GITAM UNIVERSITY

(Declared as Deemed to be University U/S 3 of UGC Act, 1956)

REGULATIONS & SYLLABUS

OF

B.Tech. (Biotechnology)

(w.e.f 2012 -13 admitted batch)

Gandhi Nagar Campus, Rushikonda

VISAKHAPATNAM – 530 045

Website: www.gitam.edu

REGULATIONS

(w.e.f 2012-13 admitted batch)

1.0 ADMISSIONS

1.1 Admissions into B.Tech. (Biotechnology) programme of GITAM University are governed by GITAM University admission regulations.

2.0 ELIGIBILTY CRITERIA

2.1 A pass in 10+2 or equivalent examination approved by GITAM University with Physics, Chemistry and Mathematics or Biology.

2.2 Admissions into B.Tech. will be based on an All India Entrance Test conducted by GITAM University and the rule of reservation, wherever applicable.

3.0 STRUCTURE OF THE B.Tech. PROGRAMME

3.1 The Programme of instruction consists of:

(i) A general core programme comprising Basic Sciences, Basic Engineering, Humanities & Social Sciences and Mathematics.
(ii) An engineering core programme imparting to the student the fundamentals of engineering in the branch concerned.
(iii) An elective programme enabling the students to take up a group of departmental/interdepartmental courses of interest to him/her.

In addition, a student has to

(i) carry out a technical project approved by the department and submit a report.
(ii) undergo summer training in an industry for a period prescribed by the department and submit a report.

3.2 Each academic year consists of two semesters. Every branch of the B.Tech programme has a curriculum and Course content (syllabi) for the courses recommended by the Board of Studies concerned and approved by Academic Council.

4.0 CREDIT BASED SYSTEM

4.1 Each Course is assigned certain number of credits which will depend upon the number of contact hours (lectures & tutorials) per week.

4.2 In general, credits are assigned to the courses based on the following contact hours per week per semester.
One credit for each Lecture / Tutorial hour.

One credit for two hours of Practicals.

Two credits for three (or more) hours of Practicals.

4.3 The curriculum of B.Tech programme is designed to have a total of 190 to 200 credits for the award of B.Tech degree.

4.4 Every Course of the B Tech programme will be placed in one of the nine groups of courses with minimum credits as listed in the Table 1.

Table 1: Group of Courses

S.No,	Group of Courses	Code	Minimum credits
1	Humanities & Social Sciences	HS	12
2	Basic Sciences	BS	17
3	Mathematics	MT	10
4	Basic Engineering	BE	26
5	Core Engineering	CE	68
6	Departmental Elective	DE	9
7	Inter Departmental Elective	IE	8
8	Project Work	PW	8
9	Industrial Training	IT	2
Total			160

5.0 MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6.0 REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute / University.

7.0 CONTINUOUS ASSESSMENT AND EXAMINATIONS

7.1 The assessment of the student's performance in each Course will be based on continuous internal evaluation and semester-end examination. The marks for each of the component of assessment are fixed as shown in the Table 2.

Table 2: Assessment Procedure

S.No.	Component of assessment	Marks allotted	Type of Assessment	Scheme of Examination
1	Theory	40	Continuous evaluation	(i) Three mid semester examinations shall be conducted for 15 marks each. Best two examinations will contribute towards a maximum of 30. (ii) Balance of 10 marks are to be awarded by Teacher assessment based on Assignments, Quiz, Class tests and daily assessment.
		60	Semester-end exam	The semester-end examination in theory courses will be for a maximum of 60 marks.
	Total	100		
2	Practicals	100	Continuous evaluation	(i) 40 marks are allotted for record work and regular performance of the student in the lab. (ii) One examination for a maximum of 20 marks shall be conducted by the teacher handling the lab Course at the middle of the semester (iii) One examination for a maximum of 40 marks shall be conducted at the end of the semester (as scheduled by the Head of the Department concerned).
3	Project work (VII & VIII semester)	100	Project evaluation	(i) 50 marks are allotted for continuous evaluation of the project work throughout the semester by the guide. (ii) 50 marks are allotted for the presentation of the project work & viva-voce at the end of the semester.*
4	Industrial Training (VII semester)	100	Industrial training evaluation	(i) 50 marks are allotted for report submission and seminar presentations after completion of the training. (ii) 50 marks are allotted for the viva-voce at the end of the semester.*
5	Comprehensive Viva (VIII semester)	100	Viva-voce	100 marks are allotted for comprehensive viva to be conducted at the end of programme.*

* Head of the Department concerned shall appoint two examiners for conduct of the examination.

8.0 RETOTALLING, REVALUATION & REAPPEARANCE

8.1 Retotalling of the theory answer script of the end-semester examination is permitted on a request made by the student by paying the prescribed fee within ten days of the announcement of the result.

8.2 Revaluation of the theory answer script of the end-semester examination is also permitted on a request made by the student by paying the prescribed fee within fifteen days of the announcement of the result.

8.3 A Student who has secured 'F' Grade in any theory Course / Practicals of any semester shall have to reappear for the semester end examination of that Course / Practicals along with his / her juniors.

8.4 A student who has secured 'F' Grade in Project work / Industrial Training shall have to improve his report and reappear for viva – voce Examination of project work at the time of special examination to be conducted in the summer vacation after the last academic year.

9.0 SPECIAL EXAMINATION

9.1 A student who has completed the stipulated period of study for the degree programme concerned and still having failure grade ('F') in not more than 5 courses (Theory / Practicals), may be permitted to appear for the special examination, which shall be conducted in the summer vacation at the end of the last academic year.

9.2 A student having 'F' Grade in more than 5 courses (Theory/Practicals) shall not be permitted to appear for the special examination.

10.0 ATTENDANCE REQUIREMENTS

10.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He /She has to repeat the semester along with his / her juniors.

10.2 However, the Vice Chancellor on the recommendation of the Principal / Director of the University College / Institute may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine medical grounds and on payment of prescribed fee.

11.0 GRADING SYSTEM

11.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table 3.

Table 3: Grades & Grade Points

Grade	Grade points	Absolute Marks
O	10	90 and above
A+	9	80 – 89
A	8	70 – 79
B+	7	60 – 69
B	6	50 – 59
C	5	40 – 49
F	Failed, 0	Less than 40

11.2 A student who earns a minimum of 5 grade points (C grade) in a Course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course. However, a minimum of 24 marks is to be secured at the semester end examination of theory courses in order to pass in the theory course.

12.0 GRADE POINT AVERAGE

12.1 A Grade Point Average (GPA) for the semester will be calculated according to the formula:

$$GPA = \frac{\Sigma [C \times G]}{\Sigma C}$$

Where

C = number of credits for the course,

G = grade points obtained by the student in the course.

12.2 Semester Grade Point Average (SGPA) is awarded to those candidates who pass in all the subjects of the semester.

12.3 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student's performance in all the courses taken in all the semesters completed up to the particular point of time.

12.4 The requirement of CGPA for a student to be declared to have passed on successful completion of the B.Tech programme and for the declaration of the class is as shown in Table 4.

Table 4: CGPA required for award of Degree

Distinction	**≥ 8.0***
First Class	**≥ 7.0**
Second Class	**≥ 6.0**
Pass	**≥ 5.0**

* In addition to the required CGPA of 8.0, the student must have necessarily passed all the courses of every semester in **first attempt**.

13.0 ELIGIBILITY FOR AWARD OF THE B.TECH DEGREE

13.1 **Duration of the programme**:

A student is ordinarily expected to complete the B. Tech. programme in eight semesters of four years. However a student may complete the programme in not more than six years including study period.

13.2 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

13.3 A student shall be eligible for award of the B.Tech degree if he / she fulfils all the following conditions.

a) Registered and successfully completed all the courses and projects.

b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.

c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc, and

d) No disciplinary action is pending against him / her.

13.4 The degree shall be awarded after approval by the Academic Council.

RULES

1. With regard to the conduct of the end-semester examination in any of the practical courses of the programme, the Head of the Department concerned shall appoint one examiner from the department not connected with the conduct of regular laboratory work, in addition to the teacher who handled the laboratory work during the semester.

2. In respect of all theory examinations, the paper setting shall be done by an external paper setter having a minimum of three years of teaching experience. The panel of paper setters for each Course is to be prepared by the Board of Studies of the department concerned and approved by the Academic Council. The paper setters are to be appointed by the Vice Chancellor on the basis of recommendation of Director of Evaluation / Controller of Examinations.

3. The theory papers of end-semester examination will be evaluated by internal/external examiner

4. Panel of examiners of evaluation for each Course is to be prepared by the Board of Studies of the department concerned and approved by the Academic Council.

5. The examiner for evaluation should possess post graduate qualification and a minimum of three years teaching experience.

6. The appointment of examiners for evaluation of theory papers will be done by the Vice Chancellor on the basis of recommendation of Director of Evaluation / Controller of Examinations from a panel of examiners approved by the Academic Council.

7. The number and selection of electives may be restricted based on availability of faculty and other resources. Choice of electives will be decided at the end of 2nd Year based on student aptitude, student interest and Counseling by Faculty of the Department of Biotechnology.

8. Maximum of 5 marks will be awarded for regularity (daily class test and/or attendance) :

SYLLABUS

B.Tech. (BT) Programme Code: EURBT 20103

I SEMESTER

Sl. No.	Course Code	Name of the Course	Cate-gory	Scheme of Instruction		Scheme of Examination			Credits to be awarded
				Hours per week		Dura-tion in Hrs.	Maximum Marks		
				L/T	D/P		Sem. End Exam	Con. Eval.	
1	EUREG 101	Engg.English - I	HS	3	---	3	60	40	3
2	EURPH 103	Engg. Physics-I #	BS	4	---	3	60	40	4
3	EURCS 105	Programming with C #	BE	3	---	3	60	40	3
4	EURBT 106 / EURMT 106	Bridge Course-I ** Fundamentals of Biology-I **or** Maths-I	BC	4	---	3	60	40	3
5	EURCH 107	Inorganic Chemistry	BS	3	---	3	60	40	3
PRACTICALS									
6	EURIE 111/211	Workshop Practice #	BE	---	3	3	-	100	2
7	EURPH 112/212	Engg. Physics Lab #	BS	---	3	3	-	100	2
8	EURCS 113	Programming with C Lab #	BE	---	3	3	-	100	2
9	EURCH 116	Inorganic & Physical Chemistry Lab	BS	---	3	3	-	100	2
		Total		17	12	-	300	600	24

****** Biology for MPC stream in 10+2 and Mathematics for BPC stream in 10+2.
\# Common with other branches of Engineering.
L – Lectures T – Tutorials D – Drawing P – Practicals

B.Tech. (BT)II SEMESTER

Sl. No	Course Code	Name of the Course	Cate-gory	Scheme of Instruction		Scheme of Examination			Credits to be awarded
				Hours per week		Durati on in Hrs	Maximum Marks		
				L/T	D/P		Sem. End Exam	Con. Eval.	
1	EUREG 201	Engineering English - II	HS	3	---	3	60	40	3
2	EURPH 204	Engg. Physics-II #	BS	3	---	3	60	40	3
3	EURCS 206	Object Oriented Programming with C++ #	BE	3	---	3	60	40	3
4	EURBT 207 / EURMT 207	Bridge Course-II ** Fundamentals of Biology-II or Maths-II	BC	4	---	3	60	40	3
5	EURCH 208	Physical Chemistry	BS	3	--	3	60	40	3
6	EURCH 209	Organic Chemistry	BS	4	---	3	60	40	4
7	EURBT210	Engineering Drawing	BE	1	3	3	60	40	3
PRACTICALS									
8	EURCS 213	Object Oriented Programming with C ++ Lab #	BE	---	3	3	-	100	2
9	EURCH 216	Organic Chemistry Lab	BS	---	3	3	-	100	2
		Total		21	9	-	420	480	26

****** Biology for MPC stream in 10+2 and Mathematics for BPC stream in 10+2.
\# Common with other branches of Engineering.

B.Tech. (BT)III Semester

Course code	Name of the course	Category	Credits	Marks			Hours per week			
				Semester End Exam	Con. Eval	Total	L	T	P	Total
EURBT 301	Engg. Mathematics-I	MT	4	60	40	100	3	1	-	4
EURBT 302	Biochemistry	BS	3	60	40	100	3	-	-	3
EURBT 303	Bioanalytical techniques	BS	3	60	40	100	3	-	-	3
EURBT 304	Microbiology	BS	3	60	40	100	3	-	-	3
EURBT 305	Thermodynamics	BE	3	60	40	100	3	-	-	3
EURBT 306	Chemical process calculations	CE	3	60	40	100	3	-	-	3
EURBT 311	Microbiology Laboratory	BS	2	-	100	100	-	-	3	3
EURBT 312	Biochemistry and BAT Laboratory	BS	2	-	100	100	-	-	3	3
Total			**23**	**360**	**440**	**800**				

B.Tech. (BT) IV Semester

Course code	Name of the Course	Category	Credits	Marks			Hours per week			
				Semester End Exam	Con Eval	Total	L	T	P	Total
EURBT 401	Engg. Mathematics-II	MT	3	60	40	100	3	-	-	3
EURBT 402	Heat transfer	CE	3	60	40	100	3	-	-	3
EURBT 403	Mechanical operations	CE	3	60	40	100	3	-	-	3
EURBT 404	Fluid mechanics	CE	3	60	40	100	3	-	-	3
EURBT 405	Fermentation technology	CE	3	60	40	100	3	-	-	3
EURBT 406	Environmental studies	HS	4	60	40	100	3	1	-	4
EURBT 411	Fermentation technology Laboratory	CE	2	-	100	100	-	-	3	3
EURBT 412	Fluid mechanics & MO laboratory	CE	2	-	100	100	-	-	3	3
EURBT 413	Industrial Tour	IT	Non Credit Audit Course							
Total			**23**	**360**	**440**	**800**				

B.Tech. (BT)V Semester

Course code	Name of the Course	Cate-gory	Credits	Marks			Hours per week			
				Sem End	Con Eval	Total	L	T	P	Total
EURBT 501	Engg. Mathematics-III	MT	3	60	40	100	3	-	-	3
EURBT 502	Genetics & Molecular Biology	BS	3	60	40	100	3	-	-	3
EURBT 503	Mass transfer	CE	3	60	40	100	3	-	-	3
EURBT 504	Genetic engineering	CE	4	60	40	100	3	1	-	4
EURBT 505	Engg. Economics and entrepreneurship	HS	3	60	40	100	3	-	-	3
EURBT 506	Environmental biotechnology	CE	3	60	40	100	3	-	-	3
EURBT 511	Genetic engineering laboratory	CE	2	-	100	100	-	-	3	3
EURBT 512	Heat and Mass transfer laboratory	CE	2	-	100	100	-	-	3	3
EURBT 513	English Communication skills Lab	HS	2	-	100	100	-	-	3	3
EURBT 514	Personality Development								No	Credits
Total			**25**	**360**	**540**	**900**				

B.Tech. (BT) VI Semester

Course code	Name of the Course	Cate-gory	Credits	Marks			Hours per week			
				Sem End	Con Eval	Total	L	T	P	Total
EURBT 601	Bioinformatics	BE	3	60	40	100	3	-	-	3
EURBT 602	Medical biotechnology & Immunology	CE	3	60	40	100	3	-	-	3
EURBT 603	Electrical ciruits and Electronics	BE	4	60	40	100	3	1	-	4
EURBT 604	Chemical reaction engineering	CE	3	60	40	100	3	-	-	3
EURBT 605	Pharmaceutical Biotechnology	CE	3	60	40	100	3	-	-	3
EURBT 606	Enzyme technology	CE	4	60	40	100	3	1	-	4
EURBT 611	Chemical reaction engineering Laboratory	CE	2	-	100	100	-	-	3	3
EURBT 612	Bioinformatics lab	BE	2	-	100	100	-	-	3	3
Total			**24**	**360**	**440**	**800**				

B.Tech (BT) VII Semester

Course code	Name of the Course	Category	*Credits*	Marks			Hours per week			
				Semester End Exam	Con. Eval	Total	L	T	P	Total
EURBT 701	Bioprocess engineering	CE	3	60	40	100	3	-	-	3
EURBT 702	Process dynamics and control	CE	3	60	40	100	3	-	-	3
EURBT 703	Downstream processing	CE	3	60	40	100	3	-	-	3
EURBT 721 - 723	Departmental elective-I	DE	3	60	40	100	3	-	-	3
EURBT 731-733	Departmental elective-II	DE	3	60	40	100	3	-	-	3
EURIE 711	PDC lab	CE	2	-	100	100	-	-	3	3
EURBT 712	Bioprocess engineering Laboratory	CE	2	-	100	100	-	-	3	3
EURBT 713	Industrial training	IT	2	-	100	100	-	-	3	3
EURBT714	Project	PW	3	50	50	100	-	-	-	-
Total			**24**	**350**	**550**	**900**				

B Tech (BT) VIII Semester

	Name of the Course	Category	*Credits*	Marks			Hours per week			
				Semester End Exam	Con. Eval	Total	L	T	P	Total
EURBT 801	Bioreactor design	CE	3	60	40	100	3	-	-	3
EURBT 802	Plant Biotechnology	CE	3	60	40	100	3	-	-	3
EURBT 852- 859	Interdepartmental Elective I	IE	4	60	40	100	4	-	-	4
EURBT 863- 8610	Interdepartmental Elective II	IE	4	60	40	100	4	-	-	4
EURBT 841-843	Departmental elective III	DE	3	60	40	100	3	-	-	3
EURBT 811	Plant Biotechnology Lab	BE	2	-	100	100	-	-	3	3
EURBT812	Project	PW	5	50	50	100	-	-	-	-
EURBT813	Comprehensive Viva	CE	2	50	-	50				
Total			**26**	**400**	**350**	**750**				

*** Inter Departmental Elective will be from other departments. The list of courses that would be offered by the department in any semester will be notified from which the student may select a course.**

B Tech (BT)

ELECTIVES

Name of the course	Course code
DEPARTMENTAL ELECTIVES (3)	
Departmental elective I	
Genetics, Genomics & Proteomics	EURBT 721
Marine biotechnology	EURBT 723
Departmental elective II	
Molecular modeling and drug design	EURBT 732
Industrial Instrumentation	EURBT 733
Food processing technology	EURBT 731
Departmental elective III	
Clinical biochemistry and clinical trials	EURBT 841
Modeling and simulation in biotechnology	EURBT 842
Biological programming	EURBT 843
INTERDEPARTMENTAL ELECTIVES (2)	
Interdepartmental elective I	
DBMS	EURBT 852
Entrepreneurial biotechnology	EURBT 853
Bioelectronics	EURBT 859
Interdepartmental elective II	
Web technologies and networking	EURBT 863
Biomedical Instrumentation	EURBT 868
Agricultural engineering	EURBT 864
Nanotechnology	EURBT 8610

B Tech (BT)

Details of category wise minimum credits as per AICTE norms and actual credits allocated are as follows:

S.No.	Category	Code	Allocated Credits	Minimum Credits as per AICTE
01.	Humanities & Social Sciences	HS	15	12
02.	Basic Sciences	BS	39	17
03.	Maths	MT	10	10
04.	Basic Engg.	BE	29	26
05.	Core Engg.	CE	71	68
06.	Departmental Electives	DE	09	09
07.	Inter-Departmental Elective	IE	08	08
08.	Project Work	PW	08	08
09.	Industrial Training	IT	02	02
	Bridge courses	BC	06	
Total			197	160

B.Tech. (BT) First Semester

EUREG 101: ENGINEERING ENGLISH-I

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con. Eval.	
EUREG 101	HS	3	---	3	60	40	3

Unit – I : Introduction to Communication

Role and Importance of Communication, Features of Human Communication

Process of Communication, Types of Communication: Verbal and Non-Verbal

Importance of Listening in Effective Communication, Barriers to Communication

Unit – II :Effective Vocabulary

Words Often Confused, One-word Substitutes, Idiomatic Usage, Using Dictionary and Thesaurus

Unit – III :Functional Grammar

Functions: Making proposals, Offering suggestions, Apologizing, Requesting, Offering and Refusing help, Giving and asking for information, Making complaints, Interrupting, Giving and asking directions, Inviting, Asking Permission, Expressing ability, etc.,

Articles, Prépositions, Tenses , Concord

Unit – IV: Communication through Writing

Paragraph writing

Communication through letters: official and personal letters, letters of complaint, letters of enquiry and responses.

Résumé writing, Cover letters, E-mail etiquette, Punctuation

Unit – V:Reading for Enrichment

Sachin Tendulkar, Michael Jackson

Text Books Prescribed:

1. E. Suresh Kumar et al., Enriching Speaking and Writing Skills, Orient Blackswan, 2012.

Reference Books:

1. E. Suresh Kumar et al., Communication Skills and Soft Skills, Pearson, 2010.
2. Jayashree Mohanraj et al., Speak Well, Orient Black Swan, 2011.
3. Oxford Advanced Learners' Dictionary, 2010 Edition.

B.Tech. (BT) First Semester
EURPH 103: ENGINEERING PHYSICS – I

Code No.	Category	Scheme of instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con. Eval.	
EURPH 103	BS	4	---	3	60	40	4

The aim of the course is to impart knowledge in basic concepts of Physics relevant to Engineering applications.

UNIT - I (9 hours)

THERMODYNAMICS: Heat and Work - First Law of Thermodynamics and Applications - Reversible and Irreversible Processes - Carnot's Cycle and Efficiency - Second Law of Thermodynamics - Carnot's Theorem - Entropy - Entropy in Reversible and Irreversible Processes - Entropy and Second Law - Entropy and Disorder - Third Law of Thermodynamics.

UNIT - II (10 hours)

ELECTROMAGNETIC OSCILLATIONS AND ALTERNATING CURRENTS: Energy Stored in a Capacitor and an Inductor - LC Oscillations (Qualitative and Quantitative) - Analogy to Mechanical Motion-Damped Oscillations - Damped Oscillations in an RLC Circuit - Alternating Current (Including Equations for Voltages and Currents) - Fundamental Definitions - (Cycle, Time period, Frequency, Amplitude, Phase, Phase Difference, Root Mean Square (RMS) value, Average Value, Form Factor, Quality Factor, Power in Alternating Current Circuits) - Forced Oscillations and Resonance - The Series RLC Circuit.

ELECTROMAGNETIC WAVES: Induced Magnetic Fields - Displacement Current - Maxwell's Equations - Traveling Waves and Maxwell's Equations - The Poynting Vector - Light and the Electromagnetic Spectrum.

UNIT-III (8 hours)

DIELECTRIC PROPERTIES: Introduction - Fundamental Definitions - Local Field - Claussius-Mossotti Relation -Different Types of Electric Polarizations (electronic, ionic, and dipolar polarizations) - Frequency and Temperature Effects on Polarization - Dielectric Loss - Dielectric Breakdown - Determination of Dielectric Constant - Properties and Different Types of Insulating Materials - Ferroelectric Materials - Spontaneous Polarization in $BaTiO_3$ - Electrets.

UNIT-IV (8 hours)

MAGNETIC PROPERTIES: Introduction - Fundamental Definitions - Different Types of Magnetic Materials - Weiss Theory of Ferromagnetism - Domain Theory of Ferromagnetism – Hysteresis - Hard and Soft Magnetic Materials - Ferrites - Microwave Applications - Magnetic Bubbles.

UNIT-V (9 hours)

SUPERCONDUCTIVITY : Introduction - BCS Theory - Meissner Effect - Properties of Superconductors - Type-I and Type-II Superconductors - High T_c Superconductors - Applications.

ULTRASONICS: Introduction - Production of Ultrasonics by Magnetostriction and Piezo-electric Effects - Detection and Applications of Ultrasonics.

Prescribed Books :

Physics part I & II Resnick, Halliday, Krane. John Wiley & Sons.
Engineering.Physics P.K.Palani samy. Scitech Publications (India) Pvt Ltd., Chennai

Reference Books:

Heat, Thermodynamics, and Statistical Physics Agarwal, Singhal, Satya Prakash. Pragati Prakashan, Meerut.
Solid StatePphysics S.O.Pillai. New Age International (P)Limited, New Delhi.
Materials Science M. Arumugam. Anuradha Agencies, Kumbhakonam.
A Text Book of Engg. Physics Kshirsagar & Avadhanulu. S.Chand and Co.
The Feynman Lectures on Physics Addison-Wesley.

Note: The figures in parentheses indicate approximate number of expected hours of instruction.

B.Tech. (BT)First Semester

EURCS 105: CS116: PROGRAMMING with C

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con. Eval.	
EURCS 105	BE	3	---	3	60	40	3

UNIT – I (8 periods)

Algorithm, flowchart, program development steps, structure of C program, Compilers, Linker, Preprocessor, identifiers, basic data types and sizes, Constants, variables, operators, expressions, type conversions, conditional expressions, precedence and order of evaluation. Input-output statements, statements and blocks, programming examples.

UNIT – II (8 periods)

Control Structures: if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels.

Designing structured programs, Functions, basics, parameter passing, block structure, user defined functions, standard library functions, recursive functions, Comparison of Iteration and Recursion, header files, C preprocessor, storage classes- extern, auto, register, static, scope rules, example c programs.

UNIT – III (8 periods)

Arrays: concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays.

Pointers: concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory management functions, command line arguments, c program examples.

UNIT – IV (8 periods)

Strings: What are Strings, Arrays of Strings and Standard Library String Functions.

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, bitfields, C program examples.

UNIT – V (8 periods)

Input and output - concept of a file, , File Structure , text files and binary files, streams, standard I/O, Formatted I/O, file I/O operations, error handling, C program examples.

Text Books:

1. Computer science, A structured programming approach using C, B.A. Forouzan and R.F. Gilberg, Third edition, Thomson.
2. MASTERING C, byK R Venugopal, S R Prasad published by Tata McGraw Hill.

Reference Books:

1. Programming with ANSI and Turbo C by Ashok N. Kamthane, published by PEARSON Education
2. Let us C by Yashwant Kanetkar, published by BPB Publications.

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B.Tech. (BT)First Semester
Bridge Course – I (MPC Stream)

EURBT106: FUNDAMENTALS OF BIOLOGY-I

Code: EURBT 106 **Category : BC**

Credits: 3 **Hours : 4 per week**

Department: Biotech

The aim of the Course is to impart knowledge in Basic Concepts of Biology relevant to Biotechnological applications.

UNIT-I

Cell Biology: (7 hours)

Structure and function of prokaryotic and eukaryotic cell. Cell organelles – Cell membrane, Chloroplast, Mitochondria, Golgi complex, Endoplasmic reticulum, Lysosomes, Ribosomes and Nucleus, Chromosome structure, Mitosis and Meiosis.

UNIT-II

Anatomy: (8 hours)

Structure and function of xylem and phloem, internal structure of dicot root, stem and leaf, monocot root, stem and leaf, Secondary growth of dicot stem.

Parts of Flowering Plant: (2 hours)

Flower – Structure of a typical flower, outline description of floral parts – Perianth, Andorecium, Gynoecium.

UNIT-III

Embryology: (4 hours)

Structure of anther, microsporogenesis and development of male gametophyte. Structure of ovule, megasporogenesis, development of embryo-sac, Fertilization and process of fertilization. Post fertilization changes.

Plant Breeding: (4 hours)

Method of Plant Breeding – Selection, Hybridization, Hybrid vigour and Mutation breeding.

UNIT-IV

Plant Physiology: (8 hours)

Water relations of plants: Absorption of water by plants, diffusion, water potential, osmosis, plasmolysis, imbibition, active and passive absorption.

Mineral nutrition: Criteria for essentiality, macroelements (Nitrogen, Phosphorus and Potassium) and microelements.

Plant Growth Regulators: (3 hours)

Auxins, Gibberlins, Cytokinins, Abscic acid and Ethylene.

UNIT-V

Photosynthesis: (6 hours)

Photosynthetic pigments, light reaction – Emerson enhancement effect, Photosystem I and II, Photolysis of water, Photophosphorylation, CO_2 fixation – C_3 C_4 and CAM pathway, Photorespiration, Factors affecting photosynthesis – Blackman's Law of limiting factors.

Nitrogen Metabolism: (3 hours)

Introduction, nitrogen cycle, biological nitrogen fixation.

Text Books Prescribed :

1. *Biology* text book for class XI and XII, NCERT.
2. T*ext book for Botany and Zoology at Intermediate*. AP Academy

Reference Books:

1. *Biology* - Raven and Johnson, Mc. Graw Hill.
2. *Biology – The Network of life*, M.C.Mix, P. Farber & K.I.King Harper Collins
3. *Biology Schaum serie*, George H.Fried, Mc. Graw Hill

Note: The figures in parentheses indicate approximate number of expected hours of Instruction.

B.Tech (BT) First Semester

Bridge Course-I,(BiPC Stream) Mathematics-I

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Sessionals	
EURMT 106	MT	3+1	--	03	60	40	03

The objective of the course is to impart knowledge in Basic concepts of Mathematics relevant to Engineering applications

Unit-I: Partial fractions (10)

Introduction – Resolving $\frac{f(x)}{g(x)}$ into partial fractions when g(x) contains non repeated linear factors, repeated linear factors, repeated and non-repeated irreducible quadratic factors

Unit-II: Trigonometry (12)

Trigonometric functions – graphs – periodicity – trigonometric ratio of compound angles, multiple and sub multiple angles – transformations – trigonometric equations. Brief introduction of inverse Trigonometric, Hyperbolic and inverse hyperbolic functions.

Unit-III: Complex numbers (10)

Complex number as an ordered pair of real numbers, representation of z = (a, b) in the form (a+ ib) – conjugate complex numbers – modulus and amplitude of a complex number – geometrical representation of a complex number – Argand plane – Argand diagram. Demoiver's theorem for integral index and rational index (without proof) – n^{th} roots of unity – Geometrical representation, cube roots of unity.

Unit-IV: Differential Calculus (12)

Limits & Continuity

Definition of right hand limit, left hand limit, limit. Limits of f + g, $\frac{f}{g}$, f o g (with out proof), standard limits

1) $\lim_{x \to a} \frac{x^n - a^n}{x - a}$ 2) $\lim_{\theta \to 0} \frac{\sin\theta}{\theta}$

3) $\lim_{n \to 0} \left[1 + \frac{1}{n}\right]^n$ 4) $\lim_{x \to 0} \frac{e^x - 1}{x}$ 5) $\lim_{x \to 0} \frac{a^x - 1}{x}$ (without proofs) : Definition of continuity and simple illustrations.

Differentiation: Introduction – definition – differentiation of a function at a point and on an interval – Derivative of a function – Differentiation of sum, difference, product and quotient of functions- Differentiation of algebraic, exponential, logarithmic functions - composite, implicit, parametric, hyperbolic and inverse hyperbolic functions- Logarithmic differentiation - derivative of a function with respect to another function. Derivatives of first and second order.

Unit-V: Co-ordinate Geometry – I (10)

Locus: Definition and Equation of Locus

Straight lines: Recapitulation of general equation of a straight line - forms of equation of a straight line: slope - intercept form, intercept form, point – slope form, Two point form. Normal form $x \cos \alpha + y \cos \alpha = P$, symmetric form $\frac{x - x_1}{\sin \theta} = \frac{y - y_1}{\cos \theta} = r$ – Reduction of general equation into different forms- point of intersection of two straight lines, family of straight lines. Line passing through the point of intersection of two given lines - condition for concurrency of three straight lines- angle between two intersecting lines, condition for perpendicularity and parallelism- length of the perpendicular from a point to a straight line, distance between two parallel lines. (Proofs of the theorems are not required)

Textbooks Prescribed :

1. *Intermediate Mathematics Volume I & II* , V.Venkateswara Rao, N.Krishna Murthy, B.V.S.Sharma, S.Chand& Company Ltd.

References :

A first Course in Mathematics for Engineers, Chandrika Prasad. Prasad Mudranakya, Allahabad

Note: The figures in parentheses indicate approximate number of expected hours of Instruction.

B. Tech (BT) First Semester

INORGANIC CHEMISTRY

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Sessionals	
EURCH 107	BS	3	---	3	60	40	3

The objective of the syllabus is to provide knowledge in the basic concepts of the Chemistry of Engineering materials.

Unit - I. (8 hours)

Periodic Table: Modern Periodic Table – Classification of elements -Periodic properties: atomic size, ionization energy, electron affinity, electronegativity,

Representative elements : General Properties and oxidation states of s and p block elements. Groups IA and IIA – Alkali and Alkaline earth metals : oxides-hydroxides – halides-carbonates and bicarbonates – anomalous behavior of lithium and beryllium – difference between IA and IIA.

Group IIIA – Boron family: oxides, halides and hydrides of boron – structure of diborane.

Group IVA – Carbon family: carbides – carbonyls – silicates – silicones.

Unit - II. (7 hours)

Group VA-Nitrogen family: hydrides – halides – oxides and oxyacids of nitrogen and phosphorous.

Group VIA-Oxygen family: halides – oxides and oxyacids of sulphur.

Group VIIA-Halogen family : Hydrogen halides – halogen oxides- oxyacids of chlorine – interhalogen compounds – pseudo halogens.

Unit - III. (7 hours) **Chemical Bonding :** Types of bonds, Molecular orbital theory – shapes and sign convention of atomic orbital, modes of overlapping, concepts of sigma and pi bonds, criteria for forming molecular orbital from atomic orbital, LCAO – Concept, types of molecular orbital – bonding, anti-bonding and non-bonding. Molecular orbital treatment for H_2, He_2, N_2 O_2, O_2^- O_2^{2-}, F_2, NO and CO.

Unit - IV. (7hours)

Transition elements: Oxidation states – colour – magnetic properties – complexes – comparison of the elements of second and third transition series with the first transition series. **Coordination Compounds :** Nomenclature, Werner's theory – Sidgwick's theory – effective atomic number (EAN) –valence bond and crystal field theory – splitting of d – orbital in Octahedral, tetrahedral and square planar complexes.

Unit - V. *(7 Hours)*

Analytical Chemistry: Titrimetric analysis, Classification of reactions in titrimetric analysis – standard solutions, Equivalents, Normalities and Oxidation numbers. Preparation of standard solutions, Primary and Secondary standards – Accuracy and Precision, Errors - classification of errors. Determinate and Indeterminate errors, absolute and relative error. Minimization of errors, significant figures – mean and standard deviation.

Prescribed Books:

Inorganic Chemistry:

1) Concise Inorganic Chemistry, 5th edition – Oxford: J.D.Lee., Blackwell Science Ltd., 2003.
2) University General Chemistry: an introduction to chemical science by C.N.R.Rao., - Madras: Macmillan, 1990.

Reference Books:

1) Advanced Inorganic chemistry - a comprehensive text by Albert F Cotton and Geoffrey Wilkinson – 5th edition – New Delhi: Wiley Eastern ltd.,
2) Principles of Inorganic Chemistry by B.R Puri, L.R. Sharma and K.C.Kalia, 29th edition – Delhi : Vallabh Publications 2004.
3) Advanced Inorganic Chemistry by F Albert, Cotton (etal), 6th edition – New York: Joh Wiley and sons, inc: 2003.

B.Tech (BT) First Semester

EURIE 111/211 WORKSHOP PRACTICE

Category	Maximum marks			Periods				Credits
	Semester End Exam	Con. Eval	Total	Lectures	Tutorials	Practicals	Total	
BE	60	40	100	--	--	3	3	2

The main aim of Workshop Practice is to acquaint the student with the basic tools used in Workshop Practice and to develop skills in using these tools to perform simple tasks. The students should be able to work with these tools to prepare simple jobs in Wood Work PRACTICE, Sheet Metal Working, Forging and Fitting.

An illustrative list of tasks to be performed by the student is given below:

I. Wood Working - Familiarity with different types of woods used and tools used in wood Working technology.

Tasks to be performed:

1) To make Half – Lap joint
2) To make Mortise and Tenon joint
3) To make Corner Dovetail joint
4) To make Briddle joint.

II. Sheet Metal Working – Familiarity with different types of tools used in sheet metal working, Developments of sheet metal jobs from GI sheets, knowledge of basic concepts of soldering.

Tasks to be performed:

1) To make Square Tray
2) To make Taper side Tray
3) To make Conical Funnel
4) To make Elbow Pipe.

III. Forging – Familiarity with different types of tools used in forging technology. Knowledge of different types of furnaces like coal fired, electrical furnaces etc...

Tasks to be performed:

1) To make round M.S rod to square rod
2) To make L bend in given M.S. Rod.
3) To make S bend in given M.S. Rod.
4) To perform heat treatment tests like annealing, Normalizing etc..

IV. Fitting – Familiarity with different types of tools used in fitting technology.

Tasks to be performed:

1) To make "V" – fitting
2) To make Rectangular fitting
3) To make Dovetail fitting
4) To make Semi circular fitting
5) To make Hexagon fitting

- Student is required to work individually and complete at least three jobs in each trade.

Dress Code:

- For Boys : Blue Colour Long Apron, Khaki Trousers, Half Sleeve Shirt (Tucked-in), Black Leather Shoes.
- For Girls: Blue Colour Long Apron, Salwar Suit, Black Shoes.

Reference Book:

1. Workshop Technology, Part 1, W.A.J. Chapman, Viva Low Priced Student Edition.

2. Elements of Workshop Technology, Volume 1, S.K.Hajra Choudhury, S.K.Bose.

3. A.K.Hajra Choudhury and Nirjhar Roy, Media Promoters and Publishers Pvt. Ltd.

B.Tech. (BT) First Semester

EURPH 212/112:ENGINEERING PHYSICS LAB

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
EURPH		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
212/112		L/T	D/P		Sem. End Exam	Con. Eval.	
	BS	---	3	3	--	100	2

1. **J – by Callender and Barne's Method.**
2. **Thermal Conductivity of a Bad Conductor – Lee's Method.**
3. **Magnetic Field Along the Axis of a Circular Coil Carrying Current – Stewart and Gee's Galvanometer.**
4. **Hall Effect- Measurement of Hall Coefficient.**
5. **Carey Foster's Bridge – Laws of Resistance and Specific Resistance.**
6. **Calibration of Low Range Voltmeter – Potentiometer Bridge Circuit.**
7. **Thickness of a Paper Strip- Wedge Method.**
8. **Newton's Rings – Radius of Curvature of a Plano Convex Lens.**
9. **Diffraction Grating – Normal Incidence.**
10. **Determination of Refractive Indices (o and e) of a Bi-Refringent Material (Prism).**
11. **Cauchy's Constants – Using a Spectrometer.**
12. **Dispersive Power of a Prism – Using a Spectrometer.**
13. **Determination of Rydberg Constant.**
14. **LASER – Diffraction.**
15. **Determination of Band Gap in a Semiconductor.**
16. **Optical Fibres – Numerical Aperture and Loss of Signal.**
17. **VI Characteristics of a pn-junction diode**
18. **Response of a series RLC Circuit**

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B.Tech. (BT)First Semester

EURCS 113: PROGRAMMING LAB WITH C

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con. Eval.	
EURCS 113	BE	---	3	3	--	100	2

1. a) Write a C program to ask the user to enter one char (Upper-Case letter) check whether user entered a Upper-case letter or not(by using relational and logical operators) and then if user has entered a Upper-case letter convert into a Lower-case letter? (hint: Upper-case means capital letters, use ASCII information to check for Upper-case and convert)
b) Write a C program to ask the user to enter two integers and apply all arithmetic operations on those print the corresponding values?(hint : +,-,*,/,%)
c) Write a C program to Determine the ranges of char, short, int and long int variables both signed and unsigned
(i) By using sizeof operator(ii) By printing appropriate values from standard header (limits.h)

2. a) Write a Program to Find the Roots of a Quadratic Equation using if else and Switch statements.

b) Write a Program which Generates One Hundred Random Integers in the Range of 1 To 100, store them in an array and then prints the average. Write three versions of the program using Different Loop Constructs.

3. a) Write a C program to find the sum of individual digits of a positive integer.
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 sequence.

c) Write a C program to calculate the following

Sum=$1-x^2/2! +x^4/4!-x^6/6!+x^8/8!-x^{10}/10!$

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

b)Write C programs that use both recursive and non-recursive functions
i) To find the factorial of a given integer.
ii) To find the GCD (greatest common divisor) of two given integers.
iii) To solve Towers of Hanoi problem.

5. a) Write a C program to find both the largest and smallest number in a list of integers.

b) Write a program to read set of elements in the array and sort them in ascending order.

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

i) Addition of Two Matrices

ii) Multiplication of Two Matrices

iii) Transpose of a given Matrix

6. a) 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.

   b) Write a C program to determine if the given string is a palindrome or not

   c) Given an Array of Strings Write a Program to Sort the String in Dictionary Order.

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

   i) Reading a complex number

   ii) Writing a complex number

   iii) Addition of two complex numbers

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

   a)Count number of characters, words in a file.

   b) Write a C program to reverse the first n characters in a file.

   (Note: The file name and n are specified on the command line.)

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

B. Tech (BT) First Semester

PHYSICAL AND INORGANIC CHEMISTRY LAB

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con.Eval.	
EURCH 116	BS	--	3	3	-	100	2

The objective of the Laboratory Practicals is to make the student to acquire the basic concepts on Chemistry.

1. Estimation of Sodium Hydroxide using Hydrochloric acid
2. Estimation of sodium carbonate in soda ash.
3. Estimation of oxalic acid using potassium permanganate
4. Estimation of Mohr's salt using potassium permanganate
5. Estimation of Hydrogen Peroxide using potassium permanganate
6. Estimation of Ferrous iron using potassium dichromate
7. Estimation of potassium dichromate using sodium thiosulphate
8. Estimation of copper using sodium thiosulphate

Demonstration Experiments:

1. Determination of rate constant of acid catalysed hydrolysis of an ester.
2. pH metric titration – Estimation of Sodium Hydroxide using Hydrochloric acid.
3. Potentiometric titration – Estimation of Ferrous Iron using Potassium dichromate

4) Determination of Viscosity of a Liquid.

5) Determination of Surface Tension of a Liquid.

Textbook Prescribed:

1. A Text book of Quantitative Inorganic Analysis A.I. Vogel (Orient Longmans Ltd.)

B.Tech (BT)Second Semester
EUREG 201: ENGINEERING ENGLISH-II

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con. Eval.	
EUREG 201	HS	3	---	3	60	40	3

Unit – I :Interpersonal Communication:
Introduction to Interpersonal Communication, Models of Interpersonal Relationship, Development, Team Work, Persuasion Techniques

Unit – II:Spoken Communication:
Importance of spoken communication, Basics of Spoken English,
Situational Dialogues, Speech Making: Formal and Informal

Unit – III :Developing Vocabulary and Correcting Common Errors:
Homonyms, Homophones and Homographs, Synonyms and Antonyms,
Oral and Written

Unit – IV:Information Transfer:
Using charts, Figures, Tables, Pictograms, Maps, Note Making,
Note Taking

Unit – V:Reading for Enrichment
Sir Mokshagundam Visvesvaraya
Steve Jobs: The Early Years

Text Book Prescribed:

1. E. Suresh Kumar et al., Communication for Professional Success, Orient Blackswan, 2012.

Reference Books:

1. E. Suresh Kumar et al., Communication Skills and Soft Skills, Pearson, 2010.
2. Jayashree Mohanraj et al., Speak Well, Orient Black Swan, 2011.
3. Oxford Advanced Learners' Dictionary, 2010 Edition.

B.Tech. (BT) Second Semester
EURPH 204:ENGINEERING PHYSICS – II

Code No.	Category	Scheme of instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con. Eval.	
EURPH 204	BS	3	---	3	60	40	3

The aim of the course is to impart knowledge in basic concepts of physics relevant to engineering applications.

UNIT – I (9 hours)

INTERFERENCE: Introduction - Interference in Thin Films - Wedge Shaped Film - Newton's Rings - Lloyd's Mirror - Michelson's Interferometer and Applications.

DIFFRACTION: Introduction - Differences between Fresnel and Fraunhofer Diffractions - Single Slit Diffraction (Qualitative and Quantitative Treatment) - Differences between Interference and Diffraction - Gratings and Spectra-Multiple Slits - Diffraction Grating - X-ray Diffraction - Bragg's Law.

UNIT – II (9 hours)

POLARISATION: Introduction - Double Refraction - Negative Crystals and Positive Crystals - Nicol's Prism - Quarter Wave Plate and Half Wave Plate - Production and Detection of Circularly and Elliptically Polarised Lights.

LASERS: Introduction - Spontaneous and Stimulated Emissions - Population Inversion – Ruby Laser - He-Ne Laser - Semiconductor Laser – Applications.

UNIT – III (10 hours)

MODERN PHYSICS (QUANTUM PHYSICS): Matter Waves - Heisenberg's Uncertainty Principle - Schrodinger's Time Independent Wave Equation - Physical Significance of Wave Function (ψ) - Application to a Particle in a one Dimensional Box (Infinite Potential Well) - Free Electron Theory of Metals - Band Theory of Solids (qualitative) -Distinction between Metals, Insulators and Semiconductors - Elementary Concepts of Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics (No Derivation).

UNIT – IV (9 hours)

SEMICONDUCTORS: Introduction - Intrinsic and Extrinsic Semiconductors - Carrier Concentration in Intrinsic Semiconductors - Carrier Concentration in n-Type Semiconductors - Carrier Concentration in p-Type Semiconductors - Hall Effect and Applications -Variation of Carrier Concentration with Temperature - Conductivity of Extrinsic Semiconductor - PN Junction - Forward Bias - Reverse Bias -VI Characteristics of a PN Junction - Fundamentals of LED, LCD - Photovoltaic Cell (Solar Cell).

UNIT – V **(**8 hours)

FIBRE OPTICS: Introduction - Optical Paths in Fibre - Optical Fibre and Total Internal Reflection - Acceptance Angle and Cone of a Fibre - Fibre Optics in Communications - Applications.

NANOSCIENCE: History – Definition - Size Dependent Properties (Qualitative): Mechanical and Electrical - Growth Techniques: Top Down (PVD, Ball Milling) - Bottom Up (Sol-Gel and Co-Precipitation) - Applications.

Prescribed Books :

Physics part I & II Resnick, Halliday, Krane. John Wiley & Sons.
Applied.Physics P.K.Palani samy. Scitech Publications (India) Pvt Ltd., Chennai

Reference Books:

Modern Physics Arthur Beiser.Tata Mc Graw-Hill.
Solid State Physics S.O.Pillai. New Age International (P)Limited, New Delhi.
Materials Science M. Arumugam. Anuradha Agencies, Kumbhakonam.
A Text Book of Engg. Physics Kshirsagar & Avadhanulu. S.Chand and Co.
The Feynman Lectures on Physics Addison-Wesley.

B.Tech. (BT) Second Semester
EURCS206: OBJECT ORIENTED PROGRAMMING WITH C++

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con. Eval.	
EURCS206	BE	3	---	3	60	40	3

UINT-I

Introduction to OOPS: Origins of C++, Object Oriented Programming, Headers & Name Spaces,Applications of OOP, Structure of C++ Program.

C++ Basics: Keywords, Constants, Data Types, Dynamic Initialization of Variables, Reference Variables, Operators in C++.

C++ Class Overview: Class Definition, Objects, Class Members, Access Control, Class Scope.

UNIT-II

Dynamic memory allocation and deallocation (new and delete), Parameter passing methods, static class members, Arrays of Objects, Objects as Function Arguments, Default Arguments, Const Arguments, Inline functions,Function Overloading, Friend Functions,this pointer,pointers to data members and member function.

UNIT-III

Constructors, Parameterized Constructors, Multiple Constructors in a Class, Constructors with Default Arguments, Dynamic initialization of Objects, Copy Constructors, Dynamic Constructors, Destructors.

Introduction to inheritance, Defining Derived Classes, Single Inheritance, Multiple Inheritance, Multi Level Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes.

UNIT-IV

Introduction to pointers, Pointers to Objects, Pointers to Derived Classes, compile time polymorphism, Run time polymorphism, Virtual Functions, Pure Virtual Functions,Virtual Destructors, Operator overloading, Rules for Operator overloading, overloading of binary and unary operators.

Files in C++: File I/O, Unformatted and Binary I/O, file handling library functions.

UNIT-V

Templates: Introduction, Class Templates, Class Templates with Multiple Parameters, Function Templates, Function Templates with Multiple Parameters, Member Function Templates.

Exception Handling: Basics of Exception Handling, Types of exceptions, Exception Handing Mechanism, Throwing and Catching Mechanism, Rethrowing an Exception, Specifying Exceptions.

Text Books:

1. Object Oriented Programming in C++ by E.Balagurusamy., published by Tata McGraw-Hill.
2. Computer Science : A Structured Approach Using C++ second edition, Behrouz A. Forouzan and Richard F. Gilberg

Reference Books:

1. Mastering C++ by K.R.Venugopal., published by Tata McGraw- Hill.
   Object- Oriented Programming with ANSI and Turbo C+ + , 1/e**By Ashok Kamthane**
2. Problem Solving, Abstraction, and Design using C++ (6TH Ed.), Frank L. Friedman

B.Tech. (BT) Second Semester
Bridge Course – II (MPC Stream)

EURBT 207: FUNDAMENTALS OF BIOLOGY - II

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con. Eval.	
EURBT207	BS	3+1	---	3	60	40	3

The aim of the Course is to impart knowledge in Basic Concepts of Biology relevant to Biotechnological applications.

UNIT-I General Characteristics : **(8 hours)**

General Characters of Invertebrates; Morphology, life cycle and reproduction of Plasmodium vivax, General characters of Vertebrates.

UNIT-II ANIMAL PHYSIOLOGY: **(4 hours)**

Nutrition :

Modes of nutrition, Digestive system of Humans and accessory digestive organs, gastrointestinal secretions. Digestion, absorption and assimilation of digested products, egestion

Respiration: **(3 hours)**

Respiration in humans – Respiratory system, mechanism of respiration.

UNIT-III Circulatory System: **(10 hours)**

Blood vascular system in humans – blood and its components, heart, pumping action of heart, heart beat and pulse, important blood vessels and Course of blood circulation, Lymphatic system – lymph, lymph vessels, lymph nodes and lymphatic ducts and Pace makers.

UNIT-IV Excretion: **(9 hours)**

Elimination of nitrogenous waste – Ammonotelic, ureotelic and uricotelic. Structure of human excretory system – structure of urinary system, anatomy of kidney and structure of nephron.

UNIT-VNervous System: **(12 hours)**

Structure of neuron, impulse and its conduction, synapse, central nervous system – lobes of brain and its meninges, spiral cord. Peripheral nervous system – Cranial nerves and spinal nerves. Autonomous nervous system – sympathetic and parasympathetic nervous system - reflex action – reflex arc of humans.

Text Books:

1. *Biology* text book for class XI and XII, NCERT.

2. T*ext book for Botany and Zoology at Intermediate*. AP Academy

Reference Books:

1. *Biology* Raven, Johnson, Mason, losos and singer. Mc. Graw Hill. (2013)
2. *Biology – The Network of life* M. C.Mix, P. Farber & K.I.King, Harper Collins
3. *Biology Schaum series* George H.Fried Mc. Graw Hill

B.Tech (BT) Second Semester

Bridge Course-II,(BiPC Stream)
Mathematics-II

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Sessionals	
EURMT 207	MT	4	--	03	60	40	03

Unit-I: Matrices (10)

Matrices and Determinants – definition – types of matrices – algebra of matrices – properties of determinants of 2 X 2 and 3 X 3 order matrices – Inverse of a matrix – Solving simultaneous linear equations in 2 and 3 variables using matrix inverse method and Cramer's rule

Unit-II: Permutations & Combinations (12)

Definition of linear and circular permutations – number of permutations of n dissimilar things taken r at a time – number of permutations on dissimilar things taken r at a time when repetition of things is allowed any number of times – number of circular permutations of different things taken all at a time – number of permutations of n things taken all at a time when some of them are alike and the rest are dissimilar number of combinations of n dissimilar things taken r at a time.

Introduction of Binomial theorem – expansion of $(x + a)^n$, $(1 + x)^{-1}$, $(1 - x)^{-1}$, $(1 + x)^{-2}$ & $(1 – x)^{-2}$.

Unit-III: Indefinite Integrals (10)

Integration as the inverse process of differentiation standard forms – properties of integrals- integration by method of substitution covering algebraic, trigonometric and exponential functions - Integration by parts – logarithmic functions, Inverse trigonometric functions

Unit-IV:

(10)

Integrals of special types and definite integrals: Integrals of the following types of functions.

$$\frac{1}{x^2 \pm a^2}, \frac{1}{a^2 - x^2}, \frac{1}{\sqrt{x^2 \pm a^2}}, \frac{1}{\sqrt{a^2 - x^2}}, \sqrt{x^2 \pm a^2}, \sqrt{a^2 - x^2}$$

Integration of rational functions using partial fractions.

Definite Integrals: Definition of a definite integral and its properties (without proof) - Formulae

$$\int_0^{\pi/2} Sin^n\theta \, d\theta, \quad \int_0^{\pi/2} \cos^n\theta \, d\theta, \quad \int_0^{\pi/2} \cos^n\theta \, Sin^m\theta \, d\theta$$ (without proofs)

Unit-V: Co-ordinate Geometry – II (12)

Circles:

Equation of a circle – standard form – centre and radius – equation of a circle with a given line segment as diameter – equation of a circle through 3 non collinear points – parametric equations of a circle, position of a straight line in the plane of the circle – condition for a straight line to be a tangent – chord joining 2 points on a circle – equation of the tangent at a point on the circle – point of contact – equation of normal.

Relative positions of 2 circles – circles touching each other – externally, internally, of common tangents -Angle between 2 intersecting circles – conditions for orthogonality. (Proofs of the theorems are not required)

Textbooks Prescribed:

Intermediate Mathematics V.Venkateswara Rao, S.Chand& Company Ltd.
Volume I & II N.Krishna Murthy, B.V.S.Sharma,

References : *A first Course in Mathematics* Chandrika Prasad. Prasad Mudranakya,
for Engineers Allahabad

Note: The figures in parentheses indicate approximate number of expected hours of Instruction.

B. Tech (BT) Second Semester
PHYSICAL CHEMISTRY

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Sessionals	
EURCH - 208	BS	3	---	3	60	40	3

The objective of the syllabus is to provide knowledge in the basic concepts of the Chemistry of Engineering materials.

UNIT-I. (8hours)

Thermodynamics : First law – internal energy – enthalpy, Heat capacity of a system – work done in isothermal, adiabatic expansion of an ideal gas. Heat of reaction – heat of formation, heat of combustion and heat of neutralization – Kirchoff's equation - Thermo-chemical laws- Hess law of constant heat summation. Second law – spontaneous process – entropy – physical significance, entropy change accompanying phase change.

UNIT-II. (8 hours)

Chemical Equilibrium: Reversible reactions – law of mass action – Le Chatelier's principle, homogeneous equilibria in gaseous and liquid systems – Effect of temperature on equilibrium – vant Hoff's equation.

Electrochemistry: Difference between Galvanic and Electrolytic cells. Single electrode potential and its determination. Nernst equation. electrochemical series - Reference Electrodes - Hydrogen and Calomel electrodes. Conductance – Molar and equivalent conductivities - Kohlraush's Law.

UNIT-III. (6 hours)

Physical properties of liquids :

Surface tension: Definition, explanation, measurement, applications and viscosity : Definition, explanation, measurement, applications.

Phase rule : Terms used – phase diagrams – one component system (Water and Sulphur) – two component system (Silver-Lead and Potassium lodide-Water)- Eutectic point and Triple point.

UNIT-IV. (6 hours)

Colligative properties : Raoult's law, Osmotic pressure, elevation of boiling points, depression in freezing points (Elementary treatment) – elementary treatment of vapour pressure - composition diagrams of binary liquid mixtures.

UNIT-V. (8 hours)

Chemical Kinetics : Rate constant - Order and molecularity of a reaction – zero, first and second order kinetics – activation energy-effect of temperature on reaction rate-elementary treatment of collision theory and activated complex theory.

Prescribed Books:

1) Elements of Physical Chemistry by P.W.Atkins, third edition, Oxford University press.
2) Essentials of Physical Chemistry by B.S.Bahl, Arun Bahl and G.D.Tuli – New Delhi: S. Chand & Company, 2007.

Reference Books:

1) Text book of Physical Chemistry by Samuel Glasstone, - second edition New Delhi: Macmillion, 1980.
2) Physical Chemistry by Gilbert. W. Castellan, second edition – Reading Addison Wiley,
3) Principles of Physical Chemistry by B.R. Puri, L.R Sharma and Madan S.Pathanic, 41st edition Jalandhar : Vishal Publishing Co.2004.

B. Tech (BT) Second Semester
ORGANIC CHEMISTRY

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Sessionals	
EURCH - 209	BS	4	---	3	60	40	4

Unit-I Stereochemistry: (9 Hours)

Stereoisomerism – Optical activity – The Polarimeter - Specific rotation – Enantiomerism – chiral center - Enantiomers – Racemic modification – Configuration – R & S notation - Examples - Cahn – Ingold – Prelog's sequence rules – Diastereomers - Conformations of Cyclohexane – 1, 3 – Diaxial interactions.

Unit- II. Aliphatic Compounds: (10 Hours)

Alkanes – Free radical substitution (Mechanism of halogenation) - Energy of activation – Transition state; **Alkenes** – 1, 2 eliminations (E_1 and E_2 mechanism) – Electrophilic and Free radical addition reactions - Markovnikov's and Anti – Markovnikov's rule; (Peroxide effect) - **Alkynes** – Acidity of alkynes – Dienes – 1,2 vs. 1,4 additions. (electrophilic additions) – Diels – Alder Reactions (HOMO-LUMO Interactions) - Cyclic aliphatic compounds – Bayer's strain theory – **Alkyl halides** – S_N1 and S_N2 reactions with mechanism.

Unit- III: **Aromatic Compounds:**

(11Hours)

Benzene Mechanism of electrophilic aromatic substitution – Nitration, Sulphonation, halogenation, Friedel crafts alkylation, Friedel Crafts acylation- Orientation of disubstituted benzenes – activating and deactivating groups. **Arenes-** Friedel – crafts alkylation and its limitations – Clemmenson and Wolff-Kishner reductions - **Aryl halides** – Sandmayer and Gattermann reactions – Nucleophilic aromatic substitution - **Phenols** – Acidity of phenols – Kolbe's reaction - Reimer Tiemann reaction.

UNIT-IV. Alcohols, Aldehydes and Ketones, **Carbohydrates:** **(**10 hours)

Alcohols - Differentiation tests of alcohols - **Aldehydes and ketones** : Differentiation tests, Nucleophilic addition reactions - Cannizzaro reaction, Perkin, Reformatsky and Wittig reactions. **Carbohydrates**: Classification, Kiliani–Fischer Synthesis, Ruff's degradation and Wohl's degradation.

UNIT-V: Carboxylic acids and Derivatives, Amines: (11 hours)

Claisen condensation; Preparation and Synthetic applications of Malonic Ester and Acetoacetic Ester. Keto-enol tautomerism. **Amines:** Benzidine rearrangement; Effect of substituents on basicity, Distinguishing tests for amines. Preparation and synthetic applications of Diazonium salts. **Sulpha Drugs** – preparation of sulphanilamide, antibacterial activity. **Soaps and Detergents:** Preparation and Cleansing action.

Text Books Prescribed:

1. Organic Chemistry by Mehta and Mehta, Prentice Hall of India
2. Text Book of Organic Chemistry by C.N.Pillai, Orient blackswan Pvt. Ltd.,
3. Text book of organic chemistry by R.T Morrison and R.N Boyd.

References :

1. *A Text book of Organic Chemistry by* I.L.Finar (Vol.1) Longman group.
2. *A Text book of Organic Chemistry* by L.G. Wade, Jr. Pearson education.
3. *A Text book of Organic Chemistry* by Francis A. Carey. Tata Mc Graw – Hill.

B. Tech (BT) Second Semester
EURBT 210 : ENGINEERING DRAWING

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con. Eval.	
EURBT 210	BE	1	3	3	60	40	3

UNIT-I:

Orthographic projections and Projection of points:

Introduction to orthographic projections: First angle projection and third angle projection. Projection of points.

Projection of straight lines: Projection of straight lines: line parallel to one or both planes, line perpendicular to one of the planes, line inclined to one plane.

UNIT-II:

Projections of Planes: Introduction, types of planes, perpendicular planes, perpendicular to one plane and parallel to other plane, perpendicular to one plane and inclined to other plane, oblique planes, simple problems.

UNIT-III:

Projections of Solids: Introduction, types of solids, polyhedral tetrahedron- prism, pyramid and solids of revolution- cylinder, cone. Projections of solids, simple positions, axis inclined to one plane and parallel to other, axis inclined to both the planes, simple problems.

UNIT-IV:

Developments of surfaces: Introduction, Developments of lateral surfaces of right solids- prisms, cylinders, pyramids and cones, simple problems.

UNIT-V:

Sections of solids: Introduction, section planes, sections and true shape of a section. Sections and sectional views of solids- prism, pyramid, cylinder and cone, simple problems.

Text books:

1. Engineering Drawing by N.D. Bhatt and V. M .Panchal, Charotar publishing house Pvt. Ltd, 49th edition, 2008.

References:

1. A text book on Engineering Drawing" by K.L .Narayana and P. Kanniah (Scitec publications (India) Pvt. Ltd)
2. Fundamentals of Engineering Drawing by Warren J. Luzzader, Printice Hall of India

B.Tech. (BT)Second Semester

EURCS 213: OBJECTED ORIENTED PROGRAMMING LAB WITH C++

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con. Eval.	
EURCS 213	BE	---	3	3	--	100	2

1. Write a CPP program that contains a function to exchange values of two arguments(swap) by using pointers and reference parameters.
2. Write a CPP program to find the given string is palindrome or not. Declare private member function to find palindrome of the given string and access it using public member function.
3. Write a CPP program to find transpose of 2D matrix and allocate memory dynamically to the matrix using dynamic memory allocation. Initialize and display contents of the matrix and deallocate memory.
4. Write a CPP program to add two polynomials of any degree using object as function arguments. Hint: create two objects each representing one polynomial equation.
5. Write a CPP program to add corresponding elements of two 2D matrices using friend function. Create two classes each capable of storing one 2D matrix. Declare the matrix under private access specifier and access them outside the class.
6. Write a program to find total and average marks of each student in class. Create a student class with student number, name, 6 subject marks as its members and initialize the details. Use friend class that will access the details of student, calculate total and average marks and print the result.
7. Write a program to add two matrices of same copy. Create two objects of the class and each of which refers one 2D matrix. Use constructor to allocate memory dynamically and use copy constructor to allocate memory when one array object is used to initialize another.
8. Write a Program to Generate Fibonacci Series by using Constructor to Initialize the Data Members.
9. Write a program for finding area of different geometric shapes (circle, Rectangle, cube). Use function overloading with type, order, sequence of arguments to find the area of shapes.
10. Write a program which prompts the user to enter a string and returns the length of the longest sequence of identical consecutive characters within the string using pointers to data members and member function. For example, in the string "aaaAAAAAjjB", the longest sequence of identical consecutive characters is "AAAAA".
11. Write a program to calculate gross and net pay of employee from basic salary. Create employee class which consists of employee name, emp_id, basic salary as its data members. Use parameterized constructor in the derived class to initialize data members of the base class and calculate gross and net pay of the employee in the derived class.
12. Write a program to calculate bonus of the employees. The class master derives the information from both admin and account classes which in turn derives information from class person. Create base and all derived classes having same member functions called getdata, display data and bonus. Create a base class pointer that is capable of accessing data of any class and calculates bonus of the specified employee. (Hint: Use virtual functions)
13. Write a program to add two matrices of mxn size using binary operator overloading.

14. Write a program to find transpose of a given matrix of mxn size using unary operator overloading.
15. Write a program to concatenate one string to another using binary operator overloading.
16. Write a program that uses functions to perform the following operations:
    a) To copy contents of one file into another file.
    b) To replace a word with another word in a given file.
    c) To count the number of occurrences of a word in a given file
17. Write a program to sort a given set of elements using function template.
18. Write a program to search a key element in a given set of elements using class template.
19. Write a program to find average marks of the subjects of a student. Throw multiple exceptions and define multiple catch statements to handle division by zero as well as array index out of bounds exceptions.
20. Write a program to find factorial of a given number. Throw multiple exceptions and define multiple catch statements to handle negative number and out of memory exception. Negative number exception thrown if given number is negative value and out of memory exception is thrown if the given number is greater than 20.

B. Tech (BT) Second Semester

ORGANIC CHEMISTRY LABORATORY

Code No.	Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
		Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
		L/T	D/P		Sem. End Exam	Con.Eval.	
EURCH - 216	BS		3	3	-	100	2

1. Qualitative analysis: Identification of the following functional groups in at least SIX organic compounds by adopting a systematic qualitative analysis:

a) Carboxylic acids
b) Phenols
c) Aldehydes and Ketones
d) Esters
e) Carbohydrates
f) Hydrocarbons and Ethers
g) Primary, Secondary and Tertiary amines
h) Amides and imides
i) Nitro groups.

2. Preparation of a minimum of three simple organic compounds involving the following Reactions:

a) Acetylation : Acetanilide from Aniline and Aspirin from Salicylic acid

b) Benzoylation : Benzanilide from Aniline

c) Nitration : p – nitroacetanilide from acetanilide

d) Methylation : b- naphthyI methyI ether from b-naphthol.

e) Sulphonation : Sulphanilic acid from Aniline

f) Oxidation : p-benzoquinone from Hydroquinone,

Text Book:

A Text book of Qualitative Organic Analysis by A. I. Vogel (Orient Longmans Ltd.,)

B.Tech. (BT) III Semester
ENGINEERING MATHEMATICS-I

Course Code: **EURBT301** Category: **MT**

Credits: **4** Hours: **4 per week**

The objective of the course is to impart knowledge in Basic concepts of Mathematics relevant to Engineering applications

UNIT – I : Linear Algebra: Elementary Transformations, Rank of a Matrix, Normal form, Solutions of Linear equations - Guass Jordan method, Consistence of system of linear equations. **(08)**

UNIT –II : Eigenvalues and Eigen vectors: Eigen values and Eigen vectors of matrices, Cayley Hamilton theorem (without proof), Inverse and powers of matrix by Cayley Hamilton theorem, Hermiltian, Skew Hermitian and unitary matrix and orthogonal matrix. **(10)**

UNIT-III: Differential Equations of First Order and Applications: Formation of differential equations, solution of differential equation – Geometrical interpretation, equations of the first order and first degree, separable variables, Homogeneous equations, Linear equations, Bernouli's equation. **(08)**

UNIT-IV: Linear Differential Equations and Applications: Definition, Complete solution, Operator D, Rules for finding complementary function, Inverse operator, Rules for finding particular integral, Method of variation of parameters, Simultaneous linear equations with constant coefficients. **(12)**

UNIT-V: Laplace Transforms: Transforms of elementary functions, properties of Laplace transforms, Existence conditions, Inverse transforms, Transforms of derivatives, Transforms of integrals, multiplication by t, division by t, convolution theorem, applications to Ordinary Differential Equations and simultaneous linear equations with constant coefficients, unit, step function, unit impulse function and periodic functions. **(12)**

Text Books:

1. Theory of Matrices by Shantinarayan,
2. Higher Engineering Mathematics by Dr.B.S.Grewal, Khanna Publications.
3. A Text book on Engineering Mathematics by N.P.Bali, Laxmi Publications (P) Ltd

Reference Books:

1. Higher Engineering Mathematics by Dr.M.K.Venkataraman, National Pub. Co
2. Advance Engineering Mathematics by Erwin Kreyszig, Wiley Eastern Pvt. Ltd.
3. Advanced Mathematics for Engineering Students Vol.2, by Narayanan, Manikkavachakam Pillay and Ramanaiah.

Note: The figures in parentheses indicate approximate number of expected hours of Instruction.

B.Tech. (BT) III Semester
BIOCHEMISTRY

Course Code: **EURBT302** Category: **BS**

Credits: **3** Hours: **3 per week**

UNIT-I : Organization of Life, Importance of Water in living Cell, Chemistry, Structure and functions of Amino acids; **Peptides**: Solution and solid phase synthesis of peptides; **Proteins**: classification, purification and physicochemical characterization. **Protein structure**: Primary, secondary, tertiary and quaternary structure of proteins. Folding and functions of Hemoglobin, Myoglobin, and Chymotrypsin. **Enzymes**: classification, factors effecting enzyme action, Coenzymes.

UNIT-II : Carbohydrates: Classification structure and functions of: monosaccharide (ribose, glucose, fructose), disaccharides (Sucrose and lactose), polysaccharides (starch, cellulose and glycogen), Energetics of metabolic pathways, Glycogenesis and glycogenolysis, glycolysis and TCA cycle, HMP shunt pathway, Electron transport chain and oxidative phosphorylation. Energy coupling.

UNIT-III : Lipids: Classification, structure and physiological functions of triglycerides, fatty acids, phospholipids, cerebrosides, gangliosides and cholesterol. Digestion and absorption of fats. Synthesis and degradation of fatty acids and triglycerides.

UNIT-IV : Nucleic acids: Structure, properties and functions of purines pyrimidines, nucleotides and nucleic acids. Cellular localization, isolation and estimation of nucleic acids, Types of DNA and RNA. Biosynthesis and degradation of purine and pyrimidine nucleotides, Oligonucleotide synthesis

UNIT-V : Biosynthesis and degradation of Heme. Physiological functions of vitamins and minerals, hormones, Nutritional aspects of amino acids, protein and fatty acids.

Text Books:

1. Principles of Biochemistry by A.L.Lehninger, Nelson and Cox., CBS Publications
2. Biochemistry by L.Stryer 6th Ed. 2006 (Freeman-Toppan)
3. Biochemistry by D.Voet and J.G.Voet. 2004 3rd ed. (John Wiley)

Reference:

1. Text Book of Biochemistry by West and Todd., (Mac Milan)
2. Essentials of Biochemistry by U. Satyanarayana. and Chekrapani. 2nd ed. 2005. Allied publishers.
3. Harper's Biochemistry 25th ed. 2000 McGrawHill.
4. Lehninger's principles of biochemistry. Nelson and Cox. 2007. 4th ed.

B.Tech. (BT) III Semester
BIOANALYTICAL TECHNIQUES

Course Code: **EURBT303** Category: **BS**
Credits: **3** Hours: 3 per week

UNIT-I : Chromatography: General Principles. Modes of chromatography.
Principles, chromatographic media and applications of the following types of chromatography: Ion-exchange, Gel permeation, Affinity, Gas-Liquid, HPLC.
Electrophoresis: General principles. Polyacrylamide and agarose gel electrophoresis. Isoelectric focusing. 2DGE. Pulse field gel electrophoresis. Capillary electrophoresis.
Centrifugation: Principles. Differential centrifugation. Density gradient centrifugation. Analytical centrifugation – sedimentation velocity and sedimentation equilibrium for determination of Mr.
Radioisotope techniques: Principles, measurement and applications of radioactivity.

UNIT-II: UV-Visible Spectroscopy: Principles, instrumentation and applications.
Turbidimetry and Nephelometry: Principles and applications.
Infrared and Raman: Principles, instrumentation and applications.

UNIT-III: Spectrofluorimetry: Basic principles. Uses of Fluorescence parameters, intensity, wavelength dependence, quantum yield, lifetime, polarization and rate of resonance energy transfer with emphasis on DNA sequencing, Fluorescence Immunoassays, and Molecular beacons.
Mass spectrometry: Basic Principles. Ionization techniques with emphasis on EI, FAB, Electrospray and MALDI. Analyzers with emphasis on Magnetic sector, quadrupole and TOF. FTICRMS.
Applications of MS– determination of relative molecular mass, empirical formula, small molecule structural analysis, peptide sequencing and protein identification for proteomic studies.

UNIT-IV : ESR spectroscopy: Principles and applications.
NMR spectroscopy: Principles of magnetic resonance. Use of NMR parameters chemical shift, coupling constants and areas for structural elucidation. Nuclear Overhauser effect. Principles of FTNMR and 2D-NMR. Introduction to Protein structure determination by NMR. Principles of MRI and MR-spectroscopy.

UNIT-V: Electrochemical methods: Principles of potentiometry. Clark's oxygen electrode.
Biosensors: Principles and applications of electrochemical, thermometric, optical and piezoelectric biosensors. Glucose biosensors.
Microarrays: Basic principles. Introduction to different types. Methods of manufacture. Applications – differential expression, SNP analysis.

Textbooks:

1. Practical biochemistry. Principles and Techniques. Keith Wilson and John Walker. 1994. 5th ed. Cambridge University Press.
2. Biophysical chemistry. Principles and Techniques. Upadhyay, Upadhyay and Nath. 11th ed. Himalaya Publishing House.

Reference:

1. Molecular biology and biotechnology. Walker and Rapley. (for Biosensors). 4th ed. 2003.
2. Microarrays for an integrative genomics. I.S.Kohane, Alvin Kho and Atul J.Butte. 2004. Ane books/MIT press.
3. NMR spectroscopy of proteins and nucleic acids. K.Wuthrich (for NMR spectroscopy)
4. Spectrometric identification of organic compounds. Silverstein, Webster and Kiemle (for problems in NMR, MS) 6th ed. 2004.

B.Tech. (BT) III Semester
MICROBIOLOGY

Course Code : **EURBT304** Category: **BS**
Credits: **3** Hours : **3** per week

UNIT-I : History and development of Microbiology: Contributions of van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck.
Microbial taxonomy and diversity: Bacteria, Archea and their broad classification, molecular approaches to microbial taxonomy. Physiology of Archaebacteria - thermophiles, psychropiles, halophiles, methanogens.

UNIT-II : Morphology and functions of Viruses, Yeast, Molds and Bacteria.
Viruses: Morphology of viruses – size, shape and symmetry, replication of viruses – lytic and lysogenic cycle.
Yeasts and Molds: morphology, life cycle, economic importance of yeast and Aspergillus.
Bacteria: ultrastructure of bacteria, cell wall, cell membrane, flagella, pili, capsule, endospore, and cell inclusions, differences between prokaryotic and eukaryotic cell.

UNIT-III : Microbial growth: bacterial growth batch, fed batch, continuous kinetics, synchronous growth and methods of growth estimation, fungal growth.
Control of microorganisms, sterilization and disinfection, effect of physical (moist and dry heat, radiation and filtration) and chemical agents, antibiotics: classification, mode of action and resistance. Microbial nutrition: Nutrition requirements, nutritional types of bacteria, uptake of nutrients by cell.

UNIT-IV : Methods in microbiology: culture media, synthetic and complex media, solidifying agents, types of media, isolation of pure cultures – spread plate, pour plate and streak plate, preservation of microorganisms, light(bright field only) and electron microscopy.

UNIT-V : Applied Microbiology: Water, Food and Milk borne contamination and remedy. Basic microbial genetics - conjugation, transformation and transduction. Strain improvement of microbes of industrial importance.

Text Books:

1. Microbiology: Prescott, Harley and Klein. 2008. 7th ed. McGraw Hill
2. Brock Biology of Microorganisms, Madigan, M.T., Martinko, JM and Parker, 2003. 10th ed. Prentice Hall.
3. Microbiology, Pelczar, M.J., Chan, ECS and Krieg, NR , 2007. 5th ed. Tata McGraw Hill.
4. General Microbiology, Stanier, R.Y.Ingraham, J.L., Wheelis, M.L. and Painter, P.5th ed. 2003. The MacMillan Press Ltd.
5. Microbiology: Ananthanarayanan, R and J.Paniker, J. 2005 7th ed. Orient Longman

B.Tech. (BT) III Semester
THERMODYNAMICS

Course Code : **EURBT305** Category: **BE**
Credits: **3** Hours: **3 per week**

UNIT-I : The first law and other basic concepts: Joule's experiments – internal energy – The first law of thermodynamics – thermodynamic state functions – enthalpy – the steady state – steady flow process – equilibrium – the phase rule – the reversible process – constant V and constant P processes – Heat capacity.

UNIT-II : The second law of thermodynamics: Statement of the second law – heat engines – thermodynamic temperature scales – thermodynamic temperature and ideal gas scale.
Entropy: entropy changes of an ideal gas – mathematical statement of the second law – the third law of thermodynamics.

UNIT-III : Thermodynamic properties : PVT behavior, Thermodynamic property relations.Solution thermodynamics : fundamental property relations – chemical potential and Phase equilibria, fugacity and fugacity coefficient, vapor/liquid equilibrium for pure species, fugacity of a pure liquid, fugacity and fugacity coefficient species in solution.

UNIT-IV : Chemical reaction equilibria: the reaction coordinate – application of equilibrium criteria to chemical reactions – the standard Gibbs energy change and the equilibrium constant – effect of temperature on the equilibrium constant – evaluation of equilibrium constants – relation of equilibrium constants to composition – equilibrium conversions for single reactions – phase rule and duhem's theorem for reacting systems – multireaction equilibria.

UNIT-V
Factors affecting stability of double stranded DNA. Statistical thermodynamics of monomer-dimer equilibrium for DNA and brief discussion of implications for PCR primer design and DNA microarray design. The helix-coil transition in polypeptides. Ligand-receptor binding equilibria.

Text Books:

1. Introduction to chemical engineering thermodynamics. J.M.Smith, H.C.Vanness and M.M.Abbott. 6th Ed. McGraw Hill Book Co., New York., 2001
2. Kinetics and energetics and biotechnology. J.A.Roels. Elsevier. 1983.
3. Chemical, Biochemical and Engineering Thermodynamics 4th Edition, Sandler. W (2006) Wiley.
4. Physical chemistry: principles and applications in biological sciences. I.Tinoco, Sauer and Wang. 2007. Dorling Kindersley (India) pvt.ltd.

B.Tech. (BT) III Semester
CHEMICAL PROCESS CALCULATIONS

Course Code : **EURBT306** Category: **CE**
Credits: **3** Hours: **3 per week**

UNIT-I: Stoichiometric and composition relationships. Limiting reactant. Excess reactant. Degree of completion. Basis of calculation. Weight percent, volume percent and mole percent. Density and specific gravity.
Behaviour of ideal gases, application of the ideal-gas law. Dalton and Amagat laws to gaseous mixtures. Composition of gases on dry basis and on wet basis.

UNIT-II : Vapor pressures. Effect of temperature on vapor pressure. Antoine equation. Reference substance vapor pressure plots. Vapor pressure of immiscible liquids. Ideal solutions and Raoult's law. Non-volatile solutes.
Humidity. Percentage saturation. Relative saturation or relative humidity. Dew point. Vaporization. Condensation. Wet and dry bulb temperatures. Adiabatic vaporization and adiabatic saturation temperature.

UNIT-III : Material balances. Tie substance. Yield. Conversion. Processes involving chemical reactions. Material balance calculations involving drying, dissolution and crystallization, Processes involving recycle, bypass and purge.

UNIT-IV : Heat capacities of gases and gaseous mixtures. Effect of temperature on heat capacity of gas. Mean heat capacity of gas. Kopp's rule. Latent heats. Heat of fusion. Heat of vaporization. Trouton's rule. Kistyakowsky equation for nonpolar liquids. Estimation of latent heat of vaporization using Clausius – Clapeyron equation. Enthalpy of humid air, and humid heat capacity.

UNIT-V : Standard heat of reaction. Standard heat of formation. Laws of thermochemistry. Standard heat of combustion. Calculation of heat of formation from heats of combustion. Calculation standard heat of reaction from heats of formation, and from heats of combustion. Standard integral heat of solution. Effect of temperature on heat of reaction. Kirchoff's equation. Adiabatic and non-adiabatic reactions. Theoretical and actual flame temperatures.

Text Book:

1. Chemical Process Principles Part-I Material and Energy balances, by Olaf A Hougen, Kwenneth M.Watson, and Roland A. Ragatz, CBS Publishers and Distributors (1995)
2. Chemical Process Principles (Stoichiometry), by K.A. Gavhane.

Reference Books:

1. Stiochiometry, by B.I. Bhatt, and S.M. Vora (Third Ed.,), Tata McGraw Hill Publishing Company Limited, New Delhi (1996)
2. Stiochiometry for chemical engineers, by Williams and Johnson, McGraw Hill.

B.Tech. (BT) III Semester
MICROBIOLOGY LABORATORY

Course Code : **EURBT311** Category: **BS**
Credits: **2** Hours: **3 per week**

1. Preparation of Nutrient broth and inoculation of Bacteria.

2. Preparation of Nutrient agar and inoculation of Bacteria.

3. Isolation of pure cultures.

4. Staining of Microbes- Simple staining, Gram staining, Negative staining, Capsule staining and spore staining.

5. Motility of Microbes.

6. Morphology of Fungi (Aspergillus niger)

7. Morphology of Yeast (Saccharomyces cerivisiae)

8. Bio-chemical tests - IMViC test, Amylase test, Hydrogen Sulphide production test.

9. Testing of Microbiological quality of milk.

10. Testing of Microbiological quality of water.

11. Microbial assay of antibiotics.

12. Evaluation of disinfectant.

Text Book:

1. Microbiology – a laboratory manual. Cappuccino. J.G. Sherman, N. 6th ed. 2005. Pearson education.

B.Tech. (BT) III Semester
BIOCHEMISTRY AND BAT LABORATORY

Course Code: **EURBT312** Category: **BS**

Credits: **2** Hours : **3 per week**

1. Calibration of pH meter and preparation of Buffers: Acetate, Phosphate and Citrate buffers.
2. Estimation of total carbohydrates, amino acids, protein, lipid.
3. Assay of amylase, phosphatase, urease, and catalase – (any two)
4. Determination of K_m value.
5. Paper chromatographic separation of amino acids, carbohydrates.
6. Estimation of Thiamine and Riboflavin by Fluorimeter.
7. Thin Layer chromatographic separations of sugars and lipids
8. Absorption spectra of proteins and nucleic acids.
9. Determination of T_m of DNA.
10. Extraction of plant pigments from leaves and separation through column chromatography
11. Electrophoretic separation of proteins and determination of molecular weight by SDS-PAGE.
12. Extraction of theophyllin from Tea leaves and estimation.
13. Separation of proteins through native PAGE.

Demonstration experiments:

1) Separation of proteins through Gel filtration & Ion exchange chromatography
2) Separation of proteins using HPLC
3) ELISA

Text books:

1. Biochemical methods: 2nd Ed.Sadasivam and Manickam. 1996. New Age
2. Introduction to Practical Biochemistry. Plummer, DT. 3rd ed. 2002. Tata-McGraw Hill.
3. Practical Biochemistry by Sawhney and Randhir Singh. 2002. Narosa publications.
4. Experimental Biochemistry by B. 0Shashidhar Rao and Vijay Desh Pande I.K. International publishing House Pvt. Ltd.
5. Lab Ref by Jane Roskans and Linda Rodgers by I.K. International publishing House Pvt. Ltd.
6. Lab Math by D.S. Adams I.K. International publishing House Pvt. Ltd.
7. Practical in Biochemistry and Biotechnology by M.Z. Abdin and S. Javed by I.K. International publishing House Pvt. Ltd.

B.Tech. (BT) IV Semester
ENGINEERING MATHEMATICS-II

Course Code : **EURBT401** Category: **MT**
Credits: **3** Hours: **3 per week**

The objective of the course is to impart knowledge in Basic concepts of Mathematics relevant to Engineering applications

UNIT-I: Partial Differentiation and its application:

Functions of two or more variables, partial derivatives, Homogeneous functions – Euler's theorem, total derivative, differentiation of implicit functions, Geometrical interpretation, Tangent plane and normal to a surface, change of variables, Jacobians, Taylor's theorem for functions of two variables, Errors and approximations, total differential Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers. **(10)**

UNIT-II: Multiple Integrals and their applications:

Double Integrals, Change of order of integration, Double integrals in polar coordinates, Areas enclosed by plane curves, Triple integrals, volume of solids, change of variables, Area of curved surface, Beta function, Gamma function, relation between Beta and Gamma functions. **(10)**

UNIT-III: Probability and Statistics:

Introduction to statistics and probability, sampling and sampling methods, presentation of data, curve fitting, linear regression. Measures of central tendency, (mean/mode/median), measures of dispersion: range, mean deviation, standard deviation, variance, standard error. Review of Binomial, Poisson and Normal distribution. **(10)**

UNIT-IV: Testing of Hypothesis and Sample tests:

Test of significance. Testing of hypothesis, level of significance, confidence limits. Student's t-distribution, f-distribution, Fisher's Z-distribution and Chi-square distribution. **(10)**

UNIT-V: Numerical Analysis:

Solution of Algebraic and Transcendental equations – Bisection method, Newton – Raphson method, Solution of linear algebraic equations using Jacobi, Gauss-Seidel iterative methods, eigen values, eigen vectors using power method. Numerical solutions of ODE's by Picard's method, Euler's method, Runge-Kutta method (4^{th} order). **(10)**

Text Books:

1. Higher Engineering Mathematics by Dr.B.S.Grewal, Khanna Publications.
2. A Text book on Engineering Mathematics by N.P.Bali, Laxmi Publications (P) Ltd.

Reference Books:

1. Higher Engineering Mathematics by Dr.M.K.Venkataraman, National Pub. Co
2. Advance Engineering Mathematics by Erwin Kreyszig, Wiley Eastern Pvt. Ltd.
3. Advanced Mathematics for Engineering Students Vol.2, by Narayanan, Manikkavachakam Pillay and Ramanaiah.

Note: The figures in parentheses indicate approximate number of expected hours of Instruction.

B.Tech. (BT) IV Semester
HEAT TRANSFER

Course Code : **EURBT402** Category: **CE**
Credits: **3** Hours: **3 per week**

UNIT-I: Introduction: modes of heat transfer. Basic laws of heat transfer. Analogy between heat flow and electrical flow.

Conduction: The fourier heat conduction equation. Steady state and one dimensional heat conduction through plane wall, cylindrical wall, spherical wall and composite structures. Heat transfer from extended surfaces. Three dimensional heat conduction equation. Numerical problems on unsteady state heat conduction through a semi-infinite slab; through an infinite slab, infinite cylinder, sphere. Critical insulation thickness.

UNIT-II : **Convection:** the convective heat transfer coefficient. Introduction to thermal boundary layer. Dimensionless numbers in heat transfer and their significance. Dimensional analysis.
Forced convection: heat transfer by forced convection inside tubes and ducts in laminar transition and turbulent flow. Analogy between momentum and heat transfer. Reynolds, colburn and prandtl analogies.
Natural convection: Natural convection from vertical and horizontal surfaces. Grashoff number.

UNIT-III : Heat transfer with phase change: heat transfer from condensing vapors. Filmwise and dropwise condensation. Derivation and practical use of nusselt equations. Condensation of superheated vapors. Effect of non-condensable gases on rate of condensation.
Heat transfer by boiling liquids: boiling of saturated liquid. Maximum heat flux and critical temperature drop – minimum flux and film boiling.

UNIT-IV : Heat transfer by radiation: thermal radiation. Black body radiation. Kirchoff's law, emissivity, gray body. Laws of black body radiation. Geometric or shape factor. Radiation in enclosures with black and gray surfaces. Large parallel plates. Concentric cylinders and spheres. Combined heat transfer by conduction, convection and radiation.

UNIT-V : Heat exchangers: types of heat exchangers. Log-mean temperature difference. Energy balances. Overall heat transfer coefficients. Heat exchanger effectiveness. Fouling factors. Design and description of heat transfer equipment. Heat exchangers, condensers, boilers, and kettles. Extended surface equipment.

Text book:
1. Unit operations of chemical engineering. McCabe, Smith and Harriot. McGraw Hill Book CO.

Reference:
1. Heat transmission. William McAdams. 3rd ed. 1985. McGrawHill.
2. Fluid dynamics and Heat transfer. JG.Knudsen and D.L.Katz
3. Process heat transfer. D.W.Kern. 2002 Tata-McGrawHill.

B.Tech. (BT) IV Semester
MECHANICAL OPERATIONS

Course Code : **EURBT403** Category: **CE**
Credits: **3** Hours: **3 per week**

UNIT-I : Characteristics of solid particles: shape-size differential and cumulative screen analysis – specific surface area – particle population – different mean diameters for a mixture of particles – storage of solids.

UNIT-II: Principles of communition – laws of crushing (rittinger's, bond's, kick's laws) – work index – classification, description and working of size reduction equipment – jaw, gyratory and roll crushers – hammers – revolving mills – attrition mills – fluid energy mill – cutting machines – open and closed circuit grinding – wet and dry grinding – grindability index.

UNIT-III: Size separation: screening – industrial screens – grizzly – gyratory and vibratory screens – revolving screens – trommels – capacity and effectiveness of screens – froth flotation.

Filtration: description and working of filtration equipment – plate and frame filter press. Shell and leaf filters, rotary drum filter – filter aid – centrifugal filtration – top suspended batch centrifuge. Theory of filtration – washing of cakes.

UNIT-IV: Motion of particles through fluids: drag – free and hindered settling.
Settling velocities – classification – sink & float methods – differential setting.
Batch sedimentation – thickeners – flocculation – centrifugal sedimentation – gravity and centrifugal decanters.

UNIT-V: Agitation of liquids – power consumption in agitated vessels – scale up of agitation equipment – mixing equipment for mixing of solids and pastes – mixing for dry powders – mixing index.

Text book:

1. Unit operations of chemical engineering. McCabe, Smith and Harriot. 7th ed. 2005. McGraw Hill Book Co.

B.Tech. (BT) IV Semester
FLUID MECHANICS

Course Code : **EURBT404** Category: **CE**
Credits: **3** Hours: **3 per week**

UNIT-I : Units and dimensions, dimensional analysis, similarity, types of fluids, hydrostatic pressure, pressure distribution in a static fluids, pressure measuring devices.

UNIT-II : Introduction to fluids in motion, concept of stream lines, stream tubes, viscosity, types of fluids, flow in boundary layers, its formation and growth in tubes and on plates, basic equations of fluid flow continuity, momentum and Bernouli's equation.

UNIT-III : Flow of incompressible fluids in pipes, relation between skin friction – wall shear, laminar flow in pipes, Hagen-Poiseulle equation, turbulent flow in pipes, velocity distribution equation, friction factor, friction from changes in velocity or direction, flow of compressible fluids, basic equations, flow through variable area conduits, adiabatic and isothermal frictional flow.

UNIT-IV : Flow past immersed bodies, Drag, drag coefficient, friction in flow through beds of solids, motion of particles through fluids, its mechanics, terminal velocity, fluidization, mechanism of fluidization, pressure drop in fluidization, applications of fluidization.

UNIT-V: Transportation and metering of fluids, pumps, fans, blowers and compressors, reciprocating, rotary and centrifugal pumps. Flow measuring devices, venturi meter, orifice, pitot tube, rotameter, notches and weirs.

Text Book:

1. Unit Operations of Chemical Engineering – Warren L.Mc.Cabe and Julian C.Smith 5th Edition.

Reference Books:

1. Unit Operations. Brown et al., 1995 CBS.

2. Fluid Dynamics and Heat Transfer. Knudsen and Katz.

B.Tech. (BT) IV Semester
FERMENTATION TECHNOLOGY

Course Code : **EURBT405** Category: **CE**

Credits: **3** Hours: **3 per week**

UNIT-I: Introduction and scope of microbial processes. Sources of industrial cultures and maintenance. Alcoholic fermentation: Production of Industrial Alcohol – Fermentation mechanism. Recent developments, brewing and malting, manufacture of wine and other distilled liquors.

UNIT-II: Microbial Foods – Food, Fodder and Bakers yeast, applications of the non-conventional raw materials (cellulosic material and hydrocarbons) Nutritional characteristics of food yeast, mushroom production. Vitamins- Vitamin B-2, Riboflavin, Soya-sauce & cheese production.

UNIT-III : Organic acids: Production of acids, viz., citric, lactic and gluconic acid. Mechanism of each fermentation, their uses.

UNIT-IV : Production of Amino acids (Lysine and glutamic acid) and Antibiotics (Pencillin, Streptomycin and Tetracyclines) and its new Developments.

UNIT-V : Production of Organic Acids (Acetic acid and vinegar) its spoilage and prevention.

Recommended books:

1. Biotechnology: a textbook of industrial microbiology. Crueger and Crueger. 2nd ed. 2003. Panima publications.

2. Fermentation microbiology and biotechnology. Ed. El-mansi. 2nd ed. 2007. Taylor and Francis.

B.Tech. (BT) IV Semester
ENVIRONMENTAL STUDIES

Course Code : **EURBT406** Category: HS
Credits: **4** Hours: 4 **per week**

UNIT-I: The Multidisciplinary nature of environmental studies – Definition, scope and importance, need for public awareness. **Natural Resources**: Renewable and non-renewable resources. Natural resources and associated problems – Forest Resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests 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, case studies. Food resources: world food problems, changes caused by agricultural and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies. Land resources: Land as a resources, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable life styles.

UNIT-II: 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 the following ecosystems: Forest ecosystems, Grassland ecosystems, desert ecosystems. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). **Biodiversity and its conservation**: Introduction: Definition of ecosystem diversity. Bio-geographical classification of India. Value of Biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local levels. India as a mega-diversity nation. Hotspots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT-III: Environmental Pollution: Definition, Causes, effects and control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear hazards. Solid waste management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies, Disaster Management: floods, earthquakes, cyclones and landslides.

UNIT-IV: Social Issues and the environment: From unsustainable to sustainable development. Urban problems related to energy, Water conservation, rain water harvesting and watershed management. Resettlement and rehabilitation of people, its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment 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-V: Human Population and the Environment: Population growth, variation among nations, Population explosion – Family welfare programme. Environment and human health. Human rights, Value education, HIV / AIDS, Women and Child welfare, Role of information technology in environment and human health. Case Studies. **Field Work**: Visit to local area to document environmental assets-river / forest / grassland/ hill/mountain. Visit to a local polluted site – Urban / Rural / Industrial / Agricultural. Study of common plants, Insects, birds. Study of simple ecosystems – pond, river, hill slopes, etc.

Text Book:

1. Textbook of Environmental Studies for Undergraduate Course s by Erach Bharucha. 2006. Published by – University Grants Commission, Universities Press, India.

B.Tech. (BT) IV Semester
FERMENTATION TECHNOLOGY LABORATORY

Course Code: **EURBT411** Category: **CE**
Credits: **2** Hours: **3 per week**

1. Isolation and characterization of industrial cultures.

2. Analysis of raw materials.

3. Ethylalcohol fermentation and analysis of spirit.

4. Fermented beverages – fermentation and analysis.

5. Amino acids (glutamic acid)

6. Citric acid production

7. Enzymes (Amylase and amyloglucosidase etc.,)

8. Baker's yeast production.

9. Yeast protein, fat production by yeast

10. Vinegar fermentation.

Text Books:

1. Fermentation, A Practical approach IRL.

B.Tech. (BT) IV Semester

FLUID MECHANICS AND MECHANICAL OPERATIONS LABORATORY

Course Code : **EURBT412** Category: **CE**
Credits: **2** Hours: **3 per week**

List of Experiments (Fluid Mechanics Lab):

1. Identification of laminar and turbulent flows (Reynolds apparatus)

2. Measurement of point velocities (pitot tube)

3. Verification of bernoulli's equation.

4. Calibration of Rotameter

5. Variation of Orifice Coefficient with Reynolds Number

6. Determination of Venturi Coefficient

7. Friction losses in fluid flow in pipes

8. Pressure drop in a packed bed for different fluid velocities.

9. Pressure drop and void fraction in a fluidized bed.

10. Studying the coefficient of contraction for a given open orifice

11. Studying the coefficient of discharge in a V-notch

12. Studying of the characteristics of a centrifugal pump.

List of experiments (Mechanical Operations Lab):

1. Sampling of materials (Riffle sampling and cone quartering sampling).
2. Determination of energy consumption in size reduction (crushability test (roll or jaw crusher), Ball mill grindability indices.
3. Size separation: tabling, froth flotation.

B.Tech. (BT) V Semester
ENGINEERING MATHEMATICS-III

Course Code : **EURBT 501** Category: **MT**
Credits: **3** Hours: **3 per week**

The objective of the course is to impart knowledge in Basic concepts of Mathematics relevant to Engineering applications

UNIT-I: Partial Differential Equations: Introduction. First and second order equations, method of separation of variables. **(08)**

UNIT-II: Applications of Partial Differential Equations: Vibrations of a stretched string-wave equation, One-dimensional and two-dimensional heat flow equations, solution of Laplace equation. Laplace equation in polar coordinates. **(08)**

UNIT-III: Fourier Series: Euler's formulae. Conditions for a Fourier expansion, functions having points of discontinuity, change of interval, odd or even functions – expansions of odd or even periodic functions, Half range series. Parseval's formulae. **(12)**

UNIT-IV: Vector Calculus: Scalar, Vector fields, Gradient, Divergence, curl, directional derivative, identities, irrotational and solenoidal vector fields, line integral, surface integral and volume integral, introduction of orthogonal curvilinear coordinates. Cylindrical, Spherical and Polar coordinates. **(12)**

UNIT-V: Complex Analysis: Differentiability, Cauchy-Riemann equations, analytic functions, Cauchy's Theorem, Cauchy's integral formula, Taylor and Laurent expansions (without proofs)Singularities, Residue Theorem, Contour integration. **(10)**

Text Books:

1. Higher Engineering Mathematics by Dr.B.S.Grewal, Khanna Publications.
2. A Text book on Engineering Mathematics by N.P.Bali, Laxmi Publications (P) Ltd

Reference Books:

1. Higher Engineering Mathematics by Dr.M.K.Venkataraman, National Pub. Co
2. Advance Engineering Mathematics by Erwin Kreyszig, Wiley Eastern Pvt. Ltd.
3. Advanced Mathematics for Engineering Students Vol.2, by Narayanan, Manikkavachakam Pillay and Ramanaiah.

Note: The figures in parentheses indicate approximate number of expected hours of Instruction.

B.Tech. (BT) V Semester
GENETICS AND MOLECULAR BIOLOGY

Course Code **: EURBT 502** Category**: BS**
Credits**: 3** Hours**:3 per week**

UNIT-I: Principles of Inheritance: Mendelian and Non mendelian inheritance, linkage and crossing over, mapping of genes and cytoplasmic inheritance,

UNIT-II : Structure of cell membrane, cellular organelles and their structure and functions, organization of the chromosome, euchromatin and heterochromatin; nucleosome; cell division, cell cycle and its regulation; CDC mutants, protein kinases, cyclins; biochemistry of meiosis.

UNIT-III : DNA structure and topology; replication in prokaryotes and eukaryotes; models of replication, nucleotide sequence composition; unique, middle and highly repetitive DNA, redundant DNA; genetic recombination, transposons- molecular nature mutations, DNA repair mechanisms..

UNIT-IV: Principles of transcription: prokaryotic RNA polymerase, mechanism of transcription in prokaryotes and eukaryotes, post transcriptional processing. Regulation of gene expression in E. coli. Operon concept; Biochemical control of gene expression in eukaryotes.

UNIT-V: General features of genetic code, translation machinery in prokaryotic and eukaryotic systems, protein targeting and processing. signal sequences, signal receptor protein, signal hypothesis.

Text Books:

1. Molecular Biology of the Gene, J.D.Watson et al., 1997. Benjamin.
2. Molecular Biology of the Cell, Alberts et al., 4th Ed.2002, Garland Publishers

Reference Books:

1. Cell and Molecular Biology, DeRobertis, E.D.P. 8th ed. 2004. Lippincott, Williams and wilkins.
2. Molecular Biology, Freifelder, D. 2nd ed. 2004. Narosa publishers.
3. DNA Science. 2nd ed. 2003. Cold spring harbor lab. Press.
4. Molecular Cell biology. by Lodish et al. 5th ed. 2004. Freeman and company.

B.Tech. (BT) V Semester
MASS TRANSFER

Course Code **: EURBT 503** Category**: CE**
Credits**: 3** Hours**:3 per week**

UNIT-I : Introduction: Mass transfer Operations, molecular diffusion in fluids, binary solutions, Fick's law, equation of continuity, steady state equimolal counter current diffusion, Stefan's diffusion, estimation of diffusivity of gases and liquids, application of molecular diffusion, theories of mass transfer, analogy between momentum, heat and mass transfer in laminar and turbulent flow, diffusion in solids.
Interphase mass transfer: concept of equilibrium, diffusion between phases, material balances in steady state co-current and counter-current stage processes.
Phase equilibra:

UNIT-II : *Gas-Liquid (Absorption)* : Solubilities of gases in liquids, two component system, multi-component system, ideal and non-ideal solutions, choice of solvent for absorption, single component absorption, material balance, counter current multistage operations, dilute gas mixtures, absorption and stripping factors, continuous contact equipment, HETP, HTU, NTU concepts for single component absorption, graphical construction for transfer units, absorption with chemical reaction.

UNIT III: Equipment for gas-liquid Operations : sparged vessels, mechanically agitated vessels for single phase liquids and gas – liquid mixtures. Description of tray towers & its components, Sieve tray towers, various tray efficiencies, Venturi scrubbers, spray towers and spray chambers, Description of packed towers, Comparison of tray tower and packed towers.

UNIT-IV : Vapor-Liquid (Distillation) : Principles of VLE for binary systems, phase diagrams, relative volatility, Ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, differential distillation (Rayleigh equation), steam distillation, continuous distillation, McCabe-Thiele method, azeotropic and extractive distillation.

UNIT-V : Liquid-liquid (Extraction) : Liquid-liquid equilibria, choice of solvent for extraction, analytical and graphical solutions for single and multistage operations, continuous counter current operation. Equipment : Mixer settler cascades, Rotating disc contactor, Schiebel extractor, Pulsed column, Centrifugal extractor.

Text Books:

1. Mass Transfer Operations, Robert E.Treybal. Third edition, McGraw-Hill Book Co.,
2. Mass transfer – I & II, K.A. Gavhane.

Reference Books:

1. Unit Operations in Chemical Engineering, McCabe, W.L., Smith, J.C. and Harriot, P., 5th Edition, McGraw-Hill Book Co.,
2. Chemical Engineering Hand Book J.H.Perry.

B.Tech. (BT) V Semester
GENETIC ENGINEERING

Course Code **: EURBT 504** Category**: CE**
Credits**: 4** Hours**:4 per week**

UNIT-I : Isolation and purification of nucleic acids. History and Scope of Enzymes involved in DNA manipulation. Isolation of gene using restriction endonucleases, mechanical shearing. Restriction mapping, strategies for DNA ligation.

UNIT-II : Cloning vectors: structure and properties of plasmids, cosmids, Ti and Ri plasmids, expression vectors, YAC, BAC, PAC and phagemids and vectors used for cloning in mammalian cells. Cloning strategies: Construction of recombinant vectors; Gene transfer methods for bacteria, plants and animals: Biological delivery systems and artificial delivery systems.

UNIT-III : Expression of cloned genes in bacteria, yeast, animal and plant cells, synthesis of cDNA, construction and Screening of Genomic DNA and cDNA Libraries. Isolation of cloned genes, identification of recombinants; Methods of Sequencing of DNA and RNA, Preparation of labeled probes and primers.

UNIT-IV : Molecular Techniques involved in detection and their expression of genes in host: Southern, Northern, Western, Dot and Slot blots, In-situ hybridization. Advanced Techniques in gene expression and analysis: PCR and RT-PCR, DNA finger printing, RAPD, RFLP and AFLP.

UNIT-V : RNA silencing: siRNA and anti sense RNA their design and applications, Applications of genetic engineering in medicine, agriculture, animal husbandry, environmental management and industry, Achievements, limitation and negative aspects of genetic engineering.

Text Books:

1. Recombinant DNA 2nd ed.Watson et al., 1992. Freeman and Co.
2. Principles of Gene manipulation: an introduction to genetic engineering. Primrose, Twyman and Old. 5th ed. 2001. Blackwell.
3. From genes to clones. Winneker
4. Gene cloning and DNA analysis, 4th ed. Brown, TA, Blackwell Science

B.Tech. (BT) V Semester

ENGINEERING ECONOMICS AND ENTREPRENEURSHIP

Course Code**: EURBT 505** Category**: HS**

Credits**: 3** Hours**:3 per week**

UNIT-I: Introduction. Basic concepts of the following: Value of money, equation for economic studies, equivalence, types of interest, discrete, continuous. Continuous cash flow and interest compounding. Present worth of an annuity, perpetuities and capitalised costs. Bonds and debentures: value of a bond and yield rate. Definition and structure of entrepreneur. Definitions, kinds and importance of IPRs.

UNIT-II : Depreciation: Types and various methods of calculating depreciation, depreciation accounting. Cost accounting: Basic relationship in accounting, balance sheet and income statement. Various ratios to study the balance sheet and income statements.
Cost estimation: cash flow for industrial operations. Factors affecting investments and production costs – estimation of capital investment, cost indices. Methods of estimating capital investment.

UNIT-III : **Profitability:** alternative investments and replacements. Mathematical methods for profitability evaluation. Economic production charts for plants operating below 100%, above 100% and under dumping conditions. General procedure for determining optimum conditions. Break-even chart of a production schedule and its significance for optimum analysis. Economic balance in cyclic operations and semicontinuous cyclic operations – simple examples.

UNIT-IV : Theories of entrepreneurship, institutes in aid of entrepreneurs, problems of entrepreneurship. Project report.

UNIT-V : Copyright and related rights. Patents, trade secrets, copyrights, trademark, plant breeders and farmers rights. Indias PVP legislation, international development in plant protection; biodiversity – related issues. Biopiracy; Govt. initiatives.

Recommended Textbooks:

For engineering economics:

1. Plant design and economics for chemical engineers (Fourth edition) by Max S Peters and Klaus D. Timmerhaus (Chapters 5 – 11). McGraw Hill Book Company.
2. Process engineering economics by Herbest E Schweyer. McGraw Hill Book Company.
3. for entrepreneurship and IPRs:
4. Dynamics of entrepreneurial development and management by Vasant desai, Himalaya Publishing, House. (2006)
5. Mashelkar Committee report. (internet)
6. Importance of IPR by Abhishek Joshi. National Law Institute, Bhopal University. (Internet)
7. Mohd Usama and Amit Pal. Intellectual property rights. EnviroNews. Vol.12, No.4, Dec. 2006. (Internet)

Reference:

1. Patents for Chemicals, Pharmaceuticals and Biotechnology: Fundamentals of Global Law, Practice and Strategy by Philip W. Grubb
2. Biotechnology: Law, Business and Regulation. by Michael J. Malinowski
3. Biotechnology and Pharmaceutial Patents: Law and Practice (Hardcover) by Marc S. Gross, S. Peter Ludwig, Robert C., Jr. Sullivan
4. Agricultural Biotechnology and Intellectual Property Protection: Seeds of Change Edited by J Kesan

B.Tech. (BT) V Semester
ENVIRONMENTAL BIOTECHNOLOGY

Course Code **: EURBT 506** Category**: CE**
Credits**: 3** Hours**:3 per week**

UNIT-I : Sources of wastewater, characteristics of wastewater; disposal standards; health hazard due to pollution.

UNIT-II : Conventional Physical, Chemical unit operations / unit processes, Screens, Grit chambers, Primary and Secondary clarifiers.

UNIT-III : Aerobic Biological Treatment Processes: Attached and Suspended Film Growth processes, Trickling filter, Design, Types, Activated Sludge Process, Types, Design, RBC

UNIT-IV : Anaerobic Suspended / Attached Growth Processes, Anaerobic filter, Upward Anaerobic Sludge Blanket Reactor – Design.

UNIT-V: Solid waste management, Sources of solid waste, characteristics of solid waste, waste disposal, landfilling, landfill gas generation, recovery, aerobic and anaerobic composting, Recovery and reuse, recycling.

Text Book:

1. Environmental Biotechnology, T.Srinivas, New-Age Publications, New Delhi (2008)

Reference Books:

1. Environmental Engineering, Howard S.Peavy, Donal R.Rowe and George Tchobanoglous, 1985. McGraw Hill Book Company.

2. Environmental Biotechnology: Principles and Applications, Bruce E.Rittmann and Perry L.Mc Carty, 2001. Mc Graw Hill Company.

B.Tech. (BT) V Semester

GENETIC ENGINEERING LABORATORY

Course Code **: EURBT 511** Category**: CE**
Credits**: 2** Hours**:3 per week**

1. Isolation of DNA, RNA and estimation by Diphenyl amine and orcinol methods
2. Isolation of plasmid DNA and estimation by UV spectroscopy
3. Separation of plasmid DNA through agarose gel electrophoresis
4. Isolation of Genomic DNA from plants and bacteria.
5. Restriction digestion of DNA
6. Ligation of restricted DNA fragments
7. Preparation of competitive *E. coli* cells and Transformation
8. Southern blotting
9. PCR amplification DNA
10. Expression of cloned genes (GFP)
11. DNA finger printing (RFLP & RAPD)
12. Regulation of Gene expression

Reference Books:

1. A guide to molecular cloning. Vol. 1,2 and 3. Sambrook, Fritsch and Maniatis. Cold spring harbor lab.
2. Practical in Biochemistry and Biotechnology by M.Z. Abdin and S. Javed by I.K. International publishing House Pvt. Ltd.

B.Tech. (BT) V Semester
HEAT & MASS TRANSFER LABORATORY

Course Code **: EURBT 512** Category**: CE**
Credits**: 2** Hours**: 3 per week**

List of Experiments:

1. Thermal conductivity of metal rod (Steady conduction)
2. Calculation of thermal conductance in a unsteady heat exchange unit
3. Calculation of film & overall heat transfer coefficients in a
   1. Double pipe heat exchanger 2. Shell & tube heat exchanger
4. Ternary liquid equilibria (Binodal curve)
5. Liquid-liquid equilibria
6. Limiting flow rates in spray tower
7. Studies of axial mixing characteristics in a packed bed.
8. Vapor-Liquid equilibria
9. Steam distillation
10. Gas-liquid mass transfer in
    (i) Packed tower. (ii) Tray towers

EURBT 513: ENGLISH COMMUNICATION SKILLS LAB

Course Code **: EURBT 513** Category**: HS**
Credits**: 2** Hours**:3 per week**

1. Concept and importance of communication.
2. Developing Communicative abilities.
3. Paper Presentation – Planning, preparation and Presentation using Audio-Visual aids.
4. Proposals and Research Reports.
5. Oral Presentation.
    a. Group Discussion.
    b. Interviews
    c. Conducting a meeting.
    d. Telephone Etiquette.

Suggested Texts:

1. Himstreet, William C., Gerald w.Maxwell, Mary Jean Onorato. Business Communications. A Guide to effective writing, speaking and listening. Gelencoe publishing company. California 1982.
2. Murphy, Hurta A etal, Effective Business communications, The McGraWHill companies Inc. 1997.
3. Thill, John V., Bove'e, Courland L. Excellence in Business Communication. McGraw Hill Inc. 1996.
4. Lesitar & Pettit. Report writing for Business. Irwin – McGraw Hill. 1995. Tenth Edition.
5. Paulery and Riordan. Technical report writing today. Houghton Mifflin company. 1999.5th edition. Reprint.

B.Tech. (BT) V Semester
PERSONALITY DEVELOPMENT

Course Code **: EURBT 514** Category**: IT**
Credits**:** Hours **:**

B.Tech. (BT) VI Semester
BIOINFORMATICS

Course Code **: EURBT 601** Category**: BE**
Credits**: 3** Hours**:3 per week**

UNIT-I: Introduction to Biological databases. Brief introduction to types of information available in different biological databases (details to be covered in practicals).

Fragment assembly. Gene prediction - Statistical and similarity based approaches. Gene annotation.

UNIT-II: Sequence analysis: introduction. Similarity matrices – PAM and BLOSUM.

Searching databases using BLAST. Description of the BLAST algorithm.

UNIT-III: Pairwise sequence alignment using dynamic programming. Needleman & Wunsch algorithm for global alignment. Smith-Waterman algorithm for local alignment. Dynamic programming for sequence alignment with affine gap penalties. Searching for repeats and partial overlaps using dynamic programming.

UNIT-IV: Phylogenetic analysis. Distance based methods: UPGMA and Neighbor joining. Classical parsimony and weighted parsimony methods. Branch and bound.

Multiple sequence alignment. Multidimensional dynamic programming. Progressive alignment and profile alignment. Sankoff and Cedergren method for Simultaneous alignment and phylogeny.

UNIT-V: Prediction of secondary structure from protein sequence – Chou-Fasman rules, neural networks.

Prediction of transmembrane helices.

Prediction of protein conformation from protein sequence. Information theoretical methods: Homology and threading. Basic Concepts of prediction using Force fields - Energy minimization, molecular dynamics and simulated annealing.

Recommended Textbooks:

1. Bioinformatics: Sequence and Genome analysis by D.Mount. 2nd ed. 2005. CBS publishers.
2. Biological sequence analysis: Probabilistic models of proteins and nucleic acids by Durbin, Eddy, Krogh and Mitchison. 1998 Cambridge University Press.
3. Molecular modeling: principles and applications. A. Leach. 2nd ed. 2001. Pearson.

Reference:

1. Molecular modeling and simulation: Tamar Schlick.(2002) Springer-Verlag.
2. Bioinformatics: a practical guide to the analysis of genes and proteins. Baxevanis, 3rd Ed. (2004) Wiley.

B.Tech. (BT) VI Semester
IMMUNOLOGY AND MEDICAL BIOTECHNOLOGY

Course Code **: EURBT 602** Category**: CE**
Credits**: 3** Hours**:3 per week**

UNIT-I : History of immunology; Types of immunity: Innate and adaptive. Cells and organs of the immune system. B cell, T cell and macrophages, Antigens, Structure of antibody, antibody classification, antigen-antibody reactions.

UNIT-II : Hybridoma technology: Monoclonal antibody production and applications, Major Histocompatability Complex (MHC); Humoral and cell mediated immunity. Cytokines, Complement components and biological consequences of complement activation.

UNIT-III : Immunological memory, Immunoregulation, Adjuvants and Immunological tolerance, hyper sensitivity, autoimmunity, Transplantation immunology: graft versus host reaction, immuno deficiency and immuno proliferative diseases. Vaccines: types of vaccines, development.

UNIT-IV : Blood formation, Anaemias: Blood loss anaemia, Magaloblastic anaemia, Leukaemia, Necrosis & Apoptosis, Biochemistry of cancer, The Parts of Brain; Brain Tumours, Principles of Animal Tissue Culture, Types of animal cell cultures and Stem cells.

UNIT-V: Stem cell, Bone marrow and kidney transplants. Molecular diagnostics: PCR and RT-PCR based and RFLP based techniques. Gene therapy: types and use of rDNA constructs for Gene therapy. Transgenic mice development.

Text Books:

1. Kuby Immunology by Ed., T.J.Kindt, R.A. Goldsby and Osborne. 6th ed. 2007. Oxford.
2. Fundamental Immunology, Paul, WE. 4th ed. 1999 Raven Press.
3. Roitt's essential immunology. 10th ed. Roitt and Delves. 2005. Blackwell science.
4. Text book of Medical Biochemistry by Ranashinde chaterjee
5. An Introduction to molecular Biotechnology Edited by Michael wink, IK international publishing house PVT. Ltd.

B.Tech. (BT) VI Semester
ELECTRICAL CIRCUITS and ELECTRONICS

Course Code **: EURBT 603** Category**: BE**
Credits**: 4** Hours**: 4 per week**

UNIT-I : Kirchoff's laws. Analysis of circuits using loop current method and node voltage method. Thevenin's theorem. Norton's theorem and superposition theorem. Types of induced emf. Principles of DC machines. EMF equation in DC machines. Response of RLC circuits to sinusoidal inputs. AC machines: Principles of single phase and three phase induction motors.

UNIT-II: Semiconductor diodes : P.N. Junction diode, Zener diode, Tunnel diode. Diode rectifiers. Special purpose diodes: LED, photodiode.

UNIT-III : Bipolar junction transistor. Transistor biasing. Transistor amplifiers types and their properties. Small signal analysis of BJT amplifiers. RC couple amplifier and its frequency response.

Field effect transistors: JFET and its characteristics, MOSFET - Enhancement and Depletion modes.

UNIT-IV : Feedback amplifier. Feedback topologies – Voltage series, Voltage shunt, Current series, Current shunt. Oscillators – LC and RC oscillators, RC phase shift oscillator, Wein-bridge Oscillator, Crystal oscillator.

UNIT-V : Introduction to Op-amps. Applications of Op-amps. Design of Filters – low pass, high pass, band pass, band reject. Convertors - A/D convertors, D/A convertors, Sample-and-hold circuit. Timers. PLL. Digital oscilloscope.

Text Books:

1. Integrated Electronics by Jacob Millman and C.C.Halkias, 1999 McGraw Hill.
2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad.
3. Introduction to electrical engineering. M.S.Naidu and S.Kamakshaiah. Tata McGraw-Hill.
4.

Reference:

1. Electronic devices and circuits by C. Dharmaraj and BT Krishna.

B.Tech. (BT) VI Semester
CHEMICAL REACTION ENGINEERING

Course Code **: EURBT 604** Category**: CE**
Credits**: 3** Hours**: 3 per week**

UNIT-I : **Batch reactors:** Introduction and overview of the subject, kinetics of homogeneous reactions, non elementary reactions; collision theory and transition-state theory, arrhenius relation, various methods of analysis of batch reactor data (including variable volume and variable pressure data). Isothermal batch reactor design.

UNIT-II: Homogeneous flow reactors: design equation for plug flow reactor (PFR) and continuous stirred tank reactor (CSTR), data analysis in flow reactors. Design of PFR and CSTR. Cascade of CSTRs and combination of PFR and CSTR. (design of autocatalytic reactions not included).

UNIT-III: Multiple reactions: design for multiple reactions, parallel reactions, series reactions (omit reversible and series-parallel reactions).

UNIT-IV : Non-isothermal design: energy balance equations for batch, PFR and CSTR under non-isothermal conditions. Equilibrium conversion under adiabatic conditions. Design of the homogeneous reactors under adiabatic conditions.

Non-ideal flow: residence time distribution curves E,F and C; interpretation of the response data for the dispersion and tanks-in-series models (omit multiparameter models).

UNIT-V : **Heterogeneous catalysis**: catalyst properties, physical adsorption and chemisorption, adsorption isotherm, derivation of rate equations for various mechanisms (adsorption, surface reaction and desorption controlling etc.) data analysis for heterogeneous laboratory catalytic reactors. Isothermal packed bed (PFR) reactor design, effectiveness factor and internal pore diffusion. Criteria for internal pore diffusion.

Text book:

1. Chemical reaction engineering. Levenspiel. 3rd edition. John Wiley. 1999

Reference books:

1. Elements of chemical reaction engineering. H.S.Fogler. 2nd editon. Prentice Hall, India.
2. Chemical engineering kinetics. J.M.Smith. 3rd edition. McGraw Hill. 1981

B. Tech Biotechnology VI Semester
PHARMACEUTICAL BIOTECHNOLOGY

Course Code **: EURBT 605** Category**: CE**
Credits**: 3** Hours**: 3 per week**

UNIT- I: Introduction and Drug Metabolism: Development of drug and pharmaceutical Industry; Therapeutic agents, their uses, economics and regulatory aspects. **Drug Metabolism:** Factors effecting drug metabolism. Dose effect relationships; Pharmacokinetic effects on humans (including foetus). **Drug reactions:** Adverse drug reactions and drug interactions.

UNIT – II: Screening: Screening principles, correlations between various animal models and human situations. Correlation between in-vitro and in-vivo Screens; Special emphasis on cell lines/success cases and limitations.

UNIT – III: Bulk Drug Manufacturing: Bulk drug Manufacturing, Types of Reactions in Bulk drug Manufacture and Processing. Special Requirements for Bulk Drug Manufacture. Case Study: Unit Processes and Unit Operations of Penicillin G production, purification, formulation and packaging.

UNIT – IV: Manufacturing principles: Compressed tablets, Coating of tablets, Capsules, Sustained action dosage forms – Parenteral solutions, oral liquids and ointments. Packaging techniques.

UNIT – V: Quality control: GMP. Purity determination as per ICH guidelines; use of different biochemical, molecular biology techniques.

Textbooks and Reference Books:

1. Biopharmaceutics by Brahmankar
2. Leon Lachman et al–Theory and practice of industrial pharmacy. 3rd edition. Lea and Febiger, 1986.
3. Remington's Pharmaceutical sciences. Mark publishing and Co.

B.Tech. (BT) VI Semester
ENZYME TECHNOLOGY

Course Code **: EURBT 606** Category**: CE**
Credits**: 4** Hours**: 4 per week**

UNIT-I : **Enzyme Kinetics**: Simple enzyme catalyzed reactions, single intermediate mechanism, Double intermediate mechanism, Comparison of enzyme parameters, Quasi-steady state kinetics.

UNIT-II : **Enzyme inhibition:** Types of inhibition, competitive, non competitive, uncompetitive and mixed inhibition. Reversibility and product inhibition.

UNIT-III : Methods of immobilization, Kinetics of immobilized enzymes, external and internal mass transport resistance of immobilized systems.

UNIT-IV : Production of enzymes, selection of organisms, Industrial approach to enzyme production and comparison of cells and enzymes as Industrial catalysts. Enzyme reactor performance, operational strategies, carrier life and cycle time.

UNIT-V: Industrial application: Applications of enzymes in Pharmaceutical & Food Processing Industry.

Text Books:

1. Applied biochemistry and bioengineering, Vol. I Ed.Wingard, LB., Katchalski-Katzir, E.Goldstein, L.Academic Press.

2. Biochemical engineering fundamentals, Bailey and Ollis. 2nd Ed. 1986. McGrawHill.

3. Fundamentals of Enzymology, 3rd Edition, Price, NC and Stevens, L.2003. Oxford University Press

4. Immobilization of enzymes and cells; Methods in biotechnology, Vol.1, Bickerstaff.G.F.

B.Tech. (BT) VI Semester
CHEMICAL REACTION ENGINNERING LABORATORY

Course Code **: EURBT 611** Category**: CE**
Credits**: 2** Hours**: 3 per week**

1. Determination of the order of a reaction using a batch reactor and analysing the data by a) differential method and b) integral method.
2. Determination of the activation energy of a reaction using a batch reactor.
3. To determine the effect of residence time on conversion and to determine the rate constant using a CSTR.
4. To determine the specific reaction rate constant of a reaction of known order using a batch reactor.
5. To determine the order of the reaction and the rate constant using a tubular reactor.
6. Determination of RTD and dispersion number in a tubular reactor using a tracer.
7. Mass transfer with chemical reaction (solid-liquid system) – determination of mass transfer coefficient.
8. Axial mixing in a packed bed. Determination of RTD and the dispersion number for a packed-bed using tracer.
9. Langmuir adsorption isotherm: determination of surface area of activated charcoal.
10. Performance of reactors in series:
11. A plug-flow reactor followed by a CSTR.
12. A CSTR followed by a plug flow reactor.

B.Tech. (BT) VI Semester
BIOINFORMATICS LABORATORY

Course Code **: EURBT 612** Category**: BE**
Credits**: 2** Hours**: 3 per week**

Needleman-Wunsch algorithm for Global alignment.

Smith-Waterman algorithm for Local alignment.

Multiple sequence alignment.

Prediction of coding regions.

Phylogeny: Parsimony, Neighbor-Joining, Tree display

Secondary structure prediction.

Prediction of transmembrane regions.

Molecular graphics.

Molecular modeling.

Use of following databases:

Pubmed and PMC.

NCBI-Genbank.

PDB.

KEGG.

B.Tech. (BT) VII Semester
BIOPROCESS ENGINEERING

Course Code **: EURBT 701** Category**: CE**
Credits**: 3** Hours**: 3 per week**

UNIT-I : Definition and scope of biochemical engineering**.** Stoichiometry and energetic analysis of cell growth and product formation – degree of reduction concepts – oxygen consumption and heat evolution in aerobic cultures – thermodynamic efficiency of growth. Principles and mechanism of media and air sterilization, batch and continuous sterilization of media, design of air filter.

UNIT-II: Aeration and agitation in bioreactors: Oxygen transfer in microbial systems, oxygen demand mass transfer theories, measurement of volumetric mass transfer coefficient, power requirement in gassed and ungassed bioreactors, mixing and heat transfer in dispersed systems, bioreheology.

UNIT-III : Microbial growth kinetics, substrate utilization and product formation kinetics for batch growth- unstructured non-segregated models, models for transient behavior in batch reactor.

UNIT-IV : Growth in ideal chemostat, chemostat with recycle, multistage chemostat, fed-batch growth.

UNIT-V : Scale-up: Basic concepts, problems related to the scale-up of the microbial processes.

Text Books:

1. Biochemical engineering fundamentals, Bailey and Ollis. 2nd Ed. 1986. McGrawHill.
2. Bioprocess engineering, Shuler and Kargi, 2nd ed. 2005. Prentice Hall.
3. Introduction to Biochemical Engineering, D.G.Rao, 2005. Tata McGrawHill.
4. Bioprocess Engineering Principles, Pauline M.Doran, 2005. Elsevier
5. Principles of Fermentation Technology, Stanbury, P.F.A., Whitaker & Hall, 1997. Aditya books.

B.Tech. (BT) VII Semester
PROCESS DYNAMICS AND CONTROL

Course Code **: EURBT 702** Category**: CE**
Credits**: 3** Hours**: 3 per week**

UNIT-I : Linear Open-loop Systems: Response of First-Order Systems, Physical examples of First-Order systems, Response of First-Order Systems in series, Second-Order Systems, Transportation Lag.

UNIT-II : Linear Closed-Loop Systems: The control system, Controllers and Final Control elements, Block diagram of a Chemical- Reactor Control system. Closed-Loop transfer functions, Stability, Root Locus.

UNIT-III : Frequency Response: Introduction to frequency response. Control system design by frequency response.

UNIT-IV : Process Applications: Cascade control. Feed forward control, Ratio control, Selective Controllers, Split Range Controller, Controller tuning, Control valves.

UNIT-V : Applications of controllers in Bioprocesses: Bioreactor operation, measurement and control: Aseptic operations, Biochemical process variables (pH, dissolved oxygen, viscosity, temperature, NADH), measurement and control of agitation rate, foam control. Data acquisitions, analysis and computer control of bioreactors.

Text Book:

1. Process Systems Analysis and Control, 2nd Edn. Donald R.Coughnowr, McGraw-Hill Inc., 1991.
2. Biochemical engineering fundamentals, Bailey and Ollis. 2nd Ed. 1986. McGrawHill.
3. Principles of Fermentation Technology, Stanbury, P.F.A., Whitaker & Hall, 1997. Aditya books.

B.Tech. (BT) VII Semester
DOWNSTREAM PROCESSING

Course Code **: EURBT 703** Category**: CE**
Credits**: 3** Hours**: 3 per week**

UNIT-I: Overview of bioseparation.
Recovery of intracellular products: Cell disruption methods – physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear) – chemical methods (alkali, detergents) – enzymatic methods.

UNIT-II: Separation of cells and other insolubles from fermented broth – sedimentation, filtration (pretreatment, filtration theory, continuous rotary filters), microfiltration, Centrifugation (batch, continuous and basket).

UNIT-III: Isolation and purification: precipitation, leaching, adsorption and ultrafiltration. Precipitation (ammonium sulphate, organic solvents, high MW polymers)

Leaching: preparation of solid, steady and unsteady state operation, equipment, analytical methods both theoretical and problematic approaches for single and multistage operations. Liquid-liquid extraction methods in DSP.

Adsorption: Theory of adsorption. Industrial adsorbents, adsorption equilibria. Freundlich equation. Single and multi-stage operations. Unsteady stae adsorpton. Equipment for single stage and continuous contact. Ion-exchange. Column chromatography.
Ultrafiltration.

UNIT-IV : Product polishing: crystallization and drying.
Crystallization: yields and material balances, heat effects and heat balances. Equipment for crystallization. Crystallization theory: Rate of nucleation and rate of crystal growth. Particle size distribution of crystals. Model for MSMPR.
Drying of bioproducts: methods of drying. Equipment for drying. Equilibrium moisture content of bioproducts. Rate of drying curves. Convective, radiative and conductive heat transfer in constant rate drying period. Falling rate drying period. Freeze drying. Effect of thermal processing on food constituents.

UNIT-V : Product recovery: ethanol, citric acid, penicillin, recombinant renin from E.coli.

Textbooks:
1. Bioseparations: Downstream processing for biotechnology. P.A.Belter, E.L.Cussler, W-S.Hu. Wiley-Interscience. (1988).
2. Bioseparation science and engineering. Harrison et al. 2006. Oxford Univ. Press.
3. Unit operations in chemical engineering. McCabe, Smith and Harriot. McGraw Hill Co.
4. Separation Processes in biotechnology.J.Asenjo.(1990)CRC.

B.Tech. (BT) VII Semester

DEPARTMENTAL ELECTIVE-I

Course Code **: EURBT 721 -723** Category**: DE**
Credits**: 3** Hours**: 3 per week**

DEPARTMENTAL ELECTIVE-II

Course Code **: EURBT 731 - 733** Category**: DE**
Credits**: 3** Hours**: 3 per week**

B.Tech. (BT) VII Semester

PROCESS DYNAMICS & CONTROL LABORATORY

Course Code **: EURBT 711** Category**: CE**
Credits**: 2** Hours**: 3 per week**

List of Experiments:

1. Response of Resistance Thermometer
2. Response of Thermometer with and without Thermal Well.
3. Response of Manometer
4. Response of Single-Tank Liquid-level system
5. Response of Two-Tank Liquid-level system.
6. Calibration of Thermocouples.
7. Response of mixing process.
8. Calibration of Rotameter with compressible fluid.
9. Study of ON-OFF control action.
10. Feedback amplifier – calculation of gain, input resistance, output resistance, frequency response characteristic.
11. RC differentiator
12. RC integrator.

B.Tech. (BT) VII Semester

BIOPROCESS ENGINEERING LABORATORY

Course Code **: EURBT 712** Category**: CE**
Credits**: 2** Hours**: 3 per week**

1. Study of cell growth kinetics of batch and continuous culture.
2. Measurement of volumetric oxygen transfer coefficient ($k_L a$)
3. Efficiency of fibrous air filters.
4. Heat inactivation of microbial cells, calculation of rate constant, thermal death rate, activation energy.
5. Determination of settling velocity of biomass.
6. Immobilization of cells and enzymes.
7. Mixing time in a bioreactor.
8. Mass transfer analysis of immobilized enzyme reactor.

Additional student oriented innovative/creative experiments under guidance of teacher.

INDUSTRIAL TRAINING

Course Code **: EURBT 713** Category**: IT**

Credits**: 2** Hours**: 3 per week**

PROJECT

Course Code **: EURBT 714** Category**: PW**

Credits**: 3** Hours**:**

B.Tech. (BT) VII Semester

Departmental Elective: Genetics, Genomics and Proteomics

Course Code **: EURBT 721** Category**: DE**

Credits**: 3** Hours**: 3 per week**

UNIT-I : Viral genomes. Molecular description of viral replication methods. Genetic diversity of infectious microbes and humans and domestic animals.

UNIT-II : Identification of the components of a complex mixture. Protein sequencing by mass spectrometry. Genome sequence analysis by mass spectrometry. Analysis of microarray data.

UNIT-III : The genome of bacteriophage □X-174. Genomes of Mycoplasma genitalium, Escherichia coli, Methanococcus jannaschi, Mycoplasma genitalium, Saccharomyces cerevisiae, Caenorhabditis elegans, Drosophila melanogaster, Arabidopsis thaliana. The genome of Homo sapiens and its sequence determination.

UNIT-IV : Introduction to systems biology. Networks and graphs. Protein complexes and aggregates. Protein interaction networks.

UNIT-V: Regulatory networks. Structural biology of regulatory networks.

Textbooks:

1. A.M.Lesk. Introduction to Bioinformatics. 2nd edition. (Oxford.).
2. S.R.Pennington and M.J.Dunn. Proteomics. Viva books. New delhi, 2002.

Reference:

1. Kohane, IS., Kho, A and Butte, A.J. 2002. Microarrays for an integrative genomics. Barnes and Nobles, MIT press.
2. T.A.Brown. Genomes. 2nd edition. Bios scientific. 2002.
3. Molecular Biology of the Gene, J.D.Watson et al., Benjamin. 1987. 4th ed.

B.Tech Biotechnology VII Semester
Departmental Elective: **MARINE BIOTECHNOLOGY**

Course Code **: EURBT 723** Category**: DE**
Credits**: 3** Hours**: 3 per week**

UNIT I: Historical background, Overview of the present status of marine biotechnology, Marine ecosystems – intertidal zone, inhabitants and ecology of estuaries, salt marshes, mangrove swamps, coral reefs and the deep sea, Plankton, nekton and benthos.

UNIT II: Marine biodiversity, indices, evaluation and maintenance of biodiversity. Conservation and applications from both the biology and policy perspectives (e.g. endangered species, captive breeding, habitat fragmentation, ecosystem restoration, rehabilitation. Marine food web dynamics - primary, secondary and tertiary production. Living resources of Indian Sea.

UNIT III: Introduction to tides and waves. Water currents and winds. Major and minor elements in the sea water and their importance, dissolved oxygen. Biogeochemical cycles (Carbon, Nitrogen, Sulphur and Phosphorus) in the ocean. Global climatic change and potential effects on coral bleaching, eutrophication.

UNIT IV: Marine natural products, aquaculture, valuable chemicals, bioactive compounds from micro-algae, macro-algae, algal production in real sector. Commercially important enzymes from marine microorganisms: Xylanase, proteases, chitinases. Marine food analysis – spoilage, quality control ISO standard keeping export in consideration. Biodegradation.

UNIT V: Marine biotechnology for economic development and environmental problem solving. Aquaculture- fish,shrimp and pearl oyster culture. Marine bio-film and bio-remediation, marine bio-sensors and transgenic marine organisms. Biofouling and prevention. Sea weeds for removal of metal pollutants. Probiotic bacteria and their importance in acquaculture. PCR, molecular and immunological techniques for determination and identification of bacterial and viral pathogens in aquaculture. Vaccines for aquaculture.

TEXT BOOKS:

1. Text book of Marine Ecology.(1989). Nair N.B. & Thampy, D.M.
2. Recent Advances in Marine Biotechnology. Vol.2 (1998) Fingerman, M., Nagabushanam, R., Thompson, M.

REFERENCES

1. Biological Oceanography.(1999). Lilly, C.M.
2. Ecology of Coastal water.(1988). Mann, K.H.
3. An introduction to Marine Sciences.(1988). Meadows, P.S. & Campbell J.J.
4. General Oceanography–An introduction (1980). Dietrich,G., Kalle,K, Krauss,W& Siedler, G.
5. Biotechnology in the marine sciences: Proceedings of the first annual MIT Sea grant lecture & seminar. (1984). Colwell, R.D.(Ed)
6. Methods of Sea Water Analysis. (1995). Grasshoff,K., Ehrhardt,M. & Kremling,K.
7. Quantitative Ecology & Marine Biology. (1990). Bakus,G.J.
8. Methods of study of Marine Benthos. (1984). Holme,N.A. & McIntyre, A.D.

B.Tech. (BT) VII Semester
Departmental Elective: Food Processing Technology

Course Code **: EURBT 731** Category**: DE**
Credits**: 3** Hours**: 3 per week**

UNIT-I: **Principles of Food processing:** Scope and importance of food processing

An over view of Membrane technology. Micro-filtration, Ultra filtration (UF), Nano filtration (NF) and Reverse Osmosis (RO) and their industrial applications. Microwave and radio frequency processing.

UNIT-II : Hurdle technology: concept of hurdle technology and its application. High Pressure Concept, equipment for HPP treatment, mechanism of microbial inactivation and its application in food processing. Ultrasonic processing: Properties and application of ultrasonic processing techniques.

UNIT- III : Application of technologies of high intensity light, pulsed electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays in food processing and preservation. Nanotechnology its Principles and applications in foods

UNIT-IV : Food quality assurance and packaging: Methods of quality assessment of food materials.Concept of codex Almentarious / HACCP/ USFDA/ ISO 9000 series. Packaging operation, package function and design. Deteriorative changes in foodstuff and packaging methods for prevention. Shelf life of packaged foodstuff. Methods to extend shelf life.

UNIT-V: Introduction to nutraceuticals. Manufacturing aspects of selected nutraceticals such as lycopene, isoflavonoids, prebiotics and probiotics, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals.

Text Books:

1. Fellows, P. & Ellis H.1990 Food Processing Technology. Principles and practice; Newyork
2. Jelen P. 1985.Introduction to food processing, Prentice Hall, Reston Virginia, USA.
3. Food Processing: Principles and Applications, Michele Maracotte, Hosahalli Ramaswamy, Taylor and Francis.

Reference Books:

1. Barbosa-Canovas 2002. Novel Food Processing Technologies. CRC.
2. Gould GW.2000. New Methods of Food Preservation. CRC.
3. Shi J. (Ed) 2006. Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC.
4. Nesser JR & German BJ.2004. Bioprocesses and Biotechnology for Nutraceuticals. Chapman & Hall.
5. Early R.1995. Guide to Quality Management Systems for Food Industries. Blackie Academic.
6. Krammer A & Twigg BA.1973. Quality Control in Food Industry. Vol.I, II A VI Publ.
7. Macrae R, Roloson R & Sadlu MJ. 1994. Encyclopedia of Food Science & Technology & Nutrition. VolXVI. Academic Press.

B.Tech. (BT) VII Semester

Departmental Elective: Molecular Modeling and Drug design

Course Code **: EURBT 732** Category**: DE**
Credits**: 3** Hours**: 3 per week**

UNIT-I : Quantum chemistry for Modeling of small molecules: Variation method and Time independent Perturbation theory. Ab initio methods for molecules: Hartree-Fock SCF method. Common basis sets.

UNIT-II : Introduction to semi-empirical methods: Huckel molecular orbital theory. Pariser-Parr-Pople method. CNDO, AM1 and PM3.

UNIT-III : Force fields for molecular modeling: Choice of functional form. Parametrization of a force field. Anharmonicity. Distributed multipole and polarizable forcefields. The hydrogen bond. Hydrophobic effect and solvation energy. Potentials of mean force.

UNIT-IV : Conformational analysis: Geometry optimization using steepest descent and conjugate gradients. Restrained and constrained molecular dynamics. Distance geometry.

Case studies: Prediction of protein-protein interactions. DNA conformation.

UNIT-V : Principles of ligand based drug design: SAR, QSAR and 3D-QSAR. Receptor based drug design: Principles of receptor based de novo ligand design. Rigid body molecular Docking.

Case study: Structure based design of non-peptide inhibitors specific for HIV1 protease.

Textbooks:

1. Andrew Leach. Molecular modeling: principles and applications. 2nd ed. Pearson Education. 2001.
2. Atkins and Friedman. Molecular quantum mechanics. Oxford University Press. 4th ed. 2005.

B.Tech. (BT) VII Semester
INDUSTRIAL INSTRUMENTATION (ELECTIVE)

Course Code **: EURBT 733** Category**: DE**
Credits**: 3** Hours**: 3 per week**

UNIT-I: Thermoelectric temperature measurement: Thermoelectricity, Industrial Thermocouples, thermocouple lead wires, Thermal wells, response of thermocouples.

Resistance thermometers: Thermal coefficient of Resistance, Industrial resistance thermometer bulbs, Resistance thermometer circuits, Null-Bridge resistance thermometers. Deflectional Resistance Thermometers.

Radiation temperature measurement: Introduction, Black Body devices, Radiation receiving Elements, Radiation Pyrometers, Photoelectric Pyrometers, Optical Pyrometers.

UNIT-II : Measurement of pressure and vacuum: Pressure, Vacuum and Head, Liquid column Manometers, Measuring elements for Gauge pressure and vacuum. Indicating elements for Pressure gauges, Measurement of absolute pressure, Measurement of pressure in Corrosive fluids, Static accuracy of pressure gauges.

UNIT-III : Measurement of Head and Level: Density and Specific gravity, Direct measurement of liquid level, Pressure (Level) measurement in Open Vessels, Level measurement in pressure vessels, Density measurement, Level measurement by weighing.

UNIT-IV : Flow metering: Flow of incompressible fluids in pipe, Orifice Installation. The Venturi tube, Pitot tube, Head flow meters, Area flow meters, Open channel meters, Velocity meters, Quantity meters.

UNIT-V: Methods of Composition analysis: Gas analysis by thermal conductivity. Analysis of moisture in gases (Humidity), Psychrometer method, Hygrometer method, Dew-point method for moisture analysis in Gases, measurement of moisture in paper, textile and Lumber.

Text Books:

1. Industrial Instrumentation, Donald P. Eckman, 2003 CBS Publishers

2. Industrial instruments by D.Patranabis, 2nd Ed. 2004. Tata McGraw Hill.

Reference Books:

1. Hand Book of Instrumentation and Control, Considine**.**

B.Tech. (BT) VIII Semester
BIOREACTOR DESIGN

Course Code **: EURBT 801** Category**: CE**
Credits**: 3** Hours**: 3 per week**

UNIT-I: Fermentation Kinetics:

Microbial, plant and animal cell culture – Batch, Continuous and Fed-batch culture. Kinetic relationships – parameters, variables and constraints, simple problems on the topics.

UNIT-II: Mass Transfer in Bioreactors: Importance of interfacial mass transfer in Biotechnology. Mass Transfer between phases – factors affecting mass transfer between phases. Mass Transfer in porous solids. Oxygen uptake in fermenters. Simple problems on topics.

UNIT-III : Design of a Fermenter:

Basic functions of a fermenter for microbial or animal cell culture. Aseptic operation, sterilization and containment, temperature control. Reactor body construction – construction material. Reactor Dynamics. Design calculation for stirred tank Bio-reactor. Simple problem on it.

UNIT-IV : Rheology, Aeration and Agitation in Animal Cell Bioreactors

Design, Operation and types of agitators and spargers, power and time requirements for agitation. Effects of agitation on mass transfer, Oxygen delivery system, foam control system, factors affecting antifoam requirements, Antifoam addition system.

UNIT-V: Types of Reactors and Accessories:

Description, working, advantages and limitations of stirred tank, Airlift, Bubble-driven, packed bed, fluidized bed, trickle bed and flocculated cell Bioreactors.

Description and functions of the following accessories for bioreactors:

Pumps, filters, valves, steam traps.

Textbooks:

1. Biochemical engineering fundamentals, Bailey and Ollis. 2nd Ed. 1986. McGrawHill.
2. Principles of Fermentation Technology, Stanbury, P.F.A., Whitaker & Hall, 1997. Aditya books.

Reference Books:

1. Introduction to Biochemical Engineering, D.G.Rao, 2005. Tata McGrawHill.
2. Basic Bioreactor Design - Van't Riet, K & J,Tramper, Marcel Dekkar Inc. New York 1991.

B.Tech. (BT) VIII Semester
PLANT BIOTECHNOLOGY

Code **: EURBT 802** Category**: CE**
Credits**: 3** Hours**: 3 per week**

UNIT-I : History developments and land marks in the development of plant tissue culture, sterilization methods, nutritional components of tissue culture media, plant growth regulators, regulation of cell differentiation, Regeneration of plants through organogenesis and somatic embryogenesis.

UNIT-II : Clonal (Micro) propagation and its applications; Somaclonal variation, its genetic basis and application in crop improvement; callus/cell line selection for resistance to herbicide, stress and diseases.

UNIT-III : Anther culture - methods of haploid production and their application in plant breeding; Protoplast technology - isolation, culture and plant regeneration, protoplast fusion, identification and characterization of somatic hybrids, cybrids applications of protoplast in gene transfer; indirect and direct methods, current status and limitations.

UNIT-IV: Bioreactor system and models for mass cultivation of plant cells.

Production of secondary metabolites by plant cell cultures.

UNIT-V : Cryopreservation of germplasm, methods of production of synthetic seeds and their applications. Automation in plant tissue culture, field techniques for propagation of regenerated plants, economics of tissue culture.

Text books:

1. Plant Cell, Tissue, and Organ culture by J.Reinert and YPS Bajaj. 1997. Narosa
2. "Plant Cell and Tissue Culture" by S.Narayanaswamy. 2004. McGrawHill
3. An introduction to plant tissue culture. MK.Razdan. 2nd Ed. 2003. Oxford and IBH.
4. "Hormones at Cellular Level" Ed. by Scott, T.K.
5. "Handbook of Plant Cell Culture" Eds. Sharp et al.
6. Plant Biotechnology C.Chawla. 2004. Oxford and IBH.

Reference Books:

1. Plant tissue and cell culture. Street, HE. Blackwell.
2. "Plant Tissue Culture" Thorpe, T.A. (Ed.)

B.Tech. (BT) VIII Semester

DEPARTMENTAL ELECTIVE – III

Course Code **: EURBT 841** or **842** or **843** Category**: DE**

Credits**: 3** Hours**: 3 per week**

INTER DEPARTMENTAL ELECTIVE – I

Course Code **: EURBT 852 or 853 or 859** Category**: IE**

Credits**: 4** Hours**: 4 per week**

INTER DEPARTMENTAL ELECTIVE – II

Course Code **: EURBT 863 or 864 or 868 or 8610** Category**: IE**

Credits**: 4** Hours**: 4 per week**

B.Tech. (BT) VIII Semester
PLANT BIOTECHNOLOGY LABORATORY

Course Code **: EURBT 811** Category**: BE**
Credits**: 2** Hours**: 3 per week**

1. Preparation of stock solutions. Preparation of MS medium,
2. Establishment of callus cultures from carrot cambial explants.
3. Embryo culture of maize or any suitable crop.
4. Root/shoot initiation (organogenesis) from different explants.
5. Micropropagation and plant regeneration.
6. Isolation, culture and fusion of plant protoplasts
7. Anther and production of haploids.

Additional student oriented innovative/creative experiments under guidance of teacher.

Text Books:

1. Plant cell culture: A practical approach. R.A.Dixon
2. Plant cell and tissue culture – a laboratory manual. Reinert, J. and Yeoman, MM. Springer-Verlag.
3. Plant cell culture. Manual. Fundamentals and Applications K.Lindsey
4. Plant cell culture Fundamental method O.L.Gamborg and G.C.Philips.

B.Tech. (BT) VIII Semester

PROJECT

Course Code **: EURBT 812** Category**: PW**

Credits**: 5** Hours **:**

The project work should consist of the following engineering components to give a comprehensive blueprint of a biochemical plant and should be presented in the form of a Feasibility Report having the following chapters:

1. Introduction
2. Physico-chemical properties and uses
3. Literature survey regarding various processes reported
4. Selection of the process
5. Flow-chart and Material and Energy Balances
6. Process Design in general for the topical work and Specific Equipment Design (including Mechanical design); materials of construction
7. Plant Location and Plant Layout
8. Health, Safety factors and Regulatory Issues (if any)
9. Preliminary cost estimation
10. Bibliography & References

B.Tech. (BT) VIII Semester

COMPREHENSIVE VIVA

Course Code **: EURBT 813** Category**: CE**

Credits**: 2** Hours **:**

B.Tech. (BT) VIII Semester

Departmental Elective: CLINICAL BIOCHEMISTRY & CLINICAL TRIALS

Course Code **: EURBT 841** Category**: DE**
Credits**: 3** Hours per week **: 3**

UNIT I: Maintenance of clinical laboratory, Units of measurement and normal range, Quality control in laboratory, Selection and evaluation of methods, Automation in clinical laboratory, Collection and preservation of samples and sampling methods.

UNIT II: Digestive system disorders: Gastric functions and methods of evaluation, Pancreatic exocrine functions and methods of evaluation. Plasma proteins: properties and their functions, their variation during diseases. Plasma lipid and lipoproteins and their variation during diseases.

UNIT III: Cerebrospinal fluid: Functions and their variations in diseases. Kidney: Function and composition of urine, investigation of renal disorders. Inborn errors of metabolism: Carbohydrates, lipids, protein, purine, pyrimidines and porphyrins.

UNIT IV: Liver: Liver functions and function tests, Liver diseases: Jaundice, Hepatitis, Gall stones, Cirrhosis and fatty liver. Clinical chemistry of new born, clinical enzymology: Isoenzymes in health and disease.

UNIT V: Endocrine disorders of pancreas: Diabetes mellitus, Hypoglycemia and Glucose tolerance tests, Thyroid: Hypo and Hyper thyroidism, BMR and tests for thyroid functions, Pregnancy tests, Biochemistry of reproductive disorders, Pituitary clinical syndromes. Selection of clinical subjects and deciding amount of dosage and delivery routes.

Text Books:

1. Text book of Medical Biochemistry by Ranashinde Chaterjee,
2. Biochemistry by U. Satya Narayana,
3. Biochemistry by Voet and Voet
4. Text book of Biochemistry with clinical correlations by Thomas Devlin
5. Teitz Fundamentals of Clinical chemistry by CA Burtis, ER Ashwood

B.Tech. (BT) VIII Semester
Departmental Elective: Modeling and simulation in Bioprocesses

Course Code **: EURBT 842** Category**: DE**
Credits**: 3** Hours per week **: 3**

UNIT I: Introduction to Bioprocesses, Modeling and Assessment in Process Development, Development of Bioprocesses, Types of Bioprocesses and Bioproducts, Bioreaction Stoichiometry, Thermodynamics and Kinetics, Elements of Bioprocesses, The Development Process.

UNIT II: Modeling and Simulation of Bioprocesses: Problem Structuring, Process Analysis and Process Scheme. Modelling Fundamentals, Formulation of Dynamic Models, Implementation and Simulation, Uncertainty Analysis.

UNIT III: Sustainability Assessment. Sustainability, Economic Assessment, Environmental Assessment, Assessing Social Aspects, Interactions Between the Sustainability Dimensions.

Bioprocess Case Studies.

UNIT IV: Citric Acid - Alternative Process Using Starch , Introduction, Fermentation Model, Process Model, . Inventory Analysis, Environmental Assessment, Economic Assessment and Conclusions.

L-Lysine - Coupling of Bioreaction and Process Model, Introduction, Basic Strategy, Bioreaction Model, Process Model, Coupling of Bioreaction and Process Model, Results and Discussion.

UNIT V: Penicillin V. Introduction. Modeling Base Case. Inventory Analysis. Environmental Assessment. Economic Assessment. Monte Carlo Simulations Conclusions.

Recombinant Human Serum Albumin. Introduction Bioreaction Model. Process Model . Economic Assessment. Ecological Assessment. Conclusions.

α-1-Antitrypsin from Transgenic Plant Cell Suspension Cultures. Introduction. Process Description. . Model Description. Discussion. Conclusions.

Text Books:

1. Chemical Engineering Dynamics: An Introduction to Modelling and Computer. Simulation, Third, Completely Revised Edition John Ingham, Irving J. Dunn, Elmar Heinzle, Jiri E. Prenosil, Jonathan B. Snape (2007)
2. Development of Sustainable Bioprocesses: Modeling and Assessment. Elmar Heinzle, Arno P. Biwer, Charles L. Cooney (2007)
3. Biological Reaction Engineering: Dynamic Modelling Fundamentals with Simulation Examples, 2nd, Completely Revised Edition. Irving J. Dunn, Elmar Heinzle, John Ingham, Jiri E. Prenosil (2003)

B.Tech. (BT) VIII Semester

Departmental Elective - Biological Programming

Course Code **: EURBT 843** Category**: DE**
Credits**: 3** Hours **: 3 per week**

Unit-I: Python : Variables, operators and functions. Regular expressions. Pattern matching. Braching and looping. Input/Output operations. Example programmes : Program to find restriction sites, Program to convert genbank format file to Fasta format.

Unit-II: Biopython : Data structures. Arrays. Modules. NumPy and SciPy. Dynamic programming. Image manipulation. Text mining. Example programmes : Translate given DNA sequence to predict possible polypeptides, Program to convert genbank format file to Fasta format.

Unit-III: Java: Java Structure. Constants, Variables and Data Types. Classes, Objects and Methods. Class declaration. Mathematical functions. Decision making and Branching.

Unit-IV: Applet Programming, Java applets. Graphics. Fonts. color. animation. Graphics programming, Managing Input/Output files in Java.

Unit-V: BioJava: Alphabets and symbols. Basic sequence manipulation: Sequence I/O, Annotation, Locations and features, Translation, Sequence alignment. Example Programmes: Write a Biojava program to illustrate dynamic programming using the Needleman-Wunsch method and the Smith-Waterman method.

Recommended books:

1. Mark Lutz. Learning python. 2009. O'Reily.
2. Jason Kinser. Python for Bioinformatics. 2009. Jones and Bartlett.
3. Programming with Java – A premier by Balaguruswamy, Tata Mc Graw Hill, New Delhi.
4. Java for Bioinformatics and Biomedical appliations. H.Bal & J.Hujal(2006) Springer.

B.Tech. (BT) VIII Semester

Interdepartmental Elective - Data Base Management System

Course Code **: EURBT 852** Category**: IE**
Credits: **4** Hours per week**: 4**

Prerequisite: File processing

UNIT I: Introduction to DBMS – Overview, File system vs DBMS, Advantages of DBMS, Storage data, queries, Transaction Management, DBMS Structure

UNIT II: E-R model Entities, Attributes and Entity sets, Relation ship and Relationship sets, Features of ER model, Conceptual database design with ER model.

UNIT III: Relational model – integrity constraints over relations and enforcement, Querying relation data, Logical database design, views, destroying/altering tables and views.Relational algebra and calculus

UNIT IV: SQL – Basic SQL, Query, union, intersect, except, Nested Queries, Aggregated Operation, Null values, Embedded SQL, cursors, ODBC and JDBC, Triggers and Active database, designing active databases

UNIT V: Transaction management, concurrency control & crash recovery – Transaction concept, transactions and schedules, concurrent execution of transactions, lock – based concurrency control, crash recovery.
Case Study: Oracle (SQL, PL/SQL & Triggers)

Text Books:

1. Database Management Systems – Raghu Ramakrishnan and Johannes Gehrke McGraw-Hill
2. Data System Concepts – H.F.Korth and A.Silberschatz McGraw-Hill

Reference Book:

1. Fundamentals of Database System – R.El. Masri and S.B.Navathe

B.Tech. (BT) VIII Semester
Interdepartmental Elective: Entrepreneurial Biotechnology

Course Code: **EURBT 853** Category**: IE**
Credits: **4** Hours **: 4 per week**

Unit I: Project design. Market survey and assessment of demand for product. Assessment of competing technologies for production. Evaluation of cost and accessibility of raw materials, transportation, land, technology and HR inputs for plant location. Plant design and economic assessment for variable product demand. Environmental impact assessments.

Unit II: Intellectual Property: Concepts and Fundamentals

Mechanisms for protection of Intellectual Property- patents, copyright and trademark. Protection of plant and animal genetic resources and other biological materials. Gene patenting. Criteria for patentability. Types of patents. Protection for computer databases and multimedia. Trademarks legislation and registration system. Trade secrets: scope, modalities and protection.

Unit III: Technology Development/Transfer/Commercialization related aspects: Biotechnology development. Toxicological studies, Bioequivalence (BU), Clinical Trials-Phase 1,Phase II and Phase III. Approval Bodies and Agencies. Scale-up, semi-commercialization and commercialization.

Unit IV: Managing technology transfer (TOT). Compulsory Licensing and access to medicine issues. Drug Registration and Licensing Issues. Drug Master file submissions, SOPS; Funding sources for commercialization of Technology**:** Preparation of a project report, financial appraisal. Business models.

Unit V: Case studies: The foundation of Genentech. Brief discussion of Affymetrix and Applied Biosystems. Brief descriptions of the products and infrastructure for top 10 biotechnology companies (Amgen, Genentech, Serono, Biogen-Idec, UCB-Celltech, Genzyme, Gilead, MedImmune, Chiron, Millennium). Brief description of product portfolio of top ten biotechnology companies in India based on revenue in 2006 (Serum Institute of India, Biocon, Panaceae Biotech, Monsanto Biotech, Rasi seeds, Venkateswara Hatcheries, Novo nordisk, Tulip, Indian immunologicals, Tranasia biomedics).

Textbooks:

1. Building Biotechnology: Starting, Managing, and Understanding Biotechnology Companies - Business Development, Entrepreneurship, Careers, Investing, Science, Patents and Regulations by Yali Friedman 2nd ed. (2006) Thinkbiotech publisher.
2. Plant design and economics for chemical engineers. M.S.Peters and K.D.Timmerhaus. 4th ed. McGraw Hill.
3. Dynamics of entrepreneurial development and management by V.Desai. (2006) Himalaya Publishing.
4. Biotechnology and Pharmaceutial Patents: Law and Practice by Marc S. Gross, S. Peter Ludwig, Robert C., Jr. Sullivan

B.Tech. (BT) VIII Semester
Interdepartmental Elective : BIOELECTRONICS

Course Code **: EURBT 859** Category**: IE**
Credits**: 4** Hours**: 4 per week**

Unit I : Information, energy and power. Connections between feedback loops and circuits. Low power transimpedance amplifiers and photoreceptors. Low power transconductance amplifiers and scaling laws for power in in analog circuits. Low power filters and resonators. Low power current mode circuits. Cytomorphic electronics.

Unit II : Wireless inductive power links for medical implants. Energy harvesting RF antenna power links. Thevenin equivalent circuit models of antennas. Near field coupling. Far field coupling. Impedance mathing. Rectifier optimization. Neuromorphic system example – RF cochlea. Bionic ear.

Unit III : RF telemetry: Impedance modulation in coupled paralled resonators. Impedance-modulation receiver. Pulse-width modulation receiver. Energy efficiency of the uplink and downlink. Scaling laws for power consumption in impedance modulation links. Rf antenna links for implants. Brain-machine interfaces.

Unit IV : Biofuel cells: Fuel cell fundamentals. Performance of a fuel cell. Concentration overpotential. Efficiency of fuel cells. Economics of conventional fuel cells and biofuel cells. Biofuel cells with microbial catalytic elements. Biofuel cells with oxido-reductases as catalytic elements.

Unit V : Biosensors. Direct electron transfer between enzymes and electrodes. Modeling and simulation of enzyme electrodes. Hybridization efficiency and sensitivity of oligonucleotide sensitive electrodes. Design and construction of glucose biosensors. Design and applications of phenol biosensors. Screen printing methods in biosensor production.

Recommended textbooks:

1. Pethig, Ronald R. / Smith, Stewart. Introduction to Bioelectronics: For Engineers and Physical Scientists. (2012). John Wiley and Sons.
2. P.N.Bartlett. *Bioelectrochemistry: Fundamentals, Experimental Techniques and Application.* John Wiley and Sons. (2008) (Chapter 8: Modeling Biosensor responses and Chapter 10 : Biofuel cells).
3. Rahul Sarpeshkar. Ultra low power bioelectronics: fundamentals, biomedical applications and bio-inspired systems. (2010). Cambridge University Press.

Reference books:

1. Jonathan M. Cooper, Jon Cooper, A. E. G. Cass. Biosensors: a practical approach. Edition2. Volume 268 of Practical approach series (2004). Oxford University Press.

Prerequisites: Basic Electronics, *Process dynamics and Control.*

B.Tech. (BT) VIII Semester
Interdepartmental Elective : Web technologies and networking

Course Code : **EURBT 863** Category **: IE**
Credits**: 4** Hours per week **: 4**

UNIT I: Introduction to Web Technology and networking: Physical layers and data link layers. Concepts of switches, repeaters, hubs, DNS, routers and gateways. Introduction to UDP, TCP, IP, Ipv6, HTTP.

UNIT II: Introduction to HTML & DHTML: Syntax, Forms and CSS.
Cascade Style Sheets: Levels of style sheets, specification formats, style classes and properties.

UNIT III: The Basics of Java Script: Primitives, Operators and Expressions. Control statements. Arrays. Functions. Element access and element positioning.

UNIT IV: Java Script for Dynamic documents: Event driven computation.
Changing colors and fonts. Locating the cursor. Dragging and dropping elements.

UNIT V: Introduction to PHP: Overview of PHP. General server characteristics. Creating PHP pages. Form handling. Data base access with PHP and MySQL. Introduction to deploying web application with the Tomcat web server.

Text Books:

1. Programming the World Wide Web by Robert W Sebesta, 4th Ed. (2007) Addison Wesley.
2. Computer networks. Andrew S. Tanenbaum. 4th Ed. Pearson education/PHI
3. Beginning PHP5, Apache & MY Sql Web Development E. Naramore etal. (2005) **Wrox.**

B.Tech. (BT) VIII Semester
Interdepartmental Elective : Agricultural Engineering

Course Code **: EURBT 864** Category**: IE**
Credits**: 4** Hours**: 4 per week**

UNIT-I : Farm Machinery: Design and selection of machine elements - gears, pulleys, chains and sprockets and belts; overload safety devices used in farm machinery; measurement of force, torque, speed, displacement and acceleration on machine elements. Classification of pumps; pump characteristics; pump selection and installation.

UNIT-II : Soil tillage; forces acting on a tillage tool; hitch systems and hitching of tillage implements; mechanics of animal traction; functional requirements, principles of working, construction and operation and performance parameters of manual, animal and power operated equipment for tillage, sowing, planting, fertilizer application, spraying, mowing, chaff cutting, harvesting, threshing and transport.

UNIT-III : Tractors and power tillers - type, selection, maintenance and repair; tractor clutches and brakes; power transmission systems - gear trains, differential, final drives and power take-off; mechanics of tractor chassis; traction theory; three point hitches- free link and restrained link operations; mechanical steering and hydraulic control systems used in tractors; tractor tests and performance.

UNIT-IV: Soil Engineering: Engineering properties of soils; fundamental definitions and relationships; index properties of soils; permeability and seepage analysis; shear strength, Mohr's circle of stress, active and passive earth pressures; stability of slopes. Soil-water-plant relationship.
Hydrological cycle: hydrograph analysis, unit hydrograph theory and application; stream flow measurement; flood routing, hydrological reservoir and channel routing.

UNIT-V : Water Conservation Engineering: Water requirement of crops; Groundwater occurrence: confined and unconfined aquifers, evaluation of aquifer properties; well hydraulics; groundwater recharge. Irrigation efficiencies; design of irrigation channels; surface, sprinkler and drip methods of irrigation; Drainage coefficient; planning, design and layout of surface and sub-surface drainage systems; leaching requirement and salinity control; irrigation and drainage water quality.

Text Books:

1. Field, Roth. Introduction to agricultural engineering. 1996. CBS Publishers.
2. Harry Field, John B. Solie. Introduction to agricultural engineering technology. A problem solving approach. 3rd Ed. 2009. Springer.

Reference Books:

1. H.F. McColley. Introduction to agricultural engineering. 2010. Agrobios.

B.Tech. (BT) VIII Semester
Interdepartmental Elective : Bio Medical Instrumentation

Course Code : **EURBT 868** Category**: IE**
Credits: **4** Hours : **4 per week**

UNIT-I : Bioelectric Signals and Electrodes: Origin of bioelectric signals – action potentials, Recording electrodes – Skin – contact impedance – Electrodes for ECG – Electrodes for EEG – Electrode for EMG – Electrical conductivity of electrode jellies and creams – microelectrodes.

UNIT-II : Physiological Transducers: Pressure transducers, Transducers for body temperature measurement – Pulse sensors – Respiration sensors.

UNIT-III : Biomedical recorders: Electrocardiograph – Block diagram, ECG leads, effects of artifacts on ECG recordings; Phonocardiograph; Electroencephalograph – Electromyograph – Preamplifier, filters, delay circuits, stimulators.

UNIT-IV : Biomedical telemetry: Wireless telemetry – single channel telemetry systems – Temperature telemetry system – Multichannel wireless telemetry system – Multipatient telemetry – Implantable telemetry systems – Transmission of analog physiological signals over telephone lines. Laser guided and robot aided surgery.

UNIT-V : Biomedical imaging instruments: X-ray, PET and MRI. Patient safety: Electric shock hazards – Leakage currents – Test instruments for checking safety parameters of biomedical equipments.

Text Books:

1. R.S.Khandpur, Hand Book of Biomedical Instrumentation, TMH, New Delhi, 2001
2. Cromwell, Weibell and Pfeiffer, Biomedical instrumentation and measurements, Pearson Education 2003.

Reference:

1. John. G. Webster., Medical Instrumentation application and design, John Wiley & sons onc., 3rd edition, 1999.

B.Tech. (BT) VIII Semester
Interdepartmental Elective : Nanotechnology

Course Code : **EURBT 8610** Category**: IE**
Credits: **4** Hours per week **: 4**

UNIT-I : Introduction : Evolution of science and technology, Introduction to Nanotechnology, Nanotechnology – Definition – Difference between Nanoscience and Nanotechnology, Feynman predictions on Nanotechnology, Moores law, Role of Bottom up and top down approaches in nanotechnology, challenges in Nanotechnology.

UNIT-II : Nano materials : History of materials, Nanomaterials – Definition, Classification of Nanostructured materials, cause of interest in nanomaterials, some present and future applications of nanomaterials.

UNIT-III : Synthesis and processing of nano powders: Processes for producing ultrafine powders – mechanical milling, wet chemical synthesis, gas condensation process, chemical vapour condensation, laser ablation.

Design and Synthesis of self assembled nano structured materials.

UNIT-IV: Special nanomaterials, characterization and tools: Carbon nanotubes, nano composites, carbon fullerenes: An overview of preparation, properties applications. Electron Microscopy Techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Probe Microscopy – X ray methods:

UNIT-V: Nanoelectronics: Introduction to micro, nano fabrication: Optical lithography, Electron beam lithography, Atomic lithography, Molecular beam epitaxy, MEMS:- Introduction, Principles, Types of MEMS:- Mechanical, Thermal, Magnetic MEMS; Fabrication of MEMS.

Books:

1. Nano materials by A S Edelstein & R C Cammarata, Institute of physics publishing, Bristc and Philadelphia.

Reference Books:

1. Nano materials by J.Dutta & H.Hofman.
2. Nano structures & Nano materials by Guozhong cao, Imperial college press.
3. Micro manufacturing and Nano Technology by N.P.Mahalik.
4. Nano Technology by Mark Ratner & Danier Ratner, Prentice Hall.