B.Tech. (Biotechnology)
Scheme & Syllabi
Effective from 2020-21 Admitted Batch

Group- A

(For the branches of Civil Engg., Chemical Engg, **Biotechnology**,Computer Science Engg and Information Technology)

B.Tech I Year - I Semester

Course code	Category	Course Title	Hours per week			Internal Marks	External Marks	Total Marks	Credits C
			L	T	P				
BT-1101	BS	Mathematics – I	3	0	0	30	70	100	3
BT-1102	BS	Chemistry	3	0	0	30	70	100	3
BT-1103	HSS	English	3	0	0	30	70	100	3
BT-1104	ES	CPNM	3	0	3	30	70	100	3
BT-1105	ES	Biology	3	0	0	30	70	100	3
BT-1106	HSS	English Language Lab	0	0	2	50	50	100	1.5
BT-1107	BS	Chemistry Lab	0	0	3	50	50	100	1.5
BT-1108	ES	CPNM Lab	0	0	3	50	50	100	1.5
Total Credits									**19.5**

B.Tech I Year - II Semester

Course code	Category	Course Title	Hours per week			Internal Marks	External Marks	Total Marks	Credits C
			L	T	P				
BT-1201	BS	Mathematics – II	3	0	0	30	70	100	3
BT-1202	BS	Physics	3	0	0	30	70	100	3
BT-1203	ES	Engineering Graphics	1	0	4	30	70	100	3
BT-1204	ES	Genetics	3	0	0	30	70	100	3
BT-1205	ES	Microbiology	3	0	0	30	70	100	3
BT-1206	ES	Workshop Lab	0	0	3	50	50	100	1.5
BT-1207	BS	Physics Lab	0	0	3	50	50	100	1.5
BT-1208	ES	Microbiology lab	0	0	3	50	50	100	1.5
Total Credits									**19.5**

B.Tech II Year - I Semester

Course code	Category	Course Title	Hours per week			Internal Marks	External Marks	Total Marks	Credits
			L	T	P				
CH-2101	BS	Mathematics-III	3	0	0	30	70	100	3
BT-2101	PC	Biochemistry	3	0	0	30	70	100	3
CH-2103	HSS	Managerial Economics	3	0	0	30	70	100	3
BT-2102	PC	Bio-analytical Techniques	3	0	0	30	70	100	3
BT-2103	PC	Downstream processing	3	0	0	30	70	100	3
BT-2104	PC	Biochemistry and Bioanalytical techniques lab	0	0	3	50	50	100	1.5
BT-2105	PC	Downstream processing lab	0	0	3	50	50	100	1.5
CH 2108	SC	*MATLAB(Software)*	1	0	2	50	50	100	2
CH-2109	MC	Environmental Science	2	0	0	-	100	100	0
Total Credits									**20**

B.Tech II Year - II Semester

Course code	Category	Course Title	Hours per week			Internal Marks	External Marks	Total Marks	Credits
			L	T	P				
BT-2201	ES	Basic Electrical and Electronics Engineering	3	0	0	30	70	100	3
CH-2202	PC	Material and Energy balances	3	0	0	30	70	100	3
BT-2202	PC	Fluid Mechanics and heat transfer	3	0	0	30	70	100	3
BT-2203	PC	Biochemical Thermodynamics	3	0	0	30	70	100	3
CH-2205	HSS	Industrial management & Entrepreneurship	0	0	3	50	50	100	3
BT-2204	PC	Plant cell and tissue culture	3	0	0	30	70	100	3
BT-2205	PC	Fluid mechanicsand heat transfer lab	0	0	3	50	50	100	1.5
BT-2206	PC	Plant cell and tissue culture lab	0	0	3	50	50	100	1.5
CH-2208	SC	*ASPEN PLUS (Process design)*	1	0	2	50	50	100	2
CH-2209	MC	Professional ethics and human values	2	0	0	-	100	100	0
Total Credits									**23**
Summer Internship (Community Service)									

B.Tech III Year - I Semester

Course code	Category	Course Title	Hours per week			Internal Marks	External Marks	Total Marks	Credits
			L	T	P				
BT-3101	PC	Mass transfer	3	0	0	30	70	100	3
BT-3102	PC	Enzyme Engineering	3	0	0	30	70	100	3
BT-3103	OE	Open Elective- I	2	0	2	30	70	100	3
BT-3104	PE	Core Elective -I	3	0	0	30	70	100	3
BT-3105	PC	Cell and molecular biology	3	0	0	30	70	100	3
BT-3106	PC	Mass transfer lab	0	0	3	50	50	100	1.5
BT-3107	PC	Cell and molecular biology lab	0	0	3	50	50	100	1.5
BT-3108	SC	Seminar/ Minor project	0	0	3	100	-	100	2
CH-3109	MC	Indian constitution	2	0	0	-	100	100	0
BT-3109	MC	Summer internship 2 months (Mandatory after second year) to be evaluated during V semester	-	-	-	100	0	100	2
Total Credits									**22**

Core Elective-I:(BT 3104)

A. Food technology
B. Process optimization
C. Energy Engineering
D. Systems Biology

B.Tech III Year - II Semester

Course code	Category	Course Title	Hours per week			Internal Marks	External Marks	Total Marks	Credits
			L	T	P				
BT-3201	PC	Immunology	3	0	0	30	70	100	3
BT-3202	PC	Bioinformatics	3	1	0	30	70	100	3
BT-3203	PC	Genetic Engineering	3	0	0	30	70	100	3
BT-3204	PC	Process control	3	0	0	30	70	100	3
BT-3205	PE	Core elective- II	3	0	0	30	70	100	3
BT-3206	OE	Open Elective-II	2	0	2	30	70	100	3
BT-3207	PC	Process control lab	0	0	3	50	50	100	1.5
CH-3209	SC	Intellectual Property Rights	3	0	0	30	70	100	2
CH-3210	MC	Essence of Indian traditional knowledge	2	0	0	-	100	100	0
Total Credits									**21.5**
SUMMER INTERNSHIP (2 MONTHS)									

Core Elective-II: (BT 3205)

A. Pharmaceutical Biotechnology

B. Animal cell culture and Hybridoma technology

C. Cancer Biology

D. Stem cells in health care.

B.Tech IV Year - I Semester

Course code	Category	Course Title	Hours per week			Internal Marks	External Marks	Total Marks	Credits
			L	T	P				
BT-4101	PC	Engineering economics & Bioprocess design	3	1	0	30	70	100	3
BT-4102	PC	Biochemical Reaction Engineering	3	0	0	30	70	100	3
BT-4103	PC	Industrial Biotech Products	3	0	0	30	70	100	3
BT-4104	OE	Open Elective -III	3	0	0	30	70	100	3
BT-4105	OE	Open Elective - IV	2	0	2	30	70	100	3
BT-4106	PC	Biochemical reaction Engineering lab	0	0	3	50	50	100	1.5
BT-4107	SC	Biostatistics	2	1	0	50	50	100	2
BT-4108	MC	Summer internship 2 months (Mandatory after third year) to be evaluated during VII semester	-	-	-	100	-	100	2
Total Credits									**20.5**

B.Tech IV Year - II Semester

Course code	Category	Course Title	Internal Marks	External Marks	Total Marks	Credits
BT-4201	Major Project	Project work	50	50	100	14
(6 Months Internship in industry)Total credits						**14**

MINOR REQUIREMENTS IN BIOTECHNOLOGY

Total Credit requirement: 20

Student must have acquired a minimum of 8 SGPA up to the end of 2nd semester without backlogs. In case after declaration 3rd semester results if student fails to score required minimum of 8 SGPA his/her registration for Minorprogramme stands canceled and he/she shall continue with regular programme.

Of the 20 additional credits to be acquired, 16 Credits shall be earned by selecting courses one from each of the following pools and 4 credits through MOOCs with two courses of minimum 8 weeks duration.

Subject	L-T-P	Credit
POOL 1		
Microbiology (BT-1204)	4-0-0	4
Genetics (BT-1205)	4-0-0	4
Biochemistry (BT-2101)	4-0-0	4
Plant cell and tissue culture (BT-2204)	4-0-0	4
POOL 2		
Genetic Engineering (BT-3203)	4-0-0	4
Cell and molecular biology (BT-3105)	4-0-0	4
Enzyme Engineering (BT-3102)	4-0-0	4
Downstream processing (BT-2103)	4-0-0	4
POOL 3		
Bioinformatics (BT-3202)	4-0-0	4
Bioanalytical techniques (BT-2102)	4-0-0	4
Biochemical Reaction Engineering (BT-4102)	3-1-0	4
POOL 4		
Industrial Biotech products (BT-4103)	4-0-0	4
Food Technology (BT-3104A)	4-0-0	4
Immunology (BT-3201)	4-0-0	4
Pharmaceutical Biotechnology (BT-3205A)	4-0-0	4

B.Tech. (Honors) in Biotechnology (Total Credits: 180)

20 additional credits are to be acquired for Honors.

Student must have acquired a minimum of 8 SGPA up to the end of 2nd semester without backlogs. In case after declaration 3rd semester results if student fails to score required minimum of 8 SGPA his/her registration for Honors programme stands canceled and he/she shall continue with regular programme.

Of the 20 additional credits to be acquired, 16 credits shall be earned by undergoing specified courses listed below with four courses each carrying 4 credits. **The remaining 4 credits must be acquired through MOOCs, which shall be domain specific, each with 2 credits and with minimum duration of /12 weeks as recommended by board of studies**

The courses that are offered for B.Tech. (Honors) in Biotechnology are

Subject Code	Subject	L-T-P	Credit
BTH-1001	Advanced Microbiology	4-0-0	4
BTH-1002	Advanced Biochemistry	4-0-0	4
BTH-1003	Advanced Biochemical Engineering	4-0-0	4
BTH-1004	Advanced Down Stream Processing		
BTH-1005	Environmental Biotechnology	4-0-0	4
BTH-1006	Agricultural Biotechnology	4-0-0	4
BTH-1007	Bio-Analytical Techniques	4-0-0	4
BTH-1008	Genetic Engineering-II	4-0-0	4
BTH-1009	Nanotechnology	4-0-0	4

BT-1101

MATHEMATICS-I

Course Objectives:

- To transmit the knowledge of Partial differentiation.
- To know of getting maxima and minima of function of two variables and finding errors and approximations.
- To evaluate double and triple integrals, volumes of solids and area of curved surfaces.
- To expand a periodical function as Fourier series and half-range Fourier series.

Course Outcomes:

At the end of the course, the student will be able to

- Find the partial derivatives of functions of two or more variables.
- Evaluate maxima and minima, errors and approximations.
- Evaluate double and triple integrals, volumes of solids and area of curved surfaces.
- To expand a periodical function as Fourier series and half-range Fourier series.
- Have a fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.

Syllabus

(Partial Differentiation)

Introduction - Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler's theorem - Total derivative - Change of variables – Jacobins. Mean value Theorems (without proofs)

(Applications of Partial Differentiation)

Geometrical interpretation -Tangent plane and Normal to a surface -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 - Differentiation under the integral Sign - Leibnitz's rule.

(Multiple Integrals)

Introduction - Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

(Multiple Integrals-Applications)

Area enclosed by plane curves - Volumes of solids - Area of a curved surface - Calculation of Mass - Center of gravity - Moment of inertia - product of inertia – principal axes- Beta Function - Gamma Function - Relation between Beta and Gamma Functions. Error Function or Probability Integral.

(Fourier Series)

Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval's Formula. Practical Harmonic analysis.

TEXT BOOK:

1. Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd Edition, Khanna publishers.

REFERENCE BOOKS:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K.International publishing house Pvt. Ltd.
2. Advanced Engineering Mathematics by Erwin Kreyszig.
3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.
4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.
5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.
6. Higher Engineering Mathematics by Dr. M.K.Venkataraman.

BT-1102

CHEMISTRY

Course Objectives:

- To apply the basic knowledge of Chemistry to the Engineering Discipline.
- To develop knowledge about water and its treatment for industrial and potable purposes.
- To develop understanding in the areas of Polymers, Mechanism of Corrosion of Metals and Corrosion Control Methods, Fuels, Lubricants and Nanomaterials for of conducting polymers, bio-degradable polymers and fiber reinforced plastics and apply the knowledge for solving existing challenges faced in various engineering and societal areas.

Course outcomes:

At the end of the course, the student will be able to

- This course applies the basic concepts and principles studied in Chemistry to Engineering.
- It provides an application of chemistry to different branches of engineering
- The students will be able acquire knowledge in the areas of Water Chemistry,Polymers, Corrosion, Fuels and Lubricants and nanomaterials and suggest innovative solutions for existing challenges in these areas.

Syllabus

Water Chemistry

Sources of Water – Impurities and their influence of living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime-Soda, Zeolite and Ion Exchange - Municipal Water Treatment-Break Point Chlorination – Desalination of Sea Water – Reverse Osmosis Method, Electro-dialysis.

Polymers and Plastics

Polymers: Definition – Types of Polymerization (Addition & Condensation) – Mechanisms of Addition Polymerization – Radical and Ionic – Thermodynamics of Polymerization Process.

Plastics: Thermosetting and Thermoplastics – Effect of Polymer Structure on Properties of Cellulose Derivatives – Vinyl Resins – Nylon (6,6), Reinforced Plastics – Conducting Polymers.

Corrosion

Corrosion: Origin and Theory – Types of Corrosion: Chemical and Electrochemical; Pitting, Inter granular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion.

Corrosion Controlling Methods: Protective Coatings: Metallic Coatings, Electroplating and Electroless Plating – Chemical conversion Coatings – Phosphate, Chromate, Anodized, Organic Coatings – Paints and Special Paints.

Fuels and Lubricants

Solid Fuels: Wood and Coal, Ranking of Coal – Analysis (Proximate and Ultimate) Coke Manufacture – Otto Hoffmann's Process – Applications; **Liquid Fuels:** Petroleum Refining – Motor Fuels – Petrol and Diesel Oil – Knocking – Octane number – Cetane Number; **Gaseous Fuels:** Biogas, LPG and CNG – Characteristics – Applications; **Rocket Fuels:** Propellants – Classification – Characteristics

Lubricants: Classification – Mechanism – Properties of Lubricating Oils – Selection of Lubricants for Engineering Applications.

Nanomaterials

Nanomaterials, Properties and application of fullerenes, fullerols, Carbon nanotubes and nanowires. Synthesis - Top-down and Bottom-up approaches - Nanocomposites - Nanoelectronics- Applications of nanomaterials in catalysis, telecommunication and medicine.

TEXT BOOKS:

1. Engineering Chemistry – PC Jain and M. Jain – Dhanpath Rai and Sons, New Delhi.
2. A Text book of Engineering Chemistry – S. S. Dara – S. Chand & Co. New Delhi.

REFERENCE BOOKS:

1. Engineering Chemistry – B. K. Sharma – Krishna Prakashan – Meerut.
2. Introduction to Nanoscience - S. M. Lindsay - Oxford University Press
3. Engineering Chemistry - B. L. Tembe, Kamaluddin and M. S. Krishnan, (NPTEL).

BT-1103

ENGLISH

Course Objectives:

- To make students understand the explicit and implicit meanings of a text/topic;
- To give exposure to new words and phrases, and aid to use them in different contexts;
- To apply relevant writing formats to draft essays, letters, emails and presentations; and
- To adapt oneself to a given situation and develop a functional approach to finding solutions: adaptability and problem solving.

Course Outcomes:

At the end of the course, the student will be able to

- Students will be able to analyze a given text and discover the various aspects related to language and literature;
- Learn the various language structures, parts of speech and figures of speech;
- Develop one's reading and writing abilities for enhanced communication; and
- Learn to apply the topics in real-life situations for creative and critical use.

Syllabus

On the conduct of life: William Hazlitt

Life skills: Values and Ethics

If: Rudyard Kipling

The Brook: Alfred Tennyson

Life skills: Self-Improvement

How I Became a Public Speaker: George Bernard Shaw

The Death Trap: Saki

Life skills: Time Management

On saving Time: Seneca

ChinduYellama

Life skills: Innovation

Muhammad Yunus

Politics and the English Language: George Orwell

Life skills: Motivation

Dancer with a White Parasol: Ranjana Dave

Grammar:

Prepositions – Articles – Noun-Pronoun Agreement, Subject-Verb Agreement – Misplaced Modifiers – Clichés, Redundancies.

Vocabulary:

Introduction to Word Formation – Root Words from other Languages – Prefixes and Suffixes – Synonyms, Antonyms – Common Abbreviations

Writing:

Clauses and Sentences – Punctuation – Principals of Good Writing – Essay Writing – Writing a Summary

Writing: Essay Writing

Life skills: Innovation

Muhammad Yunus

TEXTBOOK: *Language and Life: A Skills Approach* Board of Editors, Orient Blackswan Publishers, India. 2018.

REFERENCEBOOKS :

- *Practical English Usage*, Michael Swan. OUP. 1995.
- *Remedial English Grammar*, F.T. Wood. Macmillan.2007
- *On Writing Well*, William Zinsser. Harper Resource Book. 2001
- *Study Writing*, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- *Communication Skills*, Sanjay Kumar and PushpLata. Oxford University Press. 2011.
- *Exercises in Spoken English*, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

BT-1104

CPNM

Course Objectives:

- The course is designed to provide complete knowledge of C language.
- To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.
- To provide knowledge to the Students to develop logics which will help them to create programs, applications in C.
- This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.
- This course provides the fundamental knowledge which is useful in understanding the other programming languages.

Course Outcomes:

At the end of the course, the student will be able to

- Identify basic elements of C programming structures like data types, expressions, control statements, various simple functions and Apply them in problem solving.
- Apply various operations on derived data types like arrays and strings in problem solving.
- Design and Implement of modular Programming and memory management using Functions, pointers.
- Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.
- Apply Numerical methods to Solve the complex Engineering problems.

Syllabus

Introduction to C: Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output.

Decision Making, Branching, Looping, Arrays & Strings: Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else..if ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps in Loops ,One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

Functions: Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and lifetime of variables.

Pointers: Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications

Structure and Unions: Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures, structures within structures, structures and functions and unions, size of structures and bit-fields- Program applications.

File handling: Defining and opening a file, closing a file, Input/ Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments-Program Applications

Numerical Methods: Solutions of Algebraic and Transcendental Equations, Bisection Method, Newton Raphson Method. Newton's forward and backward Interpolation, Lagrange's Interpolation in unequal intervals. Numerical Integration: Trapezoidal rule, Simpson's 1/3 rules. Solutions of Ordinary First Order Differential Equations: Euler's Method, Modified Euler's Method and Runge-Kutta Method.

TEXT BOOK:

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India) Private Limited.
2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

REFERENCE BOOKS:

1. Let Us C ,YashwantKanetkar, BPB Publications, 5th Edition.
2. Computer Science, A structured programming approach using C", B.A.Forouzan and R.F.Gilberg, " 3rd Edition, Thomson, 2007.
3. The C –Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.
4. Scientific Programming: C-Language, Algorithms and Models in Science, Luciano M. Barone (Author), Enzo Marinari (Author), Giovanni Organtini, World Scientific.

BT-1105

BIOLOGY

Course Objectives:

- To study about the cell structure and function.
- To study about the plant structure, functions of various cells in the plants, flower structure, pollination and fertilization.
- To study about the physiological processes in the plant and various methods of plant breeding techniques.
- To study about the general characters of animals- invertebrates, vertebrates.
- To study about the general physiological processes like digestion, respiration, and excretion etc of the animals.

Course Outcomes:

At the end of the course, the student will be able to

- Obtain knowledge in the biological processes occurring in the cells.
- Make use of structure of plants, and understand the phenomena of Embryology so that they produce new varieties of plants.
- Analyze various physiological processes of the plants in plant breeding techniques.
- Understand the general characters of animals, the phenomena of reproduction and life cycle of plasmodium vival.
- Illustrate various physiological processes of the animals. Digestion, respiration Excretory system, Nervous system functions are understood to the student so that student can do research in their future studies.

Syllabus

Cell Biology: 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,

Plant Biology: Parts of a flowering plant; flower-structure of a typical flower, outline description of floral parts – androecium, gynoecium,

Embryology: Structure of anther, microsporogenesis and development of male gametophyte, structure of ovule, megasporogenesis, development of embryo sac. fertilization, process of fertilization and post fertilization changes,

Anatomy: 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,

Plant Physiology: Water relations of plants, absorption of water by plants, diffusion, water potential, osmosis, plasmolysis, imbibition, active and passive absorption,
Mineral nutrition: Criteria for essentiality, macro elements (nitrogen, phosphorus and potassium) and microelements,
Photosynthesis: photosynthetic pigments, light reaction-Emerson enhancement effect, photo system 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: Introduction, nitrogen cycle, biological nitrogen fixation,

Plant Growth Regulators: Auxins, gibberellins, cytokinins, abscisic acid and ethylene,

Plant Breeding: Methods of plant breeding: selection, hybridization, hybrid vigor and mutational breeding,

Animal Biology: General characters of invertebrates, morphology, life cycle and reproduction of *Plasmodium Vivax,* general characters of vertebrates.

Animal Physiology: Animal nutrition- modes of nutrition, digestive system of humans and accessory digestive organs, gastrointestinal secretions, digestion, absorption and assimilation of digested products, egestion,

Respiration: Respiration in humans – respiratory system, mechanism of respiration,
Circulatory system: 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 pacemakers,

Excretion: Elimination of nitrogenous waste- ammonotelic, ureotelic and uricotelic, structure of human excretory system, structure of urinary system, anatomy of kidney, and structure of nephron,

Nervous system: Structure of neuron, nerve impulse and its conduction, synapse, central nervous system- lobes of brain and its meninges, spinal cord, Peripheral nervous system- Cranial nerves and spinal nerves, autonomous nervous system, sympathetic and parasympathetic nervous system, reflex action, reflex arch of humans.

TEXT BOOKS:

1. 'Biology Text Book for class XI and XII', NCERT.
2. 'AP Academy Text Book for Botany and Zoology, for intermediate

BT-1106

ENGLISH LANGUAGE LAB

Course Objectives:

- To make students recognize the sounds of English through Audio-Visual aids;
- To help students build their confidence and help them to overcome their inhibitions and self- consciousness while speaking in English;
- To familiarize the students with stress and intonation and enable them to speak English effectively; and
- To give learners exposure to and practice in speaking in both formal and informal contexts.

Course Outcomes:

At the end of the course, the student will be able to

- Students will be sensitized towards recognition of English sound patterns and the fluency in their speech will be enhanced;
- A study of the communicative items in the laboratory will help students become successful in the competitive world;
- Students will be able to participate in group activities like roleplays, group discussions and debates; and
- Students will be able to express themselves fluently and accurately in social as well professional context.

Syllabus

Introduction to Phonetics: The Sounds of English (Speech sound – vowels and consonants) - Stress and Intonation - Accent and Rhythm.

Listening Skills: Listening for gist and specific information - listening for Note taking, summarizing and for opinions - Listening to the speeches of eminent personalities.

Speaking Skills: Self-introduction - Conversation Skills (Introducing and taking leave) - Giving and asking for information - Role Play - Just A Minute (JAM) session - Telephone etiquette.

Reading and Writing skills: Reading Comprehension – Précis Writing - E-Mail writing - Punctuation.

Presentation skills: Verbal and non-verbal communication - Body Language - Making a Presentation.

REFERENCE BOOKS:

1. Ashraf Rizvi. *Effective Technical Communication*. Tata McGraw Hill Education Private Limited, New Delhi.
2. *Speak Well*. Orient Blackswan Publishers, Hyderabad.
3. Allan Pease. *Body Language*. Manjul Publishing House, New Delhi.

BT-1107

CHEMISTRY LAB

Course Objectives:

- To develop the fine skills of quantitative determination of various chemical components through titrimetric analysis
- To prepare and use ionexchange/ zeolite columns for the removal of hardness of water
- To develop the skill of organic synthesis through the preparation of a polymer/ drug

Course Outcomes:

At the end of the course, the student will be able to

- Determine the amount of various chemical species in solutions by titrations and conduct the quantitative determinations with accuracy
- Develop novel materials to be used as zeolite and prepare columns for removal of hardness of water
- Produce a polymer or a drug

Syllabus

1. Determination of Sodium Hydroxide with HCl (Na_2CO_3 Primary Standard)
2. Determination of Alkalinity (Carbonate and Hydroxide) of water sample
3. Determination of Fe(II)/Mohr's Salt by Permanganometry
4. Determination of Oxalic Acid by Permanganometry
5. Determination of Chromium (VI) by Mohr's Salt Solution
6. Determination of Zinc by EDTA method
7. Determination of Hardness of Water sample by EDTA method
8. Determination of Chlorine in water by Iodometric Titration
9. Ionexchange/ Zeolite column for removal of hardness of water
10. Synthesis of Polymer/ drug

REFERENCE BOOKS:

1. Vogel's Quantitative Chemical Analysis – V – Edition – Longman.
2. Experiments in Applied Chemistry (For Engineering Students) – Sinita Rattan – S. K. Kataria& Sons, New Delhi

BT-1108

CPNM LAB

Course Objectives:

- To impart writing skill of C programming to the students and solving problems.
- To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.,
- To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.
- This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

Course Outcomes:

At the end of the course, the student will be able to

- Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.
- Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs.
- Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.
- Apply and practice logical ability to solve the real world problems.
- Apply Numerical methods to Solve the complex Engineering problems.

Syllabus

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?
2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while).
3. Write a set of string manipulation functions e.g. for getting a sub-string from a given position, Copying one string to another, Reversing a string, adding one string to another.
4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int, long, float, and double. What happens when you add 1 to the largest possible integer number that can be stored?
5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.
6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).
7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.
8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.
9. Implement bisection method to find the square root of a given number to a given accuracy.
10. Implement Newton Raphson method to det. a root of polynomial equation.
11. Given table of x and corresponding f(x) values, Write a program which will determine f(x) value at an intermediate x value by using Lagrange's interpolation/
12. Write a function which will invert a matrix.
13. Implement Simpson's rule for numerical integration.
14. Write a program to solve a set of linear algebraic equations.

BT-1201

MATHEMATICS – II

Course Objectives:

- The way of obtaining rank, Eigen values and Eigen vectors of a matrix.
- To know the importance of Cayley-Hamilton theorem and getting canonical form from a given quadratic form.
- To solve the system of equations by using direct and indirect methods.
- To solve first order and higher order differential equations by various methods.
- To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications.

Course Outcomes:

At the end of the course, the student will be able to

- Find rank, Eigen values and Eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.
- Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.
- Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling
- Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.
- Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

Syllabus

(Linear Algebra)

Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gauss elimination

method, LU Factorization method, Gauss Seidal Method. Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

(Eigen Values and Eigen Vectors)

Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton's theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form.

(Ordinary Differential Equations of First Order and its Applications)

Formation of ordinary differential equations (ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree - Linear differential equation - Bernoulli's equation - Exact differential equations - Equations reducible to exact equations - Orthogonal Trajectories - Simple Electric (LR & CR) Circuits - Newton's Law of Cooling - Law of Natural growth and decay.

(Differential Equations of Higher Order)

Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation - Simultaneous linear differential equations.

(Laplace Transforms)

Introduction - Existence Conditions - Transforms of Elementary Functions - Properties of Laplace Transforms - Transforms of Derivatives - Transforms of Integrals - Multiplication by t^n - Division by t – Evaluation of integrals by Laplace Transforms - Inverse Laplace Transform - Applications of Laplace Transforms to Ordinary Differential Equations - Simultaneous Linear Differential Equations with Constant Coefficients - Second Shifting Theorem - Laplace Transforms of Unit Step Function, Unit Impulse Function and Laplace Transforms of Periodic Functions.

TEXT BOOK:

1. Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, $43r^d$ edition, Khanna publishers.

REFERENCE BOOKS:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.
2. Advanced Engineering Mathematics by Erwin Kreyszig.
3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.
4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.
5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

BT-1202

PHYSICS

Course Objectives:

- To impart knowledge in basic concept of physics of Thermodynamics relevant to engineering applications.
- To grasp the concepts of physics for electromagnetism and its application to engineering. Learn production of Ultrasonics and their applications in engineering.
- To Develop understanding of interference, diffraction and polarization: connect it to a few engineering applications.
- To Learn basics of lasers and optical fibers and their use in some applications.
- To Understand concepts and principles in quantum mechanics and Nanopahse Materials. Relate them to some applications.

Course Outcomes:

At the end of the course, the student will be able to

- Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.
- Gain Knowledge on the basic concepts of electric and magnetic fields. Understand the concept of the nature of magnetic materials. Gain knowledge on electromagnetic induction and its applications .
- Understand the Theory of Superposition of waves. Understand the formation of Newton's rings and the working of Michelson's interferometer. Remember the basics of diffraction, Evaluate the path difference. Analysis of Fraunhofer Diffraction due to a single slit
- Understand the interaction of matter with radiation, Characteristics of Lasers, Principle, working schemes of Laser and Principle of Optical Fiber. Realize their role in optical fiber communication.
- Understand the intuitive ideas of the Quantum physics and understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic

particles using Time independent one Dimensional Schrodinger's wave equation. Understand the fundamentals and synthesis processes of Nanophase materials.

Syllabus

THERMODYNAMICS

Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

ELECTROMAGNETISM

Concept of electric flux, Gauss's law - some applications, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart's Law, B near a long wire, B for a circular Current loop, Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Induced magnetic fields, Displacement current, Maxwell's equations (no derivation), Magnetic materials: Classification of magnetic materials and properties.

Ultrasonics : Introduction, Production of Ultrasonics – Piezoelectric and Magnetostriction methods, acoustic grating, applications of ultrasonics.

OPTICS

Interference: Principles of superposition – Young's Experiment – Coherence - Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and its applications.

Diffraction: Introduction, Differences between interference and diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit **(**Qualitative and quantitative treatment**)**.

Polarisation: Polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization.

LASERSand FIBRE OPTICS

Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications of lasers

Introduction to optical fibers, principle of propagation of light in optical fibers, Acceptance Angle and cone of a fibre, Numerical aperture, Modes of propagations, classification of fibers,Fibre optics in communications, Application of optical fibers.

MODERN PHYSICS

Introduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semi conductors and insulators.

Nanophase Materials

Introduction, properties, Top-down and bottom up approaches, Synthesis - Ball milling, Chemical vapour deposition method, sol-gel methods, Applications of nano materials.

TEXT BOOKS:

1. Physics by David Halliday and Robert Resnick – Part I and Part II - Wiley.
2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand
3. Engineering Physics by R.K. Gaur and S.L. Gupta –Dhanpat Rai

REFERENCE BOOKS:

1. Modern Engineering Physics by A.S. Vadudeva
2. University Physics by Young and Freedman

BT-1203

ENGINEERING GRAPHICS

Course Objectives:

- Understand the basics of Engineering Graphics and BIS conventions.
- Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings
- Demonstrate and practice the various profiles/curves used in engineering practice through standard procedures.
- Demonstrate and practice the orthographic projections of points, lines, planes, solids and section of solids
- Demonstrate and practice the development of surfaces of simple solids
- Familiarize the basic concept of isometric views clearly.

Course Outcomes:

At the end of the course, the student will be able to

- Develop simple engineering drawings by considering BIS standards.
- Able to draw different engineering curves with standard Procedures
- Comprehend the basics of orthographic projections and deduce orthographic projections of points, lines, planes and solids at different orientations in real life environment.
- Visualize clearly the sections of solids.
- Apply the concepts of development of surfaces while designing/analyzing any product.
- Recognize the significance of isometric drawing to relate 2D environment with 3D environment.

Syllabus

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions, and Scales.

Curves: Conic sections: General construction of ellipse, parabola and hyperbola. Construction of involutes of circle and polygons only. Normal and tangent to curves.

Projections of Points: Principal or Reference Planes, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane.

Projections of Straight Line Inclined to Both the Reference Planes: Projections of Planes: Projection of Perpendicular planes: Perpendicular to both reference planes, perpendicular to one reference plane and parallel to other reference plane and perpendicular to one reference plane and inclined to other reference plane. Projection of Oblique planes. Introduction to Auxiliary Planes.

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to other and axes inclined to both the reference planes.

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids (Prism, Pyramid, Cylinder and Cone) in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Isometric Views: Isometric projection, Isometric scale and Isometric view. Isometric view of Prisms, Pyramids, cylinder, cone, and their combinations.

TEXT BOOK:

Elementary Engineering Drawing by N.D.Bhatt, Charotar Publishing House.

REFERENCE BOOKS:

Engineering Graphics by K.L. Narayana and P. Kannaiah, Tata Mc-Graw Hill

BT-1204

GENETICS

Course Objectives:

- To introduce Mendel's law of inheritance.
- To introduce interaction of Genes and inheritance.
- To introduce Gene linkage, crossing over and mapping.
- To introduce sex determination & linkage.
- To introduce chromosomes & chromosomal variation.

Course Outcomes:

At the end of the course, the student will be able to

- Define inheritance and classify the types of inheritance.
- Different methods available to study genetics
- Performing of polymerized chain reaction, cloning and transformation
- Describe complementary, duplicate genes and interaction between different two gene pairs.
- Interpret sex determination mechanisms and inheritance of sex linked traits.
- Differentiate types of cytogenetic effects and numerical changes in chromosomes.

Syllabus

Mendel's law of Inheritance: Mendel's experiments–Mendels materials, crossing technique, results of Mendel's experiments, phenomenon of dominance, variation in dominance relation, incomplete dominance, co-dominance, principle of segregation-monohybrid cross, mechanism of segregation, monohybrid ratio, principle of independent assortment, Mendels dihybrid cross, mechanism of independent assortment, dihybrid ratio, back cross and test cross, deviations from dihybrid phenotypic ratio,

Interaction of Genes: Interaction of genes-combs in fowls, Epistasis, complementary genes, duplicate genes, additional interactions involving two gene pairs, interaction between more than two gene pairs,

Quantitative / Multiple factor inheritance: Multiple factors, quantitative and quantative traits, examples of quantitative inheritance, Kernel color in wheat, skin color in man, corolla length in tobacco, continuous variations,

Multiple alleles : (Based on classical concept of Allelomorphism): Multiple alleles and isoalleles, skin color in rodents, eye color in *Drosophila*, self sterility in *Nicotiana,* blood groups in humans, complementation test or cis-trans test,

Linkage, crossing over and mapping:

Linkage – coupling and repulsion hypothesis, Morgan's view on linkage, chromosome theory of linkage, kinds of linkage-complete linkage, incomplete linkage, linkage groups, significance of linkage,

Crossing over – Types of crossing over - mitotic and meiotic crossing over, mechanism - synapsis, duplication of chromosomes, crossing over by breakage and union, terminalization,

Molecular mechanism of recombination- Holiday model, cytological basis of crossing over; significance of crossing over,

Construction of a genetic mapping: Two point and three point test crosses and gene mapping, interference and coincidence,

Sex Determination :Genetically controlled sex determining mechanisms, sex chromosomal mechanism of sex determination, types-heterogenetic males, heterogenetic females, genic balance mechanism (X/A ratio in *Drosophila*), sex determination in man (TDF and SRY genes), sex determination in plants; Single gene control of sex; haploid males in hymenoptera; hormonal control of sex, environmental control of sex, dosage compensation (in man and *Drosophila*),

Sex Linkage: Inheritance of sex linked (X-linked) traits-eye color in *Drosophila*, haemophilia and color blindness in human and barred plumage in poultry, inheritance of Y-linked genes, inheritance of XY-linked genes, primary and secondary non-disjunction of sex chromosomes, sex influenced and sex limited traits, sex linked disorders in human beings,

CytoplasamicInheritance : Maternal effects-shell coiling in snails, pigment in flour moth, cytoplasmic inheritance involving dispensable heredity units, kappa particles in *Paramecium,* cytoplasmic inheritance by cellular organelles, plastid inheritance in variegated four-o-clock plant, mitochondrial inheritance, male sterility in plants, uniparental inheritance in chlymadomonas,

Chromosomal variations: Origin, types and cytogenetic effects,

Structural changes in chromosomes: Duplications, translocations, inversions (paracentric and pericentric cross over suppressors),

Numerical changes in chromosomes: Aneuploidy (monosomy, nullisomy, trisomy, tetrasomy), euploidy (monoploidy, haploidy, polyploidy-autopolyploids and allopolyploids).

TEXT BOOKS:

1. "Genetics", by P.K.Gupta, Rastogi Publications
2. "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology", by P.S. Verma & V.K. Agarwal, S. Chand & Company

REFERENCE BOOKS:

1. "Principles of Genetics", by E.J. Gardner, M.J.Simmons&D.PeterSnustard, John Wiley & Sons, INC. Publishing Co.
2. `Essentials of Materials Science' by A.G. Guy.
3. An introduction to corrosion science and engineering By Herbert Uhilig and R. Winston Revie, Published by John Wiley and sons, New York

BT-1205

MICROBIOLOGY

Course objectives:

- To make the student learn about origin and evolution of microbes.
- To make the student understand structure and functioning of different microbial groups.
- To make them to acquaint the cultivation of microbes in artificial medium.

Course Outcomes:

At the end of the course, the student will be able to

- Demonstrate the origin and evolution of microbes
- Understand structure and functioning of different microbial groups.
- Understand the importance of microbes in ecosystem
- Explain why microorganisms are ubiquitous in nature, inhabiting a multitude of habitats and occupying a wide range of ecological habitats.

Syllabus

History and Development of Microbiology: Contributions of van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck, further developments of microbiology,

Microbial Taxonomy: Bacteria, archea and their broad classification. Molecular approaches to microbial taxanomy, physiology of extremophiles,

Morphology and Functions of Viruses, Yeast, Molds and Bacteria:

Viruses-Morphology of viruses- size, shape and symmetry, replication of viruses- Lytic and Lysogenic cycle,

Yeast and Molds: Morphology, life cycle, economic importance of yeast and *Aspergillus,*

Bacteria : Ultra structure of bacteria, cell wall, cell membrane, flagella, pili, capsule, endospore, and cell inclusions, differences between prokaryotic and eukaryotic cell,

Microbial growth: Definition of growth- growth curve, measurement of bacterial growth (cell number and cell mass) growth yield, continuous culture- chemostat, turbidostat, synchronous growth, effect of environmental factors on growth,

Microbial Nutrition and Control of Microorganisms: Nutritional requirements, nutritional types of bacteria, up-take of nutrients by cell, sterilization, and disinfection, effect of physical (moist and dry heat, radiation and filtration) and chemical agents, antibiotics- mode of action and resistance,

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,

Applied Microbiology: Water, food and milk born contamination and remedy; basic microbial genetics- transformation, conjugation, transduction, strain improvement of industrially important micro-organisms.

TEXT BOOK:

1. **'**Microbiology', by Prescott L.M., Herley J.P., Klein D.A., McGraw- Hill

REFERENCE BOOKS:

1. "Microbiology", Pelzar, M.J., Chan, E.C.S., Kreig N.R., Tata McGraw-Hill
2. "Brock biology of Microorganisms", Madigan M.T.,Martinco J.M. and Parker J., Prentice Hall

BT-1206

WORKSHOP LAB

Course Objectives:

- Get hands on experience with the working skills in Carpentry trade.
- Know how to work with Sheet Metal tools.
- Get familiar with the working skills of Metal Fitting operations.
- Get hands on experience with house hold electrical wiring.

Course Outcomes:

At the end of the course, the student will be able to

- Work with Wood Materials in real time applications.
- Build various parts with Sheet Metal in day-to-day life.
- Apply Metal Fitting skills in various applications.
- Apply this knowledge to basic house electrical wiring and repairs.

Syllabus

Carpentry: Any three jobs from – Half lap joint, Mortise and Tenon joint, Half – lap Dovetail joint, Corner Dovetail joint, Central Bridle joint.

Sheet Metal: Any three jobs from – Square tray, Taper tray(sides), Funnel, Elbow pipe joint.

Fitting: Any three jobs from – Square, Hexagon, Rectangular fit, Circular fit and Triangular fit.

House wiring: Any three jobs from – Tube light wiring, Ceiling fan wiring, Stair-case wiring, Corridor wiring.

REFERENCE BOOKS:

1. Elements of workshop technology, Vol.1 by S. K. and H. K. Choudary.
2. Work shop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.

3. Engineering Practices Lab Manual, Jeyapoovan, Saravana Pandian, 4/e Vikas.

BT-1207

PHYSICS LAB

Course Objectives:

- To enable the students to acquire skill, technique and utilization of the Instruments
- Draw the relevance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.
- To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.
- To familiarize the handling of basic physical apparatus like Vernier callipers, screw gauge,spectrometers, travelling microscope, laser device, optical fibre, etc.

Course Outcomes:

At the end of the course, the student will be able to

- Design and conduct experiments as well as to analyze and interpret
- Apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics
- Relate theoretical knowledge and the means to imply it in a practical manner by performing various relative experiments.

Syllabus

1. Determination of Radius of Curvature of a given Convex Lens By forming Newton's Rings.
2. Determination of Wavelength of Spectral Lines in the Mercury Spectrum by Normal Incidence method.
3. Study the Intensity Variation of the Magnetic Field along axis of Current Carrying Circular Coil.
4. Determination of Cauchy's Constants of a Given Material of the Prism using Spectrometer.
5. Determination of Refractive Index of Ordinary ray μ_o and Extraordinary μ_e ray.

6. Determination of Thickness Given Paper Strip by Wedge Method.
7. Calibration of Low Range Voltmeter.
8. Calibration of Low Range Ammeter.
9. Determination of Magnetic Moment and Horizontal Component of Earth's Magnetic Field.
10. Lees Method - Coefficient of thermal Conductivity of a Bad Conductor.
11. Carey Foster's Bridge – Verification of laws of Resistance and Determination Of Specific Resistance.
12. Melde's Apparatus – Frequency of electrically maintained Tuning Fork.
13. Photoelectric cell-Characteristics.
14. Planks Constants.
15. Laser- Diffraction.

BT-1208

MICROBIOLOGY LABORATORY

Course objectives:

- To provide the basic fundamental knowledge on growth of microorganisms
- To provide the basic fundamental knowledge on reaction of microorganisms with specific growth media
- To understand biochemical reactions with media used in identification.

Course outcomes:

At the end of the course, the student will be able to

- Explainthe handling microbes and basic instrumentation used in Microbiological laboratory.
- Evaluate the growth and reaction of microorganisms on specific media
- Understand the staining and motility of microbes
- Differentiate the morphology of Fungi and yeast
- Evaluate quality of milk and water

List of Experiments:

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-(*Aspergillusniger)*
7. Morphology of Yeast-(*Saccharomyces cerevisiae*)
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:

'Microbiology- a Laboratory Manual' by Cappuccino T.G., Sherman N, Addison

CH-2101

MATHEMATICS-III

Course Objectives:

The objectives, in particular are to learn about:

- Differentiation of vector functions of real variables, curves in space, differential operators, the concept of gradient, divergence and curl and their potential applications.
- The concepts of Line-, Surface and Volume integrals and transformation theorems such as Green's theorem in the plane, Stoke's theorem, Gauss Divergence theorem and their applications.
- Formation of Partial Differential Equations and solution of first order first degree linear, non-linear Partial Differential Equations, Homogeneous and Non homogeneous linear partial differential equations with constant coefficients.
- The method of separation of variables and how to use it to find the solution of one dimensional wave (string equation), one-and two-dimensional Heat flow equations, Laplace's equation in Cartesian and polar coordinates.
- The concept of integral transforms, namely, Fourier transforms, Fourier Sine, Cosine and related inverse transforms, and their applications in solving several Physical and Engineering problems.

Course Outcomes:

At the end of the course, the students would be able to

- Understanddifferential operations and the concepts of Gradient, Divergence and Curl and their applications.
- Apply the concepts of Line integrals, Surface Integrals, Volume Integrals and their potential applications: work done by a force field, circulation and Flux etc. Also, find out the relation between Line, Surface and Volume integrals: Green's theorem in the plane, Stoke's and Divergence theorems.
- Understand the formation of partial differential equations and the solving Linear and Non linear first order partial differential equations. Also, how to find the solution of Linear Partial Differential Equations with constant coefficients by finding the complementary function and particular integrals.

- Apply the method of separation of variables to solve the important governing equations of one dimensional wave equation, One and Two dimensional heat flow equations, Laplace's equations in Cartesian and polar coordinates.
- Apply the knowledge of Fourier transform techniques in solving several Initial and Boundary value problems of Engineering, such as problems in Conduction of heat / Thermodynamics, Hydraulics transverse vibrations of a string, oscillations of an elastic beam, bending of beams, electrical circuits, free and forced vibrations of a membrane and transmission lines , etc.

Syllabus

(Vector Calculus-Differentiation)

Differentiation of vectors, curves in space, velocity and acceleration, relative velocity and relative acceleration, scalar and vector point functions, vector operator ∇ applied to scalar point functions- gradient, ∇ applied to vector point functions- divergence and curl. Physical interpretation of gradient, divergence and culrl (i.e., ∇f, $\nabla.\overline{F}$, $\nabla\times\overline{F}$), Irrotational and Solenoidal fields, the relations obtained after ∇ applied twice to point functions, ∇ applied to products of two functions.

(Vector Integration)

Integration of vectors, line integral, circulation, work done, surface integral-flux, Green's theorem in the plane, Stoke's theorem, volume integral, Gauss Divergence theorem. (All theorems without proofs)

Introduction of orthogonal curvilinear coordinates, cylindrical and spherical polar coordinates

(Partial Differential Equations)

Formation of partial differential equations, solutions of partial differential equations- equations solvable by direct integration, linear equations of first order: Lagrange's Linear equation, non-linear equations of first order, Charpit's method. Homogeneous linear equations with constant coefficients- rules for finding the complementary function, rules for finding the particular integral (working procedure), non- homogeneous linear equations.

(Applications Of Partial Differential Equations)

Method of separation of variables, One dimensional wave equation-vibrations of a stretched string, one dimensional Heat flow equation, Two dimensional heat flow in steady state - solution of Laplace's equation in Cartesian and polar coordinates (two dimensional).

(Integral Transforms (Fourier Transform)

Introduction, definition, Fourier integral, Sine and Cosine integrals, Complex form of Fourier integral, Fourier transform, Fourier Sine and Cosine transforms, Finite Fourier Sine and Cosine transforms, properties of Fourier transforms.

Convolution theorem for Fourier transforms, Parseval's identity for Fourier transforms, Fourier transforms of the derivatives of a function, simple applications to Boundary value problems.

TEXT BOOK:

1. Scope and treatment as in "Higher Engineering Mathematics", by Dr. B.S.Grewal, **43rd Edition**, Khanna Publishers.

REFERENCE BOOKS:

1. Graduate Engineering Mathematics by V B Kumar Vatti, I.K.International publications
2. Advanced Engineering Mathematics by Erwin Kreyszig.
3. A text book of Engineering Mathematics by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.
4. Mathematical Methods of Science & Engineering aided with MATLAB by KantiB.Dutta, Cengage Learning India Pvt. Ltd.
5. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw Hill Company.
6. Advanced Engineering Mathematics by H.K.Dass. S.Chand Company.

BT-2101

BIOCHEMISTRY

Course Objectives:

- To study about the principles and significance of biochemistry.
- To study about the structure and function of Carbohydrates, Proteins and Aminoacids and Lipids.
- To study about the Nucleic acids like DNA and RNA and also to study about the structure and function of enzymes.
- To study about haemoglobin and chlorophyll molecules and their functions.
- To study about the fat soluble and water soluble vitamins also to study about the structure and function of harmones.

Course Outcomes:

At the end of the course, the students would be able to

- Define Biochemistry- study of chemical reactions and processes in living systems
- Understand Carbohydrates, Proteins and Amino acids and Lipids.
- Differentiate quantitative and qualitative analysis of the biomolecules.
- Demonstrate nucleic acids-DNA and RNA hereditary materials and enzyme structure and functions.
- Explainthe basic structure of porphyrins and the detailed structure of haemoglobin and chlorophyll molecules.
- Describe the structure and function of vitamins and endocrinal glands.

Syllabus

Scope and importance of Biochemistry.

Carbohydrates: Classification, chemistry and properties of monosaccharides (Ribose, Glucose, and Fructose), disaccharides (maltose, lactose, sucrose) and polysaccharides (homopolysaccharides and heteropolysaccharides), metabolism of carbohydrates - glycolysis,

TCA cycle, electron transport and oxidative phosphorylation, HMP shunt pathway, glycogenesis and glycogenolysis,

Proteins and amino acids: Classification and properties of amino acids and proteins, peptide bond, chemical synthesis of peptides and solid-phase peptide synthesis, structural organization of proteins- primary, secondary, tertiary and quaternary structure of proteins, denaturation of proteins,

Lipids: Classification, structure and physiological functions of triglycerides, fatty acids, phospholipids, cerebrosides, gangliosides and cholesterol, digestion and absorption of fats, biosynthesis and degradation of fatty acids and triglycerides,

Nucleic acids: Structure and properties of purines and pyrimidine bases, nucleosides, nucleotides, cellular localization, isolation and estimation of nucleic acids, types of nucleic acids, double helical structure of DNA, types of RNA, biosynthesis and catabolism of purines and pyrimidines,

Enzymes: Introduction, nomenclature and classification of enzymes, kinetic properties of enzymes, factors affecting enzyme action, coenzymes, enzyme inhibition- competitive, non-competitive and uncompetitive inhibitions,

Porphyrins: Chemistry of hemoglobin and chlorophyll, synthesis of heme and chlorophyll and heme catabolism,

Vitamins and hormones: Definition, classification, chemistry, source, functions and deficiency of vitamins, outlines of hormones and their functions,

TEXT BOOKS:

1. "Fundamentals of Biochemistry" by J.L.Jain, S.Chand& Company Ltd, New Delhi
2. "Principles of Biochemistry" by Lehninger, Nelson and Cox, CBS Publications.

CH-2103
MANAGERIAL ECONOMICS

Course Objectives:

1. To bring about an awareness about the nature of Managerial Economics and its linkages with other disciplines.
2. To understand the Micro and Macro Environment of Business.
3. To familiarise the prospective engineers with the concepts and tools of Managerial Economics with an objective to understand the real world of business.

Course Outcomes:

Managerial Economics will help the prospective engineers, who are likely to occupy managerial positions in future to understand the various economic activities in business and industry for an effective and efficient running of the organisations.

Syllabus

Significance of Economics and Managerial Economics:

Economics: Definitions of Economics- Wealth, Welfare and Scarcity definition Classification of Economics- Micro and Micro Economics.

Managerial Economics: Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

Demand Analysis :Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve.

Elasticity of demand - Definition, Measurement of elasticity, Types of Elasticity (Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand.

Demand Forecasting - Need for Demand forecasting, Factors governing demand forecasting, Methods of demand forecasting: Survey methods- Experts' opinion survey method and consumers Survey methods.

Utility Analysis: Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations

Theory of Production and Cost analysis:

Production - Meaning, Production function and its assumptions, use of production function in decision making; Law of Variable Proportions: three stages of the law

Cost analysis - Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. unavoidable costs, Economies and Diseconomies of scale

Market Structures : Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinked demand curve ;Monopolistic Competition

Pricing Analysis : Pricing - Significance: Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark- down pricing of retailers.

Business cycles, Inflation and Deflation:

Business cycles - Definition , Characteristics , Phases, Causes and Consequences; Measures to solve problems arising from Business cycles

Inflation -Meaning, Types, Demand- pull and Cost push inflation, Effects of Inflation, Anti-inflationary measures.

Deflation- Meaning, Effects of Deflation, Control of Deflation, Choice between Inflation and Deflation.

TEXT BOOKS:

1. Sankaran,S., **Managerial Economics,**Marghan Publications, 2015, Chennai.
2. Aryasri, A.R., **Managerial Economics and Financial Analysis,** MC Graw Hill Education, New Delhi,2015.

BT-2102

BIO-ANALYTICAL TECHNIQUES

Course Objectives:

Bioanalysis is a sub-discipline of analytical chemistry covering the quantitative measurement of xenobiotics (drugs and their metabolites, and biological molecules in unnatural locations or concentrations) and biotics (macromolecules, proteins, DNA, large molecule drugs, metabolites) in biological systems. Many scientific endeavors are dependent upon accurate quantification of drugs and endogenous substances in biological samples; the focus of bioanalysis in the pharmaceuticalindustry is to provide a quantitative measure of the active drug and/or its metabolite(s) for the purpose of pharmacokinetics,toxicokinetics, bioequivalence and exposure–response (pharmacokinetics/pharmacodynamics studies). Bioanalysis also applies to drugs used for illicit purposes, forensic investigations, anti-doping testing in sports, and environmental concerns. Modern drugs are more potent, which has required more sensitive bioanalytical assays to accurately and reliably determine these drugs at lower concentrations. This has driven improvements in technology and analytical methods.

Course Outcomes:

At the end of the course, the student will be able to

- Explain general principles and theory of the Spectroscopy.
- Understand the basic instrumentation of HPLC, GLC for identification and characterization of compounds.
- Select separation techniques for biological components.
- Analyze instrumentation, separation and identification of compounds by Electrophoresis.

Syllabus

Chromatography- Distribution coefficient, modes of chromatography. Paper, Thin layer, Ion-Exchange and Affinity chromatography. GLC- Principle, sample preparation, apparatus, detectors types and applications. HPLC- Principle, Components and applications.

Electrophoresis- General principles, support media and applications. SDS-PAGE, Isoelectric focusing, Agarose gel electrophoresis, capillary electrophoresis. Centrifugation- Principle of

sedimentation, sedimentation coefficient, Preparative and Analytical centrifuges, Ultracentrifuge. Differential centrifugation, density gradient centrifugation. Applications- in determination of molecular mass, purity and conformation of macromolecules.

Radioisotope techniques- Detection and measurement of radioactivity. Gas ionization, Excitation of solids and solutions, Autoradiography, Application in biological sciences- Metabolic pathways, turn over time determination, isotope dilution analysis, radiodating, clinical diagnosis and sterilization and tracer techniques. Biosensors- Principle and applications of Electrochemical, Thermometric, Optical and Peizoelectric Biosensors.

UV Visisble Spectroscopy- Principle, Beer-Lamberts law, Instrumentation of Single and Double beam spectrophotometers. Bathochromic and hypsochromic shifts and applications. Turbidometry and Nephlometry- Principles and Applications. Infra red and Raman Spectroscopy- Principles and Applications. Spectrofluorimetry- Principle and Applications.

ESR Spectroscopy- Principle, Hyperfine splitting, Instrumentation and applications. NMR Spectroscopy- Principle, Theory of Proton Magnetic resonance and Instrumentation. NMR parameters- Chemical shifts, spin-spin splitting, Intensity and line width and applications- Magnetic resonance imaging. Mass spectroscopy- Principle, Instrumentation, Ionization techniques, Electron impact and chemical Ionization, Ion desorption and evaporation methods, Magnetic and electric sector analyzers, detectors (Faraday cup). X-ray crystallography- Principle, Braggs equation, determination of crystal structure-Rotating crystal method and Powder method, and applications.

TEXT BOOK:

1. Biophysical techniques, by K.Upadhyay, A. Upadhyaya and N.Nath. Himalaya publishihng house.

REFERENCE BOOK:

1. Practical Biochemistry- Principles and techniques- by Keith Wilson and John Walker.

BT-2103

DOWNSTREAM PROCESSING

Course Objectives:

The course will help to:

- Learn the fundaments of downstream processing
- Understand the principle, working and application of major unit operations in Bioprocessing of industrially important products.
- Understand strategies for development of novel Bioprocessing protocol by applying the concise principles of downstream processing.

Course Outcomes:

At the end of the course, the student will be able to

- Apply the concepts of downstream processing for separation.
- Execute precise and efficientbioseparation process, which is cost effective and yield high degree of pure substance.
- Select thebioseparation process which gives high resolution, economical bioproducts.

.

Syllabus

Cell Disruption: Physical and Mechanical methods, Chemical and Enzymatic methods.

Separation Of Insoluble Products: Filtration, Centrifugation, Coagulation and Flocculation, Sedimentation.

Separation Of Soluble Products: Extraction, Precipitation, Adsorption, Micro filtration, Ultra-filtration,Reverse Osmosis,Dialysis, Electro Dialysis, Pervaporation. Electrophoresis, Gel Exclusion Chromatography and Ion Exchange Chromatography.

Products Purification & Polishing: Crystallizationand Drying.

TEXT BOOKS:

1) "Bioseparations–principles & techniques" by B.Siva Sankar.
2) "Bioprocess Engineering" by Michael L.ShulerFikretKargi, Prentice Hall of India
3) "Bioseparations – downstream processing for Biotechnology", by Paul A Belter and E.L.Cussler.

REFERENCE BOOKS:

1) "Biochemical engineering fundamentals" 2nd ed. by J E Bailey and D Ollis, McGraw-Hill (1986).
2) "Principles' of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press (1984).

BT-2104

BIOCHEMISTRY AND BIOANALYTICAL TECHNIQUES LABORATORY

Course Objectives:

- This lab is designed to train the students in basic techniques of Biochemistry and Bioanalytical techniques like estimation of total Carbohydrates, Proteins, Lipids and DNA.

Course Outcomes:

At the end of the course, the student will be able to

- Estimate the amount of Glucose, protein, lipid, DNA in the given sample solutions.
- Determine the Enzymeactivity.
- Understand the fundamentals of recovery/purification of enzymes.
- Experiment with the Chromatographic techniques for the separation of biomolecules.

List of Experiments

1. Estimation of total Carbohydrates
2. Estimation of Proteins
3. Estimation of Lipids and of Cholesterol
4. Assay of Enzymes- Amylase. Determination of its K_m value
5. Estimation of DNA, Determination of T_m of DNA
6. Paper chromatography of sugar
7. Thin layer chromatography of lipids
8. Ion exchange chromatography for biomolecules separation
9. Electrophoresis of proteins and determination of their molecular weight by SDS-PAGE
10. Estimation of turbidity by Nephlometer
11. Separation of biomolecules by GLC

TEXT BOOKS:

1. 'Introduction to Practical Biochemistry', by Plummer, Tata Mc-Graw Hill
2. 'Practical Biochemistry', by Sawhney
3. 'Laboratory Manual in Biochemistry' by J.Jayaraman, New Age International

BT-2105

DOWNSTREAM PROCESSING LABORATORY

Course Objectives:

The objective of this course is to enable students to

- Acquire knowledge of different techniques for solid-liquid separation, product release and purification of Biotechnology products.
- To design and execute efficient and sustainable downstream processes to achieve a pure bioproduct.

Course Outcomes:

At the end of the course, the student will be able to

- Understand the fundamentals of recovery/ purification operations for biopharamaceutical production.

List of Experiments

1. Cell Disruption by Sonication
2. Cell Disruption by Enzymatic Reaction
3. Centrifugal Separation- Ultra Centrifugation, Gel Filtration
4. Micro filtration
5. Ultra filtration
6. Aqueous Two-phase Extraction
7. Dialysis

CH-2108

MATLAB

Course Objectives:

The student will learn to apply the knowledge of *MATLAB* for solving Chemical Engineering problems.

Course Outcomes:

At the end of the course the student will be able to

- Apply *Matlab* to create and print arrays and execute function files
- Solve linear equations using *Matlab*
- Determine the curve fit equation for the given data
- Draw 2D plots and 3D plots for the given data

Syllabus

Introduction, Tutorial lessons: *MATLAB* session, working with arrays of numbers, creating and printing simple data, saving and executing a script file, creating and executing function files, working with files and directories.

Interactive computation - Matrices and vectors, matrix and array operations, creating and using inline functions, using built in functions and online help, saving and loading data, plotting simple graphs.

Script files, function files, language specific features, advanced data objects.

Applications - linear algebra, curve fitting and interpolation, data analysis and statistics, numerical integration, ordinary differential equations, nonlinear algebraic equations.

Basic 2D plots, using subplot to layout multiple graphs. 3-D plots, symbolic Math tool box: two useful tools in symbolic Math tool box, using symbolic Math tool box.

TEXT BOOK:

1. 'Getting started with *MATLAB*: A quick introduction for scientists and engineers' by Rudra Pratap, Oxford University press

CH-2109

ENVIRONMENTAL SCIENCE

Course Objectives:

The aim of this course is to make the students better understand the changes in the environment and be given a greater voice and planning conservation through an interdisciplinary environmental science curriculum that is design to enhance scientific enquiry and to strengthen competence.

Course Outcomes:

At the end of the course, the student will be able to

- Understand various types of pollution regulations and their scientific bases.
- Apply knowledge for the protection and improvement of the environment.
- Recognize the major concepts in environmental science and demonstrating in-depth of the environment

Syllabus

Introduction: Definition, scope and importance, measuring and defining environmental development – indicators

Ecosystems: Introduction, types, characteristic features, structure and functions of ecosystems – forest, grassland, desert, aquatic (lakes, rivers and estuaries)

Environmental and natural resources management: Land resources- land as a resource, common property resources, land degradation, soil erosion and desertification, effects of modern agriculture, fertilizer-pesticide problems

Forest resources- use and over-exploitation, mining and dams –their effects on forest and tribal people

Water resources – use and over utilization of surface and ground water, floods, droughts, water logging and salinity, dams-benefits and costs, conflicts over water

Energy resources- Energy needs, renewable and non-renewable energy sources, use of alternate energy sources, impact of energy use on environment

Bio-diversity and its conservation: Value of bio-diversity- consumptive and productive use, social, ethical, aesthetic and option values, bio-geographical classification of India - India as a mega diversity nation, threats to biodiversity, hot spots, habitat loss, poaching of wild life, loss of species, seeds etc., conservation of biodiversity - in-situ and ex-situ conservation

Environmental pollution- local and global issues: Causes, effects and control measures of air pollution, indoor air pollution, water pollution, soil pollution, marine pollution, noise pollution, solid waste management, composting, vermiculture, urban and industrial wastes, recycling and re-use, nature of thermal pollution and nuclear hazards, global warming, acid rain , ozone depletion

Environmental problems in India: Drinking water, sanitation and public health, effects of activities on the quality of environment, urbanization, transportation, industrialization, green revolution, water scarcity and ground water depletion, controversies on major dams – resettlement and rehabilitation of people: problems and concerns, rain water harvesting, cloud seeding and watershed management

Economy and environment: The economy and environment interaction, economics of development, preservation and conservation, sustainability: theory and practice, limits to growth, equitable use of resources for sustainable lifestyles, environmental impact assessment

Social issues and the environment: Population growth and environment, environmental education, environment movements, environment versus development

Institutions and governance: Regulation by Government, monitoring and enforcement of environmental regulation, environmental Acts, water (prevention and control of pollution) act, air (prevention and control of pollution) act, environment .protection act, wild life protection act, forest conservation act, coastal zone regulations, institutions and policies relating to India, environmental governance

International conventions: Stockholm conference-1972, Earth summit-1992, World commission for environmental development (WCED)

Case studies: Chipko movement, Narmada bachaoandolan, Silent valley project, Madhura refinery and Taj mahal, Industrialization of Pattancheru, Nuclear reactor at Nagarjuna sagar, Tehri dam, Ralegaon siddhi (Anna Hazare), Kolleru lake-aquaculture, Fluorosis in Andhra Pradesh

Field work: Visit to a local area to document and mapping environmental assets – river/forest/grass land / hill/ mountain, study of local environment-common plants, insects, birds, study of simple ecosystems – pond, river hill, slopes etc, visits to industries- water treatment plants, effluent treatment plants

TEXT BOOK:

1. Environmental Studies by Anubha Kaushik & C.P. Kaushik, Second Edition, New Age International (P) Limited.

BT-2201
BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Course Objectives:

- To provide the students with knowledge of fundamental laws in electrical Engineering
- The ability to formulate and solve the differential equations describing time behavior of circuits containing energy storage elements.
- The capability to design and construct circuits, take measurements of circuit behavior and performance, compare with predicted circuit models and explain discrepancies.
- To understand the working of various D.C Machines.
- To inculcate the understanding about the AC fundamentals.
- To provide an insight into the principles of working of transformers, dc machines, alternators and induction motors.
- An understanding of how complex devices such as semiconductor diodes and field-effect transistors are modeled and how the models are used in the design and analysis of useful circuits.
- Understand the characteristics of transistors in CE, CB, CC configuration and it's usage as an amplifier and oscillator.

Course Outcomes:

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

- Understand concept source of electrical generation, transmission, distribution, protection, safety measures and power & energy measurement.
- Understand construction & working of electrical machines and evaluate their performance
- Explain theconstructional details, principle of operation, Performance, startersand speed control of DC Machines, AC Machines and Transformers
- Develop and employ circuit models for elementary electronic components like semiconductor diodes and transistors

Syllabus

Section-A

Fundamentals Laws and Theorems: KVL, KCL, ohm's law, superposition theorem, Thevenin's theorem, Norton's theorem, reciprocity theorem,

D.C. and A.C. Circuits: Mesh analysis, nodal analysis, star-delta transformation, sinusoidal steady state analysis of 1-φ circuits, series and parallel circuits, 3-φ circuits, Star-Delta circuits,

D.C. Machines : Construction and working of D.C. generators, EMF equation, classification, characteristics, armature reaction, construction and working of D.C. motors, torque equation, characteristics, speed control methods and 3-point starter, efficiency calculation,

Single phase Transformers: Construction and working of single phase transformers, equivalent circuits, efficiency, regulation, O.C and S.C tests,

A.C. Machines: Construction and working of 3 – φ Induction motor, slip, torque equation, efficiency, calculation, construction and working of synchronous generator (alternator), EMF equation, regulation-synchronous impendence method, synchronous motor, torque equation, starting methods.

Section-B

Electronics: Chartersistics of semiconductor diodes, transistors, characteristics of CB, CE, CC transistor configurations, oscillators, cathode ray oscilloscope, construction, working, applications, mechanical transducers, electrical transducers, pressure gauges, LVDT.

TEXT BOOKS:

1. 'Elements of Electrical Engineering and Electronics' by V.K. Mehta, S.Chand& Co.
2. 'Fundamentals of Electrical Engineering and Electronics' by B.L.Thereja
3. 'Electronic Devices and Circuits' by Allen Mottorshad, Prentice Hall of India
4. 'Basic Electrical Engineering' by V.N. Mitthal, Tata Mc-Graw Hill

CH-2202

MATERIAL & ENERGY BALANCES

Course Objectives:

To give intensive quantitative training in the practical applications of the principles of physical chemistry to the solution of complicated industrial problems and in methods of predicting missing physicochemical data from generalized principles.

Course Outcomes:

At the end of the course, the student will be able to

- Convert physico-chemical quantities from one system of units to another
- Identify basis and degrees of freedom
- Perform material and energy balances on single units without and with chemical reactions
- Solve the material and energy balance problems on multi-unit processes with recycle, purge and bypass
- Analyze the ideal and real behavior of gases, vapors and liquids

Syllabus

Stoichiometry and composition relationships- the gram-mole and pound-mole, limiting reactant, excess reactant, degree of completion, basis of calculation, weight percent, volume percent and mole percent, density and specific gravity- Baume and API gravity scales,

Behavior 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,

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,

Material balances- Tie substance, yield, conversion, processes involving chemical reactions, material balance- calculations involving drying, dissolution, and crystallization, processes involving recycle, bypass and purge,

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 non-polar liquids, estimation of latent heat of vaporization using Classius-Clayperon equation, enthalpy of humid air and humid heat capacity,

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, K.M. Watson and R.A.Ragatz, CBS Publishers and Distributors (1995)

REFERENCE BOOKS:

1. 'Basic principles and Calculations in Chemical Engineering' by David M. Himmelblau, Prentice Hall of India Pvt Ltd, 1995
2. 'Stoichiometry' by B.I. Bhatt and S.M. Vora, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi (1996)
3. 'Stoichiometry for Chemical Engineers' by Williams and Johnson, McGraw Hill Publishers.

BT-2202

FLUID MECHANICS AND HEAT TRANSFER

Course objectives

To provide

- Knowledge on pressure distribution in static fluids.
- Knowledge on rheological behavior of fluids, types of fluid flow, boundary layers and basic equations of fluid flow.
- Knowledge of incompressible fluid flow in pipes
- Knowledge on pipes, fittings, transportation and metering devices.
- Knowledge on conduction, convection and radiation
- Knowledge on heat flow by conduction and heat flow in fluids.
- Knowledge on heat exchange equipment.

Course Outcomes:

At the end of the course, the student will be able to

- Estimate the pressure drop.
- Calculate the pumping capacity and friction losses of flowing fluids.
- Differentiate pumps based on their performance.
- Select proper measuring device and estimate the quantity of flow.
- Solve heat transfer problems.
- Design heat transfer equipment.

Syllabus

Fluid statics and applications: Units and Dimensions, Dimensional Homogeneity, Nature of fluids, Hydrostatic Equilibrium, Applications of fluid statics – Manometers, continuous gravity decanter and centrifugal decanter.

Fluid Flow phenomena: Laminar flow, shear rate, shear stress. Rheological properties of fluids – Newtonian fluids, Non Newtonian fluids, time dependent flow, viscoelastic fluids. Viscosity, Reynolds number, Turbulence - nature of turbulence. Boundary layers - boundary layer formation over flat plate, flow in boundary layers, laminar and turbulent flow in boundary

layers, boundary layer formation in straight tubes, boundary layer separation and wake formation.

Basic Equations of Fluid Flow: Continuity equation (Mass Balance in a flowing fluid), equation of motion (Differential Momentum Balance), Navier - stokes equations, Euler's equation, Couette flow, Macroscopic Momentum Balance, layer flow with free surface, Bernoulli equation (Energy equation), corrections for effect of solid boundaries and pump work.

Incompressible flow in pipes and channels : Shear Stress and skin friction in pipes, Relation with skin friction and wall shear, Friction factor, relations between skin friction parameters, equivalent diameter, laminar flow in pipes and channels, velocity distribution, average velocity, Kinetic energy correction factor and momentum correction factor for laminar flow, Hagen-Poiseuille equation, laminar flow of non-Newtonian liquids, laminar flow in annulus. Friction from changes in velocity or direction – sudden expansion, sudden contraction, pipe fittings, friction losses in Bernoulli equation, velocity heads, separation of boundary layer in diverging channel, minimizing losses.

Transportation of Fluids: Pipes, fittings, valves, positive displacement pumps (reciprocating, rotary and peristaltic pumps), centrifugal pumps

Metering of fluids: Full bore meters – Venturi meter, Orifice meter and Rotameters.

HEAT TRANSFER

Nature of heat flow - Conduction, convection and radiation

Heat transfer by Conduction: Basic law of conduction, thermal conductivity, steady state conduction, compound resistances in series, heat flow through a cylinder and a sphere, unsteady state conduction – one dimensional heat flow with constant surface temperature.

Principles of heat flow in fluids: countercurrent and parallel flows, energy balances, heat flux and heat transfer coefficients, overall heat transfer coefficients, LMTD, individual heat transfer coefficients, fouling factor.

Heat exchange equipment: condenser, heat exchanger, evaporator and boilers.

.**TEXT BOOK:**

1. "Unit Operations of Chemical Engineering" Seventh Edition, by W.L. McCabe, J C Smith and P Harriot, Mc Graw Hill

REFERENCE BOOK:

1. “Introduction to Chemical Engineering” by W L Badger and J T Banchero, Tata Mc Graw Hill

BT-2203

BIOCHEMICAL THERMODYNAMICS

Course Objectives:

To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and to predict phase equilibria and chemical reaction equilibrium.

Course Outcomes:

At the end of the course, the student will be able to

- Understand the laws of thermodynamics
- Understand the degrees of freedom and phase & chemical reaction equilibria
- Calculate thermodynamic parameters involved in biochemical reactions
- Differentiate between ideal and non-ideal solutions

Syllabus

The first law and other basic concepts: Internal energy, the first law of thermodynamics, thermodynamics state and state functions, enthalpy, the Steady state Steady flow process, the reversible process, constant V and constant P processes.

Heat effects: Latent heats of pure substances, standard heat of reaction, standard heat of formation, standard heat of combustion.Temperature dependence of heat effects of chemical reactions.

The second law of Thermodynamics: Statement of the second law, heat engines, entropy changes of an ideal gas, mathematical statement of second law, the third law of thermodynamics.

Thermodynamic properties of fluids : Property relations for homogeneous phases, residual properties, Solution thermodynamics : partial properties, concepts of chemical potential and fugacity, ideal and non-ideal solutions, Gibbs-Duhem equation, excess properties of mixture, activity coefficients and correlations.

Criteria for phase equilibria: Vapour-liquid equilibrium calculations for binary mixtures, Liquid-liquid equilibria and solid liquid equilibria, Chemical reaction equilibria.

Biochemical thermodynamics: Energetics of metabolic pathways, Energy coupling (ATP & NADH), Energetic analysis of cell growth and product formation. Thermodynamics of microbial growth, oxygen consumption and heat evolution in aerobic cultures, energy balance equation for cell culture.

TEXT BOOKS:

1. Introduction to Chemical Engineering Thermodynamics by J.M. Smith, H.C. Van Ness and M.M. Abbott, 6^{th} Ed. McGraw-Hill, 2000.
2. Kinetics and Energetics in Biotechnology, J.A. Roels, Elsevier, 1983.

REFERENCEBOOK:

1. Chemical Engineering Thermodynamics, Y.V.C. Rao, University Press.

CH-2205

INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Course Objectives:

1. To familiarise the students with the concepts of Management.
2. To relate the concepts of Management with Industrial Organisations.
3. To explain the factors affecting productivity and how productivity can be increased with effective utilization of inputs in an industrial undertaking.
4. To set forth a basic framework for understanding Entrepreneurship.

Course Outcomes:

An engineer with his/her fundamental knowledge of Industrial Management, will be in position to take appropriate decisions in the corporate environment. The concepts of Entrepreneurship acts as a motivating factor to launch new enterprises and translate one's dream into realty.

Syllabus

Basic Concepts of Management:
Management **:-** Definition, Nature and Importance ; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management;

Forms of Business Organizations**:**Introduction, Types of Business organizations**:**

Private Sector- Individual Ownership , Partnership, Joint stock companies and Co-Operative organizations**;** Public sector- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

Production and operations Management**:** Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance

Entrepreneurship : Definition, Characteristics and Skills , Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques;, Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

TEXT BOOKS:

1. Sharma,S.C, and Banga, T.R., Industrial Organization & Engineering Economics, Khanna Publishers, Delhi, 2000.
2. Vasant Desai, The Dynamics of Entrepreneurial Development and Management(Planning for future Sustainable growth),HImalayan Publishing House, 2018.

REFERENCE BOOKS:

1. Aryasri , A.R., Management Science**,** McGraw HIll Education (India Private Limited , New Delhi 2014.
2. Sheela, P. , and Jagadeswara Rao, K., Entrepreneurship, Shree Publishing House, Guntur, Andhra Pradesh, 2017.

BT-2204

PLANT CELL AND TISSUE CULTURE

Course Objectives:

- To know the basics of plant tissue culturing.
- To know the production of callus from carrot.
- To measure the efficacy of root and shoot.
- To develop the graduate capabilities of knowledge ability, comprehension and applications of plants in cell and tissue culture systems.
- To know how cell and tissue culture contributes to global sustainability.
- To develop the practical skills and confidence of students to successfully culture plant cells and tissues.

Course Outcomes:

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

- Explain the various components of plant tissue culture media, e.g. minerals, growth factors, hormones, and what governs the choice of components
- Describe the various steps taken to establish and optimize media for particular purposes in particular species, without the aid of texts.
- Demonstrate and perform some of the more advanced techniques, e.g. embryo rescue, and protoplasting.
- Establish and maintain plants in tissue culture and micropropagation, including morphogenesis.
- Understand the various cell lines used in tissue culture and their origins and uses.

Syllabus

Fundamentals of plant tissue culture: laboratory organization, sterilization methods, culture medium and growth regulators.

Totipotency, callus culture and organogenesis- Expression of totipotency in cell culture and importance; Principle of callus culture, characteristics of callus culture and importance; Principle of organogenesis, factors effecting organogenesis and applications.

Cell culture: single cell culture-isolation, methods of single cell culture and importance; Cell suspension culture, types of suspension culture, growth pattern, synchronization, assessment of growth and viability of cultured cells, significance of suspension cultures.

Somatic embryogenesis and synthetic seeds: principle, induction of embryogenesis, embryo development and maturation, factors effecting somatic embryogenesis, synchronization, large scale production and importance of Somatic embryogenesis, synthetic seeds- methods of making synthetic seeds and applications.

Germplasm conservation

Somoclonal variations – its genetic basis and application in crop improvement- cell line selection for resistance to herbicides, stress and diseases. Haploid production and its advantages- androgenesis, principle, pollen culture, advantages of pollen culture over anther culture, homozygous diploids, importance of anther and pollen culture.

Clonal propagation –technique- multiplication by axillary and apical shoots, adventitious buds/bulbs/protocorms, by callus culture, transplantation, acclimatization

Production of disease free plants- meristem tip culture- virus indexing.

Protoplast technology- isolation, culture and plant regeneration, protoplast fusion, methods, identification and characterization of somatic hybrids, cybrids and importance of somatic hybridisation.

Genetic transformation – plant vectors – Ti plasmids, Ri plasmids - indirect and direct methods, current status and limitations.

Automation and Economics of tissue culture.

TEXT BOOK:

1. Plant tissue culture – Kalyan Kumar De – New Central Book Agency

REFERENCE BOOKS:

1. An Introduction to Plant tissue culture. Razdan. M. K., Oxford & LBH.
2. Plant tissue culture- theory and practice. Bhojwani, SS &Razdan, MK.Elsevier
3. Plant tissue and Cell culture. Street, HE.Blackwell

BT-2205

FLUID MECHANICS AND HEAT TRANSFER LABORATORY

Course Objectives:

- The student will be exposed to various fluid measuring devices and pumps. The pressure drop calculation experimentally across the pipe and packed bed will also be dealt in this lab.
- To impart the practical knowledge for the students to apply the concepts of heat transfer principles and estimate the heat transfer parameters

Course Outcomes:

At the end of the course, the student will be able to

- Distinguish laminar and turbulent flows.
- Determine the characteristics of flow meters
- Determine the characteristics of packed beds and centrifugal pumps
- Calculate pressure drop across a pipe
- Calculate heat transfer coefficients in forced and natural convection
- Determine the emissivity of the given plate

List of Experiments

1. Variation of orifice coefficient with Reynolds number Friction loses for flow through pipe.
2. Calibration of Rotameter.
3. Verification of Bernoullis Theorem.
4. Pressure drop in a packed bed for different fluid velocities
5. To study the characteristics of a centrifugal pump
6. Determination of emissivity of a given plate at various temperatures.
7. Determination of the natural convective heat transfer coefficient for a vertical tube
8. Determination of forced convective heat transfer coefficient for air flowing through a pipe.

9. Study of the temperature distribution along the length of a pin fin under natural and forced convection conditions.

BT-2206

PLANT CELL AND TISSUE CULTURE LABORATORY

Course Objectives:

- To acquaint students with the principles, technical requirement, scientific and commercial applications of Plant Tissue and Cell culture.
- To expose students to supporting methodologies of plant tissue and cell culture, micropropagation techniques and applications of Tissue and Cell culture to plant improvement.

Course Outcomes:

At the end of the course, the student will be able to

- Develop and maintain cultures of animal cells, establish cell lines with good viability, minimal contamination.
- Perform supportive tasks relevant to cell culture, including preparation and evaluation media.
- Recognize and troubleshoot problems, common to routine cell culture.

List of Experiments

1. Sterilization methods
2. Preparation of stock solutions
3. Preparation of medium
4. Establishment of callus cultures from carrot cambial explants
5. Establishment of cell culture
6. Establishment of growth and preparation of growth curve
7. Embryo culture of maize or any suitable crop, root/shoot initiation (organogenesis) from different explants
8. Micro propagation and plant regeneration
9. Isolation, culture and fusion of plant protoplasts
10. Anther and pollen culture

CH-2208

ASPEN PLUS (Process Design)

Course Objectives:

- To familiarize students with basic programming skills required for solving chemical engineering problems.
- To analyze the data obtained from simulation with theoretical concepts.
- To compare different thermodynamic property estimation methods and analysing the results.
- To familiarize students with fundamental applications of chemical engineering in ASPEN PLUS.

Course Outcomes:

At the end of the course, the student will be able to

- Carry out thermodynamic property estimations using Aspen
- Simulate Mixer, splitter, pumps, compressors and flash units
- Apply sensitivity, design specification and case study tools in Aspen
- Design heat exchangers, reactors and distillation columns
- Optimize process flowsheets using sequential modular and equation oriented approaches.

Syllabus

Solve the following steady state simulation exercises using Aspen:

1. Physical property estimations.
2. Simulation of individual units like, mixers, splitters, heat exchangers, flash columns and reactors
3. Design and rating of heat exchangers
4. Design and rating of distillation columns.
5. Mass and Energy balances.
6. Handling user specifications on output streams – Sensitivity and design Spec tools.
7. Simulation of a flowsheet
8. Simulation exercises using calculator block

9. Optimization Exercises
10. Simulation using equation oriented approach

TEXT BOOKS:

1. Lab manuals / Exercise sheets
2. A.K.Jana, Chemical Process Modelling and Computer Simulation, Prentice Hall India, 3rd Edition, 2018.

CH-2209

PROFESSIONAL ETHICS AND MORAL VALUES

Course Objectives:

- To inculcate Ethics and Human Values into the young minds.
- To develop moral responsibility and mould them as best professionals.
- To create ethical vision and achieve harmony in life.

Course Outcomes:

At the end of the course, the student will be able to

- Understand the importance of ethics and moral values in life and society.

Syllabus

Ethics and Human Values: Ethics and Values, Ethical Vision, Ethical Decisions
Human Values – Classification of Values, Universality of Values.

Engineering Ethics: Nature of Engineering Ethics, Profession and Professionalism, Professional Ethics, Code of Ethics, Sample Codes – IEEE, ASCE, ASME and CSI.

Engineering as Social Experimentation: Engineering as social experimentation, Engineering Professionals – life skills, Engineers as Managers, Consultants and Leaders, Role of engineers in promoting ethical climate, balanced outlook on law.

Safety Social Responsibility and Rights: Safety and Risk, moral responsibility of engineers for safety, case studies – Bhopal gas tragedy, Chernobyl disaster, Fukushima Nuclear disaster, Professional rights, Gender discrimination, Sexual harassment at work place.

Global Issues: Globalization and MNCs, Environmental Ethics, Computer Ethics, Cyber Crimes, Ethical living, concept of Harmony in life.

TEXT BOOKS:

1. Govindharajan, M., Natarajan, S. and Senthil Kumar, V.S., Engineering Ethics, Prentice Hall of India, (PHI) Delhi, 2004.
2. Subramainam, R., Professional Ethics, Oxford University Press, New Delhi, 2013.

REFERENCE BOOK:

1. Charles D, Fleddermann, "Engineering Ethics", Pearson / PHI, New Jersey 2004 (Indian Reprint).

SUMMER INTERNSHIP (COMMUNITY SERVICE)(2MONTHS)

All the students have to undergo Summer Internship / Community Service for two months in the industries / nearby villages and report the same in the Department.

BT-3101

MASS TRANSFER

Course Objectives:

- To explain the students with the basic principles of mass transfer operations and other separation processes with examples.
- To impart knowledge on how certain substances undergo the physical change with diffusion/mass transfer components from one phase to other phases.
- To describe the students with equipment used in operations involving mass transfer and other separation processes and their advantages and disadvantages.
- To focus on distillation operations and the process design aspects of the same operations.

Course Outcomes:

At the end of the course, the student will be able to

- Define the basic principles of mass transfer operations and other separation processes.
- Identify the basic techniques for measurement of diffusivity, mass transfer coefficient, evaporation rate.
- Understand the importance of mass transfer phenomena in the design of process equipment in distillation operation.
- Understand the VLE concepts and its application to various types of distillation.
- Identify the major parts of various mass transferequipments.

Syllabus

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.

Mass transfer coefficients: Mass transfer coefficients in turbulent flow, theories of mass transfer, analogy between momentum, heat and mass transfer in laminar and turbulent flow, correlations for mass transfer coefficients in simple situations.

Interphase mass transfer: Concept of equilibrium, diffusion between phases, two resistance theory, material balances in steady state co-current and counter-current stage processes, Murphy stage efficiency.

Equipment for gas-liquid operations: Sparged vessels, mechanically agitated vessels for single phase liquids and gas-liquid mixtures, tray towers, sieve tray for absorption and distillation, venturi scrubbers, spray towers and spray chambers, packed towers for absorption and distillation, tray towers versus packed towers.

Absorption: Solubility's of gases in liquids, two component systems, multi-component systems, ideal and non-ideal solutions, choice of solvent for absorption, single component absorption material balances, counter current multistage operations, dilute gas mixtures, tray efficiency.

Distillation: Principles of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation, McCabe-Thiele method.

TEXT BOOK:

1. Mass transfer Operations, Robert E. Treybal, 3rd edition, McGraw-Hill Book Co.,

REFERENCE BOOKS:

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

BT-3102

ENZYME ENGINEERING

Course Objectives:

- To understand the IUBMB system of enzyme classification and to know the catalytic activity and its regulation.
- To identify the sources and produce the enzymes with greater concentration.
- To learn the kinetics of single enzyme substrate catalyzed reactions, enzyme inhibition kinetics and the factors affecting the enzyme activity.
- To gain knowledge in the enzyme immobilization methods and their kinetics.
- To design the reactors.
- To use the enzymes in various industries.

Course Outcomes:

At the end of the course, the student will be able to

- Understand the enzyme structure and classify them.
- Produce the enzyme with high purity.
- Identify the kinetics and optimize the factors that affect the enzyme activity for maximum production.
- Describe the immobilization of the enzymes to produce an enzyme for industrial and other applications.

Syllabus

Introduction: Catalysis and biocatalysis, enzyme structure functionality and relationship, enzyme activity, classification of enzymes, enzymes as process catalysts.

Enzyme Production: Enzyme sources, synthesis, recovery, purification, and formulation of enzymes,

Homogeneous Enzyme Kinetics: Hypothesis of enzyme kinetics, rapid equilibrium and steady-state hypothesis, determination of kinetic parameters, various types of enzyme inhibitions, effect of pH andtemperature.

Heterogeneous Enzyme Kinetics: Various methods of enzyme immobilization, mass transfer effects in heterogeneous biocatalysis, partition effects, external (film) diffusion, internal (pore) diffusion.

Enzyme Reactors: Design of ideal reactors with enzymes (Batch, CSTR, PFR), effect of diffusion on enzyme reactor design, effectiveness factor, thermal inactivation.

Application of Enzymes: Application in biosensors, Food processing applications, Medical and pharmaceutical applications, application of immobilized enzymes.

TEXT BOOKS:

1. "Enzyme Technology" by M.F.Chaplin and C.Bucke, Cambridge University press, 1990.
2. Bioprocess Engineering 2nd edition, M. L. Shuler and F. Kargi, Prantice Hall India, New Delhi, 2002.

REFERENCE BOOKS:

1. "Biocatalysts and Enzyme Technology" by K. Buchholz,V.Kasche and U.T. Bornscheur, Wiley,2005
2. "Enzyme Technology", by Shanmugam,S. and Satish Kumar,T.,IK International Pvt. Ltd, New Delhi, 2008
3. "Biochemical Engineering Fundamentals' by Bailey,J.E., and Ollis,D.F., McGraw-Hill,1986.
4. "Enzyme Biocatalysis: Principles and Applications' by A.Illanes, Springer.

BT-3103

CELL AND MOLECULAR BIOLOGY

Course Objectives:

- The main objective is to prepare the students for career in fields that require advance knowledge of cell and molecular biology.
- With the application of study in cell and molecular biology, the student can also provide services and economic opportunities to the communities.

Course Outcomes:

At the end of the course, the student will be able to

- Understand and utilize the scientific vocabulary used in communicating information in Cell & Molecular Biology.
- Represent and illustrate the structural organization of genes and the control of gene expression.
- Develop basic knowledge and skills in Cell & Molecular Biology
- Outline the processes that control eukaryotic cell cycle and cell death.
- Conduct research in the frontier and multi disciplinary areas of modern biology.

Syllabus

The nucleus, chromatin and the chromosome: structure and function of nucleus; organization of genetic material – Packing of DNA into chromatin, Nucleosome organization; Chromosome structure; Cell cycle – Check points, Cdks and regulation.

The biochemical basis of Inheritance: DNA as the genetic material, DNA structure and replication in prokaryotes and eukaryotes – Enzymes involved and mechanism, including replication at telomere.

Genetic code: properties of genetic code, Wobble hypothesis.

Gene Expression:Transcription in prokaryotic and eukaryotic systems – enzymes and factors involved and mechanism; RNA processing in eukaryotes – capping, addition of poly(A) and removal of introns; **Translation** in prokaryotes and eukaryotes – machinery involved and mechanism;

Regulation of gene expression in prokaryotes – Lac operon concept in *E.coli* ; regulation of gene expression in eukaryotes by promoters, enhancers, silencers and transcription factors.

Mutations – Terminology, types of mutations, Biochemical basis of mutants, Mutagenesis, Chemical mutagens - base analogues - Intercalating substances, Physical mutagens- U.V radiation and ionization radiation, AMES test - Repair of DNA damage.

TEXT BOOK:

1. "The world of the cell" Becker, Klein smith &Hordin, Pearson education

REFERENCE BOOKS:

1. Molecular cell biology by Lodishet.al . Freeman Publications
2. "Cell & Molecular Biology", De.Roberties. E.D.P., International Edition
3. "Molecular Biology", Friefelder, D., Narosa publications
4. "Molecular Biology of the Gene", J.D.Watson et.al, Banzamin

BT-3104

OPEN ELECTIVE-I

(To be notified by BOS at the beginning of the semester)

BT-3105 (A)

FOOD TECHNOLOGY (CORE ELECTIVE - I)

Course Objectives:

To identify Pathogenic and spoilage microorganisms in foods, the important pathogens and spoilage microorganisms in foods and the conditions under which they will grow, the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods, laboratory techniques to identify microorganisms in foods, beneficial microorganisms in food systems ,understand the principles involving food preservation via fermentation processes, influence of the food system on the growth and survival of microorganisms, understand the role and significance of microbial inactivation, adaptation and environmental factors (i.e., pH, temperature) on growth and response of microorganisms in various environments, Understand the principles involving food preservation via fermentation processes.

Course Outcomes:

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

- Identify the good manufacturing conditions, including sanitation practices, under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods.
- Understand the elements of food processing and preservation
- Explain the techniques of food processingoperations.

Syllabus

Food processing and preservation: Biotechnology in relation to the food industry, nutritive value of the food, types of microorganisms associated with the food, food colors and flavors, enzymes and chemicals used in food processing, food preservation.

Fermented food products: Microbial culture used in food industry, fermentation technology for food industry & waste utilization. Bioprocessing and fermentation of meat, vegetables, fruits, dairy products, non-beverage plant products, beverages and related products of baking,

Food spoilage and Food Microbiology: Food spoilage, food borne illness, food quality and quality control, HFCS (High Fructose Corn Syrup), single cell protein production,

Food processing operations: Food engineering operations: characteristics, cleaning, sorting and grading of food raw materials, food conversion operations, size reduction, mixing, emulsification, filtration, membrane separation, centrifugation, extraction, and crystallization, microwave heating, thermal inactivation of microorganisms, freezing and thawing of foods,

TEXT BOOKS:

1. "Biotechnology: Food fermentation", by V.K. Joshi & Ashok pandey.
2. "Food processing and preservation", by B. Sivasankar

REFERENCE BOOKS:

1. "Food Biotechnology", by Roger Angold, Gordon Beech & Taggart 2. "Basic Food Microbiology", by George J Banward, CBS publishers
2. "Modern Food Microbiology", by James M Jay, CBS publishers.

BT-3105 (B)

PROCESS OPTIMIZATION (CORE ELECTIVE I)

Course Objectives:

Optimization of Chemical Process is an important of subject for Chemical Engineers. It deals with various optimization techniques in reducing cost of production ,energy consumption, maximum throughput and minimum labour cost etc. Onstudying the course one can understand how to write a model of the process optimize the process using the model

Course Outcomes:

At the end of the course, the student will be able to

- Understand the definition of Optimization and how to write an Objective function
- Understand various types of Objective functions like Concave and Convex functions and its properties
- Study the Optimization of uni- &multi dimensional search problems
- Solve the Optimization problems by Linear and Non-Linear Programming methods

Syllabus

Basic Concepts of Optimization: Introduction to process optimization; continuity of functions, unimodal versus multimodal functions, convex and concave functions, convex region, necessary and sufficient conditions for an extremum of unconstrained function, interpretation of the objective function in terms of its quadratic approximation,

Optimization of unconstrained Functions - One-dimensional Search: Numerical methods for optimizing a function of one variable, scanning and bracketing procedures; Newton, quasi-Newton and secant methods of uni-dimensional search, Newton's method, quasi-Newton method, secant method,

Region Elimination Methods, polynomial approximation methods - quadratic interpolation, cubic interpolation, how the one-dimensional search is applied in a multidimensional problem, evaluation of uni-dimensional search methods,

Unconstrained Multivariable Optimization: Direct methods- random search, grid search, uni-variate search, simplex method, conjugate search directions, Powell's method, indirect

methods first order - gradient method and conjugate gradient method, indirect method second order – Newton's method,

Linear Programming and its Applications: Basic concepts in linear programming, degenerate LP's – graphical solution, natural occurrence of linear constraints; the Simplex method of solving linear programming problems,

Nonlinear Programming with Constraints: Lagrange multiplier method, necessary and sufficient conditions for a local minimum, generalized reduced-gradient method, random search methods, and comparative evaluation of different methods,

Global Optimization: Overview of genetic algorithm, simulated annealing and other global optimization methods, heuristic search methods.

TEXT BOOK:

1. "Optimization of Chemical Processes", 2nd Edition, by T.F.Edgar, D.M.Himmelblau and L.S.Lasdon McGraw-Hill, 2001.

REFERENCE BOOKS:

1. "Applied Optimization with MATLAB" by .P.Venkataraman, John Wiley
2. 'Optimization for Engineering Design' by K.Deb, Prentice Hall of India Private Limited, New Delhi, 2003
3. 'Engineering Optimization', 3rd Edition, by S.S. RaoWiley, 1996.

BT-3105 (C)

ENERGY ENGINEERING (CORE ELECTIVE-I)

Course Objectives:

- To lean overview of energy sources.
- To know the production of various fuels from petroleum.
- To learn various nonconventional energy sources like solar energy, bio-energy, wind energy, water energy etc.
- To learn storage of energy.

Course Outcomes:

At the end of the course, the student will be able to

- Classify energy sources
- Demonstrate the production of fuels from petroleum
- Discussthe principles and practice of Photo voltaic cells
- Describe biogas generation
- Explain storage of energy

Syllabus

Conventional energy sources: The present and scope for future development, _ utilization of coal, formation, analysis, classification, storage and carbonization, byproduct recovery

Petroleum: Origin, classification, single and multi-stage fractionation, reforming, catalytic cracking, specification of kerosene, motor gasoline and fuel oils, liquified petroleum gas and nature gas, composition, properties and uses

Non-conventional energy sources: Solar radiation, principles of heating, cooling and photo-voltaic cells

Biogas production: Biomass, wind energy, tidal and wave energy, geothermal energy, nuclear energy, ocean thermal energy, hydrogen energy

Fuel cells: Storage of energy, types - water storage, packed bed storage, solar storage, chemical storage, phase change storage, mechanical energy storage and windmill storage

TEXT BOOKS:

1. “Fuels and Combustion”, by S. Sirkar, Orient Longmans, 2nd Ed.
2. “Solar Energy, Thermal Storage”, by S.P. Sukhatme, TMH
3. “Non-conventional Energy Sources”, by G. D. Rai, Khanna Publications.

BT-3105 (D)

SYSTEMS BIOLOGY (CORE ELECTIVE- I)

Course Objectives:

The purpose of this course is to provide insight inot quantitative modeling of biological systems at the molecular and cellular level as well as, how they are used, analyzed and developed.

Course Outcomes:

The student will be able to

- Explain the principles of system biology and experimental techniques.
- Apply achieved methodological knowledge to biologically relevant problems.
- Interpret the results from commonly used systems biology methods.

Syllabus

Introduction: Basic principles of systems biology, experimental techniques,

Standard models and approaches: Metabolism- enzyme kinetics and thermodynamics, metabolic networks, metabolic control analysis,

Biological processes: Signal transduction- introduction, function and structures, interactions, structural components, signaling selected biological processes,

Evolution: Introduction, mathematical models, prediction of biological systems, data integration,

Applications: Systems biology in various fields, databases and tools, modeling tools.

TEXT BOOKS:

1. "Systems Biology in Practice-Concepts, Implementation and Application" by Edda Klipp and Ralf Herwig, Wiley VCH, I Edition
2. "Systems Biology: Definitions and Perspectives" by Lilia Alberghina and Hans V. Westerhoff, Springer, 2005.

REFERENCE BOOKS:

1. "Systems Biology: Principles, Methods, and Concepts" by Andrzej K. Konopka, CRC Press, 2006
2. "Stochastic Modelling for Systems Biology" *by* Darren James Wilkinson, CRC Press, 2006.

BT-3106

MASS TRANSFER LABORATORY

Course Objectives:

The student will be made familiarised with distillation process and will be able to determine hydrodynamics of sieve tray tower. The student will be given practical exposure to liquid-liquid extraction and to obtain Ternary – Liquid Equilibrium.

Course Outcomes:

At the end of the course, the student will be able to

- Determine ternary LLE
- Evaluate solid-liquid equilibrium
- Determine separation performance and mass transfer coefficients of sieve plate
- Identify the axial mixing characteristics in packed bed
- Evaluate the dynamics of liquid drops

List of experiments:

1. Liquid-Liquid Extraction
2. Solid –Liquid Equilibrium
3. Hydrodynamic Studies in Sieve tray tower
4. Ternary – Liquid Equilibrium
5. Single drop Liquid – Liquid equilibrium

BT-3107

CELL AND MOLECULAR BIOLOGY LABORATORY

Course Objectives:

The students will learn the fundamental aspects of experimental cell and molecular biology

Course Outcomes:

At the end of the course, the student will be able to

- Understand the basics of techniques to study molecular biology.
- Comprehend the structures of the major classes of macromolecules.
- Handle PCR

List of Experiments:

Cell biology:

Study of mitosis, meiosis, differential staining of euchromatin and heterochromatin, florescent *in situ*hybridisation - FISH (principle & photographs),

Molecular biology:

Isolation of genomic DNA, quantification of DNA, Agarose gel electrophoresis, isolation of plasmid DNA, restriction digestion, ligation, transformation, southern blotting, isolation and analysis of RNA.

TEXT BOOKS:

1. ”A Guide to Molecular Cloning”, Vol. 1,2 & 3, Sambrook, J. et al., Cold Spring Harbor Laboratory Publications
2. ‘Chromosome Techniques’ by Sharma & Sharma

BT-3108

SEMINAR/MINOR PROJECT

Course Objectives:

- To make the student to think about the new methodologies for the Chemical Engineering problems and implement them either experimentally or theoretically.
- To enhance communication skills of the student to present his/her work and to interact with the students/ faculty/ industry people.

Course Outcomes:

At the end of the seminar/ Minor project, the student will be able to

- Conduct an independent research project involving experimentation/modelling/simulation/optimization in chemical engineering
- Analyze the results
- Communicate the research results orally to an audience
- Present a detailed written report

CH-3109

INDIAN CONSTITUTION

Course Objectives:

- The student learns about the scope and scheme of fundamental duties and fundamental rights.
- The student understands federal structure and distribution of legislative and financial powers and the parliamentary form of government of India.

Course Outcomes:

At the end of the course, the student will be able to

- Identify the scope and scheme of fundamental rights and fundamental duties
- Understand the features and characteristics of the Constitution of India
- Explain the Federal structure and distribution of legislative and financial powers betweenthe Union and the States
- Explain Parliamentary Form of Government in India
- Describe Emergency Provisions

Syllabus

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers betweenthe Union and the States
8. Parliamentary Form of Government in India – The constitution powers andstatus of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India

11. Emergency Provisions : National Emergency, President Rule, FinancialEmergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

BT-3109

SUMMER INTERNSHIP EVALUATION

All the students have to undergo Summer Internship for two months in the industries at the end of the second year second semester. Evaluation of the same will be conducted in this semesterby the Department.

BT-3201

IMMUNOLOGY

Course Objectives:

To study about the process of immunity and organs and cells of lymphoid system.

- To study about the properties of antigens and structure and function of antibodies and various reactions of antigen and antibody.
- To study about complement system, major histocompatibility and various immune responses.
- To study about the hypersensitive reactions and their role in graft rejection and to study transplantation and various auto immune diseases.
- To study the hybridoma technology and to study the various vaccines and vaccination process.

Course Outcomes:

At the end of the course, the student will be able to

- Understand immunology, the structure and function of lymphoid organs and cells.
- Explain the process of antigenecity, and in the production of antibodies
- Describe precipitation, agglutination, and other antigen-antibody reactions so that student will become a good immunologist.
- Explain complement system and immune response –humoral and cell mediated and MHC (Majorhistocompatibility).
- Understand hypersensitive reactions, organ transplantations and various auto immune diseases.
- Demonstrate fusion of cells to produce hybrid cells (Hybridoma technology), Understand the method of vaccination.

Syllabus

Immunity, Lymphoid organs and cells: Introduction to Immunology and its origin in vertebrates and invertebrates, immunity-innate immunity and acquired immunity and the

various lines of defence, organs of immune system, Thymus, bone marrow, bursa of fabricius, spleen, lymphnode and MALT, cells of immune system- B-cells, T-cells, antigen presenting cells, monocytes, NK cells and langerhan cells,

Antigens, Antibodies and Ag-Ab reactions: Antigens- properties of antigens, haptens, epitopes, T-dependent and T-independent antigens, adjuvants and their clinical importance, immunoglobulins- classification, structure and functions of immunoglobulins, antigenic determinants on antibodies, antigen – antibody reactions, and tests involving them - precipitation tests, agglutination tests, complement fixation tests, immunofluorescence, RIA, ELISA, Western blotting and ELISPOT,

Complement, MHC and Immune response: Complement system- its components, complement fixation pathways and consequences, MHC- In mice and human, structure of MHC molecules and their role in antigen presentation, immune response- humoral and cell, mediated immune response, IR curve, role of cytokines in immunity, interferons and interleukins, immune suppression, immune tolerance,

Hypersentivity, Transplantation, Autoimmune disease: Hypersensitive reactions- Type I, II, III and IV reactions and their role in graft rejection, transplantation immunology- classification of grafts and immunology of graft rejection, agents used for preventing graft rejection, autoimmune diseases- definition and few examples,

Hybridoma and Vaccination: Hybridoma technology- production of monoclonal antibodies and their applications, vaccines and vaccination, methods of attenuation of live forms, types of vaccines- whole organisms as vaccines, attenuated forms, purified molecules as vaccines, recombinant organisms, DNA vaccines and synthetic peptides.

TEXT BOOK:

1. ‘Immunology’ by A.Goldsby, Thomas J.Kindt, Barbara A.Osborne and Janis Kuby
2. ‘A Text book of Microbiology’ by R.Ananthanarayan and C.K.J.Pandey.

BT-3202

BIOINFORMATICS

Course Objectives:

The course essentially focuses on the development of skills of students for a successful career in industry or research. The course emphasizes on the delivery of the state of the art technologies in Genomics, Proteomics and Drug discovery.

Course Outcomes:

At the end of the course, the student will be able to

- Identify the major bioinformatics resources available so far
- Understand sequencing alignments and its data bases
- Explain taxonomy and phylogenetics neural networks leading to the role idea of the DNA in computer applications.
- Describe Genome mapping and its applications

Syllabus

Major Bioinformatics Resources:

Knowledge of the following databases with respect to: organization of data, retrieval of data using text-based search tools, sources of data method for deposition of data to databases.

Introduction, Primary & Secondary databse, Nucleic acid sequence databases: GenBank, EMBL, DDBJ Protein sequence databases: SWISS-PROT, TrEMBL, PIR_PSD Genome Databases at NCBI, EBI, ExPASy, TIGR, SANGER Prosite, PRODOM, Pfam, PRINTS, CATH, SCOP, DSSP, FSSP, DALI

Sequence and Structure Databases: PDB, MMDB Metabolic pathways databases such as KEGG, EMP.

Sequence Alignment and Database Searching:

Introduction- Collection, annotation and alignment of sequences. Basic concepts of sequence similarity, identity and homology. Scoring matrices – PAM and BLOSUM, gap penalties, Database similarity searching, FASTA, BLAST.

Pairwise sequence alignments: basic concepts of sequence alignment, Dynamic programming- Needleman &Wuncsh, Smith & Waterman algorithms for pairwise alignments

Multiple sequence alignments (MSA): the need for MSA, basic concepts of MSA (e,g. progressive, hierarchical etc.). Algorithm of CLUSTALW. Use of HMM method, concept of dendograms and its interpretation.

Taxonomy and phylogenetic analysis:

Basic concepts in taxonomy and phylogeny; molecular evolution; nature of data used, Definition and description of phylogenetic trees and various types of trees, tree building and tree evaluation methods, Phylogenetic analysis algorithms such as Maximum Parsimony, UPGMA, Neighbor-Joining; Maximum likelihood algorithm.

Secondary structure prediction methods- ChouFASMAN/GOR, Nearest neighbor, Neural network

Genome Mapping and Applications:

Human genome project, application of genome mapping, DNA microarrays.

TEXT BOOKS:

1. Introduction to Bioinformatics. T.K. Attwood and P.J.Parry – Smith. Pearson Bioinformatics.
2. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

REFERENCE BOOKS:

1. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.
2. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.

3. Bioinformatics Basics. Applications in Biological Science and Medicine by Hooman H. Rashidi and Lukas K.Buehler CAC Press 2000.
4. Algorithms on Strings Trees and Sequences Dan Gusfiled. Cambridge University Press

BT-3203

GENETIC ENGINEERING

Course Objectives:

- The objective of this course is to discipline to students knowledge of main engines of implementation and transmission of a genetic material at molecular and cellular levels, and also methods of change of a genetic material and construction of transgene organisms with the given properties.
- Genetic engineering: refers to the process of manipulating the characteristics and functions of the original genes of an organism. The objective of this process is to introduce new physiological and physical features or characteristics.
- A gene is a basic constituent unit of any organism. It is a locatable region of a genome which contains the whole hereditary information of the organism. A gene corresponds to a unit of inheritance. It is a segment of the DNA which determines the special features or functions of the organism.
- Genetic engineering meddles with the organism's natural reproductive process, whether sexual or asexual. It gives it a new direction which is different from its natural disposition and development. The process involves the isolation and manipulation of the genes by introducing the new DNA into the cells. DNA is a blue print of the individual characteristics of an organism. The information stored in the DNA controls the management of biochemical process of each organism. The life, development and unique characteristics of the organism depend upon on its own DNA.

Course Outcomes:

At the end of the course, the student will be able to

- Apply genetic engineering for the benefit of mankind.
- Explain the purification and manipulation of DNA
- Describe cloning vectors and libraries
- Understand PCR, Blotting and Fingerprinting techniques
- Indicate gene transfer methods and mutagenesis

The domain of genetic engineering can extend from plants to cover both the animal and human life. It can, for example, hybridize the production of the animals and promote the growth of

healthy species of milk producing animals, stronger and healthier horses, cows and bullocks which can better withstand the wear and tear of life.

Syllabus

Introduction, Purification and manipulation of DNA: History and scope of gene manipulation, isolation and purification of total cell DNA and plasmid DNA, DNA manipulative enzymes, restriction endonucleases- types, nomenclature, recognition sequence, cleavage pattern, restriction digestion and its analysis, Ligases – mode of action, strategies of ligation, linkers, adaptors and homopolymer tailing, DNA modifying enzymes,

Cloning Vectors and Libraries: *E. coli* vectors – construction and features of plasmids – p^{BR322}, p^{UC8}, p^{UC18}, p^{GEM3Z}, bacteriophage vectors – Lambda phage & M-13 phage vectors, cosmids, phasmids, shuttle vectors, yeast vectors - 2µm plasmid, yeast episomal plasmid and YACs, transfer and cloning of recombinant vectors, construction of genomic DNA libraries, cDNA libraries and their screening, gene cloning strategies,

PCR, Blotting and Fingerprinting techniques: Preparation of labeled probes and primers, DNA sequencing methods – Maxam & Gilbert method, Sangers and Automated sequencing method, PCR and its applications, southern blotting, northern blotting, DNA finger printing technique- RFLP and RAPD and its applications,

Gene transfer methods and mutagenesis: Gene transfer techniques – transformation, transfection, electroporation, lipofection and gene gun methods, cause of the mutagenesis, site specific mutagenesis, transposon mutagenesis, gene knockout technologies,

Applications, achievements and limitations: Application of genetic engineering in agriculture, animal husbandry, medicine, environmental management and in industry, achievements, limitations and negative aspects of geneic engineering.

TEXT BOOKS:

1. "Gene cloning and DNA analysis" – An Introduction, T. A. Brown, Blackwell Publishing, 2006.
2. "Biotechnology" – B.D.Singh, kalyani Publishers, New Delhi, 2006.

REFERENCE BOOKS:

1. "Principles of Gene Manipulation and Genomics", S. B. Primrose and R. M. Twyman, Blackwell Publishing, 2006.
2. "From Genes to Clones- Introduction to Gene Technology", Winnacker, Panima Publishing Corporation, New Delhi.

BT-3204

PROCESS CONTROL

Course Objectives:

In this course, the students will learn

- To represent the processes in terms of mathematical equations
- The concept of stability and know how to operate a control system in a stable way.
- To deal with various controllers and their functions and applications.

Course Outcomes:

At the end of the course, the student will be able to

- Develop transfer functions for the processes
- Examine the stability of various control systems
- Apply advanced control schemes for processes and identify the characteristics of control valves

,

Syllabus

Introduction to process dynamics and control, Response of First Order Systems - Physical examples of first order systems.

Response of first order systems in series, higher order systems: Second order and transportation lag.

Control systems Controllers and final control elements, Block diagram of a chemical rector control system.
Closed loop transfer functions, Transient response of simple control systems.

Stability Criterion, Routh Test, Root locus. Transient response from root locus, Application of root locus to control systems Introduction to frequency response, Control systems design by frequency response.

Advanced control strategies, Cascade control, Feed forward control, ratio control, Smith predictor, dead time compensation, internal model control. Controller tuning and process identification. Control valves.

TEXT BOOK:

1. D.R. Coughanowr. Process Systems Analysis and Control, Mc Graw Hill, 1991

REFERENCE BOOK:

1. Chemical Process Control, G. Stephanopolous, Prentice Hall, 1984.

BT-3205(A)

PHARMACEUTICAL BIOTECHNOLOGY (CORE ELECTIVE –II)

Course Objectives: The main objective of this course is to contribute to improve human health by exploiting the potential biopharmaceutical research by

- Promoting research and development in the field of pharmaceutical biotechnology.
- Promoting interactions between academia, biotechnology and pharma companies within the field of pharmaceutical biotechnology to support creativity, innovations and facilitate the commercialization of scientific finding.

Course Outcomes:

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

- Understand application of therapeutic agents and regulatory aspects
- Explain drugmetabolism and pharmacokinetics
- Describe important unit processes and their applicationsin bulk drug manufacturing, tablets and capsules manufacturing
- Summarize the manufacturing principles and quality management
- Categorize pharmaceutical products and indicate their control

Syllabus

Introduction- Development of Drug and Pharmaceutical Industry, Therapeutic agents – their uses and economics, Regulatory aspects.

Drug metabolism and Pharmacokinetics- Metabolism, Physico-chemical principles, radioactivity, Pharmaco kinetics action of drugs on human bodies.

Important Unit Processes and their applications: Bulk drug manufacturing, Types of reactions in bulk drug manufacturing and processes, Special requirements for Bulk Drug manufacture.

Manufacturing Principles: Wet granulation, Dry granulation or slugging, Direct compression, Tablet presses. Coating of tablets, capsules. Sustained action dosage. Forms- Parental

solutions, oral liquids, injections, ointments. Various topical drugs and pharmaceuticals, Packaging- Packaging techniques, Quality management and GMP.

Pharmaceutical products and their control- Therapeutical categories such as laxatives, vitamins, analgesics, non-steroid contraceptives, antibodies and Biologicals- Hormones.

TEXT BOOKS:

1. Leon and Lachman et al- Theory and Practice of Industrial pharmacy.
2. Cooper and Gunn's – Dispencing Pharmacy.

REFERENCE BOOK:

1. Remington's Pharmaceutical Sciences, Mark publishing and Co.

BT-3205(B)

ANIMAL CELL CULTURE AND HYBRIDOMA TECHNOLOGY

(CORE ELECTIVE II)

Course Objectives:

The main objective of this course is to contribute for the improvement of human health by exploiting the potential biotechnological research by promoting research and advanced development in the field of biotechnology.

Course Outcomes:

At the end of the course the student will be able to

- Understand the laboratory design and equipmentsfor cell culture
- Identify the media and reagents for cell culture,purification and preservation
- Differentiate the types of cell culture
- Describe the scale up of the cell culture reactors
- Apply animal cell culture in pharmaceutics, production of vaccines, growth hormones and interferons
- Apply monoclonal antibodies in various fields.

Syllabus

Cell culture: Laboratory design and equipments planning, construction and services and equipment, cryopreservation equipment and principle, water purification system, washing, packing and sterilization of different materials used in animal cell culture, asceptic concepts, maintenance of sterility in cell culture vessels,

Media and Reagents: Types of cell culture media, ingredients of media; physiochemical properties, CO2 and bicarbonates, buffering, oxygen, osmolarity, temperature, surface tension and foaming, balance salt solutions, antibiotics and growth supplements, foetal bovine serum, serum free media, selection of medium and serum, conditioned media, other cell culture reagents, preparation and sterilization of cell culture media, serum and other reagents.

Different types of cell cultures: Primary culture and its preparation, establishment of primary culture, subculture –passage number, split ratio, seeding efficiency and criteria for subculture, continuous cell lines, suspension culture, behavior of cells in culture conditions: division, growth pattern, estimation of cell number, development of cell lines, characterization and maintenance of cell lines, common cell culture contaminants, cell transformation, normal Vs transformed cell and agents that cause transformation.

Scale-up: Cell culture reactors, scale-up in suspension, scale and complexity, mixing and aeration, rotating chambers, perfused suspension cultures, fluidized bed reactors for suspension culture, scale-up in monolayers, multisurface propagators, multiarray disks, spirals and tubes, roller culture, microcarriers, perfused monolayer cultures, membrane perfusion, hollow fiber perfusion, matrix perfusion, microencapsulation, growth monitoring,

Applications: Cell cloning and selection, transfection and transformation of cells, commercial scale production of animal cells, stem cells and their application, application of animal cell culture in pharmaceutics, production of vaccines, growth hormones and interferons, hybridoma technology, production of hybridoma, screening and applications of monoclonal antibodies in various fields.

TEXT BOOKS:

1. "Culture of Animal Cells", (3rd Edition) by F1. Ian Freshney, Wiley-Liss,
2. "Animal Biotechnology" by M.M.Ranga, 2002 Edition.

BT-3205(C)

CANCER BIOLOGY (CORE ELECTIVE II)

Course Objectives:

To understand basic nature as well as advanced aspects of cancer. The cause & regulation of cancer cell cycle, Molecular approach of cancer study, Detection and prediction studies of cancer cell growth.

Course Outcomes:

At the end of the course, the student will be able to

- Understand fundamentals of cancer biologyand cancer metastasis
- Explain the causes of cancer and cancer detection
- Identify oncogenes and rectoviruses
- Differentiate cancer therapies,their advantages and limitations

Syllabus

Fundamentals of Cancer Biology: Introduction, regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, classification of cancer, modulation of cell cycle in cancer. Carcinogenesis, cancer initiation, promotion and progression,

Causes for Carcinogenesis: Chemical carcinogenesis, metabolism of carcinogenesis, natural history of carcinogenesis, targets of chemical carcinogenesis, principles of physical carcinogenesis, X - ray radiation, mechanism of radiation carcinogenesis,

Molecular Cell Biology of Cancer: Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes, growth factor and growth factor receptors that are oncogenes, oncogenes / proto oncogene activity, growth factors related to transformations, tumor suppression, tumor suppressor genes,

Principles of Cancer Metastasis: Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three-step theory of invasion, proteinases and tumor cell invasion,

Detection of Cancer; Detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection, different forms of therapy, chemotherapy, radiation therapy and immuno therapy, advantages and limitations.

TEXT BOOKS:

1. "Cancer Biology" by Raymond W. Ruddon, Oxford University Press Inc., 2007 Ed., NY.
2. "The Basic Science of Oncology" by Ian F.Tannock et al, 4th edition, 2007. Mc Graw Hill Company.

BT-3205(D)

STEM CELLS IN HEALTH CARE (CORE ELECTIVE II)

Course Objectives:

Aim of this course is to know the nature of embryonic cells which develop into specific tissues and organs.

Course outcomes:

At the end of the course, the student will be able to

- Understand the stem cell basics
- Classify stem cells and identify their applications
- Apply stem cell in drug delivery and tissue engineering
- Apply stem cells in therapeutic applications in Parkinson's disease, neurological disorder, limb amputation, heart disease, spinal cord injuries,Alzheimer's diseaseetc
- Describe the applications of stem cells in tissue engineering application and production of complete organs – kidney, eyes, heart, brain

Syllabus

Stem cell basics: Unique properties of stem cells, embryonic stem cells, adult stem cells, umbilical cord stem cells, similarities and differences between embryonic and adult stem cells, properties of stem cells – pluripotency, totipotency, multipotency,

Embryonic stemcells: Invitro fertilization, human embryonic stem cells, blastocyst, inner cellmass, growing ES cells in laboratory, laboratory tests to identify ES cells, stimulating ES cells for differentiation, properties of ES cells, human ES cells, monkey and mouse ES cells,

Adult stem cells: Somatic stem cells, test for identification of adult stem cells, adult stem cell differentiation, trans-differentiation, plasticity, different types of adult stem cells,

Stem cell in drug discovery and tissue engineering: Target identification, manipulating differentiation pathways, stem cell therapy Vs cell protection, stem cell in cellular assays for screening, stem cell based drug discovery platforms, drug screening and toxicology,

Genetic engineering and therapeutic application of stem cells: Gene therapy, genetically engineered stem cells and animal cloning (transgenic animals), biomarkers in cancer, therapeutic applications in parkinson's disease, neurological disorder, limb amputation, heart disease, spinal cord injuries, diabetes, matching the stem cell with transplant recipient, HLA typing, Alzheimers disease, spinal cord injuries, tissue engineering application, production of complete organs – kidney, eyes, heart, brain.

TEXT BOOKS:

1. "Stem Cells, Human Embryos and Ethics: Interdisciplinary Perspectives" by Larstnor, Springer, 2008
2. 'Handbook of Stem Cells', Volume-1, by Robert Paul Lanza, Gulf Professional Publishing, 2004

REFERENCE BOOKS:

1. "Embryonic Stem cells"byKursad and Turksen. 2002, Humana Press.
2. "Stem Cell and Future of Regenerative medicine by Committee on the Biological and Biomedical Applications of Stem cell Research", 2002, National Academic Press.

BT-3206

OPEN ELECTIVE-II

(To be notified by BOS at the beginning of the semester)

BT-3207

PROCESS CONTROL LABORATORY

Course Objectives:

- To understand the dynamic behaviour of the systems
- To evaluate response of fist and higher order characteristics.
- To calibrate the given thermocouple and resistance thermometer.

Course Outcomes:

At the end of the course, the student will be able to

- Identify the dynamics of first order, second order, interacting and non-interacting processes
- Explain the calibration of thermocouple

List of Experiments:

1. Response of Bare Thermometer for a step input
2. Response of Thermometer with thermal well for step input
3. Response of single tank for a step input
4. Response of Non – Interacting system for a step change
5. Response of a Interacting system for a step change
6. Response of resistance thermometer
7. Calibration of thermocouple
8. Response of manometer

CH-3209

INTELLECTUAL PROPERTY RIGHTS

Course Objectives:

- To introduce fundamental aspects of intellectual property rights.
- To disseminate knowledge on copyrights and its related rights and registration
- To provide comprehensive knowledge to the students regarding Indian position of patent law, procedure for granting patent, Infringement
- To provide knowledge to the students regarding registration of trade mark , Infringement of trade mark

Course Outcomes:

At the end of the course, the student will be able to

- Identify the types of IP and the importance of protection of IP
- Differentiate the foundation and patent laws in India and developed countries
- Explain how to obtain copy right and law of copy rights
- Learn the purpose and function of trade marks and registration of trade mark
- Describe risks involved and legal aspects of Trade Secret Protection
- Understand IP Infringement issue and enforcement

Syllabus

Introduction to Intellectual Property: Historical Perspective, Different Types of IP, agencies and treaties, Importance of protecting IP, international organizationsInnovations in products, processes, services and procedures - product life cycles, favorable and unfavorable aspects in innovation; Inventions as intellectual property.

Patents : Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge, Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India, Foundation of patents and patent laws, procedures in India and developed countries; study of patents indifferent fields and their innovative content;patent searching process, ownership rights and transfer.

Copyrights: Introduction, How to obtain a copy right and Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law, Differences of copyrights from Patents.

Geographical Indications: Definition, rules for registration, prevention of illegal exploitation, importance to India.

Trade Marks: Introduction to trademarks, Purpose and function of trademarks, acquisition of trade mark rights,protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

Trade Secrets: Introduction and Historical Perspectives, Scope of Protection, Trade secrete law, Risks involved and legal aspects of Trade Secret Protection, Determination of trade secrete status, liability formisappropriations of trade secrets, protection for submission, trade secrete litigation, Unfair competition: Misappropriation right of publicity, false advertising.

New developments and Infringement Issues of IP:

New development of intellectual property:new developments in trade mark law; copy right law, patent law, intellectual property audits. International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law, motivating and encouraging innovative attitude in individuals and organizations; entrepreneurial qualities and skills, learning and training.

IP Infringement issue and enforcement– Role of Judiciary, Role of law enforcement agencies – Police, Customs etc. Economic Value of Intellectual Property – Intangible assets and their valuation, Human attitudes, risks, hardships, examples of failure, case studies of inventors; Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

REFERENCE BOOKS:

1. Ganguli, P. Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).
2. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
3. Acharya, N.K. Textbook on intellectual property rights, Asia Law House (2001).
4. Miller, A.R. & Davis, M.H. Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
5. Watal, J. Intellectual property rights in the WTO and developing countries, Oxford University Press, New Delhi.

CH -3210
ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Course Objectives:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
- To make the students understand the traditional knowledge and analyse it and apply it to their day to day life

Course Outcomes:

At the end of the Course, Student will be able to:

CO 1:Identify the concept of Traditional knowledge and its importance.

CO 2:Explain the need and importance of protecting traditional knowledge.

CO 3:Illustrate the various enactments related to the protection of traditional knowledge.

CO 4:Interpret the concepts of Intellectual property to protect the traditional knowledge.

CO 5:Explain the importance of Traditional knowledge in Agriculture and Medicine.

Syllabus

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

TEXT BOOKS:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

REFERENCE BOOKS:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino.

SUMMER INTERNSHIP PROGRAM (2MONTHS)

All the students have to undergo Summer Internship for two months in the industries and report the same in the Department.

BT-4101

ENGINEERING ECONOMICS & BIOPROCESS DESIGN

Course Objectives:

- To introduce bioprocess design with its basic function of a bioreactor.
- To study the construction of bioreactor.
- To introduce the basic fundamentals such as aeration and agitation used in fermentation industrial.
- Designing of fermentation vessels and problems related to scale up of microbial processes.
- Engineering economics deals with value of money equivalence and depreciation.

Course Outcomes:

At the end of the course, the student will be able to

- Understand fundamentals concepts of bioprocessing
- Design and operate a Bioprocess/fermentation vessels..
- Understand the value of money equivalence and depreciation.

Syllabus

Engineering Economics:

Value of money equivalence: Value of money, equations for economic studies, equivalence, types of interest, discrete, continuous, annuities: relation between ordinary annuity and the periodic payments, 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,

Depreciation: Types and various methods of calculating depreciations, depreciation accounting, cost accounting- basic relationship in accounting, balance sheet and income statements.

Bioprocess Design:

Basic function of a Bioreactor for plant and microbial or animal cell culture, factors involved in bioreactor design and principal operating characteristics of bioreactors.

Body construction: construction material, temperature control,

Aeration and agitation: Agitators (impellers), stirrer glads and bearings, baffles, aeration system (spargers), valves and steam traps used in fermentation industries,

Scale up: Basic concepts, problems related to the scale up of the microbial processes, designing of other fermentation vessels,

TEXT BOOKS:

1. 'Plant Design and Economics for Chemical Engineers' fourth edition, by Max S Peters and Klans D Timmerhans, Mc Graw Hill Book Company
2. 'Fermentation and Biochemical Engineering Handbook' 2nd Edition by Henry C. Vogel and Celeste L. Todaro, Noyes Publications, 1997.

REFERENCE BOOKS:

1. 'Biochemical Engineering Fundamentals', 2nd edition, E.Bailey and D.F.Ollis, McGraw Hill, 1986
2. 'Bioprocess Engineering' 2nd edition, M.L.Shuler and F.Kargi, Prantice Hall India, New Delhi
3. 'Principles of Fermentation Technology' by Stanbury, Pergamon
4. 'Text Book of Biochemical Engineering', by D.G. Rao, Tata McGraw Hill

BT-4102

BIOCHEMICAL REACTION ENGINEERING

Course Objectives:

- To understand the importance of bioprocess engineering and the role of bioprocess engineer and the importance of regulatory constraints.
- To understand the mechanism of enzyme action, their kinetics and about stoichiometry of microbial growth.
- To know the configuration of various bioreactors for cell growth and their operations.
- To understand the instrumentation and control of bioreactors and scale up aspects.

Course Outcomes:

At the end of the course, the student will be able to

- Understand the importance of bioprocess aspects and the role of bioprocess engineer.
- Analyze the enzyme kinetics and mechanism of their action.
- Design of various bioreactors.
- Explain the instrumentation used in bioreactors and their control.

Syllabus

Introduction to biotechnology and biochemical engineering, role of bioprocess engineer, regulatory constraints in bioprocesses, FDA, GMP, GLP and SOPs.

Fundamentals of biochemical reaction engineering: Kinetics of homogeneous reactions,elementary and non elementary reactions, reaction mechanism, temperature dependency from Arrhenius law.

Analysis of batch reactor data: Various methods of analysis of batch reactor data obtained for various types of reactions (excluding variable volume and variable pressure reactions).

Enzyme kinetics: Mechanism of enzyme action, Michaelis-Menten equation and determination of kinetic parameters, effect of pH and temperature.

Stoichiometry of microbial growth and product formation: Elemental balances, degree of reduction, yield co-efficients, maintenance co-efficients.

Cell kinetics and fermentor design: Batch growth cultivation, batch, continuous and plug flow fermentors, Monod growth kinetics in continuous culture and evaluation of kinetic parameters, Fed batch operation, chemostat with cell recycle, multistage chemostat systems.

Non-conventional bioreactors Air lift reactor, Bubble column reactor, Trickle bed reactor, scale up of bioreactors, bioreactor instrumentation and control.

Principles and mechanism of media and air sterilization: Batch and continuous sterilization of media, air sterilization, air filter design (thickness).

TEXT BOOKS:

1. Bioprocess Engineering 2nd edition, M. L. Shuler and F. Kargi, Prantice Hall India, New Delhi, 2002.
2. Biochemical Engineering fundamentals, 2nd Edition, E.Bailey and D.F.Ollis, McGraw Hill, 1986.

REFERENCE BOOKS:

1.Textbook of biochemical engineering, D.G. Rao, Tata McGraw Hill, New Delhi,2004.
2. Biochemical Engineering, J. M. Lee, Prantice Hall 1992.

BT-4103

INDUSTRIAL BIOTECH PRODUCTS

Course Objectives:

- To study about fermentation process and to study the culturing of micro organisms and maintenance of cultures.
- To study about the preparation of alcohol using yeast cells and sugars by fermentation process.
- To study about the production of Acetic acid, Citric acid and lactic acid using fermentation technology.
- To study about the production of fungal foods- mushroom and other foods like cheese. And also studies the production of bakers yeast, amino acids and vitamins(Microbial origin)
- To study about the antibiotics production, industrial enzymes-amylase, protease, lipase, and the production of biopolymers- Xanthan gum.

Course Outcomes:

At the end of the course, the student will be able to

- Explain the preparation of microbial slants, maintenance of stock cultures and other microbial techniques
- Describe the production of alcohols using fermentation technology.
- Demonstrate the production of acetic acid, citric acid, lactic acid using micro organisms and biological substrates by fermentation technology.
- Explain the production of foods using microorganisms and the production of mushrooms, cheese and vitamins, etc.
- Demonstrate the production of antibiotics and enzymes used in large scale and production of vaccines and biopolymers

Syllabus

Microbial Processes: Introduction, types of fermentations, components of industrial microbial process, source of industrial cultures, maintenance and improvement of culture for better production,

Alcohol fermentation: Production of industrial alcohol, biosysthetic mechanism, recovery of latest developments, wine manufacture, glycerol fermentation, production of acetone and butanol,

Organic acid production- Biochemistry of acetic acid production, vinegar manufacture, production of citric acid and lactic acid,

Microbial foods: Mushrooms, cheese, Baker's yeast

Amino acids – L-Glutamic acid, Lysine

Vitamins – Vitamin B_{12}

Antibiotics – Penicilin and streptomycin.

Industrial enzymes: production of amylase, protease and lipase

Miscellaneous-Biopolymers (Xanthan gum, dextran etc), vaccines.

TEXT BOOKS:

1. "Industrial Microbiology" by Cruger&cruger
2. "Industrial Microbiology" by Cassida
3. "Industrial Microbiology" by A.H.Patel

REFERENCE BOOKS:

1 'Industrial Microbiology' by Prescott & Dunn

2 "Biotechnology" by U. Satyanarayana.

BT-4104

OPEN ELECTIVE –III

BT-4105

OPEN ELECTIVE-IV

Open Elective –III & Open Elective-IV are MOOCS courses
(To be specified/ approved by BOS)

BT-4106

BIOCHEMICAL REACTION ENGINEERING LABORATORY

Course Objectives:
To evaluate the reaction rate constant and to determine the conversion in the Batch and Continuous reactors

Course Outcomes:
At the end of the course, the student will be able to

- Explain the kinetics of enzyme catalyzed reaction in free and immobilized states.
- Develop microbial enzymes.
- Evaluate the variables affecting the production process.
- Design of optimal Batch and Continuous reactors

List of Experiments:

Bioprocess Engineering

1. Isolation and characterization of industrial cultures for use as biocatalysts in bioprocesses and Analysis of raw materials used in common industrial bioprocesses
2. Production Ethanol & Protease
3. Parameter optimization studies in bioprocesses eg.Ethylalcohol, aminoacid production etc.
4. Product purification in bioprocess studies. Eg. Enzyme production (amylase, proteaseetc).
5. Measurement of Volumetric Oxygen transfer coefficient
6. Cell immobilization protocols
7. Immobilized bioprocess with cells and enzymes
8. Filter efficiency of common air filters
9. Heat inactivation of microbial cells, thermal death rate

Reaction Engineering

1. Determination of order of reaction using a Batch Reactor
2. Determination of rate constant using a Batch Reactor
3. Determination of rate constant using a CSTR
4. Determination of rate constant using a PFR
5. Determination of rate constant using a CFR (CSTR to PFR)
6. Determination of rate constant using a CFR (PFR to CSTR)
7. RTD studies in a packed bed Reactor
8. RTD studies in a Plug flow reactor

BT-4107
BIOSTATISTICS

Course Objectives:
To make them understand about the Introduction of bioinformatics, Moments like skewness and kurtosis, correlation, Probability distribution and sampling theory, Sampling Theory: sampling, random sampling, parameters and statistic, objectives of sampling and Numerical solutions of PDEs.

Course Outcomes:
At the end of the course, the student will be able to

- Classify data and understand relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion.
- Understand coefficient of correlation both for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation.
- Solve PDE's numerically
- Explain probability distribution and sampling theory

Syllabus

Introduction, collection and classification of data, graphical representation, histogram, frequency polygon and cumulative frequency curve, comparison of frequency distributions, measures of central tendency, mean, median and mode, an empirical relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion – range, quartile deviation or semi-inter quartile range, mean deviation, root mean square deviation, standard deviation, variance, coefficient of variation, empirical relation between measures of dispersion, standard deviation of combined samples

Moments, skewness and kurtosis, correlation, scatter diagram, coefficient of correlation both for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation

Probability distribution and sampling theory: Random variable both discrete and continuous, probability distribution both discrete and continuous, cumulative distribution, expectation, variance, standard deviation, moment generating function, binomial distribution, constants of binomial distribution, mean, standard deviation, skewness and kurtosis, fitness of a binomial distribution, Poisson distribution, constant of poisson distribution, mean, standard deviation, skewness and kurtosis – fitting of a poisson distribution, normal distribution, standard normal distribution, propertive normal distribution, probability error, fitting of normal distribution, **Sampling Theory:** sampling, random sampling, parameters and statistic, objectives of sampling, sampling distribution, standard error, testing of hypothesis, errors, null hypothesis, level of significance, testing significance, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples, test of significance for means of two large samples, sampling of variables, small samples, number of degrees of student t-distribution, significance test of difference between sample means, f-distribution, Fisher's z-distribution, Chi-square distribution

Numerical solutions of PDEs – Elliptic (Liebmann iteration process), Parabolic (Schmidt explicit formula), Hyperbolic and Poisson's equations (Gauss – siedel method)

TEXT BOOK:

1. Higher engineering mathematics by B.S.Grewal

REFERENCES:

1. Numerical methods for Scientific and Engineering Computation by M.K.Jain, S.R.K.Iyengar, R.K.Jain, and Publishers New age international (P) Ltd. New Delhi
2. Probability, Statistics and random process by T. Veerarajan, Tata McGraw Hill.
3. Probability, Statistics with Reliability, Queing and Computer Science Application by Kishore S. Trivedi

BT-4108

SUMMER INTERNSHIP EVALUATION

All the students have to undergo Summer Internship for two months in the industries at the end of the third year second semester. Evaluation of the same will be conducted in this semesterby the Department.

BT-4201

PROJECT WORK

(6 months Project Work/ Internship shall be carried out in the Industry)

Course Outcomes:

At the end of the course, the student will be able to

- Carry out literature review
- Formulate the problem involving manufacture of a chemical product/ experimentation/modelling/simulation/optimization/design
- Carry out the project involving manufacture of a chemical product/ experimentation/ modelling/simulation/optimization/design/industrial problem
- Discuss the results
- Communicate results orally to audience
- Present the detailed written report

B.Tech. (Honors)

BTH-1001

ADVANCED MICROBIOLOGY

Course Objectives:

- To make the student learn about origin and evolution of microbes.
- To make the student understand structure and functioning of different microbial groups.
- To make them to acquaint the cultivation of microbes in artificial medium.
- To understand basic as well as advanced aspects of microbiology like Epidemiology and infectious diseases and immunology.

Course Outcomes:

At the end of the course, the student will be able to

- Demonstrate the occurrence and development of microbiology, and evolution of microbes
- Understand structure and functioning of different microbial groups, isolation and culturing techniques, reproduction, metabolism of micro organisms
- Explain the importance of microbes in energy production
- Interpret Epidemiology and infectious diseases
- Classify defence mechanisms and immunity
- Explain the production of vaccines and antibiotics

Syllabus

Introduction to Microbiology:Origin and evolution of microorganisms, history of Microbiology, nature and scope of microbiology, major characteristics of prokaryotes and Eukaryotes, structure and functioning of bacterial cell, staining reactions.

Classification of microorganisms:Major characteristics of microorganisms, concepts of Classification, classification methods, principles of nomenclature and identification, Modem trends in classification.

General features and classification of some groups of microorganisms - Algae, Fungi,

Chlamydiae, Rickettsiae, Mycoplasmas, Viruses and Protozoa, economic importance of Micro-organisms

Methods in microbiology:Nutritional requirements, nutritional types of bacteria, Characteristics of culture medium, type of culture media and preparation of culture media, isolation of microorganisms - general and selective methods, isolation of bacteria in pure culture, enrichment - enrichment methods, staining techniques, culture characteristics, maintenance and preservation of cultures, culture collections.
Reproduction and growth:Reproduction in bacteria, genetic transfer in bacteria, Bacterial growth, bacterial growth curve, growth measurement techniques, factors affecting growth, control of microorganisms by physical and chemical methods.

Metabolism and energy production: Respiratory chain, energy production by aerobic and anaerobic process, energy production by photosynthesis. Microbiology of air, water, soil, milk and food.

Epidemiology and infectious diseases: Epidemiological markers, role of host in infectious diseases - Air borne, water borne and food borne diseases.

Immunology: Natural resistance, internal defense mechanisms, non-specific defense mechanisms, immunity, types of immunity, immune systems, antibody and its diversity, Hypersensitivity, transplantation, autoimmunity, AIDS and other immune deficiencies, vaccines, types of vaccines, production of vaccines and synthetic vaccines, monoclonal anti bodies and their use, antibiotics, history of antibiotics, classification and production of antibiotics, microbial toxins, types of microbial toxins, effects of microbial toxins and their control.

TEXT BOOKS:

1. Microbiology by M. J. Pelczer, E. C. S. Chan, N. R. Kries. Tata McGrew Hill publications
2. Microbiology fundamentals and applications by S. S. Purohit. Agro botanical. Publications.

REFERENCE BOOKS:

1. Microbiology by Prescott, Harley, Klein. Mc Graw-Hill publications
2. General Microbiology by Roger Y. Stainer, Edward A. Adebery, John L. Ingraham. Published by Macmillan Press LTD.

BTH-1002

ADVANCED BIOCHEMISTRY

Course Objectives:

- Tostudy about the biomolecules and importance of biochemistry in the advanced level.
- To study the detailed structure and function of biomolecules like carbohydrates, amino acids, proteins, lipids and nucleic acids.
- To study the detailed structure and function of biocatalysts, enzymes. To study various types of enzyme inhibitions.
- To study in detailed vitamins, membrane assembling, bioenergetic principles and ATP cycle.
- To study the metabolism in advanced level and biosynthesis of fatty acids, DNA, RNA, and proteins.
- The student obtains advanced level knowledge n biomolecules and metabolic process a base for the higher research activity.

Course Outcomes:

At the end of the course, the student will be able to

- Understand the advanced structure of biomolecules.
- Explain biosynthesis and degradation of biomolecules.
- Describe metabolism and bioenergetic principles.
- Create new biomolecules and understand new metabolic processes.
- Summarize biosynthesis of,fattyacids- palmitic acid, β-oxidation of fatty acids, DNA (replication), RNA (transcription), proteins (translation).

Syllabus

Scope and importance of biochemistry, molecular logic of living matter,origin of biomolecules.

Molecular structure of Water,macromolecular structure of water, hydrogen bonds, dissociation of water.

Carbohydrates: classification of carbohydrates, structure and properties of monosaccharides (ribose, glucose, fructose), disaccharides (maltose, lactose, sucrose) and polysaccharides (Starch, glycogen and cellulose).

Amino acids and proteins: Classification and properties of amino acids and proteins, peptide bond, structural organization of proteins: primary, secondary, tertiary and quaternary structure of proteins. Biochemical function of proteins, denaturation of proteins.

Lipids: classification, structure and physiological functions of triglycerides, fattyacids, phospholipids, cerebrosides, gangliosides and cholesterol.

Nucleic Acids: Structure and properties of purines and pyrimidine bases, nucleosides, nucleotides.Structure of nucleic acids-DNA and RNA.

Enzymes: Classification of Enzymes, Mechanism of Enzyme action, factors affecting enzyme action, co-enzymes and regulatory enzymes.

Enzyme inhibition-competitive,non-competitive and uncompetitive inhibitions.

Structure and functionsof vitamins.Membrane assembly and transport across the membranes.Bioenergeticprinciples and ATP cycle.

Mechanism of photosynthesis,Embden-Meyerhof pathway of glucose metabolism(glycolysis),citric acid cycle(Krebs cycle),electron transport and oxidative phosphorylation.

Biosynthesis of fattyacids- palmitic acid biosynthesis, β-oxidation of fatty acids.

Biosynthesis of DNA (replication).

Biosynthesis of RNA (transcription).

Biosynthesis of proteins (translation).

TEXT BOOKS:

1. Textbook of Biochemistry by Albert-Lehninger, Kalyani Publishers,Ludhiana,New Delhi.
2. Principles of Biochemistry- Lehninger,Nelson and Cox-CBS Publishers and distributors,Delhi.
3. A text book of Biochemistry by A.V.S.S.RamaRao,UBS Publishers and Distributors Ltd,NewDelhi,Chennai.
4. Fundamentals of Biochemistry-J.L.Jain,S.Chand and company Ltd. New Delhi.

BTH-1003

ADVANCED BIOCHEMICAL ENGINEERING

Course Objectives:

- To introduce enzymes, enzymatic and microbial growth kinetics
- To introduce transport of materials in biological systems with respect to mass transfer and heat transfer
- To introduce different types of bio-reactors and special reactors like animal and plant cell reactors
- To introduce immobilization and sterilization techniques

Course Outcomes:

At the end of the course, the student will be able to

- Determine the enzyme activity, parameters affecting activity and enzyme immobilization
- Understand gas liquid mass transfer
- Evaluate the K_La and to know inter particle and intra particle diffusion
- Explain working and analysis of all types of reactors
- Describe thermal death kinetics and sterilization of air and medium

Syllabus

Enzyme Kinetics: effects on enzyme activity, deactivation, immobilized enzymes.

Microbial growth kinetics: Batch growth, unstructured models, growth in continuous culture, structured models, product formation kinetics, cell immobilization.

Transport Phenomena: Gas-liquid Mass transfer; Theoretical models for K_{La}, interfacial area and bubble oxygen transfer, gas-liquid mass transfer of components other than oxygen.Mass transfer into solid particles: External transfer, intraparticle diffusion.Heat transfer correlations.

Bioreactors: Review of various types of bioreactors used in the fermentation industry. Multiphase bioreactors: packed bed, bubble-column, fluidized bed and trickle-bedreactors.

Alternate Fermenters: New bioreactor configurations used in the fermentationtechnology. Animal and plant cell reactor technology.

Sterilization: Sterilization methods, thermal death kinetics, design criterion, batch and continuous sterilization, air sterilization.

TEXT BOOK:

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

REFERENCE BOOKS:

1. Lee, J. M., Biochemical Engineering (e Book), Prentice Hall, Englewood Cliffs, 2001.
2. Bailey, J. E., and D. F. Ollis, Biochemical Engineering Fundamentals, 2nd edition, Mcgraw-Hill, New York, 1986.
3. Blanch, H. W., and D. S. Clark, Biochemical Engineering, Marcel Dekker, New York, 1996.
4. Swamy,A.V.N.,' Fundamentals of Biochemical Engineering' , BS publications, 2007

BTH-1004

ADVANCED DOWNSTREAM PROCESSING

Course Objectives:

- To learn and understand the applied concepts of downstream processing.
- To enable the students to obtain pure proteins, enzymes and in general about product development and hands on experience in Downstream processes.

Course Outcomes:

At the end of the course, the student will be able to

- Understand methods to purify various types of compounds
- Explain purification and characterization of various types of bioproducts in large scale level.
- Summarize precise and efficient bioseparations, which is cost effective and yield high degree of pure substances.

Syllabus

Introduction - An Overview of Bioseparations: Bioprocesses, Range and characteristics of bioproducts, Need for down stream processing, Characteristics of Fermentation broths, An overview of bioseparations; A few case studies.

Cell Disruption: Intracellular products, Cell wall, Cell disruption, Proteins of inclusion bodies.

Reverse Phase and Hydrophobic Interaction Chromatography: hydrophobic interaction chromatography; Reverse phase chromatography. Basic theory of retention in RPC and HIC; Hydrophobic Interaction Chromatography. Electrokinetic Methods of Separation: the various Method; Electrophoresis; Capillary Electrophoresis; Isoelcctric Focusing; Isotachophoresis.

Liquid- Liquid Extraction with Ternary Systems-Instructional objectives: industrial example; Equipment: mixer- settlers, spray columns, packed columns, plate columns, columns with mechanically agitated agitation; General design considerations; Hunter- Nash graphical equilibrium- stage method: number of equilibrium stages, minimum and maximum solvent- to-feed flow rate- ratios, use of right- triangle diagrams, use of an auxiliary distribution curve with McCabe- Thiele diagram, extract and raffinate reflux; Maloney- Schubert graphical

equilibrium- stage method; Theory and scale-up of extractor performance: mixer- settler units, multi-compartment columns, axial dispersion.

Membrane Separations: Instructional objectives: industrial example; Membrane materials; Membrane modules; Transport in membranes: porous membranes, bulk flow, liquid diffusion in pores, gas diffusion, nonporous membranes, solution- diffusion for liquid mixtures, solution-diffusion for gas mixtures, module flow patterns, cascades, external mass transfer resistances, concentration polarization and fouling; Dialysis and electro dialysis; Reverse osmosis; Gas permeation; Pervaporation; Ultra filtration: process configurations; Micro filtration: constant-flux operation, constant- pressure operation, combined operation. Introduction to liquid membranes, principle, its advantages and its applications.

Crystallization: Instructional objectives: industrial example; Crystal geometry: crystal- size distributions, differential screen analysis, cumulative screen analysis, surface mean diameter, mass- mean diameter, arithmetic- mean diameter, volume- mean diameter; Thermodynamic considerations: solubility and material balances, enthalpy balances; Kinetic and transport considerations: super saturation, nucleation, crystal growth; Equipment for solution crystallization: circulating, batch crystallizers, continuous, cooling crystallizers, continuous, vacuum, evaporating crystallizers; The MSMPR crystallization model: crystal population balance; Precipitation.

Drying of Solids: Instructional objectives: industrial example; Drying equipment: batch operation, continuous operation; Psychrometry: wet- bulb temperature, adiabatic-saturation temperature, moisture- evaporation temperature; Equilibrium- moisture content of solids; Drying periods: constant- rate drying period, falling- rate period; Dryer models: materials and energy balances for direct- heat dryers, belt dryer with through- circulation, direct- heat rotary dryer, fluidized- bed dryer.

TEXT BOOKS:

1. 'Separation Process Principles', Seader, J.D. and Henley, EJ, 2Ed.Wiley India.
2. 'Bioseparations: Principles and Techniques' by B.Sivasankar, Prentice-Hall India.

BTH-1005

ENVIRONMENTAL BIOTECHNOLOGY

Course Objectives:

- To make the student learn about origin and evolution of microbes.
- To make the student understand structure and functioning of different microbial groups
- To make them to acquaint the cultivation of microbes in artificial medium.

Course Outcomes:

At the end of the course, the student will be able to

- Understand environment and economy
- Differentiate the biological waste water treatment methods
- Describe the applications of biodegradation and bioremediation
- Discuss Biofertilizers and Biopesticides, Biopolymers, Bioplastics andBiofuels
- Explain Biosorption, Bioleaching, Biodiversity

Syllabus

Environment:

Types and Components of Environment, Environmental Education,Ecology,Ecosystems, Ecological Pyramids, Food Chains, Food Web, Nutrient Cycling, Ecological Succession, Microbial Associations. History of Environmental Biotechnology.

Biological Waste Water Treatment:

Biological Processes for Domestic and Industrial Waste Water Treatment. Trickling filters, Activated Sludge Process, Rotating Biological Contactors (RBC), Packed Bed Reactors (PBR), Anaerobic Digestion, Fixed Film Reactors, Up Flow Anaerobic Sludge Blanket Reactor(UASBR), Waste Water Cycling.

Biodegradation and Bioremediation:

Introduction, Factors Effecting Bioremediation, Enzyme Systems for Bioremediation, Types of Bioremediation, Bioremediation of Contaminated Soils and Waste Lands,

Phytoremediation, Degradation of Xenobiotic Compounds:Petroleum products, Alkanes, Aromatic Compounds.

Biofertilisers and Biopesticides, Biopolymers and Bioplastics, Biosorption, Bioleaching Biofuels, Biodiversity.

TEXTBOOKS:

1. Environmental Biotechnology: Basic concepts and applications by Indu Sekhar Thakur I.K. International Pvt. Ltd. New Delhi.
2. Biotechnology by U. Satyanarayana, Books and Allied (P) Ltd. Koldata.

REFERENCE BOOKS:

1. Biotechnology and Biodegradation. Advances in applied biotechnology, Vol-4 by Karnely, D. Chakraborthy, Omen, G.S. Guld Publications co; LONDON.
2. Bioremediation Engineering: Design and Applications by John CooksonJr; McGrawHill.INC.

BTH-1006

AGRICULTURAL BIOTECHNOLOGY

Course Objectives:

- To make the student learn about the biotechnological approach in the field of agriculture.
- To make the student understand structure and functioning of genes and gene manipulation in plants so as to enhance the quality and crop production.
- To make them to acquaint the novel techniques in the improvement of Agriculture.

Course outcomes:

At the end of the course, the student will be able to

- Understand molecular biology, biochemical concepts for the production and improvement of agricultural practices.
- Develop the theoretical approach to study and understand the importance of genetic approach in the field of agriculture.

Syllabus

Introduction - Definition, classical vs modern approach, demand for biological resources, achievements,

Nitrogen Fixation-Basic concepts, nif genes and their regulation, potential scope in crop improvement,

Genetic engineering- aims of genetic engineering, techniques of gene manipulation, **Transformation Techniques** -Physical methods, *Agrobacterium*, mediated transformation.

Transgenics -Basic concept and essential steps of the process, some examples of transgenic plants, use of suitable promoters, gene silencing and measures to overcome it, commercial aspects of the technology.

Molecular Markers - concept, SNPs, RAPD, RFLP, role in crop improvement and genome mapping,

Molecular and biochemical basis, signalling pathways in the production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, pest resistance, drought and other abiotic stress resistance,

Plant as Biofactories- Concept, production of chemicals, pigments, perfume, flavors, insecticides, anticancer agents and other important compounds, molecular farming, use of plants for production of neutraceuticals, edible vaccines and other desired products,

SCP - micro organisms, nutritional value, production of algal biornass, bio fertilizers and bio pesticides, mass cultivation of *Rhizobium*, *Azatobacter*, *Azospirillum*, *Mycorrhiza*, bluegreen algae and *Azolla.*

TEXT BOOKS:

1. "Agricultural Biotechnology" by Arie Altman, Marcel Dekker, Inc. (2001)
2. "Agricultural Biotechnology", by S.S.Purohit, Agro Bios (India)

REFERENCE BOOK:

1. "Molecular Biotechnology Principles and Applications of Recombinant DNA", by Bernard R. Glick and Jack J. Pasternak,. ASM Press

BTH-1007

BIO-ANALYTICAL TECHNIQUES

Course Objectives:

The course is designed to impart the knowledge in the field of Pharmaceutical Analysis. The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC, different chromatographic methods and other important topics will be taught to enable the students to understand and apply the principles involved in the determination of different bulk drugs and their formulation. In addition to theoretical aspects, the basic practical knowledge relevant to the analysis will also be imparted.

Course Outcomes:

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

- Explain general principles and theory of the Spectroscopy.
- Understand the basic instrumentation of HPLC, GLC for identification and characterization of compounds.
- Learn various separation techniques.
- Analyze instrumentation, separation and identification of compounds by Electrophoresis.

Syllabus

Chromatographic Techniques - Affinity - Adsorption - paper - Thin layer - Column - Ion Exchange - Gel Chromatography - Applications.

Gas liquid chromatography - High Pressure liquid chromatography - Equipment - Applications.

Spectrophotometric Techniques - IR - UV - Visible - NMR - ESR - Optical density - Circular dichroism.

pH - pH titrations - Determination of pKa values - Buffers - Preparation - Buffer Action - Physiological buffers - potentiometric titration - centrifugal dialysis - lyophilization -

Electrophoresis - Ultra filtration - Assay techniques for proteins, lipids, sugars, amino acids and nucleic acids.

TEXT BOOKS:

1. " Instrumental methods of Chemical Analysis - Chatwal, G & Anand, S. Himalaya Publishing House, Bombay.
2. "Instrumental methods of Chemical Analysis - Sharma, B.K. Goel Publishing House, Meerut.
3. "Instrumental Methods Analusis - Willard, Merritt, Dean& Settle, CBS Publishers & Distributors, Delhi.

BTH-1008

GENETIC ENGINEERING-II

Course Objectives: A gene is a basic constituent unit of any organism. It is a locatable region of a genome which contains the whole hereditary information of the organism. A gene corresponds to a unit of inheritance. It is a segment of the DNA which determines the special features or functions of the organism. Genetic engineering or genetic modification refers to the process of manipulating the characteristics and functions of the original genes of an organism. The objective of this process is to introduce new physiological and physical features or characteristics.

Course Outcomes:

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

- State the importance of developing and practicing of genetic engineering as noble and beneficial for mankind.
- Understand the basic processes involved in manipulating genetic information used by recombinant and cloning methods, different ways that genetic engineering has used in manufacturing, agriculture, medicine.
- Identify several current issues surrounding genetic engineering.

Syllabus

Introduction to Gene manipulation. Enzymology of gene cloning, modification methylases, restriction endonucleases.

Reverse transcriptase and D N A cloning in *E. Coli,*Plasmids, cosmide and bacteriophages as cloning vectors.

Cloning strategies and gene libraries, Recombinant selection and screening.

Expression of cloned genes cloning in bacteria other than E. Coil, in yeasts, in plant cells and in mammalian cells in culture, Micro injection genes into oocytes, eggs and embryo.

The genetic code and regulation of gene expression, Application of genetic engineering in the fields of biology, medicine and industries.

TEXT BOOKS:

1. Introductory Bio - Technology by R. P. Singh.
2. Principles of genetic Engineering by R.W.Old and S.B.Primarose.

BTH-1009

NANOTECHNOLOGY

Course Objectives:

Nanotechnology may be treated as **Green technology**. It is one of the most advanced technologies now-a-days. It leads to have revolutionary changes in the fields of medical, Bio-medical, and fabrication of materials. Technologists are able to prepare ageless materials with the help of nano-techniques. Main objectives of the subject nanotechnology are:

- To define green technology properly
- To expose the students with new techniques of the nanotechnology.
- To make them to learn the importance of quantum technology
- To learn the procedure ageless materials to avoid wear-tear.
- To learn the importance of nano –robots, machines
- To know about the latest microscopes such as SEM, TEM
- To know the importance of nanotechnology in the dawn of optical instruments

Course Outcomes:

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

- Apply nanotechnology in the development of energy, solar panels, Fuel cells,DVD, LEDs, pharmaceuticals, etc
- Explain the importance of atoms manipulation
- Discuss the future applications of Nanotechnology
- Demonstrate the application of Nanotechnology in Optics

Syllabus

Introduction tonanotechnology, molecular and atomic size, surface and dimensional spaces.Molecular nanotechnology: atoms by inference, electron microscopes, nanomanipulator, nanotweezers, atom manipulation, nanodots, nanolithography.

Nanopowders and nanomaterials: preparation, plasma arcing, chemical vapor deposition, sol-gels, electrodeposition, Ball milling, applications.

Carbon nanotubes: types, formation, assemblies, purification, properties and uses.

Molecular mimics: Catenanes and rotaxanes, various molecular switches, synthesis of rotaxanes and catenanes, molecular computers, chemical rotors, prodders, flippers, atom shuttles, actuators, contacts.

Nanobiometrics: Lipids as nano-bricks and mortar, self – assembled monolayers, proteins, 3-D structures arising from amines acids, nanoscale motors, Biological Computing, ion channels as sensors, Information in DNA structure, using DNA to build nano-cubes, hinges, smart glue, wire template.

Optics, photomics and solar energy: Properties of light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, Imaging, New low cost energy efficient windows and solar absorbers based on nanoparticles, Photonic crystals, surface wave guides and control of light paths.

Nanoelectrons: birth of electrons, semiconductors, transistor, integrated circuits, the tools of micro and nanofabrication, quantum electronic devices, quantum information and quantum computers, experimental implementations of quantum computers.

Future applications: microelectomechanical systems, nano-robots , ageless materials, invisible mending of atomic dislocations inside damaged materials, nanomechanics and nanoelasticity, nanoparticle coatings, nanoelectronic and magnetic devices and new computing systems, optoelectronic devices, environmental applications.

Molecular Dynamics, Simulation and Optimization of Nanosystems: Integration of Newton equation of motion, simulation of systems in contact with a heat bath, simulation methods based on accuracy and computational time, use of local and global optimization methods. (Scope: Chapters 5&6, Ali Mansoori*: Principles of Nanotechnology)

(*This last section is not open for external assessment, but students are assessed internally by means of assignments and home work problems).*

TEXT-BOOK:

1. M.Wilson, K.Kannangara, G. Smith, M. Simmons and B. Ragues, Nanotechnology, Overseas press (India) Private Ltd; New Delhi, 2005.

REFERENCE BOOKS:

1. G. Ali Mansoori**,** Principles of Nanotechnology, World Scientific Publishing Company, 2005.
2. G. Timp, Nanotechnology, Springer-Verlag, Network, 1999.
3. P. Poole and F.J. Owens, Introduction to Nanotechnology, John Wiley, 2003.
4. D.Ratner and M.Ratner, Nanotechnology: A Gentle Introduction, Pearson Education,2003.
5. B. Bhusan, Handbook of Nanotechnology, Springer, 2004