHZ

b) RAM – 512 MB Minimum

c) Hard Disk – 80 GB

iv) Headphones of High quality

5. Suggested Software:

The software consisting of the prescribed topics elaborated above should be procured and used.

Suggested Software:

- **Clarity Pronunciation Power** – part II
- **Oxford Advanced Learner's Compass**, 7th Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **Lingua TOEFL CBT Insider**, by Dreamtech
- **TOEFL & GRE**(KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **The following software from 'train2success.com'**
  - **Preparing for being Interviewed,**
  - **Positive Thinking,**
  - **Interviewing Skills,**
  - **Telephone Skills,**
  - **Time Management**
  - **Team Building,**
  - **Decision making**
- **English in Mind**, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge

6. Books Recommended:

1. M. Ashraf Rizvi, Effective Technical Communication, Tata Mc. Graw-Hill Publishing Company Ltd, 2005.
2. Madhavi Apte, A Course in English communication by, Prentice- Hall of India, 2007.
3. Leena Sen, Communication Skills**,** 2nd revised edition, Prentice-Hall of India, 2007.
4. Stephen Bailey, Rontledge Falmer, Academic Writing- A Practical guide for students,1st Edition London & New York, 2005.
5. Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, English Language Communication : A Reader cum Lab Manual Anuradha Publications, Chennai, 2008.
6. Dr. Shalini Verma, Body Language- Your Success Mantra**,** S. Chand, 2005.
7. Nancy Gallagher, key to the Next Generation TOEFL Test: Advanced Skill Practice, DELTA publishers, 2011
8. IELTS series with CDs by Cambridge University Press.
9. Daniel G. Riordan & Steven E. Pauley Technical Report Writing Today**,** 9th edition, Wadsworth Publishers, 2004.
10. Andra J. Rutherford , Basic Communication Skills for Technology, 2nd Edition, Pearson Education, 2007.
11. Sunita Mishra & C. Muralikrishna Communication Skills for Engineers**,** Pearson Education, 2007.
12. Edgar Thorpe & Showick Thorpe, Objective English**,** 2nd edition, Pearson Education, 2007.
13. Jolene Gear & Robert Gear, Cambridge Preparation for the TOEFL Test, 4th Edition, Cambridge university Press, 2006.
14. Meenakshi Raman & Sangeeta Sharma Technical Communication**,** 1st edition, Oxford University Press, 2009.

DISTRIBUTION AND WEIGHTAGE OF MARKS:

Advanced Communication Skills Lab Practical's*:*

1. The practical examinations for the English Language Laboratory practice shall be conducted as per the University norms
   prescribed for the core engineering practical sessions.
2. For the English Language lab sessions, there shall be a continuous evaluation during the year for 25 sessional marks and 50
   End Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The End Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.

III Year – II SEMESTER

T	P	C
3+1	0	3

BIOINFORMATICS

UNIT I: INTRODUCTION TO BIOINFORMATICS

Scope of Bioinformatics, Elementary commands and protocols, ftp, telnet, http. Primer on information theory and search tools in bioinformatics.

LO: To understand the scope of bioinformatics and basic protocols.

LA: Assessment by applying basic tools in bioinformatics.

UNIT-II: INTRODUCTION TO HOMOLOGY

Introduction to Homology (with special mention to Charles Darwin, Sir Richard Owen, Willie Henning, Alfred Russel Wallace).

LO: To demonstrate homology with reference to evolution.

LA: Assessment by comparing homology in different species.

UNIT III: SPECIAL TOPICS IN BIOINFORMATICS

DNA mapping and sequencing, Map alignment, Large scale sequencing methods Shotgun and Sanger method.

LO: To understand different mapping and sequencing techniques of DNA.

LA: Assessment by sequencing and mapping DNA of different species.

UNIT IV: SEQUENCING ALIGNMENT AND DYNAMIC PROGRAMMING

Heuristic Alignment algorithms. Global sequence alignments- Neddleman& Wunsch Algorithm Smith-Waterman Algorithm-Local sequence alignments (Amino acid substitution Matrices (PAM, BLOSUM).

LO: To demonstrate different types of alignment and algorithm defining it.

LA: Assessment by computationally aligning the sequences and applying algorithm to it.

UNIT V: PRIMARY, SECONDARY& BIOCHEMICAL DATABASE AND THEIR USE

Introduction to Biological databases, Organization and management of databases. Searching and retrieval of information from the World Wide Web. Structure databases- PDB (Protein Data Bank), Molecular Modeling Databases (MMDB). Primary Databases NCBL, EMBL, DDBJ. Introduction to Secondary Databases Organization and management of databases Swissprot, PIR, KEGG. Introduction to Bio-Chemical databases - organization and Management of databases. KEGG, EXPESY, BRENDA, WIT.

LO: To demonstrate working on primary and secondary databases.

LA: Assessment by searching and retrieving of data from these databases.

UNIT VI: EVOLUTIONARY TREES AND PHYLOGENY

Construction of evolutionary trees. Multiple sequence alignment and phylogenetic analysis.

LO: To understand phylogeny and phylogenetic tree.

LA: Assessment by constructing phylogenetic tree from the given sequences.

TEXT BOOKS:

1. David Mount, Bioinformatics, 2nd Edition, Cold Spring Harbor Publications, 2004.
2. T. K. Attwood, David Parry Smith, Introduction to Bioinformatics, 1st edition, Pearson educations, 2001.

REFERENCES:

1. Andreas D. Baxevanis, B. F. Francis Ouellette. Bioinformatics – A Practical Guide To The Analysis Of Genes And Proteins, 3rd Edition , Wiley Intrscience Publishers, 2004.
2. Harshawardhan P. Bal, Bioinformatics – Principles And Applications, 6th Edition, TATA Mcgraw HILL, 2008.

III Year – II SEMESTER

T	P	C
3+1	0	3

BIOCHEMICAL REACTION ENGINEERING –II

UNIT I: BASIC CONCEPT

Definition of bioreactor, fundamental principles, Concept in energy and mass balances and in biological reaction modeling. Classification of reactors and their configurations, Application in submerged fermentation and solid state fermentation, classification based schuegerl, kafarov components of bioreactors and operation of bioreactors.
LO: To study the basic concepts and applications of bioreactors.
LA: assessment by usage to specific reactor for specific product.

UNIT II: ANALYSIS OF IDEAL & NON-IDEAL BEHAVIOUR IN REACTORS

Concepts of reactors based on flow characteristics, design of ideal reactors using material and energy balance. Batch bioreactor design. Reasons for non-ideality, concept of macro using –RTD analysis (E-C-F functions), diagnosing the ills of non- ideal bioreactors.
LO: To demonstrate the design of ideal reactors and reasons for non-ideality.
LA: Assessment by design of an ideal reactor based on product.

UNIT III: CHEMOSTAT ANALYSIS

Definition of chemostat, turbidostat, single flow single stage chemostat, single flow multistage chemostat, recycle flow in chemostat, concepts of dilution rate productivity analysis.
LO: To demonstrate various types and parameters associated with chemostat.
LA: Assessment by design and calculations.

UNIT IV: PLUG FLOW REACTION SYSTEM

Plug flow behavior, design of plug flow reactor, comparison of productivity in plug flow and single stage single flow chemostat.
LO: To understand the behavior and design of Plug flow reactor.
LA: Assessment by abilities to design and compare the productivity in different plug flow reactors.

UNIT V: DESIGN AND ANALYSIS OF ENZYME REACTORS

Application of tubular reactor concept in immobilized packed bed reactors, fluidized bed reactors.
LO: To understand the concept of tubular reactor.
LA: Assessment by ability to design and apply tubular reactor concept.

UNIT VI: SPECIFIC BIOREACTORS ANALYSIS AND SCALE-UP

Design and analysis of fed-batch and air-lift bioreactors. Application in animal cell culture. Basic concept of scale-up, non-dimensional analysis.
LO: To understand the difference between fed-batch and airlift reactors, scale-up and applications.
LA: Assessment by design, analysis and scale up of reactors.

TEXT BOOKS:

1. O. Levenspiel, Chemical Reaction Engineering. 3rd edition, Wiley Newyork, 1998.
2. D. G. Rao, Introduction to Biochemical Engineering, McGraw-Hill,2005
3. H. Scott Fogler Elements of chemical reaction Engineering 3rd edition, Prentice- Hall of India pvt ltd, 2004

REFERENCES:

1. P. M. Doran Bioprocess Engineering Principles, 2nd edition Academic Press, 2012.
2. Jens Nielsen , Johan villadsen, Gunnar liden, Bioreaction Engineering principles 2nd edition springer 2007

III Year – II SEMESTER

T	P	C
3+1	0	3

TRANSPORT PHENOMENA IN BIOPROCESSES

UNIT I: MOMENTUM TRANSPORT-I

Mechanism of Momentum Transport: Newton's Law of Viscosity, Non- Newtonian fluids, theory of viscosity of liquids, time dependent viscosity, viscosity measurement (cone-and-plate viscometer, coaxial cylinder rotary viscometer, impeller viscometer), use of viscometers with biological reaction fluids, rheological properties of fermentation broth, factors affecting broth viscosity (cell concentration, cell morphology, osmotic pressure, product and substrate concentration), Velocity distribution in laminar flow and turbulent flow

LO: To understand various laws in momentum transfer, types of fluids, viscosity & measurement and factors effecting it.

LA: Assessment by ability to differentiate Newtonian and Non-Newtonian fluids.

UNIT II: MOMENTUM TRANSPORT-II

Equation of change for isothermal system (equation of continuity, equation of motion, equation of mechanical energy), interphase transport in isothermal systems (friction factors for flow in tubes and in packed columns) mixing, mixing mechanism, power requirements in ungassed Newtonian and Non Newtonian fluids, gassed fluids, interaction between cell and turbulent Eddies, operating conditions for turbulent shear damage. Macroscopic Balances- mass, momentum and mechanical energy balances.

LO: To understand isothermal system, mixing mechanisms and power requirement for Newtonian and Non-Newtonian fluids.

LA: Assessment by ability to demonstrate interphase transport in isothermal system and interactions.

UNIT III: ENERGY TRANSPORT

Thermal conductivity and the mechanisms of energy transport- measurement of thermal conductivity, Fourier's law, steady state conduction, analogy between heat and momentum transfer. Temperature distribution with more than one independent variables- heating in a semi-infinite and finite slab, temperature distribution in turbulent flow- reference to stirred tank reactor, relationship between heat transfer, cell concentrations and stirring conditions

LO: To demonstrate the mechanisms of heat transfer in stirred tank reactor.

LA: Assessment by ability to demonstrate the effect of heat transfer on cell concentration and stirring conditions in stirred tank reactor.

UNIT IV: MASS TRANSPORT -I

Diffusivity, theory of diffusion, analogy between mass heat and momentum transfer, role of diffusion in bioprocessing, film theory, concentration distribution with more than one independent variable- unsteady diffusion, boundary layer theory, concentration distribution in turbulent flow- Corrosion equation. Definition of binary mass transfer coefficients, transfer coefficients at high mass transfer rates-boundary layer theory, penetration theory.

LO: To understand the diffusional properties and various film theory concepts.

LA: Assessment by ability to analyze and demonstrate the diffusion concepts during the transport.

UNIT V: MASS TRANSPORT II

Convective mass transfer, Liquid -solid mass transfer, liquid-liquid mass transfer, gas-liquid mass transfer

LO: To understand Mass transfer between various states.

LA: Assessment by ability to differentiate and identify the type of mass transfer in the given example.

UNIT VI: OXYGEN TRANSPORT

Oxygen uptake in cell cultures, Factors affecting cellular oxygen demand, oxygen transfer from gas bubbles to aerobic culture, oxygen transfer in fermenters, bubbles factors affecting oxygen transport- sparging, stirring, medium properties, antifoam agents, temperature, mass transfer correlations, measurements of k_La - oxygen balance method, dynamic method.

LO: To understand the requirement and effect of oxygen in the process.

LA: Assessment by ability to demonstrate and optimize the effect of oxygen and calculating the oxygen transfer coefficient.

NOTE: In all units relevant basic numerical problems should be practiced

TEXT BOOKS

1. R. B. Bird, W. E. Stewart, E. N. Lightfoot, Transport Phenomena, 2nd edition, John Wiley and sons Singapore, 2006.

2. P. M. Doran, Bioprocess Principles, 2nd edition, Academic Press, 2012.

3. Harvey W. Blanch, Douglas S. Clark Biochemical Engineering, Marcecel, Dekker, 2007.

REFERENCE BOOK

1. M. L. Shuler and F. Kargi, Bioprocess Engineering: Basic concepts, 2nd edition, Prentice Hall of India, 2003.

III Year – II SEMESTER

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3+1	0	3

ENZYME ENGINEERING

UNIT I: INTRODUCTION TO ENZYMES

Nomenclature and Classification and application of Enzymes in various sectors - pharmaceutical, food, medical and leather industries (two examples of each); Comparison of chemical and enzyme catalysis.
LO: To demonstrate the classification and applications of enzymes.
LA: Assessment by application of enzymes for productions.

UNIT II: ISOLATION OF ENZYMES

Extraction and Purification of Enzymes from Crude extracts from plant, animal and microbial sources-some case studies, methods of characterization of enzymes, development of enzyme assays.
LO: To understand the isolation of enzymes and different enzyme assays.
LA: Assessment by ability to extract enzymes from different sources.

UNIT III: MECHANISMS AND KINETICS OF ENZYME ACTION

Mechanisms of Enzyme Action- Concept of active site and energetics of enzyme substrate complex formation, Specificity of enzyme action, Kinetics of single substrate reactions, turnover number, estimation of Michaelis-Menton's parameters. Importance Reactions, Formulation of dimensionless groups and calculation of Effectiveness Factors.
LO: To demonstrate the mechanisms and kinetics of enzymes.
LA: Assessment by deriving the kinetics.

UNIT IV: ENZYME INHIBITION AND IMMOBILIZATION

Types of Inhibition- kinetic models; Substrate and Product Inhibition; Allosteric regulation of enzymes; Deactivation kinetics. Physical and Chemical techniques for enzyme Immobilization - adsorption. Matrix entrapment, encapsulation. Cross-linking. Covalent binding - examples; Advantages and disadvantages of different Immobilization techniques. Overview of applications of immobilized enzyme systems.
LO: To understand the types of immobilization techniques and enzyme inhibition.
LA: Assessment by demonstration of inhibitions.

UNIT V: ENZYME REACTORS

Design of Immobilized Enzyme Reactors-Packed- bed, Fluidized-bed Membrane reactors; Bioconversion calculations in free- enzyme CSTRs and immobilized enzyme reactors.
LO: To demonstrate different types of immobilized enzyme reactors
LA: Assessment by designing of different immobilized reactors.

UNIT VI: ENZYME BIOSENSORS

Applications of enzymes in analysis; Design of enzyme electrodes and their applications as biosensors in industry, health care and environment.
LO: To study design of enzyme electrodes and biosensors.
LA: Assessment by designing of sensors and application of enzyme electrodes.

TEXT BOOKS:

1. Trevor palmer, Enzymes, 2nd Edition, Wood head Publishing, 2007.
2. James E Bailey, David F. Olli's Biochemical engineering fundamentals, 2nd edition, McGraw Hill Intl, 1986.

REFERENCES:

1. Colin Ratledge and Bjorm Kristiansen, Basic Biotechnology, 2nd Edition, Cambridge University Press, 2001.
2. James Lee, Biochemical Engineering, 1stedition, Prentice Hall, 1991.

III Year – II SEMESTER

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IMMUNOLOGY

UNIT I: THE IMMUNE SYSTEM

Introduction, Phylogeny of the Immune system, Innate and acquire immunity. Immunogens, antigens, their chemical nature, Properties influencing immunogenicity, Haptens, adjuvants.
LO: To understand different types of immune system, chemical nature of antigens and immunogenicity.
LA: Assessment analyzing different types of immune response and immunogenicity.

UNIT II: BIOLOGY OF THE IMMUNE SYSTEM

Cells of the IS, Phagocytosis & Inflammation: Hematopoiesis and Cell Lineages T, B, Macrophages, Dendritic cells, Natural killer cells, Eosinophil's, Neutrophils, Mast cells. Phagocytosis & Inflammation.
LO: To understand different cells of immune system.
LA: Assessment by ability to differentiate cells and demonstrating the mechanism of its action.

UNIT –III LYMPHOID ORGANS

Primary and Secondary organs of lymphoid organs- Thymus, Spleen, Lymphnode, lymphoid follicle, MALT (CALT, BALT, GALT)
LO: To understand the structure and functions of lymphoid organs.
LA: Assessment by analyzing and interpreting the action of different lymphoid cells.

UNIT IV: HUMORAL IMMUNITY

B-lymphocytes, their lineage, Immunoglobulins, their structure & function, classes, sub classes, Isotype, allotypes, Idiotypes. Hybridoma Technology Monoclonal antibodies their application. Immunotoxing chimeric antibodies and abzymes, Immunoglobulin gene organization and rearrangement. Generation of immunoglobulin diversity &class switch. B cell maturation & Activation. B cells differentiation and effector functions. Antigen-Antibody intereactions. Hypersensitivity: Types of hypersensitivity, Principle, mechanisms their relevance & significance. Complement System.
LO: To understand different types of antibodies, its diversity, its interactions with antigens and different types of hypersensitivity reactions.
LA: Assessment by ability to demonstrate different antigen-antibody interactions and hypersensitivity reactions.

UNIT V: CELL MEDIATED IMMUNITY

T-cells subclasses their lineage, MHC, Ag processing and presentation, TCR diversity, T cell ontogeny: maturation, activation and effector functions.
LO: To understand different classes of T-cell and mechanism of cell mediated immunity.
LA: Assessment by ability to demonstrate cell mediated immune response to a stimuli.

UNIT VI: TRANSPLANTATION, AUTOIMMUNITY AND TUMORS

Transplantation- Graft rejection and mechanisms prevention of graft rejection, immuno suppressive drugs, Autoimmunity – experimental models of autoimmune disease. Treatment of autoimmune disorders and Tumor immunology.
LO: To understand types and treatment to autoimmune disorders.
LA: Assessment by demonstration of drugs to various autoimmune disorders.

TEXT BOOKS:

1. E. Roitt Essential Immunology, 12th edition, Wiley Blackwell Scientific publications Oxford, 2011.
2. Richard A Goldsby, Thomas J Kindt, Barbara A Osborne Kuby, Immunology, 6th edition, W H Freeman and Company, 2006.
3. Khan. F. H The Elements Of immunology, Pearson education, 2009.

REFERENCES:

1. Abul Abbas and Litchman, Cellular Molecular Immunology, 7th edition, Saunders Education, 2011.

III Year – II SEMESTER

T	P	C
3+1	0	3

INSTRUMENTATION AND BIOPROCESS CONTROL

UNIT I: PROCESS DYNAMICS

Process variables, Load variables, Dynamics of simple processes. Flow level, Process Dynamics of temperature, pressure and Measurement. Introduction to Second Order process Dynamics

LO: To understand the various process control variables.

LA: Assessment by ability to optimize various process control variables.

UNIT II: INTERACTING AND NON INTERACTING SYSTEMS

Continuous & batch process, Self-Regulator & Servo regulator operation problems.

LO: To understand the self and servo regulator operation.

LA: Assessment by ability to solve problems in self and servo regulator operations.

UNIT III: CONTROL ACTIONS AND CONTROLLERS

Basic control actions-characteristics of two position, three position, proportional, single speed floating. Integral and derivative control modes- P+I. P+D and P+I+D control modes. Problems on pneumatic, hydraulic and electronic controllers to realize various control actions.

LO: To understand the concepts of P, PI, PID controllers.

LA: Assessment by ability to understand the problems in pneumatic, hydraulic and electronic controllers.

UNIT IV: OPTIMUM CONTROLLER SETTINGS

Evaluation criteria, 1/4th decay ratio, IAE. ISE, ITAE- determination of optimum settings for mathematically described process using time response and frequency response. Tuning process reaction curve method-continuous, oscillation method- damped oscillation method-problems.

LO: To understand evaluation criteria using different optimum settings.

LA: Assessment by ability to demonstrate the optimum controller settings for a process.

UNIT V: FINAL CONTROL ELEMENT

I/P Converter-pneumatic, electric and hydraulic actuators- valve positioner- control valves-characteristics of control valves-valve body- Globe, butterfly, diaphragm; Ball valves- Control valve sizing- Cavitation, flashing problem.

LO: To demonstrate the different control valve and problems associated with it.

LA: Assessment by ability to apply different control valve based on process.

UNIT VI: MULTI LOOP CONTROL SYSTEM

Feed forward control-Ratio control-Cascade control-Split range-

Multivariable control and examples from distillation column & Boiler system.

LO: To study the Feed forward control-Ratio control-Cascade control-Split range theories.

LA: Assessment by application of control strategies to distillation and boiler systems.

TEXT BOOKS:

1. Pollard A, Process control, Heinemann Educational Books London, 1971.
2. Harriott P, Process control, 1st edition Reprint, Tata McGraw publishing Co New Delhi, 1991.
3. J.R. Leigh, Modeling and Control of fermentation Processes, Revised edition, Peter Peregrinus London, 2000.
4. Donald R. Coughanowr, Process Systems Analysis and Control, 3rd edition, McGraw-Hill, 2011.

REFERENCES:

1. Eckman D. P, Automatic process control, 1st edition, Wiley Eastern Ltd New Delhi, 1993.
2. Stephanoupoulis G, Chemical Process Control, 3rd edition, Prentice Hall New Delhi, 1984.

III Year – II SEMESTER

T	P	C
0	3	2

Biochemical Reaction Engineering Lab

1. Demonstration of various bioreactor configurations,
2. In-situ sterilization of medium and Arrhenius plot ,
3. Microbial death kinetics - Determination of Nabla Factor ,
4. Demonstration of inoculation and sampling in a CSTR;
5. Demonstration of fed-batch, batch, and continuous processes in CSTR,
6. Microbial cell growth kinetics;
7. Determination of KLa.
8. Preparation and characterization of immobilized enzymes,
9. Flow measurement using Orifice Meter or Venturi Meter
10. Leaf Filtration ;
11. Rotary Vacuum Filtration
12. Pressure Filtration

TextBooks

1. P.M.DoranBioprocessEngneeringprinciples, academicPress,London, 1995.
2. D.G.Rao,IntroductiontoBiochemicalEngineering,McGraw-Hill,2005

III Year – II SEMESTER

T	P	C
0	3	2

IMMUNOLOGY LAB

1. Immunoprecipitation

a) Ouchterlony's immunodiffusion technique. b) Counter current immunoelectrophoresis.

2. Agglutination: Haemagglutination & Blood typing / grouping.
3. Enzyme linked immunosorbant assay(ELISA)
4. Immunoglobulins purification.
5. Differential (Identification of cell types) & Total leukocyte counts of blood.
6. Isolation & Viability determination of Lymphocytes from peripheral blood.
7. Lymphocyte proliferation with mitogen.

TEXTBOOKS

1. Myers, Immunology- a laboratory manual, 2nd edition, McGraw Hill, 1994.

EQUIPMENTS:

1. Haemocytometer
2. ELISA reader
3. Centrifuge
4. Electrophoresis unit
5. Microscope

IV Year – I SEMESTER

T	P	C
3+1	0	3

COMPUTATIONAL MOLECULAR BIOLOGY

UNIT I: INTRODUCTION TO COMPUTATIONAL MOLECULAR BIOLOGY

Introduction to active areas of research in Computational Molecular Biology, Functional Genomics, Comparative Genomics,

Dynamic Programming, Graphical representation of biochemical systems, S-systems equations, steady state analysis, Model refinements, Basics of Microarray.
LO: To understand the basics branches of computational molecular biology and importance of graphical representations.
LA: Assessment by ability to differentiate and demonstrate between functional, structural and comparative genomics.

UNIT II: GENOMICS
DNA Sequence assembly and gene identification, Homology based gene prediction, SNPs and applications. Methods of studying gene expression, EST approach.
LO: To demonstrate different aspects of gene assembly, its prediction and expression.
LA: Assessment by ability to computationally assemble, and predict the expression of the given gene.

UNIT-III: PROTEOMICS- I
Introduction to proteins. Protein identification, structure and function determination, Structure comparison methods. Prediction of secondary structure from sequence.
LO: To demonstrate the structure and folding of the protein.
LA: Assessment by identifying and predicting the structure and folding of the protein computationally.

UNIT- IV: PROTEOMICS- II
Protein homology modeling, Protein threading. Protein Ab initio structure prediction. Protein design emphasis on structural Bioinformatics.
LO: To demonstrate different methods for protein structure prediction.
LA: Assessment by ability to predict and compare structure of protein computationally.

UNITI V: TAXONOMY AND PHYLOGENY
Basic concepts in systematics, Molecular evolution, Definition and description of Phylogenetic trees and its types. Dendograms and its interpretation.
LO: To understand the basics of phylogenic analysis and tree construction
LA: Assessment by ability to construct a phylogenetic tree from the given data.

UNIT-VI: DRUG DESIGN
Drug discovery cycle, Role of Bioinformatics in Drug discovery.
LO: To understand various methods involved in drug discovery.
LA: Assessment by optimization of compounds for drug discovery.

TEXT BOOKS:

1. David W Mount, Bioinformatics- Sequence and genome analysis, 2nd edition, CSHL Press 2005.
2. Jonathan Pevsner, Bioinformatics and Functional Genomics, 2nd edition, Wiley Blackwell Publication, 2009.
3. E. O. Voit, Computational Analysis of Biochemical systems, 2nd edition, Cambridge University Press 2009.

REFERENCES:

1. Creighton T E, Proteins, 2nd edition, Freeman W. H, 2007.
2. Journal BIOINFORMATICS (Oxford University), 2011.
3. BRANDOND TOOZE – Proteomics, 1st edition, Garland publications, 1999.

IV Year – I SEMESTER

T	P	C
3+1	0	3

BIOETHICS, BIO SAFETY, CLINICAL AND REGULATORY AFFAIRS

UNIT I: INTRODUCTION TO BIOETHICS

Introduction to Bioethics. Social and ethical issues in Biotechnology. The principles of Bioethics, autonomy, human rights, privacy justice, ethics related to use of experimental animals. ICMR guide lines.

LO: To familiarize about bioethics and its principles.

LA: Assessment by the ability to apply these bioethical laws.

UNIT II: BIOSAFETY

Definition of Biosafety. Biosafety for human health and environment. Social and ethical issues. Use of genetically modified organisms and their release in to the environment. Special procedures for r-DNA based products.

LO: To make a detailed study of biosafety and other ethical issues.

LA: Assessment by implementation of biosafety issues.

UNIT III: LICENSING GUIDELINES.

Licensing authorities-roles and responsibilities, Data Protection Act & Regulations, Declaration of Helsinki 2000 amendment and financial disclosure; Regulation of drug preparation and packaging, structure regulation impact of ICH GCP recent development with regard to the INDIA;/USA/EU Clinical Trial directive.

LO: To understand the licensing and regulating authorities of drug preparations.

LA: Assessment by monitoring and implementing the regulatory issued during drug preparation.

UNIT IV: QUALITY ASSURANCE GUIDELINES

Definitions of GCP, auditing, monitoring and inspection; GCP auditing requirements from a regulatory perspective; GCP compliance and audit certificates; GCP audit team structure and SOPs' GCP audit planning; GCP audit conduct; Reporting GCP audit findings; Follow up to GCP audit reports. GLP guidelines.

LO: To demonstrate good clinical practices and other governing factors.

LA: Assessment by proper application of GCP guidelines during the process development.

UNIT V: GUIDELINES FOR CLINICAL TRIALS

Roles and responsibilities in clinical research according to ICH GCP Sponsor, Monitor, Investigator, IRB/IEC; Essential documentation; The INDIAN/USA/EU Directives on GCP in Clinical Trials. Purpose; How will the introduction affect clinical research; Extracts from the guidance documents. Possible sanctions for non-compliance (a) Legal and regulatory (b) Commercial and (c) Professional.

LO: To demonstrate international regulatory guidelines.

LA: Assessment by implementation of these guidelines.

UNIT VI: ICH GUIDELINES

Latest developments in ICH; Purpose; Implications; Guidance notes; Inspections. INDIAN/USA/EU Ethics approval system: Overview; Recent developments. Current issues in Clinical research: Confidentiality issues; Medicines for human use (clinical trials) regulations 2003; other relevant issues.

LO: To familiarize about national and international clinical trials guidelines.

LA: Assessment by implementing and checking the guidelines.

TEXT BOOKS:

1. Sasson A, Biotechnologies and Development, 3rd edition, UNESCO Publications, 2000.
2. Sasson A, Biotechnologies in developing countries present and future, 2nd edition, UNESCO publishers, 2000.
3. Good Clinical Practices, Central Drugs Standard Control Organization, Govt. of India

REFERENCE:

1. Lawrence M. Friendman, Curt D. Furberg, David L. Demets, Fundamentals of clinical trials, 3rd Edition, Springer International Edition, 2010.
2. Drugs and Cosmetics Act, 1940.

IV Year – I SEMESTER

T	P	C
3+1	0	3

DOWNSTREAM PROCESSING

UNIT I: ROLE OF DOWNSTREAM PROCESSING IN BIOTECHNOLOGY

Role and importance of downstream processing in biotechnological processes. Problems and requirements of bio product purification. Economics of downstream processing in Biotechnology, cost-cutting strategies, characteristics of biological mixtures, process design criteria for various classes of bioproducts (high volume, low value products and low volume, high Value products).

LO: To develop a detailed strategy about downstream processing.

LA: Assessment by technical applications of downstream processing methods.

UNIT II: PRIMARY SEPARATION AND RECOVERY PROCESS

Cell disruption methods for intracellular products, removal of insoluble, biomass (and particulate debris) separation techniques, flocculation and sedimentation, centrifugation, precipitation and filtration methods.

LO: To understand basics of cell separation and disruption process

LA: Assessment by usage of different membrane and disruption process in cell.

UNIT III: SEPARATIONS AND FRACTIONATION TECHNIQUES

Membrane-based separations (micro and ultrafiltration), theory, design and configuration of membrane separation equipment applications, Electrophoresis of proteins and nucleic acids, 1D-2D Gels, Types of Electrophoretic techniques (Capillary and Pulse field). Chromatographic techniques- Paper, TLC, Adsorption, Ion exchange, Gel filtration, affinity chromatographic separation processes, GC, HPLC, FPLC, Chromatofocusing, electrophoretic separations.

LO: To demonstrate the various separation and fractionation techniques.

LA: Assessment by ability to perform various separation and fractionation techniques.

UNIT IV: BIO-SEPARATION

Physio-chemical basis of bio-separation processes. Recent developments in product Isolation (for ex: one step purification, reverse micellar extraction and online membrane separations).

LO: To understand various physiochemical properties of bio-separation processes.

LA: Assessment by practical application of separation principle based on the sample.

UNIT V: ENRICHMENT OPERATIONS

Precipitation methods (with salts, organic solvents, and polymers, extractive separations, aqueous two-phase extraction, supercritical extraction), in situ product removal, integrated bioprocessing.

LO: To understand various precipitation methods.

LA: Assessment by precipitation of given sample by mentioned methods.

UNIT VI: NEW AND EMERGING TECHNOLOGIES

Dialysis, Crystallization, Evaporation, super liquid extraction foam based separation case study with examples for processing of Two Industrial Products (Citric acid / Penicillin and Low volume high value product like recombinant proteins).

LO: To familiarize new emerging technologies.

LA: Assessment by practical application of these techniques and comparing it with old techniques.

TEXT BOOKS:

1. Wankat PC, Rate-controlled separations, 1st edition, Elsevier, 2005.
2. Belter PA and Cussler E. Bioseparations, 1st edition, Wiley 2011.

REFERENCES:

1. BIOTOL Series, Product Recovery in Bioprocess Technology, 1st edition, VCH, 2004.
2. Asenjo J.M. Separation processes in Biotechnology, Marcel Dekkere Inc, 1993.
3. M.R.Ladisch, Bioseparation engineering: Principles, Practice and Economics, 1st edition, Wiley Interscience 2001.

IV Year – I SEMESTER

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BIOSENSORS AND BIOELECTRONICS

UNIT I: INTRODUCTION

What are Biosensors? Advantages and limitations, various components of biosensors. Biocatalysis and bioaffinity based bio sensors

LO: To understand basics of biosensors.

LA: Assessment by preparation of biosensors

UNIT-II: TYPES OF BIOSENSORS

Microorganism based biosensors, biologically active material and analyte. Types of membranes used in biosensor constructions.

LO: To understand types of biosensors and its requirements.

LA: Assessment by preparation of specific microbial biosensors.

UNIT III: TRANSDUCERS IN BIOSENSORS

Various types of transducers; principles and applications - Calorimetric, optical, potentiometric / amperometric conductrometric/ resistormetric, Piezoelectric, semiconductor, impedimetric, mechanical and molecular electronics based transducers.

Chemiluminiscence - based biosensors.

LO: To demonstrate the various types of transducers.

LA: Assessment by evaluation of various samples by these transducers.

UNIT IV: APPLICATION AND USES OF BIOSENSORS

Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food. Low cost- biosensor for industrial processes for online monitoring; biosensors for environmental monitoring.

LO: To understand the application of biosensors.

LA: Assessment by application of principles of biosensors in various fields

UNITV: MOLECULAR ELECTRONICS

Potential advantages & Developments towards a biomolecular computer, development of molecular arrays as memory stores; molecular wires and switches; mechanisms of unit assembly;

LO: To study basics of molecular electronics.

LA: Assessment by preparation and applying these bioelectronics.

UNIT VI: DESIGN FOR A BIOMOLECULAR PHOTONIC COMPUTER

Assembly of photonic biomolecular memory store, Information processing, commercial prospects for biomolecular computing systems.

LO: To study basics of biomolecular photonic computing systems

LA: Assessment by assembly of photonic biomolecular memory store and applying it commercially.

TEXT BOOKS:

1. Aboul - Enein, H. V., Stefan, R. and Van Staden, Chemiluminiscence - based biosensors, 1999.
2. J.E. Gill A, and Vadgama. P, Analytical aspects of biosensors, Ann Clin Biochem, Pearson, 2000.

REFERENCES:

1. Roger. K. R. and Gerlach. C. L. Update on environmental for biosensors. Env. Sci. Technologies, 2000.
2. Bilitewski. U. Turner, A.P.F. Biosensors for environmental monitoring, Harwood Amsterdam, 2000.
3. Moses, V and Cape, R.E, Biotechnology the science and business, Harwood, Academic Publisher London, 1991.
4. Rogers, K.R. and Mascini, M Biosensors for analytical monitoring EPA biosensors group, 2001.

IV Year – I SEMESTER

T	P	C
3+1	0	3

Elective I

BIOMATERIAL SCIENCE AND TECHNOLOGY

UNIT I: INTRODUCTION

Biomaterials and biological materials-examples and uses: First, Second and Third generation biomaterials- General characteristics – naturally occurring biomaterials.

LO: To study basics of various types of biomaterials

LA: Assessment by graphical representation of biomaterials

UNIT II: PROPERTIES OF BIOMATERIALS

Physical, thermal, electrical and optical properties of bio-materials and their application to processing.

LO: To study properties of biomaterials.

LA: Assessment by testing the properties of biomaterials.

UNIT III: MATERIALS FOR TISSUE ENGINEERING

Novel Biomaterials and Uses in Engineering and Tissue Engineering: Hydrogels, self- assembling peptides, Implants materials Metallic implant materials, stainless steels, co-based alloys, Tibased alloys, ceramic implant materials, aluminum oxides, hydroxyapatite glass ceramics carbons

LO: To study various biomaterials used for tissue engineering.

LA: Assessment by testing the characterization and functionality of biomaterials used in tissue engineering.

UNIT IV: NANOSTRCTURED BIOMATERIALS

Nanostructured devices, Drug Delivery Timed release materials Implantable materials

Cutting Edge Technologies and Materials Nanostructure Devices (DNA-templated FETs and nanowires)

LO: To study various nanostructured devices and biomaterials.

LA: Assessments by testing the characterization of biomaterials used in synthesis of nanostructured devices.

UNIT V: FERMENTATIVE PRODUCTION

Production of Biopolyester, microbial polysaccharides, microbial cellulose, bioadhesive, polyglutamic acid

LO: To study the biopolysters.

LA: Assessments by usage of this biopolysters.

UNIT VI: OPTIMIZATION OF PRODUCTION KINETICS, SEPARATION

Statistical optimization of probable variables for production of biomaterials, use of reactors, kinetic analysis for production, separation of Biomaterials by cell digestion and extraction.

LO: To study optimization of production kinetics and separation

LA: Assessment by optimization kinetics of various production

BOOKS:

1. D. Byrom, Biomaterials –novel materials from biological sources, Stockton press, New York, 1991.
2. J.B.Park, Biomaterials science and engineering, Plenum Pulo, 1984.

REFERENCE BOOK:

1. Stephen R. Fahnestock, Alexander Steinbuchel, A. Steinbuchel Biopolymers: Volume 7, Polyamides and Complex Proteinaceous Materials, Wiley, John & Sons, Incorporated, February 2003.

CELL SIGNALING (Elective 1)

UNIT I: INTRODUCTION TO CELL SIGNALING

Introduction; component involved in signalling process. Receptors, ligands, hormones, neurotransmitter, agonist and antagonist. Concept of cell signalling and signal transduction.

LO: To Study basics of intracellular signaling.

LA: Assessment by testing various receptor ligand receptors.

UNIT II: METHODS OF CELL SIGNALLING

Cell signalling and cellular response,Interferon (IFN) signalling,TNF signalling,Methods tostudy cell signaling,Signalling by cell surface receptors. Principles of Binding, thermodynamics of Protein–Protein Interactions: Carbohydrate Recognition and Signalling, Protein–Protein Interactions and Conformational Changes.

LO: To study methods of cell signaling and protein interactions and conformational changes associated with it.

LA: Assessment by the ability to demonstrate various methods of cell signaling.

UNIT III: RECEPTORS STRUCTURE AND FUNCTION

Types of receptors: Internal and Trans membrane receptors, Cytokine receptors, G- protein coupled, Hormone receptors, Growth factor receptors and other types of receptors and their function and mechanism of action.

LO: To study the role of receptors its structure and function.

LA: Assessment by demonstrating and differentiating various types of receptors.

UNIT IV: SECONDARY MESSENGERS AND MECHANISM OF ACTION

Different types of hydrophobic molecules, Hydrophilic molecule, Gases etc and mechanism of action.

LO: To study different secondary molecules and its mechanism of action.

LA: Assessment by ability to apply different secondary messengers in cell signaling and demonstrating its mechanism of actions.

UNIT V: CELL SIGNALLING

Cell signaling and differentiation, Cell signalling during development,Transcription factors and cell signalling, Cell signalling and gene expression,Cell signaling and stem cells,RNA-signaling,Cellsignaling during diseases, Cell signalling and biochemical response, Cell adhesion molecules and cell-cellcommunication.

LO: To study various parameters associated with cell signaling.

LA: Assessment by computationally demonstrate various types of cell signaling.

UNIT VI: Defects in Cell signalling

When cell communication goes wrong? Defects in cell signalling treatments. Cell signaling and cancer metastasis.

LO: To study the role of defective signaling

LA: Assessment by computationally testing the defects

TEXTBOOKS

1. G. Posil and S.T. Crooke, Mechanism of receptor regulations, Plenum Press,1985.
2. R. H Getzenberg and E. E. Bittar, Cell structure and signaling, Elsevier Science, 1997.
3. Hand Book of Cell signalling,vol1 Ralph.A.Bradshaw,Academic press 2003.

REFERENCES

1. John Hancock, Cell Signaling, 3rd edition, Oxford University Press, 2010.
2. Geoffery. M. Cooper & Robert. E. Hausman, The Cell- Molecular approach, 5th edition, Sinauer Associates, 2009.
3. Amanda Harvey, Cancer Cell Signalling , Wiley; 1st edition, 2013

STRUCTURAL BIOLOGY (Elective - I)

UNIT I: INTRODUCTION

Levels of structures in Biological macromolecules, the chirality of biomolecules, proteins, nucleic acids, carbohydrates and lipids, cofactors, vitamins and hormones. Forces that determine Protein and Nucleic acid structure, basic problems. Polypeptide chains; geometric, potential energy calculations, observed values for rotation angles, hydrogen bonding, hydrophobic interactions and water structures; ionic interactions, disulphide bonds. The introduction of structural biology

LO: To understand the basics of structural biology

LA: Assessment by the ability to differentiate the properties and types of polymers.

UNIT II: PROTEIN FOLDING

Types of proteins and interactions that govern protein folding, protein structure, The protein globule and hydrophilic interactions organized folds, folding mechanisms, membrane proteins, helix-coil transitions,

LO: To demonstrate the protein folding and protein structure.

LA: Assessment by testing of protein interactions computationally.

UNIT III: BIOMOLECULAR INTERACTIONS

Molecular recognition, supramolecular interactions, Functional importance of Protein and protein- nucleic acid interactions. Specific and non- specific DNA- protein complexes and their importance.

LO: To understand the biomolecular interactions.

LA: Assessment by evaluating the interactions of specific molecules.

UNITIV: STRUCTURAL ANALYSIS OF MACROMOLECULES

Prediction of protein structure; Sequence-structure relationships, Nucleic acids; general characteristics of nucleic acid structure, geometric, glycosidic bond rotational isomers backbone rotational isomers and ribose puckering forces stabilizing ordered forms, base pairing, base stacking, tertiary structure of nucleic acids.

LO: To demonstrate the structural analysis of macromolecules.

LA: Assessment by analyzing and differentiating the structures of macromolecules.

UNITI V: KINETICS OF LIGAND INTERACTIONS:

Biochemical Kinetics studies, uni- molecular reactions, simple bimolecular multiple intermediates, steady state kinetics, catalytic efficiency relaxation spectrometry, ribonuclease as an example.

LO: To understand the kinetics of ligand interactions.

LA: Assessment by the ability to derive the kinetics of ligand interactions.

UNIT VI: TECHNIQUES FOR THE STUDY OF BIOLOGICAL STRUCTURE & FUNCTION

Size and shape of micro molecules: photons, chromophores, transition dipole moments, absorbance, and concentration. circular dichroism: molecular chirality and structural transitions of macromolecules, methods of direct visualization macromolecules as hydrodynamic particles - macromolecular diffusion ultracentrifugation viscometry. X- ray crystallography; determination of molecular structures, X- ray fiber diffraction electron microscopy; neutron scattering - light scattering, NMR spectroscopy.

LO: To demonstrate techniques for the study of biological structure & function

LA: Assessment by using these techniques for analysis of structure for specific molecule.

TEXT BOOK:

1. Tinoco. I Jr, Sauer. K, Wang. J. C & Puglisi, J. D. Physical Chemistry: Principles and Applications in Biological Sciences, 4thedition, Prentice Hall, 2001.

REFERENCES:

1. A.M. Lesk Introduction to Protein Architecture, 1st edition, Oxford University Press, 2001.

CANCER BIOLOGY (Elective-I)

UNIT I: FUNDAMENTALS OF CANCER BIOLOGY

Regulation of Cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches.
LO: To familiarize about regulation of cell cycle and other physical effects.
LA: Assessment by analyzing the regulations of cell cycle and other effects.

UNIT II: TUMOR SUPPRESSION

Tumor suppressor genes, modulation of cell cycle in cancer. Different forms of cancers, Diet and cancer.
LO: To understand the tumor suppressor genes and different forms of cancer.
LA: Assessment by ability to identify the tumor suppressor genes and differentiate between forms of cancers.

UNIT III: PRINCIPLES OF CARCINOGENESIS

Chemical Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis, Metabolism of Carcinogenes. Principles of Physical Carcinogenesis, X -Ray radiation - mechanism of radiation Carcinogenesis.
LO: To understand the principles of carcinogenesis.
LA: Assessment by testing the carcinogenic effects of these molecules on genes.

UNIT IV: MOLECULAR CELL BIOLOGY OF CANCER

Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, detection of Oncogenes, Growth Factor and Growth Factor receptors that are Oncogenic.
LO: To demonstrate the oncogenes and its detection and environmental effects on oncogenes.
LA: Assessment by analyzing and evaluating the effects of factors on oncogenes.

UNIT V: PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion, heterogeneity of metastatic phenotype, Metastatic cascade, Basement Membrane disruption, Three-step theory of Invasion, Proteinases and tumor cell invasion.
LO: To understand the principles of cancer metastasis.
LA: Assessment by analyzing and demonstrating the mechanism of metastasis.

UNIT VI: DETECTION AND THERAPEUTIC MOLECULES

Detection of Cancers, Prediction of aggressiveness of Cancer, Advances in Cancer detection. Different forms of therapy, Chemotherapy, radiation Therapy, and Immunotherapy: advantages and limitations.
LO: To know about the new molecules for cancer therapy and detection
LA: Assessment by practical applications of various therapeutic methods

TEXT BOOKS

1. Margarett Knowles, An Introduction to Cellular and Molecular Biology of Cancer, 4th edition, Oxford Medical publications, 2005.

2. Weinberg, Cancer biology, 2nd edition, Garland publications, 2013.

REFERENCE:

1. Dunmock N.J and Primrose.S.B., Introduction to modern Virology, 3rd edition, Blackwell publications, 1987.

IV Year – I SEMESTER

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0	3	2

BIOINFORMATICS LAB

1) Demonstration of BLAST, FASTA.
2) Clustering and contig assembly tool,
3) Multiple sequence alignment and phylogenetic analysis.
4) Gene finder (Prediction).
5) Restriction site analysis tools.
6) Protein visualization tools (RASMOL).

EQUIPMENTS:

1. Computers
2. Internet facility
3. Bioinformatics software

IV Year – I SEMESTER	DOWN STREAM PROCESSING LAB	T	P	C
		0	3	2

1. Solid liquid separation – centrifugation, microfiltration
2. Cell disruption techniques – ultrasonication, French pressure cell
3. Cell disruption techniques – batch and continuous
4. Precipitation – ammonium sulphite precipitation
5. Ultra filtration separation
6. Aqueous two phase extraction of biologicals
7. High resolution purification – affinity chromatography
8. High resolution purification – ion exchange chromatography

EQUIPMENTS:

1. Centrifuge
2. Different pore sized filtration membranes
3. Chromatography columns
4. Separating funnel

IV Year – II SEMESTER

T	P	C
3+1	0	3

ANIMAL CELL SCIENCE AND TECHNOLOGY

UNIT-I BASICS OF ANIMAL CELL AND ITS CULTURING: Structure and organization of an animal cell, Types of animal cell culture – cell culture, organ/tissue culture, organotypic culture and histotypic culture, Equipment's and materials needed for animal cell culture technology.
LO: To study the basics of animal cells and its culturing methods.
LA: Assessment by ability to organize and culture different animal cells.

UNIT-II ANIMAL CELL CULTURE MEDIUM AND ITS COMPONENTS AND THEIR SIGNIFICANCE: Introduction to the balanced salt solutions and growth medium, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, Role of carbon-di-oxide and role of serum and its supplements in maintaining cells in culture medium, Serum and protein free defined media and their application.
LO: To study different culture media and its components.
LA: Assessment by ability to develop specific media to various animal cells.

UNIT-III BASIC TECHNIQUES OF MAMMALIAN CELL CULTURE *in vitro*: Primary and established cell lines, Biology and characterization of the cultured cells, measuring parameters of growth. Maintenance of cell culture, Cell separation, Cell transformation, Cell synchronization, Measurement of viability and cytotoxicity, Apoptosis – characteristic features and molecular mechanisms, Measurement of cell death.
LO: To study basic techniques of in vitro culturing techniques of mammalian cells.
LA: Assessment by ability to culture and apply different in vitro culturing techniques of mammalian cells.

UNIT-IV ENGINEERING ANIMAL CELLS: Somatic cell genetics, Cell culture based vaccines, Genetic engineering of mammalian cells in culture, Scaling up of animal cell culture.
LO: To study genetics of various animal cells.
LA: Assessment by ability to produce cell culture based vaccines and the scale up of cell cultures.

UNIT-V STEM CELLS
Definition; Types- Pleuripotent v/s Totipotent; Embryonic, Adult and Fetal; Role of Stem cells in Tissue Engineering; Application of Stem cells.
LO: To study the definition, role and applications of stem cells.
LA: Assessment by ability to apply the concept of stem cells in various fields.

UNIT-VI APPLICATIONS OF ANIMAL CELL CULTURE:
Three dimensional culture and tissue engineering, Applications of animal cell culture technology (heterologous, Primary culture/CEF culturing, Protein Expression).
LO: To study the applications of animal cell cultures.
LA: Assessment by ability to apply animal cell culturing in protein engineering.

TEXT BOOKS:

1. Ian Froshney, Culture of Animal Cells, 3 rd Ed, Wiley-Liss 2001.
2. Animal Cell Culture Techniques – Practical Approach, Ed. John R.W. Masters Oxford 2003.

REFERENCES:-

1. Cell Cultures lab fax. Eds. M. Butter & M. Dawson, Bios Scientific publications Ltd ., Oxford 2003.
2. Animal Cell Cultures Techniques. Ed. Martin Clynes, Springer 2001.
3. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Ed. Jenni P. Mather and David Bares. Academic Press 2003.
4. Cell Growth and Division: A practical Approach. Ed. R. Basega, IRLpress 2001.

IV Year – II SEMESTER

T	P	C
3+1	0	3

ELECTIVE - II

CREATIVITY, INNOVATION AND PRODUCT DEVELOPMENT

UNIT I: INTRODUCTION
The process of technological innovation, factors contributing to successful technological innovation.
LO: To understand the process of technological innovation.
LA: Assessment by ability to incur innovations in conventional technologies.

UNIT II: CREATIVITY
The need for creativity and innovation, creativity and problem solving, brain storming- different techniques.
LO: To understand the creativity and innovation and various brain storming techniques.
LA: Assessment by analyzing and implementing the innovative techniques.

UNIT III: PROJECT SELECTION AND EVALUATION
Collection of ideas and purpose of project. - Selection criteria - screening ideas for new products (evaluation techniques).
LO: To demonstrate different evaluation criteria for an idea.
LA: Assessment by ability to evaluate, select and screen for new products.

UNIT IV: NEW PRODUCT DEVELOPMENT AND PATENT LAWS
Research and new product development Patents - patent search. Patent laws International code for patents - Intellectual property rights
(IPR).
LO: To illustrate the development of new product and patenting it.
LA: Assessment by ability to provide a pathway for patenting a new product.

UNIT V: NEW PRODUCT PLANNING
Design of proto type - testing - quality standards marketing research - introducing new products. GMP
LO: To familiarize various standards protocols and GMP guidelines for new product.
LA: Assessment by implementing the safety guidelines for a new product.

UNIT VI: LABORATORY
Creative design - Model Preparation - Testing – cost – evaluation, Patent application- GLP.
LO: To study about complete production cycle of a product.
LA: Assessment by model preparation and implementation.

TEXT BOOKS

1. HARRY B.WATTON - New Product Planning. Prentice-Hall Inc. 1992.
2. P.N.KHANDWALLA - Fourth Eye (Excellence through Creativity) 2nd edition Wheeler Publishing, Allahabad, 2000.

REFERENCES

1. HARRY NYSTROM - Creativity and innovation -John Wiley & Sons, 1989.
2. BRAIN TWISS, Managing technological innovation, volume 12 Pitman Publishing Ltd, 1992.
3. I. P. R. Bulletins, TIFAC, New Delhi, 2004.

NANO BIOTECHNOLOGY (ELECTIVE II)

UNIT I: TOOLS OF NANOSCIENCE AND NANOSTRUCTURE

Definition of Nano scale with reference to biosystems, Scope and future prospects scanning probe instrument, spectroscopy, electron microscopy. Molecular synthesis, Self-assembly, Polymerisation, Nanoscale lithography, e-beam lithography.
LO: To understand the various tools and concepts in Nanoscience.
LA: Assessment by analysis of nanoproducts with reference to biosystems.

UNIT II: SMART MATERIALS

Heterogenous Nano structure and composites, Nanoscale biostructres.
LO: To design a model for Nanostructure, composites.
LA: Assessment by ability to design a biostructure as per requirement.

UNIT III: HYBRID COMPUTERS

Protein-hybrid computers, role of genetically engineered polymer proteins.
LO: To familiarize the student with protein hybrid computer.
LA: Assessment by ability to incorporate genetically engineered proteins in protein-hybrid computers.

UNIT IV: DIRECTED SYNTHESIS

Molecular biology of biosynthesis and molecular design.
LO: To illustrate importance of molecular biology and molecular design in biosynthesis.
LA: Assessment by ability to demonstrate designing of biosysthesis at molecular level.

UNIT V: APPLICATIONS

Drugs-Photodynamic therapy, molecular motors, neuroelectronic interphases, development of Nanoluminiscent tags.
LO: To understand the applications of Nanostructures in drug development.
LA: Assessment by ability to implement the Nanostructures in drug development.

UNIT VI: BIOSYNTHESIS OF DESIGNER COMPOUNDS

Designer biopolymers, Procollagen, DNA Polynode, RNA topoisomerase,
Protein–magnetic materials.
LO: To study designer biopolymers and protein-magnetic materials.
LA: Assessment by ability to design protein biopolymers.

TEXTBOOKS:

1. M. Ratner and D. Ratner, Nanotechnology –a gentle introduction to the next big idea, Pearson education, 2007.
2. R. R. Birge, Protein based computers, Scientific American, 1995.

REFERENCES:

1. L. E. Foster, Nanotechnology-Science, Innovation and opportunity, Person Education Inc, 2007.

METABOLIC ENGINEERING (ELECTIVE – II)

UNIT I: INTRODUCTION IDENTIFICATION OF METABOLIC REGULATION IS A KEY POINT IN METABOLIC ENGINEERING

Basic concepts of Metabolic Engineering –Overview of cellular metabolism–Different models for cellular reactions, induction – Jacob Monod model and its regulation, Differential regulation by isoenzymes, Feedback regulation.

LO: To understand engineering of various metabolic pathways and analyzing its regulation by various methods.

LA: Assessment by modeling engineering of metabolic pathway and demonstrating its regulation.

UNIT II: SYNTHESIS OF PRIMARY METABOLITES AND SECONDARY METABOLITES

Amino acid synthesis pathways and its regulation at enzyme level and whole cell level, Alteration of feedback regulation, Limiting accumulation of end products. Regulation of secondary metabolite pathways, precursor effects, prophase, idiophase relationship, Catabolite regulation by passing control of secondary metabolism, producers of secondary metabolites, applications of secondary metabolites.

LO: To understand the synthesis of amino acids and secondary metabolites and its regulation.

LA: Assessment by demonstrating secondary metabolite synthesis & regulation at cellular and enzymatic level.

UNIT III: BIOCONVERSIONS

Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields, Co metabolism, Product inhibition, mixed or sequential bioconversions, Conversion of insoluble substances.

LO: To demonstrate basic concepts on bioconversions and factors affecting bioconversions.

LA: Assessment by ability to differentiate different types of bioconversions and factors affecting it.

UNIT IV: REGULATION OF ENZYME PRODUCTION

Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation, Feedback repression, Catabolite Repression, optimization and control of metabolic activities. The modification of existing-or the introduction of entirely new - metabolic pathways

LO: To study the requirements for regulation of enzyme production by microorganism.

LA: Assessment by developing a metabolic pathway by optimizing microorganism.

UNIT V: METABOLIC FLUX

Integration of anabolism and catabolism, metabolic flux distribution analysis, material balance, kinetic types, equilibrium reactions. Experimental determination method of flux distribution, metabolic flux analysis and its applications, Thermodynamics of cellular processes

LO: To study basics concepts metabolic flux analysis

LA: Assessment by ability to implement the flux analysis for product development.

UNIT VI: METABOLIC ENGINEERING WITH BIOINFORMATICS AND ITS APPLICATIONS

Metabolic pathway modeling, Analysis of metabolic control and the structure metabolic networks, Metabolic pathway synthesis algorithms, Application in pharmaceuticals (production of polyketoids), chemical bioprocess (online metabolic flux analysis), food technology (production of golden rice), agriculture (development of draught resistance), environmental bioremediation (development of super bugs) and biomass conversion(production of Ethanol).

LO: To study the engineering of metabolic pathway computationally and its application in different fields.

LA: Assessment by implementing the modeled pathways in different fields.

TEXT BOOKS:

1. Wang. D. I. C, Cooney, C. L. Demain, A. L. Dunnil, P. Humphrey A. E. Lilly M. D. Fermentation and Enzyme Technology, John Wiley and sons, 1980.
2. Stanbury P. F, and Whitaker. A, Principles of Fermentation Technology, Pergamon Press, 1984.

REFERENCES:

1. Zubay G, Biochemistry, Macmillan Publishers, 1989.
2. G. Stephanopoulos, A. Aristidou and J. Nielsen, Metabolic Engineering Principles and Methodologies, Academic Press, 1998.
3. Daniel I. C. Wang, Malcolm D. Lilly, Arthur E. Humphrey, Peter Dunnill, Arnold l.Demain, Fermentation and Enzyme Technology,1st edition John Wiley& Sons, Reprint, 2005.
4. Christina Smolke, The Metabolic Pathway Engineering Handbook (Two Volume) Set 1st edition CRC press, 2009

IV Year – II SEMESTER

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Elective III

FOOD SCIENCE & TECHNOLOGY

UNIT I: INTRODUCTION

Fundamentals and aims of food science and technology. Interdisciplinary approach, Nutritive value of foods, Food as a source of energy, Food Health and disease. Food chemistry-definition and importance, water in food, water activity and shelf life of food. Carbohydrates- functional properties of sugars and polysaccharides in foods. Lipids: use of lipids in foods, physical and chemical properties, effects of processing on functional properties and nutritive value. Protein and amino acids: physical and chemical properties, distribution, amount and functions of proteins in foods, functional properties, effect of processing.-Losses of vitamins and minerals due to processing.

LO: To study the basics of food science and technology.

LA: Assessment by knowledge in nutritive value of food, food chemistry and food processing.

UNIT II: FOOD MICROBIOLOGY

Microbial growth pattern, Types of micro-organism normally associated with food-mold, yeast, and bacteria. Micro-organisms in natural food products. Contaminants of foods-stuffs, Fisheries, milk and meat during handling and processing. Biochemical changes caused by micro- organisms, deterioration of various types of food product. Food poisoning and microbial toxins, standards for different foods. Food borne intoxicants and mycotoxins.

LO: To study different types of microorganism associated with food.

LA: Assessment by ability to understand the role of microorganisms in foods.

UNIT III: FOOD PRESERVATION

Principles of food preservation: Physical, chemical and biological methods of preservations. Bioprocessing of meat, Fisheries, vegetables, dairy products. Irradiated foods. Biotechnology in relation to food industry, Enzymes in foods and food industry, Nature and type of starters, role of starters in Fermented foods, Fermentation of Milk products-Fermented soy and peanut milk, Fruit and cereal based beverages, Non beverage plant products, Mycoprotein production.

LO: To study the principles of food preservation, enzymes used in food industry and fermented products.

LA: Assessment by knowledge in preservation methods and fermented products.

UNIT IV: FOOD ADDITIVES AND ANALYSIS

Sampling techniques and theory and practice of chemical and physical methods of food analysis for determination of food composition; Pigments in food, food flavours, food additives and toxicants. Natural sweeteners and artificial sweeteners and their role in controlling diseases and deficiencies, Nutraceuticals, and Functional Foods

LO: To study theory and practice of analysis of food and additives.

LA: Assessment by analysis of foods and food additives.

UNIT V: FOOD PROCESSING

Basic principles, unit operations, and equipment involved in the commercially important food processing methods and unit operations; materials and containers used in food packaging.

LO: To study the principles and operation of involved in food processing methods

LA: Assessment by ability to select the equipment in various food processing operations.

UNIT VI: FOOD QUALITY ASSURANCE

Objectives, importance and functions of quality control. Methods of quality, assessment of food materials-fruits, vegetables, cereals, dairy products, meat, poultry. Food regulations, grades and standards, Concept of Codex Almentarious/HACCP/USFDA/ISO 9000 series etc. Food laws and standards.

LO: To study the importance and functions of food quality

LA: Assessment by knowledge in quality control and regulations.

TEXT BOOKS:

1. William C. Frazier and Dennis C. Westhoff, Food Microbiology, 4th edition, Tata Mc Graw Hill, New Delhi(2011).
2. Meyer. L.H, Food Chemistry, East-West Press Pvt. Ltd., New Delhi(1974).
3. N. Shakuntala Manay and et.al, Foods Facts and Principles,3rd edition, New Age International Ltd, Bangalore (2012).
4. Ranganna, Handbook of Analysis and Quality Control for Fruits and Vegetable Products, 2nd edition, Tata McGraw Hill, New Delhi (2012).

REFERENCES:

1. James M. Jay, Modern Food Microbiology. 7th edition, Springer, New York (2005).
2. Norman N. Potter and et.al, Food Science, 5th edition, CBS Publishers Pvt Ltd, New Delhi(2012).

MOLECULAR MODELINGAND DRUG DESIGN (ELECTIVE III)

UNIT I: INTRODUCTION TO MOLECULAR MODELLING

Introduction to Molecular Modeling. What are models used for? Areas of application – Single molecule calculation, assemblies of molecules. Reaction of the molecules. Drawbacks of mechanical models as compared to graphical models. Co-ordinate systems two – matrix, potential energy surface.
LO: To describe a detailed note on applications of molecular modeling.
LA: Assessment by developing modeling methods.

UNIT II: QUANTUM MECHANICS

Postulates of quantum mechanics, electronic structure calculations, ab initio, semi-empirical and density functional theory calculations, molecular size versus accuracy. Approximate molecular orbital theories.
LO: To familiarize the term quantum mechanics and its application in molecular modeling.
LA: Assessment by theoretically calculating the mechanism of given molecule.

UNIT III: EMPIRICAL FORCE FIELD MODELS

Molecular Mechanisms, energy calculations, Bond stretch, angle bending, torsional term. Electrostatic interaction- Van der waals interactions. Miscellaneous interaction.
LO: To study the interaction in molecular modeling.
LA: Assessment by evaluating the molecular mechanics of the given molecule.

UNIT IV: MOLECULAR DYNAMICS

Introduction, Molecular Dynamics using simple models. Dynamics with continuous potentials. Constant temperature and constant dynamics. Conformation searching, Systematic search. Applications to protein folding
LO: To understand the molecular dynamics mechanisms.
LA: Assessment by applying molecular dynamics studies to optimize the given molecule.

UNIT V: COMPARATIVE PROTEIN MODELING

Modelling by Homology-the alignment, construction of frame work
,selecting variable regions, side chain placement and refinement, validation of protein models –Ramchandran plot, threading and ab initio modeling.
LO: To explain the concept protein modeling by homology modeling and effect of Ramchandran plot, threading and ab initio modeling.
LA: Assessment the ability to compare the effect of homology modeling, Ramchandran plot, threading and Ab initio modeling on protein structure.

UNIT VI: ANALOG AND STRUCTURE BASED DRUG DESIGN

Introduction to QSAR lead module, linear and nonlinear modeled equations, biological activities, physicochemical parameter and molecular descriptors, molecular modelling in drug discovery. 3D pharmacophores ,molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies. Applications: 3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries – generation and utility,
LO: To familiarize various methods involved in drug desining the biological activities and physiochemical properties of drug designing.
LA: Assessment by ability to optimize the molecule by these methods by drug designing.

TEXTBOOKS

1. Leach, Principles and applications of modeling, 2nd edition, 2009.
2. Hans Pieter, Heltje & Gerd Folkens, Molecular Modeling, 2nd edition, VCH, 2001.

REFERENCES:

1. Jonathan Goodman, Chemical Applications of Molecular Modeling, 1st edition, royal society of chemistry, 2004.
2. Guy H. Grant & W. Graham Richards, Computational Chemistry, 1st edition, Oxford University Press, 1995.

BIOPROCESS ECONOMICS & PLANT DESIGN(ELECTIVE – III)

UNIT I: PROCESS DESIGN DEVELOPMENT

Technical feasibility survey, process development, flow diagrams, equipment design and specifications.
LO: To state the process development and equipment design.
LA: Assessment by analyzing the process design development.

UNIT II: GENERAL DESIGN CONSIDERATION

Marketability of the product, availability of technology, raw materials, equipment's, human resources, land and utilities, site characteristics, waste disposal, government, regulations and other legal restrictions, community factors and other factors affecting investment and production costs.
LO: To study the government regulations and the factors effecting the marketability of the product.
LA: Assessment on various case studies and general design consideration.

UNIT III: COST ESTIMATION

Capital investments- fixed capital investments including land, building, equipment's and utilities, installation costs (including equipment's, instrumentation, piping, electrical installation and other utilities), working capital investments. Manufacturing costs- Direct Production costs (including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties etc.), fixed charges (including depreciation, taxes, insurance, rental costs etc.), Administration, safety and other auxiliary services, payroll overheads, warehouse and storage facilities etc.
LO: To estimate various cost effecting parameters.
LA: Assessment by analysis on case studies.

UNIT IV: PROFITABILITY ANALYSIS

Profitability Analysis- returns on original investment, interest rate of return, accounting for uncertainty and variations and future developments.
LO: To understand the analysis of profitability and accounting.
LA: Assessment by implementing these strategies for product development.

UNIT V: OPTIMIZATION

Optimization techniques - Linear and Dynamic programming, Optimization strategies.
LO: To demonstrate optimization techniques and various strategies.
LA: Assessment by analyzing the programming and strategies of optimization.

UNIT VI: PATENTS, IPR AND IPP

Patent concept and its composition and protection of right and their limitation and IPR (Intellectual property rights). Intellectual property protection.
LO: To illustrate the various patent concepts and their limitations.
LA: Assessment by implementing the concepts and various other protection rights.

TEXT BOOKS:

1. Peters and Timmerhkus, Plant design and Economics for Chemical Engineers, 5th Edition, McGraw Hill, 2003.
2. Rudd and Watson, Strategy of Process Engineering, Wiley. 1987

REFERENCE:

1. Ganguli, Gearing Up For Patents, The Indian Scenario, Universities Press, 2001.

IV Year – II SEMESTER

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ELECTIVE – IV

BIOPHARMACEUTICAL TECHNOLOGY

UNIT I: INTRODUCTION TO PHARMACEUTICALS

History & Definition of Drugs. Sources of Drugs - Plant, Animals, Microbes and Minerals. Different dosage forms. Routes of drug administration.
LO: To illustrate the various sources of drugs and its administration routes.
LA: Assessment by analyzing the routes of drug administration.

UNIT II: PHARMACODYNAMICS

Physio-Chemical Principles, Pharmacodynamics- Mechanism of drug action, drug receptors, and Physiological receptors- structural and functional families.
LO: To demonstrate the mechanism of drug action and physiological receptors.
LA: Assessment by demonstrating pharmacodynamics role in drug action.

UNIT III: PHARMACOKINETICS

Pharmacokinetics- Drug absorption, factors that affect the absorption of drugs, Distribution of drugs, Biotransformation of drugs, Bioavailability of drugs
LO: To demonstrate the factors effecting drug absorption and biotransformaton.
LA: Assessment by analyzing the pharmacokinetic aspects of drug.

UNIT IV: DRUG MANUFACTURING PROCESSES

Good manufacturing practices, manufacturing facilities, sources of Biopharmaceutical. Production & analysis of Biopharmaceuticals.
LO: To understand Good manufacturing practices and production of biopharmaceutical products.
LA: Assessment by demonstrate the production of biopharmaceuticals.

UNIT V: PRODUCTION OF BIOPHARMACEUTICALS AND APPLICATION

Production of Therapeutic Proteins, Hormones, Cytokines-Interferons, Interleukins I & II, Tumor Necrosis Factor (TNF); Nucleic acids. Role of Biopharmaceuticals in treatment of various health disorders.
LO: To understand the production of pharmaceutically important compounds and their applications.
LA: Assessment by ability to demonstrate the production of therapeutically important compounds.

UNIT VI: DRUG DELIVERY SYSTEMS, BIOMATERIALS AND THEIR APPLICATIONS

Controlled and sustained delivery of drugs. Biomaterial for the sustained drug delivery. Liposome mediated drug delivery. Drug delivery methods for therapeutic proteins.
LO: To understand the methodologies of drug delivery.
LA: Assessment by the ability to demonstrate different methods of drug delivery.

TEXTBOOKS

1. Gary Walsh, Biopharmaceuticals: Biochemistry & Biotechnology, 2nd edition John Wiley & Sons Ltd, 2010.
2. Remington's Pharmaceutical sciences, Mark Publications & Company, 1990.
3. Leon Lachman, Lea & Febiger, Theory & Practice of Industrial Pharmacy, 3rd edition, CBS Publishers, 2010.

REFERENCES

1. Michael. E. A & Kevin Taylor, Pharmaceutics, 2nd edition, Churchill Livingstone, 2001.
2. Roger Walker, Clinical Pharmacy, 3rd edition, Churchill Livingstone, 2002.

PROTEIN ENGINEERING (ELECTIVE – IV)

UNIT I: INTRODUCTION TO PROTEIN STRUCTURE

Introduction; Basic structural principles: amino acids and their conformational accessibilities, Ramachandran Plot; Motifs of protein structures and their packing; Schematic and topology diagrams; Families of protein structures: alpha, alpha/beta,beta, small etc.

LO: To give an introduction about protein structure and various parameters associated with it.

LA: Assessment by ability to demonstrate the structure of protein by various plots.

UNIT II: PROTEIN FOLDING AND ASSEMBLY

Protein folding pathways in prokaryotes and eukaryotes; Single and multiple folding pathways; Protein folding of single domain and multi-domain proteins; Inclusion bodies and recovery of active proteins; Osmolyte assisted protein folding; Structure of chaperones and role of chaperones in protein folding.

LO: To study the concepts of protein folding and its pathways.

LA: Assessment by demonstrating the protein folding pathway of a given protein.

UNIT III: PROTEIN STRUCTURES DESIGN AND PREDICTION

Similar structure and function of homologous proteins; Role of multiple alignment; Homology and ab-initio method for protein structure prediction; Phage display systems; Structure based drug design and case studies, Rational protein design.

LO: To study the protein structure design and homology.

LA: Assessment by ability to identify homology between different protein structures by various methods.

UNIT IV: PROTEIN EXPRESSION/PURIFICATION, BIOPHYSICAL CHARACTERIZATION

Different aspects of protein expression in eukaryotes and prokaryotes. Protein separation techniques: PAGE analysis, ion-exchange, size-exclusion and affinity chromatography techniques HPLC, FPLC, LC-MS etc. Protein activity analysis; biophysical characterization.

LO: To study various techniques for the purification and expression of proteins.

LA: Assessment by ability to purify the given protein by using the above mentioned techniques.

UNIT V: PROTEIN ENGINEERING

Strategies for protein engineering; Random and site-directed mutagenesis; Various PCR based strategies; Role of low-fidelity enzymes in protein engineering; Gene shuffling and Directed evolution of proteins; Protein backbone changes; Antibody engineering; All topics will deal with case studies.

LO: To study different strategies involved in protein engineering.

LA: Assessment by the ability to identify a proper strategy for a specific protein engineering.

UNIT VI: PROTEIN DATABASES

Different databases and their uses. Protein structure on the World Wide Web.

LO: To study various protein databases and importance of world wide web.

LA: Assessment by ability to utilize the structural and functional information present in these protein databases.

TEXT BOOKS

1. David Whitford, Proteins: Structure and Function, Wiley press, 2005.
2. Lilia Alberghina, Protein engineering in Industrial biotechnology, Harwood Academic Publishers, 2002.

REFERENCES

1. Carl Branden and John Tooze, Introduction to Protein structure, 2nd Ed, Garland Press, 1999.
2. Alan Fersht, Structure and Mechanism in Protein Science, Freeman, 1999.

BIOPROCESS OPTIMIZATION (ELECTIVE – IV)

UNIT I: BASIC CONCEPT

Overview of experimental design in biological processes, understanding of variables in biological processes.
LO: To determine the experimental design in biological process.
LA: Assessment by analyzing the basic concepts of biological processes.

UNIT II: OPTIMIZATION APPROACHES

Non-statistical, statistical and numerical optimization-fundamental theory.
LO: To understand the optimization approaches.
LA: Assessment by demonstrate the optimization approaches.

UNIT III: STATISTICAL AND NON-STATISTICAL OPTIMIZATION

First order and second order designs, differences in approaches, general response surface analysis. Self –directing optimization, case studies with single response and multi response analysis. Statistical experimental procedures for plckett-burman taguchi's designs.
LO: To understand statistical and non-statistical optimization approaches.
LA: Assessment by ability to implement these approaches in case studies.

UNIT IV: DETERMINATION OF OPTIMAL CONDITIONS

Method of Ridge analysis, Nelder-Mead simplex method, optimization of multi response biological systems.
LO: To demonstrate optimization methods for multi response biological systems.
LA: Assessment by evaluating and comparing the output from these methods.

UNIT V: MIXTURE DESIGNS AND ANALYSIS

Simple, lattice arrangement and their associated models.
LO: To study arrangement and their associated models.
LA: Assessment by analysis of the lattice models.

UNIT VI: VARIANCE AND DESIGN

Variance minimizing design, mixed variable and multi response generalized distance function approaches for multi response optimization.
LO: To understand variance and design approaches for multi response optimization
LA: Assessment by analyzing the designs of optimization approaches for multi response systems.

TEXT BOOKS

1. B.volesky and J .votruba,Modelling optimization of fermentation processes, Elsevier Amsterdam, 1992.
2. A. I. Khruri and J. A. Cornell,Response surface – design and optimization, Newyork, 2006.

REFERENCES

1. Vassilios & Banga, Dynamic optimization, 1st edition, John Wiley & sons, 2002.
2. Dbalina Sen Gupta & Ralph. P. wiker, Chemicals from Bomass, 1st edition, CRC Press, 2012.

IV Year – II SEMESTER

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