K. S. Rangasamy College of Technology

(Autonomous Institution)

Curriculum & Syllabus

of

B.Tech. Biotechnology

(For the batch admitted in 2016 - 20)

R 2014

Courses Accredited by NBA, Accredited by NAAC with 'A' Grade,
Approved by AICTE, Affiliated to Anna University, Chennai.

KSR Kalvi Nagar, Tiruchengode – 637 215
Namakkal District, Tamil Nadu, India.

Vision:

To produce competent Scientists, Technologists, Entrepreneurs and Researchers in Biotechnology through quality education

Mission:

Excel in Biotechnology education and research through continual process improvement
Be recognized as a place of excellence in teaching and learning
Facilitate students to function as competent professional Biotechnologists

Programme Educational Objectives (PEOs):

I. Graduates are professionally competent in Biotechnology to solve problems in environmental, food, biochemical and biomedical engineering and technology.
II. Graduates demonstrate proficiency in theory and practice of bio-techniques through life-long learning.
III. Graduates perform as an individual and / or member of a team with professional and ethical behaviour.

Programme Outcome (POs):

a) Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems in Biotechnology.
b) Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural science, and engineering sciences.
c) Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
d) Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e) Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling to complex engineering activities, with an understanding of the limitations.
f) Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and technology practice.
g) Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h) Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and technology practice.
i) Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j) Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k) Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l) Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

K.S.Rangasamy College of Technology, Tiruchengode - 637 215	
Curriculum for the Programme under Autonomous Scheme	
Regulation	**R 2014**
Department	**Biotechnology**
Programme Code & Name	BT : B. Tech. Biotechnology

Semester I

Course Code	Course Name	Hours/ Week			Credit
		L	T	P	C
	THEORY				
40 EN 001	English	3	0	0	3
40 MA 001	Ordinary and Partial Differential Equations	3	1	0	4
40 CH 005	Chemistry for Biotechnologist	3	0	0	3
40 CS 001	Fundamentals of Programming	3	0	0	3
40 EC 001	Basics of Electronics Engineering	3	0	0	3
40 BT 101	Basic Biotechnology	3	0	0	3
	PRACTICAL				
40 CH 0P1	Chemistry Laboratory	0	0	3	2
40 CS 0P1	Fundamentals of Programming Laboratory	0	0	3	2
	Total	18	1	6	23

Semester II

Course Code	Course Name	Hours / Week			Credit
		L	T	P	C
	THEORY				
40 EN 002	Communication Skills	3	0	0	3
40 MA 002	Laplace Transform and Complex Variables	3	1	0	4
40 PH 006	Biophysics	3	0	0	3
41 CH 007	Environmental Science and Engineering	3	0	0	3
41 EE 001	Basics of Electrical Engineering	3	0	0	3
40 BT 201	Bioinstrumentation	3	0	0	3
	PRACTICAL				
40 PH 0P1	Physics Laboratory	0	0	3	2
40 ME 0P2	Engineering Practices Laboratory	0	0	3	2
40 ME 0P1	Engineering Graphics Laboratory	0	0	3	2
		18	1	9	25

Semester III

	THEORY				
40 MA 007	Fourier Series and Numerical Methods	3	1	0	4
40 BT 301	Biochemistry	3	0	0	3
40 BT 302	Microbiology	3	0	0	3
40 BT 303	Food Biotechnology	3	0	0	3
40 BT 304	Principles of Chemical Engineering	3	1	0	4
40 PH 008	Applied Physics	3	0	0	3
	PRACTICAL				
40 BT 3P1	Biochemistry Laboratory	0	0	3	2
40 BT 3P2	Microbiology Laboratory	0	0	3	2
40 BT 3P3	Food Biotechnology Laboratory	0	0	3	2
40 TP 0P1	Career Competency Development I	0	0	2	0
Total		18	2	11	26

Semester IV

	THEORY				
40 MA 012	Probability and Statistics	3	1	0	4
40 BT 401	Cell and Molecular Biology	3	0	0	3
40 BT 402	Fermentation Technology	3	0	0	3
40 BT 403	Cancer Biotechnology	3	0	0	3
40 BT 404	Protein and Enzyme Engineering	3	0	0	3
40 BT 405	Biochemical Thermodynamics	3	1	0	4
	PRACTICAL				
40 BT 4P1	Cell and Molecular Biology Laboratory	0	0	3	2
40 BT 4P2	Fermentation Technology Laboratory	0	0	3	2
40 BT 4P3	Protein and Enzyme Engineering Laboratory	0	0	3	2
40 TP 0P2	Career Competency Development II	0	0	2	0
Total		18	2	11	26

K.S.Rangasamy College of Technology, Tiruchengode – 637 215	
Curriculum for the Programmes under Autonomous Scheme	
Regulation	**R 2014**
Department	**Department of Biotechnology**
Programme Code & Name	BT : B.Tech Biotechnology

Semester V

Course Code	Course Name	Hours/ Week			Credit
		L	T	P	C
	THEORY				
40 BT 501	Genetic Engineering	3	0	0	3
40 BT 502	Bioinformatics	3	0	0	3
40 BT 503	Immunology	3	0	0	3
40 BT 504	Biomedical Instrumentation	3	0	0	3
40 BT 505	Bioprocess Technology	3	1	0	4
40 BT 506	Heat and Mass Transfer Process	3	1	0	4
	PRACTICAL				
40 BT 5P1	Genetic Engineering Laboratory	0	0	3	2
40 BT 5P2	Bioprocess Technology Laboratory	0	0	3	2
40 BT 5P3	Immunology Laboratory	0	0	3	2
40 TP 0P3	Career Competency Development III	0	0	2	0
Total		18	2	11	26

Semester VI

	Course Name	Hours / Week			Credit
		L	T	P	C
	THEORY				
40 BT 601	Plant Biotechnology	3	0	0	3
40 BT 602	Animal Biotechnology	3	0	0	3
40 BT 603	Molecular Modeling and Drug Design	3	1	0	4
40 BT 604	Chemical Reaction Engineering	3	1	0	4
40 BT 606	IPR and Biosafety	3	0	0	3
40 BT E1*	Elective I	3	0	0	3
	PRACTICAL				
40 BT 6P1	Plant and Animal Biotechnology Laboratory	0	0	3	2
40 BT 6P2	Chemical and Reaction Engineering Laboratory	0	0	3	2
40 BT 6P3	Bioinformatics and Molecular Modeling Laboratory	0	0	3	2
40 TP 0P4	Career Competency Development IV	0	0	2	0
Total		18	2	11	26

Semester VII

	THEORY				
40 HS 003	Total Quality Management	2	0	0	2
40 BT 701	Biopharmaceutical Technology	3	1	0	4
40 BT 702	Nanobiotechnology	3	0	0	3
40 BT E2*	Elective II	3	0	0	3
40 BT E3*	Elective III	3	0	0	3
40 BT 705	Downstream Processing	3	1	0	4
	PRACTICAL				
40 BT 7P1	Biological data analysis Laboratory	0	0	3	2
40 BT 7P2	Downstream Processing Laboratory	0	0	3	2
40 BT 7P3	Project Work - Phase I	0	0	3	2
40 TP 0P5	Career Competency Development V	0	0	2	0
Total		17	2	11	25

Semester VIII

	THEORY				
40 HS 002	Engineering Economics and Financial Accounting	2	0	0	2
40 BT E4*	Elective IV	3	0	0	3
40 BT E5*	Elective V	3	0	0	3
	PRACTICAL				
40 BT 8P1	Project Work - Phase II	0	0	16	8
Total		8	0	16	16

K.S.Rangasamy College of Technology, Tiruchengode - 637 215								
Regulation	**R 2014**							
Department	**Department of Biotechnology**							
Programme Code & Name	BT : B.Tech., Biotechnology							
Curriculum for the Programme under Autonomous Scheme								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
Elective I								
40 BT E11	Environmental Biotechnology	3	0	0	3	50	50	100
40 BT E12	Biodiversity	3	0	0	3	50	50	100
40 BT E13	Environmental Hazards and Management	3	0	0	3	50	50	100
40 BT E14	Agricultural Engineering	3	0	0	3	50	50	100
40 BT E15	Organic Farming	3	0	0	3	50	50	100
Electives II								
40 BT E21	Biotechnology for Healthcare	3	0	0	3	50	50	100
40 BT E22	Clinical Immunology	3	0	0	3	50	50	100
40 BT E23	Stem Cell Technology	3	0	0	3	50	50	100
40 BT E24	Tissue Engineering	3	0	0	3	50	50	100
40 EC E25	Medical Imaging	3	0	0	3	50	50	100
Electives III								
40 BT E31	Biostatistics	3	0	0	3	50	50	100
40 BT E32	Research Design and Analysis	3	0	0	3	50	50	100
40 BT E33	Metabolic Engineering	3	0	0	3	50	50	100
40 BT E35	Bioreactor Design	3	0	0	3	50	50	100
40 BT E36	Bioprocess Modeling and Simulation	3	0	0	3	50	50	100
Electives IV								
40 BT E42	Marine Biotechnology	3	0	0	3	50	50	100
40 BT E43	Biofuel Technology	3	0	0	3	50	50	100
40 BT E44	Textile Biotechnology	3	0	0	3	50	50	100
40 BT E45	Human Biomechanics	3	0	0	3	50	50	100
40 BT E47	Bioresource Technology	3	0	0	3	50	50	100
Electives V								
40 BT E53	Human Physiology and Anatomy	3	0	0	3	50	50	100
40 BT E54	Genomics and Proteomics	3	0	0	3	50	50	100
40 BT E55	Systems Biology	3	0	0	3	50	50	100
40 BT E57	Entrepreneurship in Biotechnology	3	0	0	3	50	50	100
40 HS 001	Professional Ethics	2	0	0	2	50	50	100
One Credit Course*								
40 BT SE1	Molecular Diagnosis and Regenerative Medicine	1	0	1	1	50	50	100
40 BT SE2	Clinical Research Management	1	0	1	1	50	50	100
40 BT SE3	Medical Coding	1	0	1	1	50	50	100
40 BT SE4	Foreign Language (French / German/ Japanese)	1	0	1	1	50	50	100
40 BT SE5	BIOPERL	1	0	1	1	50	50	100
40 BT SE6	Self Development	1	0	1	1	50	50	100
40 BT SE7	Corporate Essentials for Biotechnologists	1	0	1	1	50	50	100
40 BT SE8	Natural and Phytochemical Products	1	0	1	1	50	50	100
40 BT SE9	Bio Techniques in Textile Technology	1	0	1	1	50	50	100
40 BT SE10	Computational Genomics	1	0	1	1	50	50	100

*one credit courses are offered by Industries, students can opt the course from third semester onwards

K.S.Rangasamy College of Technology - Autonomous								
40 EN 001 - English								
Common to All Branches								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To help learners improve their vocabulary and to enable them to use words appropriately in different academic and professional contexts. • To help learners develop strategies that could be adopted while reading texts. • To help learners acquire the ability to speak effectively in English in real life and career related situations. • To train learners in organized academic and professional writing.
Course Outcomes	**At the end of the course, the students will be able to** 1. Comprehend the basic grammatical structures and generate new sentences in a given paradigm. 2. Explain and apply the enriched vocabulary in academic and professional contexts. 3. Identify the main idea and integrate it with supporting data to facilitate effective comprehension. 4. Infer, compare and summarize lexical & contextual meaning of various technical / general passages. 5. Recognize the basic phonetic units of language and execute it for better oral competency. 6. Recognize and interpret standard English Pronunciation & use it in diverse situations. 7. Find and classify different reading strategies and demonstrate better articulation / expression 8. Categorize words into different parts of speech and use them in different contexts. 9. Retrieve information from various sources and construct a well designed descriptive writing. 10. Indentify the key words of concepts and learn to write definitions.

Grammar and Vocabulary

Word formation with Prefixes and Suffixes Level -1 (50 words), Level -2 (100 words) – Synonyms and Antonyms (100 each)– Verbal Analogy- Finding the Odd man out- Alphabet Test- One word substitute- Sentence Patterns- Subject-Verb Agreement – Tenses – Active and Passive voice – Use of conditionals – Comparative Adjectives– Expanding Nominal Compounds (100) – Articles – Use of Prepositions (basic level – 25) Identifying Phrasal Verbs - Error Detection – Abbreviations and Acronyms (100 each).

Suggested Activities

Prefixes and suffixes– identifying the lexical and contextual meanings of words – correction of errors in the given sentences -providing a context for the use of tenses, sentence structures – using comparative forms of adjectives - Identifying phrasal verbs - 'if' clauses – the three main types, probable condition, improbable condition and impossible conditions.

Note: All examples should preferably be related to science and technology.

Listening skill

Extensive listening – Listening for General Content – Listening to fill up Gapped Texts – Intensive Listening – Listening for Specific Information: Retrieval of Factual Information – Listening to Identify Topic, Context, Function, Speaker's Opinion, Attitude, etc. – Global Understanding Skills and Ability to infer, extract gist and understand main ideas – Note-Taking: Guided and Unguided

Suggested Activities

Taking a quick glance at the text to predict the content – reading to identify main content and giving feedback in response to the teacher's questions – making a thesis statement about the text – scanning for specific information – sequencing of jumbled sentences using linguistic clues (e.g. reference words and repetition) and semantic clues following propositional development –fast reading drills – comprehending a passage and answering questions of varied kinds relating to information, inference and prediction.

Speaking skill

Verbal and Non-Verbal communication – Speech Sounds – Syllables – Word Stress (structural and content words) – Sentence Stress – Intonation – Pronunciation Drills, Tongue Twisters – Formal and Informal English –

Oral Practice – Developing Confidence – Introducing Oneself – Asking for or Eliciting Information – Describing Objects – Expressing Opinions (agreement / disagreement) – Giving Instructions – (Road Maps)

Suggested Activities

Role play activities based on real life situations – discussing travel plan / industrial visits- giving oral instructions for performing tasks at home and at work (use of imperatives) -using appropriate expressions-defining / describing an object /device / instrument / machine – participating in a short discussion on a controversial topic – oral presentation

Reading skill

Exposure to different reading techniques – Reading for gist and global meaning – Predicting the content – Skimming the text – Identifying the topic sentence and its role in each paragraph – Scanning – Inferring / Identifying lexical and contextual meanings – Reading for structure and detail – Transfer of information / Guided Note-Making – Understanding Discourse Coherence.

Suggested Activities

Gap filling activity while listening to a text – listening intently to identify the missing words in a given text – listening to a brief conversation and answering questions – listening to a discourse and filling up gaps in a worksheet – taking notes during lecture – inferential comprehension and literal comprehension tasks based on listening to quizzes.

Note: The listening activities can be done using a worksheet in the Language Laboratory or in the class room using a tape recorder.

Writing skill

Introduction to the characteristics of technical style – Writing Definitions and Descriptions – Paragraph Writing (topic sentence and its role, unity, coherence and use of cohesive expressions) – Process Description (use of sequencing connectives) – Comparison and Contrast – Classifying the Data – Analyzing / Interpreting the data – Formal letter Writing (letter to the editor, letter for seeking practical training, and letter for undertaking project works in industries) – Editing (punctuation, spelling and grammar)

Suggested Activities

writing a paragraph based on information provided in a tree diagram / flow chart / bar chart / pie chart / tables – formal letters – writing to officials (leave letter, seeking permission for practical training , asking for certificates, testimonials) – letter to the editor – informal letters (persuading / dissuading, thanking and congratulating friends / relatives) – sending e- mail – editing a passage (correcting the mistakes in punctuation, spelling and grammar)

Text book(s):

1.	Ashraf M Rizvi, 'Effective Technical Communication', 1st Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2005.

Reference(s):

1.	M.Balasubramanian and G.Anbalagan, 'Performance in English', Anuradha Publications, Kumbakonam, 2007.
2.	Sharon J. Gerson, Steven M. Gerson, 'Technical Writing – Process & Product',3rd Edition, Pearson Education (Singapore) (p) Ltd., New Delhi, 2004.
3.	Mitra K. Barun, 'Effective Technical Communication – A Guide for Scientists and Engineers', Oxford University Press, New Delhi, 2006.
4.	R.S. Aggarwal, 'A Modern Approach to Verbal & Non – Verbal Reasoning', S.Chand & Company Ltd., New Delhi, Revised Edition, 2012.
5.	NPTEL Video Courses on Spoken English.

K.S.Rangasamy College of Technology - Autonomous								
40 MA 001 - Ordinary and Partial Differential Equations								
Common to All Branches								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	1	0	60	4	50	50	100

Objective(s)	• To present methods of solving system of linear equations. • To develop the mathematical skills for solving ordinary and partial differential equations. • To acquire knowledge about the concept of vectors in two-dimensional and three dimensional spaces.
Course Outcomes	At the end of the course, the students will be able to 1. (i) Understand the types of matrix and find eigen values, eigen vectors and inverse of the matrix. (ii) Solve the system of linear equations. 2. Apply transformation techniques to reduce quadratic form into canonical form. 3. Solve linear differential equations with constant and variable coefficients. 4. (i) Find the solution of differential equations by the method of variation of parameters. (ii) Solve simultaneous differential equations. 5. Understand the concepts of curvature and evolutes. 6. (i) Analyze the maxima and minima of a function (ii) Expand the function of two variables as Taylor's series and find the Jacobians. 7. Construct partial differential equations and find the solutions of non-linear partial differential equations of first order. 8. Apply the appropriate method to solve Lagrange's linear equations and solve linear partial differential equations with constant coefficients. 9. Know about gradient, directional derivative, solenoidal and irrotational of a vector function. 10. Apply the notions of vector calculus to verify Green's, Gauss divergence and Stoke's theorems.

Matrices

Basic concepts – Addition and multiplication of matrices – Orthogonal matrices – Conjugate of a matrix – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors – Cayley-Hamilton theorem (without proof) – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation – System of linear equations.

Ordinary Differential Equations

Introduction – Differential equations of first-order and first degree – Exact differential equations – Linear differential equations of second and higher order with constant co-efficient when the R.H.S is $e^{\alpha x}$, sin α x or cos α x ,x^n n>0, $e^{\alpha x} x^n$, $e^{\alpha x}$ sinβx, and $e^{\alpha x}$ cosβx – Differential equations with variable co-efficients reducible to differential equations with constant co-efficients (Cauchy's form and Legendre's linear equation) – Method of variation of parameters – Simultaneous first-order linear equations with constant co-efficients.

Differential Calculus and Functions of Several Variables

Curvature – Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Involutes and evolutes – Taylor's series for a function of two variables – Maxima and minima of function of two variables – Constrained maxima and minima (Lagrange's method of undetermined multipliers) – Jacobians(Problems only).

Partial Differential Equations

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Non-linear partial differential equations of first order (Type I – IV) – Solution of partial differential equations of first order – Lagrange's linear equations – Linear partial differential equations with constant coefficients.

Vector Calculus

Introduction – Gradient of a scalar point function – Directional derivative – Angle of intersection of two surfaces – Divergence and curl(excluding identities) – Solenoidal and irrotational vectors – Green's theorem in the plane –Gauss divergence theorem – Stoke's theorem(without proof) – Verification of the above theorems and evaluation of integrals using them.

Text book (s):

1	Kreyszig E, "Advanced Engineering Mathematics", 9th Edition, John Wiley and Sons (Asia) Limited, New Delhi, Reprint 2012.

Reference(s):

1	Grewal B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2013.
2	Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", 9th Edition, Lakshmi Publications Pvt. Ltd., New Delhi, 2014.

K.S. Rangasamy College of Technology - Autonomous

40 CH 005 - Chemistry for Bio-Technologist

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum marks		
	L	T	P	45	C	CA	ES	Total
I	3	0	0		3	50	50	100

Objectives	• To help the learners to analyze the hardness of water and its removal. • To familiarize the learners with the basics of electrochemistry, its applications, corrosion and its control. • To recall the basics of stereochemistry and reaction mechanism. • To endow with an overview of the potential of kinetics and catalysts. • To enlighten the learners on polymers.
Course Outcomes	At the end of the course, the students will be able to 1. Recognize sources of water, quality parameter and hardness of water. 2. Analyze and appraise methods to overcome hardness. 3. Relate the basic tenets of electrochemistry to arrive at mathematical expression and outline its various applications. 4. Identify the types, mechanism, and factors influencing corrosion and describe its control measures. 5. Review of stereochemistry. 6. Explain the mechanism of elimination and substitution reactions. 7. Discuss the theory of kinetics of chemical reactions. 8. Describe the types of catalysis. 9. Explain the basic concepts, characteristics of polymer and mechanisms of polymerization. 10. Discuss the preparation, properties and uses of select polymers.

Water Treatment

Sources of water and its properties - Water quality parameter (EPA) - Hard and soft water - Hardness of water - Types - Units of hardness - ppm and mg/L - Estimation of hardness - EDTA method - Boiler feed water - Boiler problems - Internal treatment - Carbonate, Phosphate and Calgon conditioning. External treatment - Zeolite and deionization process - Desalination - Reverse osmosis and Electro dialysis.

Electrochemistry and Corrosion

Basics of electrochemistry - Reversible and irreversible cells - Nernst equation (problems) - EMF-measurement - EMF series - Applications - Types of electrodes - Reference electrodes - Conductometric titration. Corrosion - Types - Galvanic and differential aeration corrosion - Mechanism (Dry and wet) - Factors influencing corrosion - Corrosion control - Cathodic protection - Corrosion inhibitors. Electroplating of nickel and chromium.

Basic Concepts of Stereochemistry and Reaction Mechanism

Isomerism in organic compounds - Structural isomerism - Stereochemistry - Geometrical isomerism (Maleic and fumaric acids) - E, Z isomerism - Optical isomerism (Lactic and tartaric acids) - Optical activity - Chirality - d & l, R & S and D & L notations - Compounds containing chiral centers - Mechanism of E_1, E_2 and SN_1, SN_2 reactions.

Chemical Kinetics and Catalysts

Introduction of chemical kinetics - Activation energy- Arrhenius equation and Transition state theory. Catalyst - Types - Acid and base - Characteristics -Types of catalysis - Homogeneous and heterogeneous - Enzyme catalysis - Michaelis- Menten equation.

Polymers

Introduction - Types of polymerization - Mechanism of polymerization - Free radical polymerization - Co-ordination polymerization - Properties of polymers - Tg, tacticity and degradation of polymers - Plastics - Thermo and thermosetting - Preparation, properties and uses of PE, PVC, PTFE, PMMA, epoxy resin, nylon 6,6 and bakelite. Basic materials and propreties of LCD and LED.

Text book(s):

1. Vairam S “Engineering Chemistry”, Wiley India, Delhi, 2nd Edition, 2013.

Reference(s):

1. Dara.S.S. ’A Text Book of Engineering Chemistry’, S Chand & Co.Ltd., 2003.
2. Bill Mayer F. W., ’Text Book of Polymer Science ‘, Wiley - New York, 3rd Edition, 1991.
3. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishing Company Pvt. Ltd., Delhi.15th Edition, 2008.

K.S.Rangasamy College of Technology - Autonomous								
40 CS 001 - Fundamentals of Programming								
Common to BT, CE, EC, EE, EI, TT, ME, MCT & NST								
Semester	Hours / Week			Total hrs	Credit	Maximum marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To enable the students to provide comprehensive knowledge about the fundamental principles, concepts and constructs of modern computer programming • To enhance the competencies for the design, coding and debugging of computer programs. • To provide ample way to identify, formulate, and solve engineering problems.
Course Outcomes	**At the end of the course, the students will be able to** 1. Recognize the generation and application of computers 2. Analyze various problem solving techniques with categories of software 3. Recognize the concepts of tokens branching and looping statements 4. Affirm the concepts of arrays and strings 5. Identity the purpose of pointers with its associated features 6. Recognize the concepts of functions, recursion with its features 7. Comprehend basic concepts of structures and unions 8. Relate the concept of user defined data types and preprocessor 9. Annotate the concepts of console input and output features 10. Interpret the concept of file input and output features

Computer Fundamentals

Evolution of computers - Generations of computers - Applications of computers - Computer Memory and Storage – Algorithm – Flowchart - Pseudo code – Program control structures -Programming languages - Computer Software – Definition - Categories of Software.

Introduction TO C

An Overview of C – Data types – Identifiers - Variables- – Type Qualifiers - Constants – Operators - Expressions – Selection statements – iteration statements – jump statements, Arrays: Introduction - Types – Initialization, Strings: Strings: Introduction - Arrays of Strings – String and Character functions.

Pointers and Functions

Pointers: Introduction - Pointer Variables - The Pointer Operators - Pointer Expressions - Pointers and Arrays - Generating a Pointer to an Array - Indexing Pointers Functions: Scope of a Function – Library Functions and User defined functions - Function Prototypes – Function Categorization - Function Arguments - Arguments to main function - The return Statement - Recursion - Passing Arrays to Functions – Dynamic memory allocation – Storage class Specifiers.

Structures, Unions, Enumerations, Typedef and Preprocessors

Structures - Arrays of Structures - Passing Structures to Functions - Structure Pointers - Arrays and Structures within Structures - Unions – BitFields - Enumerations - typedef – The preprocessor and comments.

Console I/O and File I/O

Console I/O: Reading and Writing Characters - Reading and Writing Strings - Formatted Console I/O, File I/O: Streams and Files - File System Basics - fread( ) and fwrite( ) - Random Access I/O - fprintf( ) and fscanf( ) - The standard streams

Text book(s):

1	Herbert Schildt, “The Complete Reference C”, Fourth Edition, TMH.

Reference(s):

1	Brian W. Kernighan and Dennis M. Ritchie, “C Programming Language”, Prentice-Hall.
2	E.Balagurusamy, “Programming in ANSI C”, TMH, New Delhi, 2002.

K.S.Rangasamy College of Technology - Autonomous								
40 EC 001 - Basics of Electronics Engineering								
Common to ME, BT & NST								
Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100
Objective(s)	• To introduce the fundamentals of Electron Devices and integrated Circuits.							
Course Outcomes	**At the end of the course, the students will be able to** 1. Discuss the operational basics of semiconductor devices. 2. Explain the construction, characteristics and applications of PN junction diodes. 3. Describe the construction, working and characteristics of bipolar junction transistor. 4. Discuss the applications of bipolar junction transistor. 5. Explain the construction, working and characteristics of FET. 6. Describe the construction, operating principle and characteristics of MOSFET and know the applications of FET. 7. Discuss different number systems used to represent digital data and apply Boolean laws to reduce complex logic expressions. 8. Explain the basics of logic gates, combinational and sequential logic circuits. 9. Describe the operational fundamentals and characteristics of an Opamp. 10. Discuss various Opamp Application Circuits.							

Semiconductor Diodes

Review of semiconductor physics: Insulators, Conductors and Semiconductors-Semiconductor types- Law of Mass Action- Drift and Diffusion carriers; PN Junction Diode- Ideal and Practical diode- VI characteristics-Temperature dependence-Diode specifications-Equivalent circuits-Zener Diode- Photo Diodes- Light Emitting Diodes-Applications of Diode- Rectifier, Clipper, Clamper.

Bipolar Junction Transistors

Transistor- construction, types, operation, configurations, specification and rating- Transistor as a switch-Applications- Regulator, RPS/SMPS- Power Amplifier- Block diagram.

Field Effect Transistors

JFET-Construction, operation, characteristics, effect of temperature- FET parameters and specifications-MOSFET- Types, construction and operation- Applications.

Digital Electronics

Number Systems- Boolean algebra – Logic gates- OR, AND, NOT, NAND, NOR-Adder, Subtractor, Multiplexer, Demultiplexer, Encoder, Decoder-Flip-Flops.

Operational Amplifier

Introduction, Ideal Vs. Practical- Performance Parameters- Applications- Inverting and Non-inverting Amplifiers, Voltage Follower-Summing and difference amplifier, Comparator, Integrator, Differentiator, Instrumentation amplifier.

Text book (s) :

1	Anil K. Maini, Varsha Agrawal ‘Electronic Devices and Circuits’, Wiley India Pvt.Ltd, 2013.
2	Anil K. Maini, ‘Digital Electronics Principles and Integrated Circuits’, Wiley India Pvt.Ltd, 2009.

Reference(s) :

1	Robert L. Boylestad, Louis Nashelsky, ‘Electronic Devices and Circuit Theory’, Pearson New Delhi, 11th Edition, 2012.
2	Mehta V K, ‘Principles of Electronics’, S.Chand & Company Ltd., 11th Edition, 2008.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 101 - Basic Biotechnology								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To enable students to learn basic concepts of Biotechnology and its applications. • To learn the basic concepts in biology including microbial biotechnology, plant and animal biotechnology for the applications of bio engineering • To introduce modern technologies and trends in the areas of Microbial, Plant and Animal Biotechnology.
Course Outcomes	**At the end of the course students will be able to** 1. understand the importance and historical development of biotechnology 2. appraise the nature and characteristic features of major cytological innovation 3. identify the main features and classifications of microbes 4. understand the omnipotence of microorganisms in nature 5. illustrate the importance of culturing plants *in vitro* without contamination 6. recognize and interpret the different plant tissue culture methods and its applications 7. understand the major requirements for animal cell and tissue culture *8.* demonstrate the animal cell production and sub culturing *in vitro* 9. interpret the major difference between synthetic fertilizer and biofertilizer 10. identify the key microbial source applying as biofertilizers

Introduction to Biotechnology

Importance and scope of Biotechnology; History of biotechnology; Traditional Biotechnology; emergence of modern Biotechnology, The Cell: Introduction, discovery of cell, cell theory, cell shape and size difference, cell cycle, origin of cell and organelles.

Microbes and Microbial World

Introduction to microorganisms, classification of microorganisms: three kingdom and five kingdom systems of classifications. Microbiology of air and water. General characters of Bacteria, virus, fungi and Lichens. Diseases caused by microorganisms.

Plant Biology

Historical background of Plant biotechnology, culturing of plants in *in vitro,* tissue culture laboratory, maintenance of aseptic environment, media preparation, inoculation room, plant growth regulators. Sterilization of laboratory, media and plant material. Types of cultures of plant material. Rooting and acclimatization.

Animal Biology

History of animal cell and organ culture; Requirements for animal cell tissue and organ culture, characteristics of animal cell growth in culture; substrates for cell culture; culture media; Natural media; synthetic media; sterilization of glassware, equipments required for animal cell culturing. Disaggregation of tissue; establishment of cell culture and types of cell lines.

Applications of Biotechnology

Biofertilizers, Isolation and identification of *Rhizobium, Azobactor* and *Azospirillum;* Phosphate solublizing microorganisms; production of carrier based inoculation; antagonism: Introduction of antagonists: seed inoculation, vegetative part inoculation and soil inoculation. Applications of biological control agents. Microbial pesticides; Bacterial, viral and fungal pesticides; *Azolla;* introduction and mass cultivation.

Text book(s):

1. Dubey, R.C. “A text book of Biotechnology”, Chand company Ltd., New Delhi- 110 055, 2012.
2. Ignasimuthu, S. “Biotechnology an Introduction” , Narosa Publishing House, Chennai, 2008.

Reference(s):

1. Guptha, P.K.”Cell and Molecular Biology,Rastogi Publications, Meerut, 2003.
2. Satyanarayana, U. ‘Biotechnology”, Books and allied P. Ltd., Kolkata, 2012.

K.S. Rangasamy College of Technology - Autonomous

40 CH 0P1 - Chemistry Laboratory

Common to All Branches

Semester	Hours / Week			Total hrs	Credit	Maximum marks		
	L	T	P		C	CA	ES	Total
I	0	0	3	45	2	50	50	100

Objective(s)

- Test the knowledge of theoretical concepts.
- To develop the experimental skills of the learners.
- To facilitate data interpretation
- To expose the learners to various industrial and environmental applications.

Course Outcomes

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

1. estimate the hardness of water sample.
2. estimate the alkalinity of water sample.
3. estimate the chloride content in water sample.
4. determine the dissolved oxygen in water.
5. determine the molecular weight of polymer.
6. estimate the mixture of acids by conductometry
7. estimate the ferrous ion by potentiometry.
8. estimate the strength of acid by pH metry and apply the knowledge of pH determination for health drinks, beverages, soil, effluent and other biological samples.
9. estimate ferrous ion by spectrophotometry.
10. determine the corrosion by weight loss method.

List of experiments

1. Estimation of hardness of water by EDTA method.
2. Estimation of alkalinity of water sample.
3. Estimation of chloride content in water sample (Argentometric method)
4. Determination of dissolved oxygen in boiler feed water (Winkler's method)
5. Determination of molecular weight of a polymer by viscometry method.
6. Estimation of mixture of acids by conductometric titration.
7. Estimation of ferrous ion by potentiometric titration.
8. Estimation of HCl beverages and other biological samples by pH meter.
9. Estimation of iron content by spectrophotometry method.
10. Determination of corrosion by weight loss method.

Lab Manual:

1. Vairam S "Engineering Chemistry", Wiley India, Delhi, 2 nd Edition, 2013

Reference(s):

1. Mendham. J, Denney. R.C, Barnes. J.D and Thomas. N.J.K, "Vogel's text book of quantitative chemical analysis", 6th Edition, Pearson Education, 2004.

K. S. Rangasamy College of Technology - Autonomous								
40 CS 0P1 - Fundamentals of Programming Laboratory								
Common to BT, CE, EC, EE, EI, TT, ME, MCT & NST								
Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	0	0	3	45	2	50	50	100

Objective(s)	• To enable the students to apply the concepts of C to solve basic problems • To apply the knowledge of library functions in C programming • To implement the concepts of functions, structures and enumerator in C • To implement the file handling operations through C
Course Outcomes	**At the end of the course, the students will be able to** 1. Perform basic calculations using MS-EXCEL. 2. Write a simple C program to read and display basic information. 3. Develop a C program using selection and iterative statements. 4. Demonstrate a C program to manage collection related data. 5. Interpret a C program to perform string manipulation functions. 6. Perform dynamic memory allocation using C. 7. Design and Implement different ways of passing arguments to functions. 8. Implement a C program to manage collection of different data using Structure or Enum. 9. Apply a C program to manage data using preprocessor directives. 10. Demonstrate a C program to store and retrieve data using file concepts.

List of experiments

1. Implement basic calculations using MS EXCEL.
2. Implement a simple C program to read and display basic information.
3. Implement a C program using selection and iterative statements.
4. Implement a C program to manage collection related data.
5. Implement a C program to perform string manipulation functions.
6. Implement a C program to perform dynamic memory allocation.
7. Implement different ways of passing arguments to functions.
8. Implement a C program to manage collection of different data using Structure or Enum.
9. Implement a C program to manage data using preprocessor directives.
10. Implement a C program to store and retrieve data using file concepts.

Note: Programs specific to branches are to be taught and examined.

K.S.Rangasamy College of Technology - Autonomous

40 EN 002 - Communication Skills

Common to All Branches

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To equip students with effective speaking and listening skills in English. • To help them to develop soft skills and people skills which will make them excel in their jobs. • To enhance students' performance in placement interviews.
Course Outcomes	**At the end of the course, the student will be able to** 1. look for specific details and overcome speech barriers. 2. pick key points by listening and improve casual conversational skills. 3. understand different forms of communication with differences among them. 4. know about formal speech and descriptive techniques, and use specific words in specific contexts. 5. fine tune language for different conversational contexts and purposes. 6. learn telephone etiquette by using language for assent and dissent. 7. understand grammatical structures, its technical aspects and usage 8. use discourse markers, enhance punctuation and learn discourse coherence 9. comprehend content, generate different forms of template and enhance reference skills 10. construct well-knit documents for job readiness and career competence

The Listening Process

Barriers in Listening - Listening to academic lectures - Listening to announcements at railway stations, airports, etc - Listening to news on the radio / TV - Listening to casual conversation - Listening to live speech

Suggested activities

Listening to casual conversations, talks, interviews, lectures, specific information relating to technical content, statistical information, retrieving information, gapped texts-listening comprehension through video clippings and lectures.

Nature of Communication

Stages of communication–Channels of communication- Barriers to effective communication - Differences between spoken and written communication - Giving directions - Art of small talk-presentation skills - Taking part in casual conversation - Making a short formal speech-Describing people, place, and events.

Suggested activities

Motivating and conducting prepared speech – debate on topics of interest **-** conversation (dialogue based on particular situation by using pleasantries) – extempore - picture description (people, place, things and events)

Telephonic Conversational Skill

Using the telephone - Greeting and introduction - Making requests - Asking for permission, Giving / Denying permission - Giving information on the phone – Leaving messages on Answer Machines - Making / changing appointments - Making complaints – Reminding - Listening and Taking messages - Giving instructions & Responding to instructions

Suggested activities

Familiarizing the telephone etiquette and telephone jargon – use of role play cards – conversational practices – games for spelling out proper nouns, long words, numbers, etc., -- useful phrases for complaints or making appointments – providing the needed vocabulary and expressions for agreeing and disagreeing – video clippings of speeches to drill note taking – providing context for framing yes or no questions for making requests.

Remedial Grammar

Tenses - 'Do' forms – Impersonal Passive voice - Imperatives – using should form – Direct, Indirect speech – Discourse markers – SI Units - Numerical adjectives – Prepositions (intermediate level) - Phrasal verbs (usage)- Correct use of words - Use of formal words in informal situations - Commonly confused words – Editing.

Suggested activities

Providing various contexts to fill tense gaps (stories , demos, future plans etc.,) Technical context for impersonal passive structures – transformation drills for imperatives – elucidating suggestion and recommendation formats – contextual frames for preposition and phrasal verbs – editing exercises – standard paradigm for negative structures – use of SI units (25 common units to be taught) numerical adjectives in various contexts – providing examples and drill units for commonly confused words-exemplifying the structures for direct and indirect speech – monitoring the drill units for conversion of direct to indirect, imperatives to recommendations and vice versa – reinforcing skills for discourse markers.

Written Communication & Career Skills

Writing e-mails - Writing Reports – Lab Reports - Preparing Curriculum Vitae and cover letters - Facing an Interview - Flow Charts, Interpreting the data from Tables– Recommendations – Check List – Slide Preparation – Theme Detection – Deriving Conclusions from the passages – Situation Reaction Test – Statements - Conclusions-Statement and Courses of Action

Suggested activities

Deliberating the content, format and diction for drafting e-mails -- elucidating the structure and content for writing reports especially Accident and Lab Reports -- mentoring strategy to construe the difference between Résumé and CV , and preparing the wards for the recruitment -- building self confidence in facing an interview with flawless presentation and persuasion skills -- reinforcing the interpretative skills of transcoding flow charts and Tables by employing appropriate discourse markers -- inculcating the language and format of writing Recommendations and Checklists -- enforcing innovatively the Reasoning and Logical Detection in Verbal Ability for the effective equipment of grooming for the primary leg of the recruitment process.

Text book(s):

1.	Ashraf M Rizvi, 'Effective Technical Communication', 1st Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2005.

Reference(s):

1.	P.Kiranmai Dutt, Geetha Rajeevan and CLN.Prakash, 'A Course in Communication Skills', by Ebek – Cambridge University Press India Pvt. Ltd., 2008.
2.	B. Jean Naterop, 'Telephoning in English' – Cambridge University Press India Pvt.Ltd., 2007.
3.	Jack. C. Richards, 'New Interchange Services (Student's Book)' – Introduction, Level – 1, Level – 2, Level – 3, Cambridge University Press India Pvt.Ltd., 2007.
4.	R.S. Aggarwal, 'A Modern Approach to Verbal & Non – Verbal Reasoning',S.Chand & Company Ltd., New Delhi, Revised Edition, 2012.
5.	NPTEL Video Courses on Communication Skills.

K.S.Rangasamy College of Technology - Autonomous								
40 MA 002 - Laplace Transform and Complex Variables								
Common to ME, CE, MC, EE, EI, CS, IT, TT, BT & NST								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	1	0	60	4	50	50	100

Objective(s)	• To formulate and solve problems involving volume and surface area using multiple integrals • To give an ability to apply Laplace transform technique for solving engineering problems • To provide an overview of functions of complex variables and complex integration which helps in solving many complex problems • To identify the properties of coplanar and solid geometric shapes and use these properties to solve common applications
Course Outcomes	**At the end of the course, the students will be able to** 1. (i) Apply double integral to find area between two curves. (ii) Evaluate double integral by changing the order of integration and triple integral. 2. Study the concepts of Beta and Gamma functions. 3. Understand the concepts of Laplace transforms for some elementary functions, some special functions, periodic functions, derivatives and integrals. 4. Apply the techniques of inverse Laplace transform to solve linear ordinary differential equation and simultaneous differential equations. 5. Know about the construction of analytic and conjugate harmonic functions and their properties. 6. Employ conformal maps to determine images of curves and find the bilinear transformation. 7. Expand the functions as Taylor's and Laurent's series and evaluate the complex integrals. 8. Evaluate real definite integrals with suitable contours using Cauchy's residue theorem. 9. Understand the notions of plane, straight line and skew lines. 10. Relate the concepts between tangent planes and spheres.

Multiple Integrals

Double integration – Cartesian and polar coordinates – Change of order of integration – Area between two curves – Area as double integral – Triple integration in Cartesian coordinates.

Beta and Gamma functions**:** Relationship between Beta and Gamma functions – Properties – Problems.

Laplace Transform

Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Derivatives and integrals of transforms – Initial and final value theorem – Transform of unit step function – Dirac's delta function – Transform of periodic functions. Inverse Laplace transform – Convolution theorem – Solution of linear ordinary differential equation with constant co-efficients – First order simultaneous equations with constant co-efficients.

Complex Variables

Functions of a complex variable – Analytic functions – Necessary conditions (Cauchy–Riemann equations) – Sufficient conditions (excluding proof) – Properties of analytic functions – Harmonic function – Conjugate harmonic functions– Construction of analytic functions– Conformal mapping: w = z + a, az, 1/z and bilinear transformation.

Complex Integration

Cauchy's Integral theorem (without proof) – Cauchy's integral formula – Taylor and Laurent series (without proof) – Classification of singularities – Cauchy's residue theorem – Contour integration – Circular and semi-circular contours (excluding poles on real axis).

Solid Geometry

Direction cosines – Plane – Straight lines – Coplanar – Point of intersection – Skew lines – Sphere – Tangent plane – Great circle – Orthogonal sphere.

Text book(s):

1	Kreyszig E, "Advanced Engineering Mathematics", 9th Edition, John Wiley and Sons (Asia) Limited, New Delhi, Reprint 2012.

Reference(s):

1	Grewal B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publishers, Delhi, 2013.
2	Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", 9th Edition, Lakshmi Publications Pvt. Ltd, New Delhi, 2014.

K.S.Rangasamy College of Technology - Autonomous								
40 PH 006 - Biophysics								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To impart fundamental knowledge about biomaterials advanced materials, bio-instrumentation and spectroscopic methods like UV-VIS, RAMAN, NMR, ESR and FTIR. • To correlate the theoretical principles with application oriented studies.
Course Outcomes	At the end of the course, the students will be able to 1. Recognize the properties of natural and synthetic biomaterials to fabricate medical devices/implants 2. Apply the tissue engineering principles to develop biological substitutes, soft tissues, intra-ocular lens, contact lens and dental implants 3. Understand and apply the properties of metallic glasses, Shape Memory Alloys(SMA) and Micro Electro Mechanical Systems(MEMS) 4. Understand the properties and prepration of nanomaterials and its impact in research and industrial applications. 5. Understand the principles and properties of ultrasound in scanning and outline PhonoCardioGram(PCG) to monitor human body functions 6. (i) Apply ionizing radiation techniques to construct radiation detectors and (ii) Employ Gamma camera and positron camera to monitor human body functions. 7. Describe and apply the principles of UV- VISIBLE spectroscopy 8. Describe and apply the principles of IR spectroscopy 9. Describe and apply the principles of RAMAN-NMR spectroscopy 10. Describe and apply the principle of ESR and FTIR spectroscopy

Biomaterials

Introduction-Biocompatibility –Biofunctionality-Metals and Alloys in biomaterials- Ceramic biomaterials-Composite biomaterials- polymer biomaterials-biopolymers-tissue grafts-soft tissue applications-biomaterials in ophthalmology- Dental materials

Advanced Materials

Metallic glasses: preparation, properties and applications – Shape memory alloys (SMA):Characteristics, properties of NiTi alloy, application- MEMS – Nanomaterials: Properties- Top-down process: Ball Milling method – Bottom-up process: Vapour Phase Deposition method- Carbon Nano Tube(CNT): Properties, preparation by Electric arc method-Applications

Bio-Instrumentation

Ultrasound picture of human body-Block diagram of basic pulse echo system – A Scan, B Scan and M Scan-Psychological effect of ultrasound therapy-Phonocardiograph(PCG)-Source of radioactivity for nuclear medicine-Statistical aspects-Basic instrumentation(Geiger-Muller counter)-Photomultiplier tube and scintillation detector (Renogram) and its clinical applications(Thyroid and kidney function)-Nuclear medicine imaging devices-Gamma camera-Positron camera

UV And IR Spectroscopy

Introduction-Electromagnetic radiation-UV-Visible Spectroscopy-Single beam spectrophotometer-Double beam spectrophotometer-Radiation sources-Detectors-Beer Lambert's law-Applications of UV spectroscopy-IR spectroscopy - IR spectrometer-Applications of IR spectroscopy.

Raman, NMR, ESR and FTIR Spectroscopy

Raman Effect –Experimental study of Raman Effect-quantum theory of Raman effect-Applications-NMR spectrometer-Applications of NMR-ESR spectrometer-Applications-FTIR spectroscopy-Applications

Text Book(s) :

1. P.K.Palanisamy "Physics of Materials", Scitech Publications,Chennai-2012

Reference(s) :

1. B.Willard and Merit, "Instrumental methods of Analysis", CBS Publishers and Distributors Pvt.Ltd., New Delhi, 1986.
2. B.K.Sharma, "Spectroscopy", Goel Publishing House, Meerut, UP-2001
3. R.Murugesan, "Modern Physics" S.Chand Publications, New Delhi, 2010.

K.S. Rangasamy College of Technology - Autonomous

41 CH 007 - Environmental Science and Engineering

Common to All Branches

Semester	Hours / Week			Total hrs	Credit	Maximum marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)

- To help the learners to analyze the importance of ecosystem and biodiversity.
- To familiarize the learners with the impacts of pollution, control and legislation.
- To enlighten the learners about waste and disaster management.
- To endow with an overview of food resources and human health.
- To enlighten awareness and recognize the social responsibility in environmental issues.

Course Outcomes

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

1. recognize the concepts and issues related to environment and ecosystem.
2. assess the importance of biodiversity
3. analyze the source, effects, and control measures of pollution.
4. imbibe the applications of Laws of environmental protection.
5. appraise the methods of solid waste management.
6. increase the awareness of disaster management and preparedness.
7. instill the awareness on the impacts of food resources and its related problems.
8. evaluate the problems related to population explosion and its related health issues.
9. analyze the value of sustainable development.
10. identify the issues related to environmental issues and civic responsibilities.

Environmental Studies, Ecosystem and Biodiversity

Environment - Segment - Environmental studies - Scope and multidisciplinary nature - Need for public awareness - Environmental ethics- Ecosystem - Structure and function - Ecological succession. Biodiversity - Values of biodiversity - Endangered and endemic species - Hot spots - India a mega biodiversity nation - Threats - Impact of biodiversity loss - Conservation - In-situ and ex-situ - Case studies.

Environmental Pollution and Legislation

Pollution - Sources, effects and control measures - Air, water, soil, noise, thermal, nuclear and marine - Major polluting industries of India - Land degradation - Impacts of mining. Environmental legislation in India- Environment protection act - Air pollution, water pollution, wildlife protection and forest conservation - Case studies.

Waste and Disaster Management

Waste - Solid waste - Sources, effects and control measures - Management techniques - e-waste - Effluent water treatment - Radioactive waste and disposal methods. Disaster management - Earth quakes - Landslides - Floods - Cyclones - Tsunami - Disaster preparedness - Response and recovery from a disaster - Disaster management in India - Case studies.

Food Resources, Human Population and Health

World food problems - Over grazing and desertification - Effects of modern agriculture - Fertilizer – Pesticide - Problems, water logging and salinity. Population - Population growth and explosion - Population variation among nations. Human rights - Value education - Women and child welfare - HIV/AIDS - Role of IT in environment and human health - Case studies.

Social Issues and the Environment

Unsustainable to sustainable development - Use of alternate energy sources - Energy Conversion processes - Biogas - Anaerobic digestion - Production and uses - Water conservation - Rain water harvesting - Water shed management - Resettlement and rehabilitation of people - Deforestation - Green house effect - Global warming - Climate change - Acid rain - Ozone layer depletion - Waste land reclamation. Consumerism and waste products - Role of an individual in conservation of natural resources - Case studies.

Text book(s):

1. Tyler miller. G, “Environmental Science”, 13th Edition Cengage Publications, Delhi, 2013.

Reference(s):

1. Gilbert M.Masters and Wendell P. Ela,”Environmental Engineering and Science”, Phi learning private limited, New Delhi, 3rd Edition, 2013. Learning private limited, New Delhi, 3rd Edition, 2013.
2. Rajagopalan. R, “Environmental Studies” Oxford University Press, New Delhi, 2nd Edition, 2012.
3. Deeksha Dave and Katewa. S.S, “Environmental Studies” 2nd Edition, Cengage Publications, Delhi, 2013.

K.S.Rangasamy College of Technology - Autonomous

41 EE 001 - Basics of Electrical Engineering

Common to CE, BT, NST,CS & IT

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To determine the voltage, current, power in resistive elements of simple DC circuits by understanding the concept of series-parallel circuit reduction technique. • To determine the Impedance, Power and Power factor in series RL, RC and RLC circuits by understanding the concept of instantaneous, RMS and average value of Voltage/Current in an AC source. • To describe the application of Faraday's, Lenz's laws and Fleming's rules, and determine the performance of transformers. • To explain the construction, working principle, types and applications of electromechanical energy conversion devices such as DC machines, Induction motors, synchronous generators and stepper motors. • To impart the basic knowledge on power system and its components, simple house wiring layout, types and need for earthing, and energy conservation.
Course Outcomes	**At the end of the course, the students will be able to** 1. Identify the basic elements of electrical circuits and define important terms with their units. 2. Solve DC circuits using Ohm's & Kirchhoff's laws. 3. Characterize the single and three phase AC supply. 4. Calculate impedance, power and power factor of single phase AC circuits. 5 Express the principle of electromagnetic induction and identify its usefulness in electrical engineering. 6 Explain the principle of operation of transformers and calculate its regulation and efficiency. 7 Describe the construction and working of DC machines and identify their applications. 8 Explain the construction and working of AC machines and identify their applications. 9 Outline the components of various sub-systems in a power system. 1. 10. Sketch the layout of simple house wiring by identifying the wiring materials and express the need for energy conservation.

DC Circuits

Basic elements – resistance, inductance and capacitance – Definitions and Units: Current, Voltage, Power and Energy – Ohm's law – Kirchhoff**'**s laws – Simple Series and Parallel circuits.

AC Circuits

Introduction to AC circuits –Single and Three phase AC supply – Advantages of Three phase AC system – Instantaneous, RMS and average value for sine wave form –Series RL,RC and RLC Circuits – Impedance, Admittance, Power and Power factor – Practical importance of power factor – Power & Energy Measurement.

Electromagnetic Induction

Faraday's law of Electromagnetic Induction, Fleming's rules and Lenz's law.

Transformers

Construction, Principle of operation, types, regulation and efficiency, all day efficiency -– Current and Potential transformers.

Generators and Motors

DC Machines:Construction, Principle of operation, types and applications - Three phase and Single phase Induction motors:Construction, Principle of operation, types and applications – Synchronous Generators: Construction, types, principle of operation, regulation – Stepper Motor: Construction, Principle of operation and applications.

Power Systems

Structure of power system – Generation system – Transmission System – Distribution system – Power system protection.

House Wiring

Wiring material and Accessories – Simple wiring layout – Earthing – Lightning Arrestor – UPS – Energy Conservation.

Text book(s):

1	S. Sukhija, T.K. Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford University Press, 2012.
2	M.Maria Louis, "Elements of Electrical Engineering", PHI, New Delhi, 2014.

Reference(s):

1	V.K.Mehta, Rohit Mehta, "Principles of Electrical Engineering", S.Chand Publications, New Delhi, 2014.
2	Edward Hughes, "Electrical and Electronic Technology", Pearson Education, 9th Edition, New Delhi, 2009.
3	Del Tora "Electrical Engineering Fundamentals" Pearson Education, New Delhi, 2007
4	S.P.Bihari and Bhu Pendra Sehgal, "Basic Electrical Engineering – Made Easy", Cengage Learning
5	Alan S Moris, Principles of Measurements and Instruments, Prentice Hall of India Pvt. Ltd, New Delhi, 1999.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 201 - Bioinstrumentation								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To enable students to learn about the basic concepts of pH measurement and working mechanism of various instruments. • To learn the basic concepts of measurement of radioactivity and its applications in radiopharmaceuticals.
Course Outcomes	**At the end of the course students will be able to** 1. categorize the principle, procedure and application of electrochemical techniques for measurement of pH. 2. identify the types and working mechanisms of centrifuge for application in biotechnology laboratories 3. recognize the nature, techniques for measurement of radioactivity of the particles and types of radioisotopes. 4. illustrate the biomedical application of radioisotopes in radiopharmaceuticals. 5. explore the basic concept of different chromatographic methods. 6. evaluate the principle, types and applications of different chromatographic techniques for the physical separation of a mixture of compounds. 7. discriminate the physical basis of electrophoresis and its development. 8. assess the principle, types and applications of different electrophoresis techniques for separation and analysis of macromolecules. 9. understand the applications of sterilization instruments used in biotechnology laboratories. 10. classify the various analytical instruments for measuring concentration of suspended particulates in a liquid.

Electrochemical and Centrifugation Techniques

Measurement of pH and its significance; Principle, operation, applications- Glass electrode- Clark Oxygen electrode. Determination of pH by using the pH meter. Centrifugation- Basic principles, types of centrifuges and applications in biological science- Types of centrifugation - Preparative, analytical, ultra centrifuge.

Radioisotopes

Nature of Radioactivity- Types and principles of radioactive isotope, Decay and half life units of radioactivity, physical basics of instrumentation and measurement of radioactivity – Radiation and detectors and application – Autoradiography and Radioimmunoassay, Liquid scintillation counter, Tracer Techniques.

Chromatographic Techniques

Definition, principle, performance parameters, retention, resolution, types of chromatography principles and application of Paper, Column, Affinity, Adsorption, Partition chromatography, TLC, ion exchange, GC and HPLC. Types of exchangers, DNA cellulose chromatography.

Electrophoresis

Physical basis of Electrophoresis, development, principles, types- moving boundary, gel, starch, polyacrylamide, non-denaturing and denaturing, electro – blotting. 2D-SDS PAGE and iso electric focusing. Agaraose gel – applications in DNA analysis and capillary electrophoresis.

Instrumentation for Biotechnology

Principle and application of Laminar Airflow system, autoclave – horizontal and vertical, hot air oven, incubator and types , flame photometer, nephlometer, fluorimeter, mass spectrometer and its detectors.

Text book(s):

1. Upadhyay, A., Upadhyay, K. and Nath, N., “Biophysical Chemistry: Principles and Techniques”, 4th Edition, Himalaya Publishing House, New Delhi, 2007.
2. Wilson, K. and Walker, J., “Practical Biochemistry”, 5th Edition, Cambridge University Press, Cambridge, UK, 2008.

Reference(s):

1. Willard, H. H., Merritt, Jr. L., Dean, J. A. and Settle, Jr. F. A., “Instrumental Methods Analysis”, 7th Edition, CBC Publishers and Distributors, New Delhi, 2007.
2. Ewing, G.W., “Instrumental Methods of Chemistry Analysis”, McGraw Hill Publication, New Delhi, 1989.

K.S.Rangasamy College of Technology - Autonomous								
40 PH 0P1 - Physics Laboratory								
Common to ME, MC, CE, TT, BT & NST								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	0	0	3	45	2	50	50	100

Objective(s)	• To give exposure for understanding the various physical phenomena in mechanics, optics, materials science and properties of matter. • To correlate the theoretical principles with application oriented studies.
Course Outcomes	**At the end of the course students will be able to** 1. Know the concept of parameters, such as stress, strain and elastic limit needed to achieve a given amount of deformation in the given material. 2. Grasp the knowledge of dependency of viscosity of a liquid on its density and velocity of liquid motion 3. Imbibe the property of surface tension and capillarity action in fluid dynamics, which are due to the pressure of cohesion and adhesion that causes the liquid to work against gravity 4. Understand the phenomenon of interference of light between the two reflected lights from a flat (glass plate) and spherical surfaces (Plano-convex lens) that produces puddles of Newton's rings, the application of which is an accurate measure of the size of any hollows and heights on a surface by counting the rings and knowing the wavelength of the illumination 5. Comprehend the diffraction property of light through a spectrometer grating element which yields the wavelength of mercury spectral lines 6. Know the concept of interference of light between two reflected lights from a thin air wedge. 7. Understand the concept of a wave encountering an obstacle (particle) that is comparable in size to its wavelength, undergoing scattering (diffraction) by particles and to apply it find the wavelength of light and the particle size. 8. Apply the knowledge of semiconductor thin films in conversion of optical energy into electrical energy, the application being the photovoltaic solar cells employed as one of the potential and perennial renewable energy source

List of Experiments

1. Determination of Young's modulus of a steel bar by uniform bending method.
2. Determination of Young's modulus of a cantilever (Pin & Microscope method).
3. Determination of rigidity modulus of a wire by torsional pendulum.
4. Comparison of co-efficient of viscosity of two different liquids by Poiseuille's method.
5. Comparision of surface tension of two different liquids by capillary rise method.
6. Determination of radius of curvature of a plano convex lens using Newton's rings.
7. Determination of wavelength of mercury spectral lines using spectrometer grating element.
8. Determination of thickness of a fiber by air wedge.
9. Determination of wavelength of laser and particle size.
10. V-I characteristics of Solar cell.

Lab Manual :

1. "Physics Lab Manual", Department of Physics, KSRCT.

K.S.Rangasamy College of Technology - Autonomous								
40 ME 0P2 - Engineering Practices Laboratory								
Common to all Branches								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	0	0	3	45	2	50	50	100
Objective(s)	• To provide exposure to the students with hands on experience on various basic engineering practices in Mechanical Engineering							
Course Outcomes	**At the end of the course, the student will be able to** 1. Make a model of fitting like Square and V fitting using fitting tools 2. Make a model of carpentry like Dovetail joint, and cross lap joint using carpentry tools 3. Fabricate the models of sheet metal in sheet metal shop. 4. Prepare joints by arc welding 5. Construct electrical wiring circuit and demonstrate in electrical wiring section 6. Construct the water pipe line in plumbing shop							

Fitting

Safety aspects in Fitting, Study of tools and equipments, Preparation of models- Filing, Square, Vee.

Carpentry

Safety aspects in Carpentry, Study of tools and equipments, Preparation of models- Planning, Dove tail, Cross Lap.

Sheet Metal

Safety aspects in Sheet metal, Study of tools and equipments, Preparation of models- Scoope, Cone, Tray.

Welding

Safety aspects of welding, Study of arc welding equipments, Preparation of models -Lap, butt, T-joints. Study of Gas Welding and Equipments.

Electrical Wiring And Plumbing

Safety aspects of Electrical wiring, Study of Electrical Materials and wiring components, Wiring circuit for a lamp using single and stair case switches. Wiring circuit for fluorescent lamps, wiring circuit for 3 phase motor. Study of plumbing tools, assembly of G.I. pipes/ PVC and pipe fittings, Cutting of threads in G.I.Pipes/PVC by thread cutting dies.

Lab Manual:

1. “Engineering Practices Lab Manual”, Department of Mechanical Engineering, KSRCT.

K.S.Rangasamy College of Technology - Autonomous								
40 ME 0P1 - Engineering Graphics Laboratory								
Common to BT, CS, EE, EC, IT, NST & EI								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	0	0	3	45	2	50	50	100

Objective(s)	• To enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient • To impart the graphic skills for communicating concepts, ideas and designs of engineering products
Course Outcomes	**At the end of the course the students will be able to** 1. Use the drawing instruments, drafting software and construct the conics 2. Draw the projection of points, straight lines and plane surfaces 3. Draw the projection of simple solids 4. Draw the true of section of solids 5. Develop the lateral surfaces of prism, pyramid, cylinder and cone 6. Convert the pictorial views in to orthographic views 7. Sketch the three dimensional view of solids given orthographic views.

Introduction to Engineering Drawing

Introduction to Drafting Software, Drawing Sheet Layouts - Title Block - Lines - Dimensioning, Construction of Pentagon, Hexagon, Conic Sections. Construction of Ellipse and Parabola (Eccentricity method only) with tangent and normal. Introduction to cycloid Involutes of square and circle.

Projection of Points, Lines And Planes

Projection of points, straight lines and plane surfaces in first quadrant (parallel to one plane and inclined to other), true length, true inclinations.

Projection of Solids

Projection of solids of Prisms, Pyramids, Cylinder and Cone using change of position method (axis is parallel to one plane).

Section of Solids

Section of solids of Prisms, Pyramids, Cylinder and Cone by cutting plane inclined to one reference plane (base is on HP and axis perpendicular to HP), true shape of section.

Development of Surfaces

Development of lateral surfaces of simple and truncated solids: Prisms, Pyramids and Cones with square hole perpendicular to the axis.

Orthographic Projection

Theory of projection - Terminology, Method of projection – Introduction of First angle and Third angle projection. Conversion of pictorial views into orthographic views.

Isometric Projection

Principles of isometric projection, Isometric scale - isometric projections of simple solids - Prisms, Pyramids and Cones.

Text book(s):

1	Bhatt N.D., “Engineering Drawing”, Charotar Publishing House Pvt. Ltd., 49th edition, Anand, Gujarat, 2006.
2	Venugopal K., “Engineering Graphics”, New Age International (P) Limited, 2002.

Reference(s):

1	Kulkani D.M, Rastogi A.P, Sarkar A.K, “Engineering Graphics with AutoCAD”, PHI Learning Private Limited, New Delhi, 2009.
2	Natarajan K.V., “A textbook of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2006
3	Shah M.B. and Rana B.C., “Engineering Drawing”, Pearson Education, 2005.

K.S.Rangasamy College of Technology - Autonomous								
40 MA 007 - Fourier Series and Numerical Methods								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	1	0	60	4	50	50	100

Objective(s)	• To teach students how to use Fourier series and Fourier transform for engineering discipline. • To acquire analytical skills in the areas of one dimensional boundary value problems. • To describe the concepts of solving system of equations. • To solve initial value problems of ordinary differential equations numerically.
Course Outcomes	**At the end of the course, the students will be able to** 1. Obtain the Fourier series expansion for the periodic function. 2. Understand the notions of half – range Fourier series and harmonic analysis. 3. Know about the procedure to find the solution of one-dimensional wave equation with zero or non-zero velocity. 4. Understand the procedure to find the solution of one-dimensional heat equation with steady state or unsteady state condition. 5. Apply Fourier transform technique and Parseval's identity for the continuous function. 6. Discuss the Fourier sine and cosine transforms and properties of Fourier transforms. 7. (i) Employ different techniques to find approximate roots of algebraic and transcendental equations of higher degrees. (ii) Solve the system of linear equations using direct methods 8. (i) Solve the system of linear equations using iterative methods. (ii) Find the largest Eigen value of a matrix of order 2x2 and 3x3. 9. Apply different integration techniques to evaluate single definite integrals. 10. Compute point wise solutions for initial value problem of first order ordinary differential equations using single step and multi step methods.

Fourier Series

Dirichlet's conditions – Fourier series – Odd and Even functions – Half range Fourier series – Root mean square value of a function – Parseval's identity – Harmonic analysis.

Boundary Value Problems

Classification of second order quasi-linear partial differential equations – Solution of one-dimensional wave equation – Solution of one-dimensional heat equation.

Fourier Transform

Fourier transform pair – Fourier transform of simple functions – Fourier sine and cosine transform – Properties – Convolution theorem – Parseval's identity.

Solution of Equations and Eigen Value Problem

Newton-Raphson method – Regula falsi method – Horner's method – Solution of linear system: Gauss elimination method – Gauss-Jordan method – Iterative methods: Gauss-Jacobi method – Gauss-Seidel method – Eigen values of a matrix by power method.

Numerical Integration And Initial Value Problems

Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Single step methods: Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method for solving first order equation – Multi step methods: Milne's predictor and corrector method – Adam's predictor and corrector method.

Text book(s):

1	Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, New Delhi, 2012.
2	Kreyszig E, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons (Asia) Limited, New Delhi, Reprint 2012.
3	Grewal B.S and Grewal J.S, "Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.

Reference(s):

1	Veerarajan T, "Engineering Mathematics-III", 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
2	Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", 9th Edition, Lakshmi Publications Pvt Ltd, New Delhi, 2014.
3	Kandasamy P, Thilagavathy K and Gunavathi K, "Numerical Methods", 3rd Edition, S.Chand & Company Ltd, New Delhi, 2003.
4	Subramaniam N, "Numerical Methods", SCM Publisher, 2nd Edition, Erode, 2010.

K.S.Rangasamy College of Technology - Autonomous

40 BT 301 - Biochemistry

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)

- To impart concept on Protein Engineering, Biochemical Engineering and Enzyme Engineering.
- To learn basic principles in biological molecules and its structure
- To examine the classification of biological molecules with referance to its metabolism.

Course Outcomes

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

1. pronounce major types of biochemical molecules, including small, large and supermolecular components found in cells.
2. recognize the different types of biochemical molecules and know their essential chemical characteristics that make them indispensible for life.
3. comprehend the structural functions and properties of proteins.
4. categorize the types of nucleic acids and their specialized structures.
5. illustrate how common foodstuffs are turned into metabolic energy and will be able to predict the energy content and value of different classes of chemical compounds.
6. calculate the energy yield from the catabolism of biomolecules.
7. reconstruct the anabolism of the essential building blocks of life.
8. explain the conversion of essential build blocks to specialized products.
9. describe the purpose of the electron transport chain (particularly complexes I, III, and IV) and ATP synthase, their substrates and products, their cellular localization, and their tissue distribution.
10. explicate how the cellular ATP:ADP ratio regulates the rate of ATP production by oxidative phosphorylation.

Biomolecules I

Carbohydrates: Classification, basic chemical structure, Structure and function of major lipid subclasses- acylglycerols, circulating lipids, Separation techniques Lipoproteins, chylomicrons, LDL, HDL, and VLDL. Vitamins and Co-enzymes: Classification, water-soluble and fat-soluble vitamins, coenzyme forms.

Biomolecules II

Proteins: Structure and Classification of Proteins. Primary structure, Secondary structure, Tertiary structure and Quaternary structure, aggregated proteins, Structural importance in function, Denaturation and Renaturation. Nucleic acids: Structure of nucleic acids, Structure of DNA, specialized secondary structures, Principle kinds of RNA and their structures.

Carbohdrates And Lipid Metabolism

Glycolysis: Anaerobic pathway of glucose metabolism, energy balance sheet and regulation, Citric acid cycle: Aerobic pathway of glucose metabolism. Alternate pathways of carbohydrate metabolism: Pentose phosphate pathway. Lipid metabolism: Fatty acid metabolism, Beta oxidation of saturated and unsaturated fatty acids, energetics of beta oxidation.Other types of fatty acid oxidation. Biosynthesis of lipid and cholesterol. Numerical problems on energy balance sheets.

Nitrogen Metabolism

Oxidative degradation of amino acids: Transamination, oxidative deamination, decarboxylation, Biosynthesis of urea, conversion of amino acids in to specilazed products: Spermine, DOPA, Dopamine, Epinephrine, Nor epinephrine, Hippurate. Biosynthesis of Purine and pyrimidine nucleotides: Denovo and salvage pathway Purine and pyrimidine degradation.

Bioenergetics

Electrochemical potential and redox reaction, Mitochondrial electron transport chain, oxidative phosphorylation, chemical coupling, conformation coupling and chemiostatic theories for oxidative phosphorylation, uncouplers and inhibitors of respiratory chain. Numerical problems based on the above.

Text book(s):

1. Lehninger “Principles of Biochemistry”, David L. Nelson and Michael M. Cox. Palgrave Macmillan, Freeman, Low Price Edition, 4th edition, 2007

Reference(s):

1. “Harper’s Illustrated Biochemistry”, Robert K. Murray, Daryl K. Granner and Victor W. Rodwell. McGraw Hill Lange, International edition, 27th edition, 2006.
2. Lubert Stryer, “Biochemistry”, 4th edition, W. H. Freeman and Co., New York, USA, 2002.

K.S.Rangasamy College of Technology - Autonomous

40 BT 302 - Microbiology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To impart the knowledge about the microorganisms and its classifications. • To learn basic aspects of microbial growth, development and metabolism. • Recognize and label the applications of microorganisms for industrial applications.
Course Outcomes	**At the end of the course, the students will be able to** 1. outline the existence of various types of microorganisms in the world. 2. generalize the basics of structural organization and reproduction of microorganisms 3. classify microorganisms based on Bergey's manual and Whittaker's concept. 4. identify the microorganisms by staining methods. 5. know the nutritional requirements for culturing microorganisms 6. elucidate the pattern of growth curve and growth kinetics of microbes. 7. deliver the processes involved in sterilization, preservation and sanitation of microbes 8. characterize antimicrobial agents to control their growth 9. illustrate the applications of primary and secondary metabolites in the production of organic and inorganic compounds 10. prioritize bioremediation process using microbes for pollution control

Introduction to Microbiology

Basics of microbial existence; structural organization and multiplication of bacteria- cell wall, flagella, endospore- actinomycetes, mycoplasma, archeabacteria, viruses, bacteriophage - lytic and lysogeny, algae, fungi, yeast, lichens and protozoan.

Classification and Identification of Microorganisms

Classification systems- phenetic, numerical, phylogenetic. Major characteristics used in taxonomy. Bergey's manual of determinative bacteriology. Identification of bacteria; staining methods- Gram's staining, capsule staining and fungal staining, preservation of microorganisms.

Microbial Nutrition and Growth

Nutritional requirements of bacteria - carbon, nitrogen, phosphorus, sulphur. Nutritional classification of bacteria. Different media used for bacterial culture; The mathematics of growth - generation time, kinetics of growth-mean generation time (*g*) and mean growth rate constant (*k*) - calculations. Influence of environmental factors on growth - pH, temperature, pressure, oxygen and salt. Measurement of microbial growth - cell mass and cell numbers.

Control of Microorganisms

Sterilization and disinfection - Physical methods and Chemical methods; assessment of chemical disinfectant-phenol coefficient test; host - microbe interactions; anti-bacterial, anti-fungal and anti-viral agents, mechanism and mode of action - drug resistance; clinically important microorganisms.

Industrial and Environmental Application

Primary metabolites and secondary metabolites and their applications; Industrial production of Streptomycin; Citric acid, Vitamin B12 and Steroid biotransformation; Role of microorganisms in Industrial effluent treatment – Microorganisms and pollution control, bioleaching; biofertilizer.

Text book(s):

1	Prescott, L.M., Harley, J.P. and Klein, D.A. "Microbiology", 7th edition, TATA McGraw-Hill Publications, New Delhi, India, 2010.
2	Pelczar, M.J., Chan, E.C.S. and Krieg, M.R. "Microbiology: An application Based Approach". TATA McGraw-Hill Publications, New Delhi, India, 2005.
3	Crueger, W. and Crueger, A. "Biotechnology: A text book of Industrial Microbiology". 2nd edition, Panima Publishing Corporation, New Delhi, India, 2004.

Reference(s):

1	Black, J.G. "Microbiology: Principles and Explorations". 6th edition. John Wiley and Sons, Inc, Singapore, 2004.
2	Kamal, Rao, G.P. and Modi, D.R. "Concepts of Microbiology". International Book Distributing Co., Lucknow, India, 2005.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 303 - Food Biotechnology								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To gain basic knowledge in select various aspects of food processing principles, equipments and food engineering operations in food industries . • To interpret the characteristics of various for preservation techniques. • Recognize and label the role of various agencies applied in food processing.
Course Outcomes	**At the end of the course, the students will be able to** 1. illustrate the basic concepts of food processing technology and quality improvement. 2. differentiate the various types of advance food processing methods like pulse electric field, ultra high pressure, modified atmosphere storage and packing. 3. learn the properties food and processing theory 4. investigate the importance of preparative, food conversion operation and the equipments related to food processing industries. 5. know the production process of value added products such as paneer, butter, ice cream, jam, jelly, squash, sauce and fruit juice powders 6. infer the concept and processing techniques of bakery, meat and poultry processing technology. 7. learn the importance of food fermentation technology and processing methods of fermented foods. 8. delineate the research focusing area such as probiotics and application of enzyme in food industry. 9. determine the concept of sensory evaluation responsible for food quality. 10. describe the types and regulation of organizations dealing with quality assurance and food safety.

Principles of Food Processing

Principles and methods of food preservation; thermal processing of food - 12D concept - blanching - pasteurisation - canning; freezing - evaporation - dehydration - radiation, pulse electric field - ultra high pressure - Modified atmosphere storage and packing, Food additives.

Food Engineering Operations

Properties of foods and processing theory - liquid, solid and gases: density, specific gravity, viscosity, surface activity - rheology and texture, flavour. Storage and transport, Raw material preparative operation - theory and equipments used: cleaning, grading, peeling. Food conversion operation - size reduction, mixing, emulsification, filtration, membrane separation, extraction, crystallization.

Application of Food Processing

Technology of milk and milk products - processing of market milk: Types of milk products: paneer, butter, Ice cream, Vegetables and Fruits processing technology - Jam, jelly, squash, sauce and fruit juice powders. Recent trends in meat processing - post-mortem changes- meat tenderization - poultry processing. Baking technology: Bread, Cake and Biscuit preparation.

Fermentation Technology

Food fermentation - general principles- culture maintenance. Production process of fermented foods - Cheese, Yoghurt, sauerkraut, pickles; Industrial production of alcoholic beverages: beer and wine - non-alcoholic beverages - tea. Oriental fermented foods. Microorganisms as food: probiotics and prebiotics, single cell protein. Applications of enzymes in food processing.

Food Quality and Management

Sensory evaluation of food quality: appearance, textural, flavour factors - Nine hedonic scale - Food safety - Organizations dealing with inspection, Certification and quality assurance, Food safety standards: WHO, FPO, MMPO, HACCP, GMP, FSSAI.

Text book(s):

1	Fellows, P.J., “Food processing Technology - Principle and Practice” second edition, Wood head publishing limited, Cambridge, 2005.
2	Dennis, R.H. “Food process Engineering” The AVI publishing co., Connecticut. 1971.

Reference(s):

1	Frazier, W.C and Westhoff, “ Food Microbiology”, Tata McGraw – Hill. New Delhi, 1988.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 304 - Principles of Chemical Engineering								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	1	0	60	4	50	50	100

Objective(s)	• To impart concept on material balance and Energy balance. • To learn basic principles in mechanical operations with reference to classification and application. • To identity and understand the fluid transport through various methods.
Course Outcomes	**At the end of the course, the students will be able to** 1. outline the basis of units and dimensions for unit operations and unit processes 2. analyze the basics of material balance calculations with and without chemical reactions 3. demonstrate the basic steps in energy balance calculations and enthalpy changes accompanying chemical reactions 4. analyze the problems on heat capacities and energy balance calculations 5. demonstrate the size reduction equipment and sieve analysis 6. calculate the power requirement in size reduction equipment and size separation of solids 7. classify the fluids and analyze the characteristics of fluids 8. interpret the mechanical energy balance and frictional losses in pipe fittings 9. illustrate the types and performance of pumps 10. design packed and fluidized bed column for pressure drop and minimum fluidization velocity calculations

Fundamental Concepts and Material Balance

Unit operations and unit processes; units and dimensions, basic laws, unit conversion; Material balance: guidelines for material balance calculations; material balance with and without chemical reactions; calculations in unit conversion and material balance with / without chemical reactions. Basic of recycling and bypass in unit operations.

Energy Balance

Basic steps in energy balance calculations; heat capacities, enthalpy changes accompanying chemical reactions-heat of reaction, heat of formation, heat of combustion and Hess law; adiabatic processes; problems on heat capacities and energy balance calculations.

Mechanical Operations

Size reduction: classification, laws of size reduction, equipments; sieve analysis: screening, differential and cumulative sieve analysis; problems in power requirement of size reduction equipments and screen effectiveness; storage of solids-bin, silo & hopper. Separation of solids based on specific properties: Gravity settling, Classifier, Cyclones, Jigging, and froth flotation.

Flow of Fluids

Nature of fluids: classification, hydrostatic equilibrium, application of fluid statics; concept of viscosity; concept of boundary layer; equation of continuity, mechanical energy balance for steady flow-Bernoulli's equation ; friction factor, frictional losses in laminar flow and turbulent flow, fric tional losses in pipe fittings.

Fluid Transport and Flow Through Packed Bed / Fluidized Bed

Pumps: Types-centrifugal pump and positive displacement pumps; Packed bed: flow through porous media-pressure drop calculations, Ergun equation, Kozeny carman equation, Burke-Plummer equation, Fluidization: principle; types, minimum fluidization velocity and applications.

Text book(s):

1	Gavhane K.A., "Introduction to Process Calculation", Nirali prakashan Publication, New Delhi, 2008.
2	McCabe, W.L., Smith, J.C, Harriot, P., "Unit Operations In Chemical Engineering", 7th edition, McGraw-Hill Inc., New Delhi, 2004.
3	Salil K ghosal, Shyamal K sanyal, Siddhartha Datta, "Introduction to Chemical Engineering", Tata McGraw-Hill Publication, New Delhi, 2011.

Reference(s):

1	Geankoplis C.J., "Transport Processes and Unit Operations", Prentice Hall India, New Delhi, 2002.
2	Bhatt, B.I., Vora S.M., "Stoichiometry", 5th edition, Tata McGraw-Hill Publication, New Delhi, 2004.

K.S. Rangasamy College of Technology - Autonomous								
40 PH 008 - Applied Physics								
Common to all Branches								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To enhance students' knowledge of theoretical and modern technological aspects in physics • To enable the students to correlate the theoretical principles with application oriented studies
Course Outcomes	**At the end of the course the students will be able to** 1. explain the principle of laser emission and classification of lasers 2. identify the applications of lasers. 3.explain the propagation of lights in fibre optic cables, classification of fibre, splicing and their fabrication. 4. describe the fibre optic communication link, its applications and light propagation losses. 5. explain the production and detection of ultrasonic waves. 6. identify the industrial and medical applications of ultrasonic waves. 7. explain the development of quantum theory and its applications. 8. describe the concepts of nuclear physics and identify the elementary particles. 9. classify the sound and analyze its characteristics 10. give suggestions for buildings with good acoustics

Laser Technology

Introduction – Principle of spontaneous emission, stimulated absorption and emission – Einstein's co-efficient (derivation)-population inversion-pumping mechanisms – Types of lasers: Nd:YAG, Semiconductor laser (homo junction and hetero junction), CO_2 laser – Industrial applications: Lasers in welding, cutting, drilling and soldering- Medical applications: laser endoscopy,– Holography: Construction and reconstruction of hologram –Applications.

Fiber Optics and Sensors

Principles – Cone Of Acceptance, numerical aperture (derivation)- Modes of propagation –Fabrication: Crucible-crucible technique - Classification: based on materials, modes and refractive index profile– Splicing – types of splicing- Losses in optical fiber – Light sources for fiber optics – Detectors – Fiber optical communication links(Block diagram) – Advantage of fiber optical cable over copper cables- Fiber optic sensors-principle-liquid level sensors- Temperature, Displacement, measurement.

Ultrasonics and Applications

Introduction-Properties-Production: Magnetostriction effect, magnetostriction generator- piezoelectric effect, piezoelectric generator – Ultrasonic detection- acoustical grating-Applications: Cavitation, cleaning, SONAR,– Non destructive testing: Pulse echo system, through transmission, resonance system- Medical applications: cardiology, neurology, ultrasonic imaging (A, B and TM- Scan).

Quantum and Nuclear Physics

Quantum physics: Introduction – de-Broglie hypothesis –Matter waves– Uncertainty principle, application: single slit experiment – wave function-physical significance-Schrodinger's wave equation: Time dependent and time independent – Particle in a box (one dimensional and three dimensional)–Microscopy: Scanning Electron Microscope.

Nuclear Physics: Introduction, atomic nucleus, nuclear force, nuclear density, atomic mass unit - mass defect - Binding energy-Nuclear fission-Energy released in fission- Stellar energy-elementary particles:Leptons, Hadrons: Mesons and Baryons

Acoustics

Introduction-Classification of sound – Characteristics of musical sound – sound intensity level – Weber-Fechner law – loudness level and intensity: Bel, Decibel–Reverberation – Reverberation time – Sabine's formula (derivation) – sound absorption coefficient measuring method -Absorption co-efficient (derivation)– Factors affecting the acoustics of buildings and their remedies - basic requirements for acoustically good halls - acoustical materials.

Text book:

1.	V.Rajendran, Engineering Physics, Tata McGraw Hill Publishers, New Delhi, 2011

Reference(s) :

1.	Jeremy Bernstein, Paul M.Fishbane, Stephen Gasiorowicz, Modern Physics, Pearson Education, 2009.
2.	S.Kalainathan, A.Ruban kumar, Physics for Engineers, RBA publications, Chennai, 2010.
3.	A.Arumugham, Engineering Physics, Anuradha Agencies, Chennai, 2005.

K.S.Rangasamy College of Technology - Autonomous

40 BT 3P1 - Biochemistry Laboratory

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	0	0	3	45	2	50	50	100

Objective(s)

- To determine the characteristics features of various molecules with reference to its analytical characters.
- To evaluate and estimate the biological molecules through various methods.
- To analyze the level of various elements through suitable standards.

Course Outcomes

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

1. carry out experiments follow directions, manipulate materials and lab apparatus, record data etc
2. elucidate the fundamental analysis of carbohydrates qualitatively.
3. determine the total carbohydrate content in cereals by anthrone method.
4. describe the major views to estimate the amount of proteins by Lowry's method.
5. calculate approximately the amount of cholesterol and interpret the results using Zak's method
6. interpret the amount of creatinine present in the sample using Jaff's method.
7. apply the methodology implemented using DAM method to estimate the amount of urea in the given sample.
8. predict and interpret the results by estimating the amount of DNA using diphenylamine method.
9. extract and estimate the amount of lipids Folch *et al*., method.
10. analyze the amount of microelements in soil sample using Flame photometer.

List of experiments

1. Calibration of glass wares- pipettes, burettes and volumetric flasks (demonstration) and Preparation of solutions: 1)percentage solutions, 2) molar solutions, 3) normal solutions
2. Standardisation of pH meter, preparation of buffers.
3. Qualitative analysis:
4. Carbohydrates- general reactions of carbohydrates.
5. Determination of total Carbohydrate content in cereal by anthrone method.
6. Estimation protein by Lowry's method
7. Estimation of cholesterol by Zak's method
8. Estimation of creatinine by Jaff's method.
9. Estimation of urea by Dam method
10. Estimation of DNA by diphenylamine method
11. Estimation of lipids by Folch method
12. Estimation of microelements by Flame photo meter

Lab Manual:

1	Shawney, S.D., "An Introduction to Practical Biochemistry", Narosa Publishing Home, New Delhi, 1996.
2	Palanivelu, P., "Analytical Biochemistry and Separation Techniques", Kalaivani Printers, Tamil Nadu, 2001.

K.S.Rangasamy College of Technology - Autonomous

40 BT 3P2 - Microbiology Laboratory

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	0	0	3	45	2	50	50	100

Objective(s)

- To understand the growth and development of microorganisms through various culturing methods.
- To evaluate and estimate the presence and omnipotence of microbes through various samples.
- To analyze the growth and development of microbe with reference to timeframe.

Course Outcomes

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

1. illustrate the steps involved in developing culture medium for the growth of microbes under in vitro
2. demonstrate the basic steps involved in pure culture techniques
3. interpret the different types of staining techniques for the identification of bacteria
4. perform an experiment to identify yeast and mold by suitable staining method
5. apply a suitable methodology to grow anaerobic organisms in the laboratory
6. outline the process for isolation of microorganisms from soil capable of producing enzymes
7. adapt biochemical characterization for identification microbes through IMViC and carbohydrate fermentation test
8. illustrate the water quality analysis through Most Probable Number test
9. examine the milk quality through Methylene Blue Reduction Test
10. demonstrate the antibiotic sensitivity test for the selected pathogens
11. illustrate the different growth phase of microorganisms through turbidity method
12. plan an experiment to find out the effect of different parameters on the growth of microbes

List of experiments

1. Preparation of culture media – complex, synthetic and selective media.
2. Cultivation of microorganisms – agar slant, streak plate and spread plate.
3. Gram's staining – Gram positive and Gram negative bacteria.
4. Fungal staining – Lacto phenol cotton blue staining of Yeast and Mold.
5. Cultivation of anaerobes.
6. Isolation of enzyme producing microorganisms from soil.
7. Carbohydrate fermentation test.
8. IMViC Test.
9. Rapid detection of bacteriological quality of water samples – Most Probable Number test (MPN).
10. Quality analysis of milk samples - Methylene Blue Reduction Test (MBRT)
11. Antibiotic sensitivity test.
12. Determination of microbial growth.
13. Effect of pH, temperature and UV on microbial growth.

Text Book:

1. Cappuccino, J.G. and Sherman, N. "Microbiology: A Laboratory Manual". 6th Edition. Pearson Education, New Delhi, India, 2004.

K.S.Rangasamy College of Technology - Autonomous

40 BT 3P3 - Food Biotechnology Laboratory

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	0	0	3	45	2	50	50	100

Objective(s)

- To understand the preparation and preservation methods for various food materials.
- To evaluate the preparation process of various food materials using fruits and vegetables.
- To identify the steps involved in the preparation of various bakery and dairy products.

Course Outcomes

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

1. assess the process of blanching through qualitative analysis
2. examine the drying rate of given food materials
3. demonstrate the preparation of osmotic dehydrated products
4. identify the method for preparation of jam and its quality evaluation.
5. demonstrate the process of squash preparation using seasonally available fruits
6. delineate the production process and sensory evaluation of doughnuts
7. interpret dough rising capacity of yeast in bread making process
8. describe the method of preparation of paneer using milk
9. outline the method of preparation of pickles using vegetables
10. illustrate the steps involved in preparation of Sauerkraut

List of experiments

1. Qualitative test for checking of blanching
2. Experiments on determination of drying rate of given food materials
3. Experiment on preparation of osmotic dehydrated products
4. Experiment on preparation and quality evaluation of jam.
5. Preparation of squash using seasonally available fruits
6. Production and sensory evaluation of doughnuts
7. Determination of dough rising capacity of yeast
8. Preparation of paneer using milk
9. Preparation of pickles using vegetables
10. Experiment on preparation of Sauerkraut as fermented food

Reference(s):

1	Sharma Shri, Mulvaney Stevn J and Rizvi Syed S.H., Food Process Engineering: Theory and Laboratory Experiments, Wiley Inter-Science, New York, 1999.
2	Girdhari Lai, Siddappa G.S. and Tandon.L., “Preservation of Fruits and Vegetables”, Indian Council of Agricultural Research, New Delhi. 1986.

K.S.Rangasamy College of Technology - Autonomous Regulation								R2014
Department	**Biotechnology**	**Programme Code & Name**			**B.Tech. Biotechnology**			
Semester III								
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**ES**	**Total**
40 TP 0P1	**Career Competency Development I**	**0**	**0**	**2**	**0**	**100**	**00**	**100**
Objective(s)	To enhance employability skills and to develop career competency							

Unit – 1	**Written Communication – Part 1**	**Hrs**
	Usage of noun, pronoun, adjective (Comparative Forms), Verb, Adjectives, Adverb, Tenses, Articles and Preposition - Change of Voice - Change of Speech - Synonyms & Antonyms - One Word Substitution - Using the Same Word as Different Parts of Speech - Odd Man Out **Materials:** Instructor Manual, Word Power Made Easy Book	8
Unit – 2	**Written Communication – Part 2**	
	Analogies - Sentence Formation - Sentence Completion - Sentence Correction - Idioms & Phrases - Jumbled Sentences, Letter Drafting (Formal Letters) - Reading Comprehension(Level 1) - Contextual Usage - **Materials:** Instructor Manual, Word Power Made Easy Book	6
Unit – 3	**Written Communication – Part 3**	
	Jumbled Sentences, Letter Drafting (Formal Letters) - Foreign Language Words used in English - - Spelling & Punctuation (Editing) **Materials:** Instructor Manual, News Papers	4
Unit – 3	**Oral Communication – Part 1**	
	Self Introduction - Situational Dialogues / Role Play (Telephonic Skills) - Oral Presentations- Prepared -'Just A Minute' Sessions (JAM) **Materials:** Instructor Manual, News Papers	6
Unit – 5	**Oral Communication – Part 2**	
	Describing Objects / Situations / People, Information Transfer - Picture Talk - News Paper and Book Review **Materials:** Instructor Manual, News Papers	6
	Total	**30**

Evaluation Criteria

S.No.	Particular	Test Portion	Marks
1	Evaluation 1 Written Test	50 Questions – 30Questions from Unit 1 & 2, 20 Questions from Unit 5, (External Evaluation)	50
2	Evaluation 2 Oral Communication 1	Self Introduction, Role Play & Picture Talk from Unit-3 (External Evaluation by English and MBA Dept)	30
3	Evaluation 3 Oral Communication 2	Book Review & Prepared Speech from Unit-4 (External Evaluation by English and MBA Dept)	20
		Total	**100**

Reference Books

1. Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.
2. Word Power Made Easy by Norman Lewis W.R. GOYAL Publications

Note :

- Instructor can cover the syllabus by Class room activities and Assignments(5 Assignments/week)
- Instructor Manual has Class work questions, Assignment questions and Rough work pages
- Each Assignment has 20 questions from Unit 1, 2 and Unit 5 and 5 questions from Unit 3 and 4
- Evaluation has to be conducted as like Lab Examination.

K.S.Rangasamy College of Technology - Autonomous								
40 MA 012 - Probability and Statistics								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	3	1	0	60	4	50	50	100

Objective(s)	• To acquire skills in handling situations involving random variables • To familiarize the students with various methods in hypothesis testing • To learn how to use control charts to monitor discrete data
Course Outcomes	**At the end of the course, the students will be able to** 1. acquire the knowledge of random variable and moment generating function. 2. apply discrete and continuous probability distributions to calculate the probability. 3. compute marginal and conditional distributions for discrete and continuous random variables 4. calculate the Covariance, Correlation and the Regression. 5. test the statistical hypothesis using t and F distributions. 6. test the statistical hypothesis for goodness of fit using chi-square test. 7. analyze the variance of factors using CRD and RBD. 8. analyze the design of experiment using Latin square. 9. construct and interpret quality control charts. 10. acquire the knowledge of statistical software.

Probability and Distributions

Random variable – Probability mass function – Probability density function – Moment generating function – Standard Distributions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

Two Dimensional Random Variables

Marginal distribution – Conditional distribution – Covariance – Correlation – Rank Correlation – Regression.

Testing of Hypothesis

Test of significance of small samples – Student's 't' test – Single mean and Difference of means – F- test – Chi-square test – Goodness of fit – Independence of attributes.

Design of Experiments

Analysis of variance – One way classification – Completely randomised design – Two way classification – Randomised block design – Latin square.

Quality Control and Statistical Software

Control charts – Mean $(\overline{X})$chart – Range (R) chart – P chart – nP chart – C chart – Statistical software – SPSS – MATLAB – R – XLSTAT.

Text book(s):

1	Gupta S.C and Kapoor V.K., "Fundamentals of Mathematical Statistics", 11th Edition, S Chand & Company Ltd, New Delhi, 2007.
2	Richard A Johnson, "Miller & Freund's Probability and Statistics for Engineers", 7th Edition, Prentice-Hall of India Private Limited, New Delhi, 2006.
3	Veerarajan T., "Probability, Statistics and Random Process", 2nd Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.

Reference(s):

1	Walpole R.E. Myers, R.H. Myers, R.S.L. and Ye K., "Probability and Statistics for Engineers and Scientists", 7th Edition, Pearson Education, New Delhi, 2002.
2	Mille I.R and Freund J.E., "Probability and Statistics for Engineers", Prentice Hall, New Delhi, 1995.
3	Subramaniam N., "Probability and Statistics", 2nd Edition, SCM Publications, Erode.

K.S.Rangasamy College of Technology - Autonomous

40 BT 401 - Cell and Molecular Biology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	3	0	0	45	3	50	50	100

Objective(s)

- To impart concept on structure, types and transport of the cell.
- To learn basic principles in cell division, signaling and molecular structure of genes and chromosomes.
- To understand the concepts of gene regulation and its expression.

Course Outcomes

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

1. draw the cell wall structure of prokaryotes and eukaryotes and demonstrate the models of plasma membrane.
2. discuss the proteins involved in cell permeability and apply the knowledge of concentration gradient to describe transport of small molecules in cell.
3. explain the process of cell cycle and demonstrate the mechanisms of prokaryotic and eukaryotic cell division
4. illustrate major cell signaling pathways and discriminate the mechanism of protein import and export in various cell organelles.
5. apply the knowledge of DNA structure, base pairing rule and sequence to measure superhelicity and methods to repair DNA mutation.
6. discriminate the molecular events of eukaryotic and prokaryotic chromosomal organization
7. describe the molecular mechanism of DNA replication and explain the importance of telomerase in DNA structural integrity
8. interpret the difference between prokaryotic and eukaryotic transcription initiation and termination
9. justify the importance of ribosome in phylogenetic analysis and explain the decoding process of translation in prokaryotic and eukaryotes
10. apply the knowledge of gene expression to illustrate gene regulation using positive and negative operon.

Cell Structure Permeability and Transport

Present day prokaryotes,Development of multicellular organisms, cell as experimental models, Cell wall structure of bacteria and eukaryotes, Plasma membrane structure and models, cell permeability- concentration gradient and partition coefficient, transport of small molecules- active, passive, ion channels, facilitated diffusions.

Cell division, Cell signalling and protein localization

Process of cell cycle and its regulation, Bacterial cell division, Eukaryotic cell division, mechanics of cell division, Cell signalling – signalling molecules, G protein coupled receptors, Ion-channel receptors, enzyme linked receptors, protein sorting, nuclear localization, mitochondria and chloroplast import and export mechanism.

Molecular structures of genes and chromosomes

Structure of DNA, DNA melting and reannealing, base composition and sequence, size, shape, super twisting, mathematical description of super twisting, methods of measuring of super helicity, levels of DNA packaging, molecular events of prokaryotic and eukaryotic chromosome organization, exon-intorn structure, CpG islands and its importance. DNA mutation and repair mechanism.

Replication and Transcription

Basic rules of replication, replication genes and enzymology of replication, processivity and fedility of replication, rolling circle replication, termination of replication, importance of teleomerase in eukaryotic replication. Molecular events of Prokaryotic and Eukaryotic Transcription – initiation, elongation and termination. Post transcriptional modification.

Gene expression and regulation

Genetic code, Ribosome of prokaryote and eukaryote and its evolutionary importance, mechanism of translation- initiation, elongation and termination. Inhibitors of Translation. Post translational modification. Regulation of gene expression – lac operon, trp operon, ara operon.

Text book(s):

1	Lodish, H., Berk, A., Zipurursky, S. L., Matsudaria, P., Baltimore D, and Darnell, J, “Molecular Cell Biology”, W. H. Free Man and Company, England, 2000.
2	Benjamin Lewin, “Gene IX”, OxfordUniversity Press, New Delhi, India, 2000.

Reference(s):

1	Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P,”Molecular Biology of the Cell”, Garland Science., New York, 2002
2	Watson, J.D, Hopkins, W.H, Roberts, J.W, Steitz, J.A, Weiner, A.M. “Molecular Biology of the Gene”,1987.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 402 - Fermentation Technology								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	3	0	0	45	3	50	50	100

Objective(s)	• To learn the production of primary and secondary metabolites for various industrial applications. • To identify the applications of enzymes and single cell proteins for industrial applications. • To understand the important concepts in fermentation engineering.
Course Outcomes	**At the end of the course, the students will be able to** 1. determine the substrates used for industrial fermentation process 2. illustrate the fermentation process and different stages 3. differentiate the various product recovery techniques 4. illustrate the concept of organic feed stock production using fermentation process 5. characterize the metabolism of secondary metabolite production 6. outline the role of metabolic engineering in process improvement 7. determine the concept of growth kinetics in fermentation 8. investigate the applications of bioconversion and transformation of steroid and non-steroid compounds 9. illustrate the concept of production of microbial fungicides and pesticides, chemicals and pharmaceuticals by fermentation technology 10. design the flow chart of fermentation economics and its calculations

Introduction to Fermentation Technology

Industrial Fermentation, Substrates used for Industrial Fermentation (Carbon and Nitrogen Sources), Methods of Fermentation: Batch, Fed Batch and Continuous, Fermenter systems, Stirring and Mixing, Fermentation process: Different stages of fermentation process, Fermentation medium, Microbial growth kinetics, Batch and Continuous culture calculations.

Production of Primary metabolites

Product Recovery: Centrifugation, Filtration, Chromatography, Sedimentation, Precipitation and Crystallization, Organic feed stocks produced by Fermentation – Ethanol, Acetone, Organic acids (Citric acid, Acetic acid and Lactic acid), Amino acids – L-Glutamic acid and Tryptophan, Calculations for Product recovery and yield.

Production of Secondary metabolites and Process optimization

Mechanism of secondary metabolite production, Examples-Antibiotics (Penicillin, Cephalosporin), Vitamins (Vitamin B_{12}, Riboflavin), Ergot alkaloids, Nucleotides and Nucleosides. Role of metabolic engineering in process improvement, Dynamic optimization of Batch process operations, Rate of Expressions for Cell Growth.

Growth Kinetics and Microbial Transformation

Growth kinetics in fermentation, Kinetics of fed batch fermentation, Kinetics of continuous fermentation, Introduction to Microbial transformation, Types of bioconversion reactions, Procedures for biotransformation, Applications of bioconversion, Transformation of steroid and non steroid compounds, Single cell protein.

Modern Fermentation Technology

Microbial fungicides and Pesticides, Chemicals and Pharmaceuticals made by fermentation, Biopolymers. Microbial leaching, Fermentation economics and its calculations, Future of fermentation technology, Case Study on any two fermented products.

Text book(s):

1	WulfCruger and Anneliese Crueger., “Biotechnology: A Textbook of Industrial Microbiology”, Panima Publishing Corporation, New Delhi. 2003.
2	Pierre-Yves Bouthyette, “Fermentation Technologies”, 2nd edition, Rai University, Ahmedabad, 2005.

Reference(s):

1	Presscott, D. “Industrial Microbiology”, CBS Publishers, New Delhi. 1999.
2	Irwin H.Segel, Biochemical Calculations, John Wiley & Sons, 2nd Edition, Wiley Publishers, New Delhi. 2011.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 403 - Cancer Biotechnology								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	3	0	0	45	3	50	50	100

Objective(s)	• To determine the root causes and identifications of various cancer. • To evaluate the origin and metastasis of cancer • To evaluate various diagnostic and treatment procedure for the cancer disease.
Course Outcomes	**At the end of the course, the students will be able to** 1. determine the importance of diet and modulation of cell cycle in cancer 2. identify the types of cancer cells using biochemical assays and molecular tools for early diagnosis of cancer 3. analyze and interpret the scientific theory of carcinogenesis 4. elucidate the mechanism of X-radiation carcinogenesis and Ultraviolet radiation 5. illustrate the importance of DNA damage and repair during replication and crosslink 6. explain the growth and developmental factors involved in apoptosis and cell proliferation 7. describe the importance and clinical significances of invasion and metastatic phenotype 8. design and develop the structural characteristics of basement membrane disruption and tumor cell invasion 9. recognize and classify the different forms of cancer therapeutic agents and predict the aggressiveness of cancer 10. understand the significance, importance and real time problems of signal targets in cancer therapy, drug therapy and Nano therapy

Fundamentals of Cancer Biology

Introduction to human cancers, Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Tumor genetics: genetic alterations in cancer cells, Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer, Clinical trials.

Principles of Carcinogenesis

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis,Ultraviolet radiation, x-ray radiation-mechanisms of radiation carcinogenesis.

Principles of Molecular Cell Biology of Cancer

DNA Damage and repair: damage during replication and crosslink repair, Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity, Retinoblastoma gene,Molecular Mechanisms of Apoptosis,Cell Proliferation, Growth factors related to transformation, Telomerases.

Principles of Cancer Metastasis

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, Metastatic colonization, Angiogenesis, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

New Molecules for Cancer Therapy

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Molecular diagnostics-hematological cancers-Gene therapy, Drug therapy, Immunotherapy, Nano therapy, A career in cancer research.

Text book(s):

1	Wolfgang Arthur Schulz, “Molecular Biology of Human Cancers”, Springer, 2005.
2	Lauren Pecorino, “Molecular Biology of Cancer Mechanisms, Targets and Therapeutics”, 3rd edition, Oxford University Press, 2012.
3	Challa S.S.R.Kumar, “Nanomaterials for Cancer Diagnosis” Wiley-VCH Verlag Gmbh & Co., 2007.

Reference(s):

1	“An Introduction Top Cellular And Molecular Biology of Cancer”, j Oxford Medical Publications, 1991.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 404 - Protein and Enzyme Engineering								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	3	0	0	45	3	50	50	100

Objective(s)	• To impart concept on Protein Engineering and Enzyme Engineering. • To learn basic principles in enzyme immobilization and its applications. • To evaluate the molecular mechanism of protein using various tools.
Course Outcomes	**At the end of the course, the students will be able to** 1. recognize the structural conformation of proteins and know the nature of motifs in proteins 2. comprehend the structure of chaperones and the role of chaperones in protein folding 3. exemplify the mechanisms of enzyme action and the transformations of Michelis Menton equation 4. demonstrate and analyze the enzyme kinetic parameters based on MWC model 5. illustrate the methodology and types of enzyme immobilization 6. calculate the effect of external and internal mass transfer and determine the kinetics of immobilized enzyme 7. categorize the strategies for protein and enzyme engineering and describe reengineering 8. describe the nature of protein engineering cycle and *in vitro* protein design 9. pronounce the industrial applications of enzymes with examples and antibody engineering 10. exhibit the applications of protein engineering in various industries

Introduction to Proteins and Enzymes

Introduction; Basic structural principles: amino acids and their conformational accessibilities, Ramachandran Plot; Motifs of protein structures and their packing; Structural characterization of proteins: Primary and three dimensional structure determination; Protein folding: Structure of chaperones and role of chaperones in protein folding, Enzymes: definition and nomenclature.

Mechanism and Kinetics of Enzyme catalysis

Mechanism of enzyme action, Concept of active site, specificity of enzyme action, Mechanism and kinetics of single substrate reaction, Transformations of Michelis Menton equation, turn over number, Mechanism and kinetics of Multi substrate reaction MWC model. (Analytical problems in single substrate reactions, turn over number, transformations of MM equations, MWC model).

Enzyme Immobilization & Kinetics Of Immobilization

Immobilization of Biocatalysts an Introduction, Types of enzyme immobilization Electrostatic Effect, effect of charged and uncharged support, Effect of external and internal mass transfer, Damkohler number, effectiveness factor, Intra particle diffusion kinetics, Biot number. (Analytical Problems based on the above concepts).

Strategies for protein and enzyme engineering

Directed Evolution, DNA shuffling and Error Prone PCR, Library construction methods for directed evolution, Rational Protein Design: Reshaping protein specificity, reengineering catalytic mechanisms, engineering by molecular assembling, Protein engineering cycle, Enzymes as target for protein engineering, *in vitro* protein design.

Application of Protein and Enzyme engineering

Importance of recombinant enzymes and proteins, Industrial applications of enzymes, design of enzyme electrodes, Antibody engineering, Case studies on protein engineering applications in food, detergent, environment and health care industries, Example for engineered proteins: proteases, DNA binding proteins, membrane proteins and insulin.

Text book(s):

1	Palmer, T. and Bonner, P., “Enzymes: Biochemistry, Biotechnology and Clinical chemistry”, Affiliated East – West Press Pvt. Ltd., New Delhi, India, 2008.
2	Branden, C. and Tooze, J., “Introduction to Protein structure”, Second Edition, Garland Publishing, New York, US, 1999.

Reference(s):

1	James, E. Bailey and David F. Ollis, “Biochemical Engineering Fundamentals”, 2nd Edition. McGraw Hill, New Delhi. India, 1986.
2	Moody, P.C.E. and Wilkinson, A.J., “Protein Engineering”, IRL Press, Oxford, UK, 1990.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 405 - Biochemical Thermodynamics								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	3	1	0	60	4	50	50	100

Objective(s)	• To learnt about b i o c h e m i c a l thermodynamic relations and properties of fluids such as fugacity, Gibbs- Duhem equation, Phase equilibria etc. • To understand the thermodynamics property of pure fluids and biosolutions. • To implement the novel methods to solve the operating issues in liquefaction of gases using Joule Thomson expansion and Claude process and to solveproblems based on COP, power requirements, network, circulation rate, and pressure.
Course Outcomes	**At the end of the course, the students will be able to** 1. Apply the laws of thermodynamics to predict the thermodynamic properties with respect to PVT behavior 2. Determine the primary properties using equation of state and to elucidate the entropy characteristics 3. Define a fundamental relationHelmoltz and Gibbs free energy, Maxwell's Equations, Clapeyron Equations, and Clausis - Clapeyron Equations 4. Obtain the novel methodology that can be applied by differential equations for entropy, internal energy, enthalpy, Joule-Thomson coefficient, Gibbs-Helmoltz equation, fugacity, fugacity coefficient, activity, effect of temperature and pressure on fugacity 5. Understand the various types of properties such as partial molar properties, concept of chemical potential, fugacity by Lewis Randall rule, Raoult's law, Henry's law,and activity in solutions 6. Analyze the various parameters for pressure and temperature effects, Gibbs-Duhem equations, property changes of mixing in fermenters, heat effects of mixing in biological broths in thermodynamics 7. Apply the criteria for phase equilibria and stability, phase equilibria in single and multicomponent systems withrespect to Dehum's theorem,vapour-liquid equilibria 8. Explicate the properties of V-L-E in ideal and non-ideal solutions, Azeotropes- V-L-E at low pressure with Margules and Vanlaar equations and to study V-L-E at high pressure-equilibrium 9. Design the Refrigeration, refrigerant effect with capacity and to study reversed Carnot cycle, Bell-Coleman cycle, Vapour compression and absorption system, Refrigerants and properties 10. Implement the novel methods to solve the operating issues in liquefaction of gases using Joule Thomson expansion and Claude process and to solveproblems based on COP, power requirements, network, circulation rate, and pressure

P-V-T behaviour of Fluids and Entropy

Graphical representation of PVT behavior - P-T diagram, mathematical representation of PVT behaviour, equations of state for real gases. Problems based on equations of state. Entropy- characteristics of entropy, principle of entropy increases.

Thermodynamic Properties of Pure Fluids

Helmoltz and Gibbs free energy, fundamental property relations, Maxwell's Equations, Clapeyron Equations, Clausis - Clapeyron Equations, differential equations for entropy, internal energy, enthalpy, Joule-Thomson coefficient, Gibbs-Helmoltz equation, fugacity, fugacity coefficient, activity, effect of temperature and pressure on fugacity, determination of fugacity of real gases.

Properties of Biosolutions

Partial molar properties, concept of chemical potential, Fugacity in solutions-Lewis Randall rule, Raoult's law, Henry's law. Activity in solutions- Activity coefficients, pressure and Temperature effects, Gibbs-Duhem equations, property changes of mixing in fermenters, heat effects of mixing in biological broths.

Phase Equilibria.

Criteria for phase equilibria and stability, phase equilibria in single and multicomponent systems, Duhem's theorem, vapour-liquid equilibria, phase diagram for binary solutions, V-L-E in ideal and non-ideal solutions, Azeotropes - V-L-E at low pressure - Margules and Vanlaar equations; V-L-E at high pressure - equilibrium constant, bubble point and dew point equilibria and flash vapourisation.

Refrigeration and Liquefaction

Refrigeration - Application, Types, refrigerant effect and capacity, reversed Carnot cycle, Bell-Coleman cycle, Vapour compression and absorption system, Refrigerants and properties. Liquefaction of gases- Joule Thomson Expansion, Claude process. Problems based on COP, power requirements, network, circulation rate and pressure.

Text book(s):

1. K.A. Gavhane, "Chemical Engineering thermodynamics-1", Nirali Prakasan Publications, Pune, 2013.

Reference(s):

1. Narayanan,K.V.,"AText Book of Chemical Engineering Thermodynamics ",Prentice Hall of India, New Delhi,2002.
2. Gopinath Halder.,"Introduction to Chemical Engineering Thermodynamics", PHI Learning Pvt.Ltd.New Delhi, 2009.

K.S.Rangasamy College of Technology - Autonomous

40 BT 4P1 - Cell and Molecular Biology Laboratory

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	0	0	3	45	2	50	50	100

Objective(s)	• To identify the structure, properties and stages of cell division. • To understand steps involved in the isolation of DNA form Bacteria, Fungi and Plant. • To understand the concepts of DNA extraction and identification.
Course Outcomes	**At the end of the course, the students will be able to** 1. handle various instruments used in cell and molecular biology laboratory and also to troubleshoot it. 2. identify the difference between prokaryotic and eukaryotic cell components through microscopy 3. identify and interpret the different stages of mitosis and meiosis 4. perform the steps to isolate the genomic DNA from different sources like bacteria, fungi, plant and blood 5. perform the steps to isolate the plasmid DNA from the bacterial cells 6. prepare the required concentration of agarose gel and perform agarose gel electrophoresis 7. excise and elute out the DNA from the agarose gel using column and silica based methods 8. analyse and interpret the data obtained from the agarose gel using graphical, UV spectrophotometric and software methods. 9. perform the steps to isolate the total RNA from the given bacterial cultures 10. apply the knowledge of DNA extraction to design experiment to isolate DNA from environmental samples and interpret the data obtained from the results.

List of experiments

1. Identification of given plant, animal and bacterial cells and their components by microscopy
2. Staining for different stages of mitosis in *Allium cepa* (Onion)
3. Quantification of DNA by UV spectrometer and agarose gel electrophoresis
4. Isolation of genomic DNA from bacterial cells
5. Isolation of genomic DNA from fungal cells
6. Isolation of genomic DNA from plants by CTAB method
7. Isolation of genomic DNA from blood by high salt method
8. Isolation of total RNA from prokaryotes
9. Extraction of DNA from Agarose gel Design Experiment
10. Isolate DNA from any five different samples, quantify it and interpret your result by comparing the data obtained.

Reference(s):

1	Sambrook, J., Russsel, D.W., “Molecular cloning – A laboratory manual”, Third edition, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York, USA, 2001.
2	Ansubel, F.M., Brent, R., Kingston, R.E. and Moore, D.D., “Current Protocols in Molecular Biology”, Geone Publication Associates, New York, USA, 1988.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 4P2 - Fermentation Technology Laboratory								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	0	0	3	45	2	50	50	100

Objective(s)	• To learn the steps involved in the production of primary and secondary metabolites for various industrial applications. • To determine the growth kinetics of microorganisms in fermentation process • To understand the important aspects in fermentation engineering.
Course Outcomes	**At the end of the course, the students will be able to** 1. determine growth of bacterial yeast and to estimate biomass specific growth rate and yield coefficient. 2. outline the steps involved in the production process of ethanol and wine. 3. determine the growth kinetics of microorganisms in fermentation process. 4. illustrate the mechanism of solid state fermentation process for the production of metabolites(primary and secondary). 5. outline the process for production antibiotics using *Streptomyces* species. 6. analyse the residence time distribution in fermentation process. 7. outline the process involved in the production of protease from different sources. 8. demonstrate the formulation of biofertilizers using nitrogen fixing and phosphate solubilizing bacteria. 9. outline the steps involved in the production of microbial biomass. 10. adapt suitable protocol for the production of single cell protein. and vermicompost process.

List of experiments

1. Growth of Bacterial yeast-Estimation of Biomass, Calculation of μ and Yp/s
2. Production of ethanol from yeast
3. Production of wine from black grapes
4. Growth Kinetics in Fermentation
5. Solid State Fermentation (Production of Metabolite Primary & Secondary)
6. Production of Antibiotics using Streptomycin species
7. Residence Time Distribution
8. Production of Protease
9. Production of Biofertilizers(N – Fixers & P - Solubilizers)
10. Production of Microbial Biomass
11. Production of Single cell Protein (Spirulina)
12. Production of Vermicompost

Reference(s):

1	Irwin H.Segel, “Biochemical Calculations”, John Wiley & Sons, 2nd Edition, Wiley Publishers, New Delhi. 2011.
2	Pierre-Yves Bouthyette, “Fermentation Technologies”, 2nd edition, Rai University, Ahmedabad, 2005.

K.S.Rangasamy College of Technology - Autonomous

40 BT 4P3 - Protein and Enzyme Engineering Laboratory

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	0	0	3	45	2	50	50	100

Objective(s)

- To impart concept on Protein engineering and Enzyme Engineering.
- To learn basic principles in enzyme immobilization and its applications.
- To evaluate and apply the molecular mechanism of protein using various tools.

Course Outcomes

At the end of the course students will be able to

1. determine the extraction of intra cellular proteins by enzymatic methods.
2. find out the effect of pH and temperature on Acid Phosphatase.
3. determine the K_m & V_{max} value for the given enzyme.
4. interpret the amount of purified protein present in the sample using column chromatography.
5. resolve the purification of protein sample using and SDS PAGE in the given sample.
6. visualize the isozyme pattern of Peroxidase in Native-PAGE.
7. elucidate the method of production and estimation of enzyme.
8. illustrate the immobilization of enzymes using entrapment method.
9. describe the enzyme activity can be modified using chemical method.
10. analyze the pattern of protein expression using western blotting.

List of experiments

1. Extraction of intra cellular proteins from *S. cervisiasee* by enzymatic methods
2. Effect of pH and Temperature on Acid phosphatase activity
3. Kinetic characterization (K_m & V_{max}) of Acid phosphatase - LB plot
4. Purification of protein by ion exchange chromatography
5. SDS PAGE analysis for purification of protein sample
6. Identification of isozyme pattern of Peroxidase by Native-PAGE analysis
7. Production and estimation of protease
8. Immobilization of enzymes using entrapment method
9. Engineering the active site using chemical modification method
10. Western blot - Analysis of protein expression pattern.

Reference(s):

1	Talwar, G.P., Gupta, S.K. A Handbook of Practical and Immunology. CBS Publishers & Distributors, New Delhi. India, 2004.
2	Enzyme Kinetics: Principles and Methods by Hans Bisswanger and Leonie Bubenheim, April 2002. Protein Immobilization: Fundamentals and applications edited by Richard F. Taylor, 1991.
3	Proteins and Proteomics: a lab manual By R J simpson, Cold Spring Harbor, US 2003.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	**Biotechnology**	**Programme Code & Name**				**B.Tech. Biotechnology**		
Semester IV								
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**ES**	**Total**
40 TP 0P2	**Career Competency Development II**	**0**	**0**	**2**	**0**	**100**	**00**	**100**
Objective(s)	To enhance employability skills and to develop career competency							

Unit – 1	**Written Communication – Part 3**	**Hrs**
	Reading Comprehension Level 2 (Paraphrasing Poems) - Letter Drafting - Email Writing - Paragraph Writing - News paper and Book Review Writing - Skimming and Scanning - Interpretation of Pictorial Representations. **Practices:** Sentence Completion - Sentence Correction - Jumbled Sentences - Synonyms & Antonyms - Using the Same Word as Different Parts of Speech - Editing **Materials:** Instructor Manual, Word power Made Easy Book, News Papers	6
Unit – 2	**Oral Communication – Part 3**	
	Self Introduction - Miming (Body Language) - Introduction to the Sounds of English - Vowels, Diphthongs & Consonants, Introduction to Stress and Intonation - Extempore - News Paper and Book Review - Technical Paper Presentation. **Material:** Instructor Manual, News Papers	4
Unit – 3	**Verbal Reasoning – Part 1**	
	Analogies - Alphabet Test - Theme Detection - Family Tree - Blood Relations (Identifying relationships among group of people) - Coding & Decoding - Situation Reaction Test - Statement & Conclusions **Material:** Instructor Manual, Verbal Reasoning by R.S.Aggarwal	8
Unit – 4	**Quantitative Aptitude – Part 1**	
	Problem on Ages - Percentages - Profit and Loss - Simple & Compound Interest - Averages - Ratio, Proportion **Material:** Instructor Manual, Aptitude Book	6
Unit – 5	**Quantitative Aptitude – Part 2**	
	Speed, Time & Work and Distance - Pipes and Cisterns - Mixtures and Allegations - Races - Problem on Trains - Boats and Streams **Practices** : Puzzles, Sudoku, Series Completion, Problem on Numbers **Material:** Instructor Manual, Aptitude Book	6
	Total	**30**

Evaluation Criteria

S.No.	**Particular**	**Test Portion**	**Marks**
1	Evaluation 1 Written Test	15 Questions Each from Unit 1, 3, 4 & 5 (External Evaluation)	60
2	Evaluation 2 Oral Communication	Extempore & Miming – Unit 2 (External Evaluation by English, MBA Dept.)	20
3	Evaluation 3 Technical Paper Presentation	Internal Evaluation by the Dept.	20
		Total	**100**

Reference Books

1. Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.
2. Abhijit Guha, “Quantitative Aptitude”, TMH, 3rd edition
3. Objective Instant Arithmetic by M.B. Lal & GoswamiUpkar Publications.
4. Word Power Made Easy by Norman Lewis W.R. GOYAL Publications

Note :

- Instructor can cover the syllabus by Class room activities and Assignments (5 Assignments/week)
- Instructor Manual has Class work questions, Assignment questions and Rough work pages
- Each Assignment has 20 questions from Unit 1, 3, 4 and Unit 5 and 5 questions from Unit 2.
- Evaluation has to be conducted as like Lab Examination.

K.S.Rangasamy College of Technology - Autonomous

40 BT 501 - Genetic Engineering

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	50	50	100

Objective(s)

- To discuss the methods, tools and techniques involved in genome analysis, expression of cloned genes in different host system, production of recombinant proteins, mutation analysis and the importance of PCR in genome analysis.
- The student would learn about various aspects of Genetic Engineering, its application and ethical issues.
- This will be of very useful for the students to undertake research / project work in Genetic Engineering.

Course Outcomes

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

1. define and describe restriction enzymes and their role in genetic engineering including other DNA modifying enzymes
2. illustrate the different types of blotting techniques such as Northern blotting, Southern blotting and their methodology, instrumentation and application in genetic engineering
3. characterize the cloning vectors used in manipulation of genes like plasmids, phagemids, cosmids etc.
4. describe the artificial chromosomes used in genetic manipulation studies such as YAC, BAC, PAC, HAC etc.
5. determine the strategies involved in gene cloning with the help of genomic libraries, cDNA libraries and other libraries
6. outline the methods involved in screening of cloned genes like nucleic acid hybridization, immunoscreening and functional screening
7. illustrate the PCR based techniques involved in genetic manipulation including mutagenesis
8. describe the methods involved in sequencing of nucleic acid like Maxem – Gilbert method etc,.
9. comprehend the applications of rDNA technology and describe the role of yeast two hybrid systems and RNA interference
10. discuss the production of useful molecules like cytokines, vaccines and antibiotics and define the safety guidelines for recombinant

Fundamental Techniques of Gene Manipulation

Restriction enzymes: types and mechanisms, Basics and other modification systems, Restriction mapping, Design of linkers and adapters, Joining of DNA molecules, Basics of cloning, Nucleic acid blotting: Southern blotting, Western Blotting and Northern Blotting.

Biology of Cloning Vectors

Characteristics of cloning vectors, Types of vectors, Selectable markers, Experimental applictions of vectors: Plasmids- pBR322, pUC, λ vectors, cosmids, M13 vectors, Phagemids, Artificial Chromosomes: YAC, PAC, BAC, HAC, Expression vectors, Insect, Yeast and Mammalian vectors.

Gene Cloning Strategies and Screening

Cloning of genes: Genomic libraries, cDNA libraries, Directional cDNA cloning, PCR based libraries-RACE, Subtraction libraries, Screening: Nucleic acid probe hybridization, Immunoscreening and Functional screening.

Amplification and Sequencing of DNA

PCR: Mechanism, Types- Nested PCR, AFLP, RAPD, RFLP, Hot start, colony PCR, Real-time PCR, Taqman assay, Molecular beacons, RAPD, RFLP, Site directed mutagenesis: primer extension - Strand selection - Cassette mutagenesis - PCR based, Methods of nucleic acid sequencing: Sanger's method, Automated sequencing method and Next Generation sequencing method.

Applications of rDNA Technology

Differential display, Microarrays, FISH, Knock-out analysis, Antisense and RNA interference, Yeast two hybrid system, Production of useful molecules: cytokines, vaccines and antibodies, improving agronomic traits. Safety guidelines for recombinant DNA technology.

Text book(s):

1. Dr.SmitaRastogi and Dr. NeelamPathak, "Genetic Engineering" Oxford Publication, 2010.
2. Dr.K.Ragagopal, "Recombinant DNA Technology and Genetic Engineering" Tata McGraw Hill Education Private Ltd., 2012.

Reference(s):

1. Principles of GeneManipulation and Genomics, 7th edition. S. B. Primrose & R. M. Twyman. Blackwell Publishing. 2006
2. Richard J. Reece., "Analysis of Genes and Genomes", John Wiley and Sons Ltd., Singapore, 2004.
3. Desmond S.T. Nicholl "An Introduction toGenetic Engineering" Third Edition Cambridge University Press NewYork, 2008

K.S.Rangasamy College of Technology - Autonomous								
40 BT 502 - Bioinformatics								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	50	50	100

Objective(s)	• To develop inter disciplinary skills in the application of computers in biotechnology and learn about the biological databases and machine learning techniques • To Analyze the structure and functions of protein and DNA using *in silico* tools • To apply the acquired programming Knowledge in *insilico* Biology
Course Outcomes	**At the end of the course, the students will be able to** 1. describe the primitive concepts of Unix OS, biological database and its nomenclature. 2. demonstrate the objectives of primary databases, secondary databases and different sequence formats. 3. characterize the optimal alignment of sequences either by local or global algorithm. 4. describe the BLAST and FASTA algorithms and their applications in similarity search. 5. classify the phylogenetic analysis for evolutionary tree and its validation methods. 6. categorize the protein and RNA structure prediction algorithms. 7. describe and deduce soft computing algorithms that are applied in gene prediction and in protein structure patterns. 8. characterize the gene expression using Microarray images and various steps involved in drug designing. 9. apply prerequisite basic programming concepts to Perl. 10. write, compile, and run Perl programs, Analyze the effects of using Perl structures that implement decisions, loops, and store arrays

Introduction to Bioinformatics

Introduction to Operating Systems, Linux Commands, File transfer protocols, telnet. Definition, Scope of Bioinformatics, Biological Sequences, Characteristics and categories of Biological databases, Data file formats, Data life Cycle and Database Management System models.

Pattern Matching

Pairwise sequence alignment: Dot matrix analysis, Local vs global alignment; Substitution matrices: PAM and BLOSUM, Dynamic programming: Needleman Wunch and Smith waterman algorithm; BLAST-PSI and PHI, FASTA; Multiple sequence alignment, Generating motifs and profiles.

Phylogeny and Homology Modeling

Phylogenetic analysis: Distance based method; Character based method, Boot Strapping, Protein Secondary structure and tertiary structure prediction methods. Homology modelling, *ab initio* approaches, Threading, CASP and Structural genomics.

Machine Learning and Applications of Bioinformatics

ANN in protein secondary structure prediction. HMM for gene finding, Decision trees, Support Vector Machines. Introduction to System Biology and Synthetic Biology, Microarray data analysis, DNA computing, Molecular Docking.

Perl Programming

Basics of PERL programming for Bioinformatics: Datatypes, scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions and File handling.

Text book(s):

1	Rastogi, S.C., “Bioinformatics – Concepts, skills and applications”, CBS Publishers and Distributors, New Delhi, India, 2003.
2	Bergeron, B., “Bioinformatics Computing”, Prentice Hall of India, New Delhi, India, 2002.
3	Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi, 2005.
4	James Tisdall, “Mastering Perl for Bioinformatics”, O'Reilly Media, Inc., US, 2003.

Reference(s):

1	Gibas, C. and Jambeck, P., “Developing Bioinformatics Skills’’, O’Reilly Shroff Publishers and Distributors Pvt, Ltd., New York, US, 1999.
2	David W. Mount., “Bioinformatics Sequence and Genome Analysis”, 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US, 2004.
3	Jin Xiong, “Essential Bioinformatics” Cambridge University Press, First edition, 2006.

K.S.Rangasamy College of Technology - Autonomous

40 BT 503 - Immunology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	50	50	100

Objective(s)	• To learn the basic concepts of immune response towards various antigens in mammalian host system • To impart the knowledge of various cells involved in immunity • To emphasize their significance in developing therapeutic modalities for immunological disorders of humans
Course Outcomes	**At the end of the course, the students will be able to** 1. describe the features of cells and tissues of the immune system. 2. differentiate immunogens, antigens, haptens and adjuvants with respect to immunological functions. 3. understand the developmental behaviors of B cells and study antigen and antibody interaction 4. develop the monoclonal antibodies through hybridoma technology for humoral immunity. 5. classify various stages of development of T cell receptor in cellular immunity. 6. apply the mechanism of biology of antigen processing and presentation. 7. describe the injury and inflammation and the broad education necessary to understand AIDS. 8. study the function as immune responses to infections to ensure immunity. 9. understand the mechanism of immune responses with respect to transplantation and graft rejection. 10. Identify modern techniques to analyze tumor antigens and study autoimmune diseases.

The Cells of Immune System

An overview of the immunology- Classification of the immune response; theory of clonal selection. Cells and tissues of the immune system. Haematopoiesis: Origin and differentiation of Lymphocytes and phagocytic cells. Primary and secondary lymphoid organs. Immunogens and antigens- haptens, adjuvants.

Humoral Immunity

Development, maturation, activation and differentiation of B-lymphocytes; Antibody: structure, classes and subclasses; antibody diversity- Antigen and antibody interaction. Complement pathways – Classical and alternate complement pathway; Hybridoma technology for production of the monoclonal antibody and applications.

Cellular Immunity

Thymus derived (T) Lymphocytes: Classification and stages of development- T cell receptor gene rearrangement- Major histocompatibility complex –structure, classification and genetic organization of MHC; mechanism of phagocytosis- the cell biology of antigen processing and presentation.

Immunity To Infections and Hypersensivity Reactions

Injury and inflammation; immune responses to infections: immunity to viruses, bacteria, fungi and parasites; cytokines; immunosuppression, tolerance; allergy and hypersensitivity; AIDS and Immuno deficiencies; Immunization; Vaccines.

Transplantation, Autoimmunity and Immunology of Tumors

Transplantation: types, immunological mechanisms of graft rejection- immunological strategies to prevent graft rejection- role of immuno-suppressive drugs. Autoimmunity: Mechanism of auto immune response – autoimmune diseases. Tumors: Immune response to tumors- type of tumor antigens.

Text book(s):

1	Owen, J., Punt, J and Strandford, S. “Kuby Immunology”, 7th Ed., W. H. Freeman Publication, New York, USA, 2012.
2	Abbas, K. A., Litchman, A. H. and Pober, J. S. “Cellular and Molecular Immunology”, 4th Ed., W. B. Saunders Co., Pennsylvania, USA, 2005.

Reference(s):

1	Roitt, I., Brostoff, J. and David, M. “Immunology”, 6th Ed., Mosby publishers Ltd., New York, USA, 2001.
2	Tizard, R.I. “Immunology”, 4 th Ed., Saunders college publishing, Chennai Microprint Pvt. Ltd., Chennai, 2004.

K.S.Rangasamy College of Technology - Autonomous

40 BT 504 - Biomedical Instrumentation

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	3	50	50	100

Objective(s)

- To learn about the instrumental analysis of human physiology and anatomy.
- To identify the applications of chemicals in the synthesis of implant materials.
- To understand the concepts of medical imaging.

Course Outcomes

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

1. comprehend the electrophysiology of human body
2. exhibit the applications of bio-potential recording equipments
3. outline the method of measuring the blood pressure and its flow
4. illustrate the instrumentation of blood analyzer
5. characterize the biomaterials for wound healing and body response to it
6. list the types of biomaterials for wound healing
7. distinguish the role of each medical imaging modalities
8. analyze the medical images and patient monitoring system
9. demonstrate the working principle of therapeutic equipments for heart and lung
10. analyze the applications of therapeutic equipments

Electro-physiology and Bio-potential recording

Electrical Potentials in the human body and the origin of Bio-potentials. Neuromuscular system: neurons, synapses and muscles, electrical properties of nerves and muscles. Biopotential electrodes, biological amplifiers, ECG, EEG, EMG, ERG, lead systems and recording methods, typical waveforms and signal characteristics.

Non-electrical parameter measurements

Measurement of blood pressure; Cardiac output, Heart rate and Heart sound. Pulmonary function measurement: spirometer, Photo Plethysmography and Body Plethysmography – Blood Gas analysers : pH of blood: measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

Biomaterials

Definition and classification of bio-materials, wound healing process, body response to implants, blood compatibility. Implant materials: Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, and carbons. Polymeric implant materials: Polymerization, polyamides, Acryrilic polymers, rubbers. Bio polymers: Collagen and Elastin. Medical Textiles: Silica, Chitosan, PLA composites, Sutures and wound dressings

Medical imaging

Ionizing radiation, Diagnostic x-ray equipments, use of Radio Isotope in diagnosis, medical image modalities: magnetic resonance (MR) imaging, positron emission tomography (PET), single photon emission computed tomography (SPECT), computer tomography (CT) - Endoscopy: bronchoscope, gastro scope, colonoscope – Ultrasonography –Thermography – Different types of biotelemetry systems and patient monitoring system.

Therapeutic equipments

Pacemakers, Defibrillators, Ventilators, Heart and Lung machine. Nerve and muscle stimulators – Diathermy – Audio meters – Dialysers and Lithotripsy.

Text book(s):

1	Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TATA McGraw-Hill, New Delhi, 2003.
2	Sundararajan V. Madihally, “Principles of Biomedical Engineering”, Artech House, Boston, London, 2010.

Reference(s):

1	Leislie Cromwell, “Biomedical instrumentation and measurement”, Prentice Hall of India, New Delhi, 2007.
2	Joseph J.Carr and John M.Brown, “Introduction to Biomedical equipment Technology”, John Wiley and Sons, New York, 2004.
3	Sujata V. Bhatt, “Biomaterials”, Second Edition, Narosa Publishing House, 2005.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 505 - Bioprocess Technology								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	1	0	60	4	50	50	100

Objective(s)	• To learn the historical development in bioprocess technology of production and recovery process • To design a bioreactors and the strategy of scale up reactor for commercial prospects • To understand the important concepts of softwares in monitoring and validation of Bioprocess Technology
Course Outcomes	**At the end of the course, the students will be able to** 1. enumerate the historical development of bioprocess technology 2. differentiate the various method of recovery of bioproduct purification 3. illustrate the fermentation process, requirements and types of fermentation 4. design a kinetic parameters of cell growth of structured and unstructured model 5. explain the concept of design and construction of reactor and types in bioprocess 6. illustrate the mechanism of controlling of various bioreactor 7. characterize the scale up parameters for mixing requirement 8. outline the role of power consumption in scale up of bioreactor 9. simulate the various commercial process in bioreactors 10. upgrade the role of validated protocol of bioprocess technology through softwares.

Introduction to Bioprocess Technology

Introduction to Bioprocessing: Historical development of Bioprocess technology, General requirements and types of fermentation processes, aerobic and anaerobic fermentation process. Bio-product recovery process: Filtration, sedimentation, centrifugation, precipitation, cell disruption, chromatography, crystallization, lyophilization and drying.

Fermentation Processes

Medium requirements for fermentation processes, batch growth, balanced growth, effect of substrate concentration. Monod model. Determining cell kinetic parameters from batch data. Kinetics of cell growth: OfStructured and unstructured models.

Process Design and Control of Bioreactors

Bioreactor design and construction - Reactor Engineering in perspective. Types of Reactors (Batch, Fed Batch and Continuous) Design of Stirrers and impellers. Principles and Strategies for Control of Bioreactors (feedback, feed forward, adaptive and statistical control, fuzzy logic control).Bioprocess design for Plant and Animal cell reactor.

Rheology and Scale Up of Fermentation

Newtonian and Non Newtonian fluids, Effect of scale on oxygenation, mixing, sterilization, nutrient availability and supply. Bioreactor scale up based on constant power consumption per volume, mixing time, impeller tip speed (shear), Calculation of mass transfer coefficient in fermentation and its role in scale up.

Simulation and Validation In Bioprocess Technology

Introduction to Process Analytical Technology (PAT) and Quality by Design (QbD). Simulation techniques (Software):Continuous system simulators (CSMP, INT); dynamic process simulators (DYFLO, DYNSIS); steady state material and energy balance programs (PACER, FLOWTRAN, CHESS);.Simulation of batch reactor using MATLAB, SIMULINK for dynamic systems. Application of modelling and simulation in bioprocess industries.

Text book(s):

1	Rao, D.G., "Introduction to Biochemical Engineering", Second Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, India, 2010.
2	Ashok Kumar verma, Process Modelling and Simulation in Chemical, Biochemical and Environmental Engineering, CRC Publication press. 2014.

Reference(s):

1	Shuler,M.L. and Kargi, F.," Bioprocess Engineering Basic Concepts", Prentice Hall of India, Pvt. Ltd., New Delhi, India, 2003.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 506 - Heat and Mass Transfer Process								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
V	3	1	0	60	4	50	50	100

Objective(s)	• To understand the different modes of heat transfer and its application with phase change • To understand the different types of mass transfer operations. • To apply heat and mass transfer processes in different biological systems
Course Outcomes	**At the end of the course, the students will be able to** 1. Understand the basics of heat transfer operations and different modes of heat energy. 2. Calculate heat flow through plane wall, composite wall, cylindrical surface and sphere and heat transfer coefficients 3. Quantify the heat energy and energy balance in the different types of heat exchangers with various flow arrangements 4. Develop the model for the heat utilization and rejection in evaporators and condensation processes with phase change operation 5. Describe the mechanism of diffusion in mass transfer operation and mass transfer theories for various states of fluids 6. Design and solve the operational and control issues in distillation process by McCabe-thiele analysis 7. Develop suitable solvents, minimum solvent requirements, and maximum circulation rate for absorption operation in chemical industries. 8. Develop process operation for absorption and extraction equipment applicable to industrial process. 9. Characterize the relationship between heat transfer, cell concentration and stirring of diffusion in biological process. 10. Study the oxygen up take rate, transfer rate and dissolved oxygen concentration in fermentation medium and bioreactors

Basics of Heat Transfer Operations

Modes of heat transfer operation: Fourier's law of heat conduction ,heat transfer resistance and conductance, thermal conductivity, steady state conduction, heat flow through plane wall, composite wall, cylindrical surface and sphere; convection; individual heat transfer coefficient and overall heat transfer coefficient

Heat Exchangers and Heat Transfer with Phase Change

Heat exchangers-shell and tube and double pipe heat exchangers, flow arrangements in heat exchangers, energy balance, LMTD, single and multiple effect evaporators; natural and forced circulation evaporators; heat transfer in condensation of single vapour, drop wise condensation and film wise condensation and heat transfer to boiling liquids

Diffusion and Liquid-Vapour Mass Transfer

Diffusion: Molecular diffusion, Fick's law of diffusion, steady state molecular diffusion in gases and liquids, mass transfer coefficients, penetration and surface renewal theories, diffusivity and flux calculations; Differential or Simple distillation Continuous rectification- Binary systems, McCabe Thiele analysis and calculations.

Liquid-Gas/Liquid Mass Transfer

Absorption: Selection criteria for solvents, material balance, minimum liquid-gas ratio, calculations on circulation rate and composition; Industrial absorbers - types, characteristics and channelling of tower packings, Liquid-liquid extraction-distribution co-efficient, ternary systems and triangular diagrams, Solvent selection criteria for extraction, extraction equipments and material balance calculations.

Applications of Heat and Mass Transfer In Biological Systems

Heat transfer in bioreactors, Relationship between heat transfer cell concentration and stirring conditions. Analogy between heat and mass transfer. Role of diffusion in bioprocess, film theory, Oxygen uptake in cell cultures-oxygen transfer to cell, Oxygen transfer in fermentors and measurement of dissolved oxygen concentration.

Text book(s):

1	Gavhane, K.A., "Unit Operations-II", 27th edition, Nirali Prakasan Publication, Pune, India, 2013.
2	Pauline M. Doran "Bioprocess Engineering Principles" 2nd edition, Academic Press, California, US, 2005.

Reference(s):

1	Treybal, R. E. "Mass Transfer Operations", 3rd edition, McGraw-Hill, New Delhi, India, 1982.
2	McCabe, W.L., and Smith J.C. "Unit Operations of Chemical Engineering". 7th edition, McGraw Hill, Singapore, 1993

K. S. Rangasamy College of Technology - Autonomous

40 BT 5P1 - Genetic Engineering Laboratory

B. Tech Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum marks		
	L	T	P		C	CA	ES	Total
V	0	0	3	45	2	50	50	100

Objective(s)	• To understand the basic methods applied in extraction and amplification of genetic material. • To experiment the advanced procedure for recombinant DNA technology for the human welfare.
Course Outcomes	**At the end of the course, the students will be able to** 1. isolate the plasmid DNA and select the correct restriction enzymes to digest the vector DNA that give cohesive ends . 2. mix the components of restriction digestion reaction and optimize the incubation time to partially digest the chromosomal DNA 3. mix-up the reaction components for ligating the restricted samples using T4 DNA ligase to produce recombinant DNA 4. make the *E.coli* DH5α cells competent using calcium chloride mediated method and perform the transformation experiment through heat shock induction method 5. screen and select the transformed cells using antibiotic and blue-white selection method 6. mix the reaction components of PCR at appropriate concentration and operate the thermocycler to amplify the DNA 7. select the correct oligo primer, optimize the reaction condition to perform RAPD and draw the phylogenetic tree using bioinformatics tool. 8. select the suitable enzyme, optimize the reaction condition to perform RFLP and draw the phylogenetic tree using bioinformatics tool. 9. perform the steps involved in the transfer of DNA from agarose gel to the nylon membrane through Southern transfer technique 10. Apply the knowledge of restriction digestion, ligation, transformation and PCR to design experiment to insert gene of interest into to a vector and confirm its presence either by PCR or by cloning and screening and interpret the data obtained from the results.

List of experiments

1. Extraction of Plasmid DNA
2. Restriction Enzyme Digestion of Vector
3. Partial digestion of genomic DNA
4. Ligation of restricted vector and genomic DNA
5. Competent cell preparation- Calcium Chloride method
6. Transformation by heat-shock induction method
7. Screening and selection of recombinants
8. PCR- 16S rDNA amplification
9. Random Amplification of Polymorphic DNA
10. Restriction Fragment Length Polymorphism
11. Southern Transfer Technique
12. Make a recombinant DNA of your own gene of interest using the given vector and confirm it by the any one of the following techniques:
    (i) Transformation and blue-white screening
    (ii) Colony PCR

Lab Manual :

1. Sambrook, J. and Russsel, D.W. “Molecular cloning - A laboratory manual”, Fourth Edition, Cold Spring Harbor Laboratory Press, Cold Spring harbor, New York, USA. 2012.

K. S. Rangasamy College of Technology - Autonomous

40 BT 5P2 - Bioprocess Technology Laboratory

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum marks		
	L	T	P		C	CA	ES	Total
V	0	0	3	45	2	50	50	100

Objective(s)

- To understand the industrial requirement of fermentation process for biooproduct
- To study the different factors affecting the yield and biomass of product
- To demonstrate the aspects of modelling and simulation in Bioprocess Technology

Course Outcomes

At the end of the course, the student can able to

1. handle the techniques of media optimization for bioprocess
2. determine the Kla for fermentation process
3. understand the concept of monod model for growth of microorganisms
4. investigate the thermal death kinetics of microorganisms
5. demonstrate the kinetic mechanism of mixed flow reactor
6. examine the role of Kla through sodium oxidation method
7. validate the yield and biomass coefficient of yeast on glucose production
8. analyze the software techniques for simulating the reactor system
9. demonstrate the production of industrial enzymes through modeling in the system
10. understand the role of solid substrate in the production sector.

List of experiments

1. Media optimization – Plackett Burman design
2. Determination of Kla value by gassing out method
3. Evaluation of parameters on Monod model for growth of microorganism
4. Thermal Death Kinetics of microorganisms
5. Study of Mixed flow reactor and its kinetics design of reaction
6. Determination of Kla by sodium sulpide oxidation method
7. Determination of yield and biomass coefficient of Yeast on glucose
8. Simulation of Batch and continuous Reactor by SIMULINK
9. Modelling of Batch, Fed Batch and Continuous using Berkeley Madonna software.
10. Solid state fermentation process of production of industrial enzymes.

Lab Manual:

1. Ponmurugan. P., Nithya Ramasubramanian and M. Fredimoses., “Experimental Procedures in Bioprocess Technology and Downstream Processing”, Anjanaa Book House, Chennai, India, 2012.
2. Ashok Kumar verma, Process Modelling and Simulation in Chemical, Biochemical and Environmental Engineering, CRC Publication press. 2014.

K. S. Rangasamy College of Technology - Autonomous								
40 BT 5P3 - Immunology Laboratory								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum marks		
	L	T	P		C	CA	ES	Total
V	3	0	0	45	2	50	50	100

Objective(s)	• To identify and understand the concepts of various cells present in immune system • To learn the steps involved in immune diffusion techniques • To understand the concepts of specific antigen and antibody reaction in identifying diseases
Course Outcomes	**At the end of the course, the students will be able to** 1. demonstrate the handling of animals and raising of antibodies for the experimental purpose. 2. collect and identify different blood groups in human beings for human health care 3. identify the different types of blood cells and know about their functions. 4. execute the heamoglobin content in blood 5. demonstrate the presence of antigen and antibody in sample and its related functions based on ODID test 6. perform immune electrophoresis specificity of the antibody in the serum sample against the antigen 7. understand the nature, quantity of antigen and antibody in blood serum. 8. execute the presence of reagin antibody against syphilis antigen in the patients. 9. demonstrate the identification of typhoid and its seriousness by following WIDAL test 10. understand the binding of antigen and antibodies and their interaction through ELISA technique.

List of experiments

1. Handling of animals and raising of antibodies in rats (Demonstration)
2. Blood collection, grouping, serum and separation of plasma
3. Differentiation and identification of blood cells
4. Determination of haemoglobin
5. Ouchterlony double immune diffusion (ODID) test
6. Immunoelectrophoresis
7. Radial immuno diffusion
8. Rapid Plasma Reagin (RPR) test
9. WIDAL - slide and tube agglutination test
10. ELISA - Sandwich

Lab Manual:

1.	Talwar, G. P. and Gupta, S. K. A., “Handbook of Practical and Immunology” CBS Publishers & Distributors, New Delhi, 2004.
2.	Ravi, M. And Paul, S.F.D., “A practical manual for basic immune techniques”, Samanthi Publications Pvt. Ltd, Chennai, 2008.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	**Biotechnology**	**Programme Code & Name**			**B. Tech Biotechnology**			
Semester V								
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**ES**	**Total**
40 TP 0P3	**Career Competency Development III**	**0**	**0**	**2**	**0**	**100**	**00**	**100**
Objective(s)	To enhance employability skills and to develop career competency							

Unit – 1	**Written and Oral Communication – Part 1**	**Hrs**
Reading Comprehension Level 3 - Self Introduction - News Paper Review - Self Marketing - Debate-Structured and Unstructured GDs Psychometric Assessment – Types & Strategies to answer the questions **Practices:** Sentence Completion - Sentence Correction - Jumbled Sentences - Synonyms & Antonyms - Using the Same Word as Different Parts of Speech - Interpretation of Pictorial Representations - Editing - GD - Debate. **Materials:** Instructor Manual, Word power Made Easy Book, News Papers		6
Unit – 2	**Verbal & Logical Reasoning – Part 1**	**8**
Syllogism - Assertion and Reasons - Statements and Assumptions - Identifying Valid Inferences - identifying Strong Arguments and Weak Arguments - Statements and Conclusions - Cause and Effect - Deriving Conclusions from Passages - Seating Arrangements **Practices:** Analogies - Blood Relations - Statement & Conclusions **Materials:** Instructor Manual, Verbal Reasoning by R.S.Aggarwal		
Unit – 3	**Quantitative Aptitude – Part 3**	**6**
Probability - Calendar- Clocks - Logarithms - Permutations and Combinations **Materials:** Instructor Manual, Aptitude Book		
Unit – 4	**Quantitative Aptitude – Part 4**	**6**
Algebra - Linear Equations - Quadratic Equations - Polynomials **Practices:** Problem on Numbers - Ages - Train - Time and Work - Sudoku - Puzzles **Materials:** Instructor Manual, Aptitude Book		
Unit – 5	**Technical & Programming Skills – Part 1**	**4**
Core Subject – 1,2 3 **Practices :** Questions from Gate Material **Materials:** Text Book, Gate Material		
	Total	**30**

Evaluation Criteria

S.No.	Particular	Test Portion	Marks
1	Evaluation 1 - Written Test	15 Questions each from Unit 1, 2, 3, 4 & 5 (External Evaluation)	60
2	Evaluation 2 - Oral Communication	GD and Debate (External Evaluation by English, MBA Dept & External Trainers)	20
3	Evaluation 3 - Technical Paper Presentation	Internal Evaluation by the Dept.	20
		Total	**100**

Reference Books

1. Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.
2. Abhijit Guha, “Quantitative Aptitude”, TMH, 3rd edition
3. Objective Instant Arithmetic by M.B. Lal & GoswamiUpkar Publications.
4. Power Made Easy by Norman Lewis W.R. GOYAL Publications

Note :

- Instructor can cover the syllabus by Class room activities and Assignments (5 Assignments/week)
- Instructor Manual has Class work questions, Assignment questions and Rough work pages
- Each Assignment has 20 Questions from Unit 1,2,3,4 and 5 and 5 Questions from Unit 1
- Evaluation has to be conducted as like Lab Examination.

K.S.Rangasamy College of Technology - Autonomous

40 BT 601 - Plant Biotechnology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	50	50	100

Objective(s)

- To develop the skills of the students in the area of Plant Biotechnology and its wide applications.
- To widen the knowledge about the production and applications of Transgenic plants and its uses.
- To produce potential biofertilizers using valuable native microbial strains for sustainable agriculture.

Course Outcomes

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

1. describe the basic concepts of plant tissue culture, media preparation in the field of *in vitro* culture of plants.
2. discriminate the applications of different techniques applied in plant tissue culture.
3. defend the process of acclimatization of tissue cultured plants.
4. investigate the process of conservation of plants for future posterity.
5. describe the concept of direct gene transformation along with vector mediated gene transformation.
6. summarize the role of various r DNA techniques applicable to plants.
7. investigate the various method of biotic and abiotic disease resistance and modification of seed protein quality.
8. learn the prospects and problems of GM crops along with the guidelines as well as safety regulations for transgenic plants.
9. discriminate the mechanism of biological nitrogen fixation and understand the role of various biofertilizers and to remediate the pollutants using plants.
10. describe the concepts of various farming practices for sustainable agriculture.

Introduction to Plant Tissue Culture

History of Plant tissue culture, preparation of Plant tissue culture media and Plant growth regulators, Sterilization of explants, Callus and suspension cultures, Micropropagation, meristem culture, organogenesis, regeneration of shoots and roots. Embryo culture, Somatic embryogenesis, Synthetic seeds, Somaclonal variants, Haploid plant production: Anther, pollen and ovary culture

Advanced Plant Tissue Culture

Protoplast culture, Somatic hybrids and Cybrids, Transfer and establishment of whole plants to greenhouse and field, Production of bio active secondary metabolites by plant tissue culture. Plant genome organization, Germplasm conservation and Cryopreservation. Application of tissue culture for crop improvement in agriculture, horticulture and forestry.

Production of Transgenic Plants

Conventional methods of crop improvement, selection, mutation, polyploidy and clonal selection. Gene transformation techniques: Direct gene transformation: Electroporation, partical gun method, Lipofection, Microinjection, Fibre mediated DNA delivery and Laser induced DNA delivery. Biological gene transfer: Agro bacterium mediated gene transformation and hairy root induction, Role of rDNA technology (RAPD, RFLP, AFLP and SSCP) in transgenic plant production.

Transgenic Plants

Organization and expression of chloroplast genome and mitochondrial genome, Cytoplasmic male sterility. Intergenomic interaction, Transgenic plants: Disease resistance; Insect resistance, virus resistance, Biotic and abiotic stress resistance, Modification of seed protein quality, Chloroplast and Mitochondria functions, GM Crops- Prospects and problems, Current research in genetically modified plants. Guidelines and safety regulations for transgenic plants.

Applications of Plant Biotechnology

Production of antibodies, viral antigens and peptide hormones in plants, biodegradable plastics in plants. Applications of secondary metabolites: Isolation, characterization and drug development, Plant derived vaccines: Edible vaccines, Subunit vaccine and Plantigens. Applications of Antisense RNA technology. Organic agriculture, precision farming and hydrophonics. Phytoremediation.

Text book(s):

1. Singh, B.D., “Biotechnology”, First Edition, Kalyani Publishers, New Delhi, India, 2015.
2. Ponmurugan, P. and Suresh Kumar, K. “Applications of Plant tissue culture”, New Age Internationals, New Delhi, India, 2011.

Reference(s):

1. Purohit, S.S., “Plant Tissue Culture”, Student Edition, Jodhpur, India, 2010.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 602 - Animal Biotechnology								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	50	50	100

Objective(s)	• To develop the skills in the area of Animal Biotechnology and its applications. • To widen the knowledge about production and applications of transgenic animals. • To understand the importance of ethical issues involved in the production of transgenic animals.
Course Outcomes	**At the end of the course, the students will be able to** 1. depict the crucial animal cell culture techniques and types of media used in animal cell cultures 2. illustrate the maintenance and preservation of animal cell cultures. 3. describe the steps involved in preservation of animal cell lines. 4. exemplify the concept of cytotoxic and viability assessment using different assays. 5. outline the process of *in vitro* fertilization and artificial insemination methods. 6. express the methods of micromanipulation of embryos and its potentials and hazards. 7. determine procedure for gene transformation techniques in animals. 8. sequence the steps and ethical issues involved in the process and production of transgenic animals 9. apprise the use of animal cell culture in production of various vaccines for human welfare 10. summarize the applications of cell culture technology for *in vitro* testing of drugs and protein expression in animal cell culture.

Introduction to Animal Cell Line

Introduction to Animal cell culture, Basic tissue culture techniques, Animal cell culture media and its preparations, Types of primary culture - Chicken embryo fibroblast culture - Chicken liver and kidney culture - Secondary culture –Trypsinization, Suspension cultures, dependent culture, Continuous flow cultures, Immobilized cultures, Role of serum and supplements, Mass transfer in mammalian cell culture. Maintenance and preservation of animal cell cultures; Measurement of viability and cytotoxicity.

Cryopreservation and Cytotoxicity

Cryopreservation- steps involved in cryopreservation of cell culture, cell banks, transporting cells . Various methods of cell quantitation – hemocytometer, electronic cell counting. Cytotoxicity assessment in cell culture- viability assesement by dye exclusion and dye uptake test, MTT based cytotoxicity assay, clonogenic survival assay.

***In Vitro* Fertilization and Micromanipulations of Embryos**

In vitro fertilization and embryo transfer – composition of IVF media, steps involved in IVF, fertilization by micro-insemination, artificial insemination. Embryo transfer- objectives and applications multiple ovulation and embryo transfer. Super ovulation, freezing of embryos, Embryo sex determination micromanipulation of embryos, techniques of nuclear transplantation. Potential and hazards of artificial breeding

Transgenic Animals

Cloning techniques in animals, Therapeutic cloning, Gene transformation techniques in animals: Physical and chemical methods of gene transfer, Embryonic stem cell transfer. Artificial animal breeding, Transgenic animals: Transgenic mice, genotyping transgenic mice by PCR, Transgenic rabbits, Transgenic cattle, Transgenic Pig and Transgenic Fish, , Ethical issues related to transgenic animals.

Applications o f Animal Biotechnology

Organ culture technology- production of complete organ. Biotechnology in animal production, manipulation of growth hormone, somatotropic hormone. Probiotics - as growth promoters, mode of action, uses. Vaccinology- Animal vaccines: killed vaccines, live vaccines and Genetic vaccines, Application of animal cell culture for *in vitro* testing of drugs. Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

Text book(s):

1	Ranga, M. M., “Animal Biotechnology”, 3rd edition, Agrobios India limited, Jodhpur. India, 2007.
2	Singh, B. D., “Biotechnology”, 1st edition, Kalyani Publishers, New Delhi, India, 2005.

Reference(s):

1	Masters, J. R. W., “Animal Cell Culture”, Practical Approach, Oxford University Press, UK, 2000.
2	Ian freshney, R., “Culture of Animal Cells”, 5th edition, Wiley Publications, New Delhi, India, 2006.

K.S.Rangasamy College of Technology - Autonomous

40 BT 603 - Molecular Modeling and Drug Designing

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	1	0	45	4	50	50	100

Objective(s)

- To provide the fundamental knowledge and mathematical skills to model biomolecules.
- To learn the different force field methods for energy minimization and analysing the dynamics and stable conformation of molecules.
- To apply the modelling skills to understand the analog and structure based drug design concepts for synthesizing new potent drugs.

Course Outcomes

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

1. describe the basic concepts of coordinate systems and the components needed for molecular graphics in hardware and software.
2. illustrate the applications of mathematics in molecular modeling and basics for molecular and quantum mechanics.
3. determine the features of force field calculations with their basic laws on the behavior of bonded and nonbonded interactions.
4. generate the energy function for a macromolecule and probe the applications of energy minimization.
5. describe the different models of molecular dynamics and the simulation process under constant temperature and pressure.
6. summarize the properties and functions involved in solvent effects and the process performed in conformational changes.
7. analyze the methods concerned in docking studies and the methods involved in ligand designing.
8. determine the available 3D databases for drug designing and understand the steps involved in drug discovery.
9. describe the methods and concept for QSAR and descriptors used for pharamacophore mapping.
10. determine the soft computing techniques and their applications in rational drug designing.

Concepts In Molecular Modelling

Introduction, Coordinate System, potential energy surfaces, Introduction of molecular mechanics and quantum mechanics, Schrodinger wave equation - Born-Oppenheimer approximation, Components of Molecular Graphics hardware and software; Mathematical concepts.

Molecular Mechanics and Energy Minimization

Features of molecular mechanics, force fields; Bond structure and bending angles – electrostatic, Vander Waals and non-bonded interactions, hydrogen bonding in molecular mechanics; Derivatives of molecular mechanics energy function; Calculating thermodynamic properties using force field; Transferability of force field parameters, treatment of delocaliised*pi* system; Force field for metals and inorganic systems – Application of energy minimization.

Molecular Dynamics Simulation Methods

Molecular Dynamics using simple models; Molecular Dynamics with continuous potentials and at constant temperature and pressure; Time-dependent properties; Solvent effects in Molecular Dynamics and Monte Carlo Simulation.

Molecular Modeling In Drug Design

Membrane Proteins, Deriving and using 3D pharmacophore; Molecular Docking; Structure-based methods to identify lead compounds, *de novo* ligand design; Mechanism – drug and targets ; Applications of 3D Database Searching and Docking, and Virtual Screening.

Structure Activity Relationship

QSARs and QSPRs, QSAR Methodology, QSAR Models, Descriptors used in QSARs: Electronic; Topology; Quantum Chemical based Descriptors and ADME Modeling.

Text book(s):

1. Andrew R. Leach “Molecular Modeling – Principles and Applications”; Second Edition, Pearson Education Ltd., UK, 2010.
2. Hans Pieter Heltje and GerdFolkens, Molecular Modelling, VCH, 2001.

Reference(s):

1. Fenniri, H., “Combinatorial Chemistry – A practical approach”, Oxford University Press, UK, 2000.
2. Lednicer, D., “Strategies for Organic Drug Discovery Synthesis and Design”; Wiley International Publishers. Singapore, 1998.
3. Gordon, E. M., and Kerwin, J.F., “Combinatorial chemistry and molecular diversity in drug discovery”, Wiley-Liss Publishers, Singapore, 1998.
4. Swatz, M.E., “Analytical techniques in Combinatorial Chemistry”, Marcel Dekker Publishers, New Delhi, India, 2000.

K. S. Rangasamy College of Technology - Autonomous								
40 BT 604 - Chemical Reaction Engineering								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	1	0	60	4	50	50	100
Objective(s)	• To learn the chemical kinetics, design of single / multiple reactors and multiphase reactor systems. • To acquire knowledge in analysis and design of chemical and bioreactors. • To apply the reaction engineering concepts in various biochemical reaction systems.							
Course Outcomes	**At the end of the course, the students will be able to** 1. outline chemical reactors, concentration and temperature dependence of rate equation 2. develop rate equation for irreversible and reversible reactions. 3. derive performance equation for single ideal reactors and also compare its performance 4. determine the final conversion achieved in multiple reactor systems 5. analyse the basics aspects and reactor performance with non-ideal flow 6. construct tank-in-series and dispersion model to analyse non ideality in flow reactors 7. analyse reaction rate, heat effects of heterogeneous reactions and diffusion resistances 8. develop performance equation for multiphase reactors and analyse experimental methods of finding rate 9. outline the importance of enzyme fermentation and substrate limiting fermentation. 10. demonstrate the importance of batch and continuous fermentors in enzyme fermentation.							

Scope of Chemical Kinetics & Chemical Reaction Engineering

Broad outline of chemical reactors; rate equation; concentration and temperature dependence; development of rate equation for Irreversible unimolecular type first- order reactions, Irreversible bi-molecular type Second -order reactions; Zero order reactions; Irreversible reactions in series and parallel; Reversible reactions.

Ideal Reactors

Ideal Reactors: Design of single ideal reactors - performance equation of batch reactor, semi batch reactor, mixed flow reactor, plug flow reactor, recycle reactor; Performance comparison of single reactors; Autocatalytic Reactions; Multiple-reactor systems.

Non Ideal Flow

Basic aspects of non-ideal flow, Residence time distribution measurement; C,E and F curves; Reactor performance with non-ideal flow; Conversion in non-ideal flow reactors; Non- ideal flow models; Tank in series Model, Dispersion Model; Mean concentration and conversion in non-ideal flow reactors.

Heterogeneous Catalysis

Catalytic reactions-mechanism, deactivation; Heterogeneous reactions: surface reaction rate, film diffusion resistance, pore diffusion resistance combined with surface kinetics, porous catalyst particles, heat effects; Catalytic reactors: design of slurry reactor, trickle bed reactor, fluidized bed reactor; performance equation of porous catalytic reactors; experimental methods of finding rates.

Biochemical Reaction Systems

Enzyme fermentation; substrate limiting microbial fermentation: batch fermentors, mixed flow fermentors; optimum operation of fermentors; product limiting microbial fermentation: batch or plus flow fermentors and mixed flow fermentors.

Text book (s) :

1.	Levenspiel, O., “Chemical Reaction Engineering”, 3rd Edition. John Wiley and Sons, New Delhi,2010.
2.	Fogler, H.S., “Elements of Chemical Engineering”, 4th Edition, Prentice Hall of India, New Delhi, 2005.

Reference(s) :

1.	Gavhane, K.A., “Chemical Reaction Engineering”, Vol I &Vol II, NiraliPrakashan, Pune, 2011.
2.	Tapio Salmi,O., Jyri-Pekka Mikkola, Johan Warna,P.,“Chemical Reaction Engineering and Reactor Technology”, CRC Press, Florida, 2011.
3.	Hayes, R.E., Mmbaga, J.P.,“Introduction to Chemical Reactor Analysis”, Second Edition, CRC Press, New York, 2013.

K.S.Rangasamy College of Technology - Autonomous

40 BT 606 - IPR and Biosafety

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	50	50	100

Objective(s)

- To provide an overview on IPR to the graduates.
- To bring out techno-legal professionals in the field of IPR.
- To provide an insight into the issue related to the patenting of biotechnological products.

Course Outcomes

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

1. describe the types of IPR and their importance.
2. explain the role in IPR in protection of GMO's.
3. differentiate the different theories related to IPR.
4. acquire knowledge on various organizations involved in IPR maintenance.
5 outline the patent law and procedures for filing a patent.
6. analyze the problems that can arise after patenting.
7. gain knowledge on various database of IPR.
8. explain the importance of maintaining and protecting data.
9. understand the biological safety cabinets and biosafety guidelines.
10. investigate the role of GMOs and LMOs and their risk assessment and management.

Introduction to Intellectual Property Rights

IPR: definition, role and importance - types of IPR: Patents, Trademarks, Tradesecrets, Copyright and Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications - Protection of GMO's IPR in R&D.

Theories and Conventions

Indian theory - Constitutional Aspects of Property, Constitutional Protection of Property and IP - Western theory - Locke's Labour, Hegel's Personality and Marxian Theory - Berne Convention, Universal Copyright Convention, the Paris Convention, TRIPS, the WIPO and the UNESCO.

Patent Filing

Patent Law - Rights under Patent Law and its Limitations - Patent Requirements - Ownership and Transfer - Patentable and Non patentable inventions - Patent Application Process and Granting of Patent - Patent Infringement and Litigation - International Patent Law - Double Patenting, Patent Searching - Patent Cooperation Treaty - New developments in Patent Law.

IPR Database

Patent database - National, International, Country-wise patent searches (USPTO, EPO), PATENT Scope (WIPO, IPO) - commercial and free patent databases - search tools and functions - database for trademark and industrial design - data security, confidentiality, privacy - International aspects of Computer and Online Crime.

Biosafety

Introduction to Biological safety cabinets - primary containment for biohazards - biosafety levels - biosafety levels of specific microorganisms - biosafety guidelines - Government of India; definition of GMOs & LMOs - roles of Institutional Biosafety committee, GMO applications in food and agriculture - environmental release of GMOs - Risk analysis, risk assessment, risk management and communication.

Text book(s):

1	Gopalakrishnan N.S. and Ajitha T.G, "Principles of Intellectual Property", 2nd edition, Eastern Book Company, 2014.
2	BAREACT, Indian Patent Act, 1970, Acts and Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi, 2007.

Reference(s):

1	Subbaram N.R. "Handbook of Indian Patent Law and Practice ", S.Viswanathan Printers and Publishers Pvt. Ltd., 1998.
2	Tzotzos, G.T., "Genetically modified organisms - A guide to Biosafety", CAB International, Walling ford, U.K. 213p.1995.

K. S. Rangasamy College of Technology - Autonomous

40 BT 6P1 - Plant and Animal Biotechnology Laboratory

B. Tech Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum marks		
	L	T	P		C	CA	ES	Total
VI	0	0	3	45	2	50	50	100

Objective(s)

- To experiment the techniques involved in Plant tissue culture.
- To understand the applications of genetic engineering in plants and to develop transgenic plants.
- To experiment the techniques in sterilization and maintenance of various Animal cell culture for molecular diagnostic of Animal diseases and transgenic Animal production.

Course Outcomes

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

1. adapt the preparation of plant tissue culture media for plant cell, tissue and organ culture with effective and safe operation.
2. illustrate the steps involved in developing a reliable protocol for *in vitro* culturing of plants.
3. calculate the required hormonal combination for various *in vitro* plant production techniques.
4. experiment the aseptic explant production through *in vitro* seed germination,
5. observe the formation of multiple shoots branches from micro propagated explants and apply the technology for mass plant propagation.
6. adapt callus culture from tissues of medicinal plants and to observe the growth pattern of callus culture.
7. dissect the production of haploid plants and their application along with their importance for hybridization.
8. illustrate the basic concepts of *Agrobacterium* mediated gene transformation.
9. operate a reliable procedure to produce and study the ontology of somatic embryos for synthetic seed preparation for transgenic plant production.
10. adapt the preparation of animal cell culture media and to know about trypsinization, sub culturing process for the production of transgenic animals.

List of experiments

Plant Biotechnology

1. Preparation of stock solutions of MS basal medium and plant growth regulator stocks.
2. Aseptic culture techniques for establishment and maintenance of cultures
3. Micropropagation of plants through meristematic explats.
4. Multiplication of plant through Micropropagation
5. Micropropagation of Rice by indirect organogenesis from embryo
6. Haploid plant production (Ovary and Pollen culture)
7. *Agrobacterium* mediated gene transformation and hairy root culture
8. Preparation of synthetic seed

Animal Biotechnology

9. Preparation of tissue culture medium, sterilization and Membrane filter system
10. Trypsinization of Monolayer and sub culturing
11. Isolation of Primary cells from Chicken fibroblast

Text book(s):

1. Gamborg, O.L. and Philips G.C., “Plant Cell, Tissue and Organ Culture fundamental Methods”, Narosa Publishing House, New Delhi, India, 2005.
2. Ian Freshney, R., “Culture of Animal Cells”, Fifth Edition, Wiley Publications, New Delhi, India, 2006.

K. S. Rangasamy College of Technology - Autonomous

40 BT 6P2 - Chemical and Reaction Engineering Laboratory

B. Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum marks		
	L	T	P		C	CA	ES	Total
VI	0	0	3	45	2	50	50	100

Objective(s)

- To learn the performance and kinetic analysis of different reactors and flow measuring devises.
- To analyze unit operations to study the transfer coefficients.

Course Outcomes

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

1. demonstrate kinetic studies and performance characteristics of batch, semi batch and continuous reactors.
2. perform experiment to account non-ideality by determining residence time distribution
3. calculate the fractional conversion achieved inmultiple reactor systems.
4. analyse flow of fluids by determining viscosity, friction factor and co-efficient of discharge.
5. calculate pressure drop per unit length of packed column and minimum fluidization velocity in fluidized column.
6. characterize mean particle size by differential and cumulative analysis of fraction obtained from jaw / Roll crusher by sieve analysis
7. determine heat and mass transfer coefficients and study adsorption equilibrium
8. calculate resistance offered by filter cake and filter medium in filter press

List of experiments

1. Kinetic studies in batch reactor and semi batch reactor
2. Performance characteristics of mixed flow reactor and plug flow reactor
3. Residence Time Distribution studies in flow reactors
4. Conversion studies in multiple reactor system (Mixed Flow Reactor/Plug Flow Reactor)
5. Measurement of Viscosity
6. Studies on Orifice and Venturi meter
7. Studies on Flow through Packed Column and fluidized Column
8. Friction factor studies in straight pipes
9. Studies on Jaw / Roll Crusher
10. Determination of heat transfer coefficient in Shell and Tube Heat exchangerDiffusivity measurement
11. Studies on Adsorption equilibrium
12. Studies on filtration in leaf filter or plate and frame filter press

Reference(s):

1. McCabe W.L., Smith J.C. and Harriot P., "Unit Operations of Chemical Engineering", 7th edition, McGraw Hill, New York, 2005.
2. Perry Robert, "Perry's Chemical Engineers Hand Book", 8th edition, McGraw Hill, New York, 2007.

K. S. Rangasamy College of Technology - Autonomous

40 BT 6P3 - Bioinformatics and Molecular Modeling Laboratory

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum marks		
	L	T	P		C	CA	ES	Total
VI	0	0	3	45	2	50	50	100

Objective(s)	• To acquire knowledge in various aspects of Bioinformatics and Molecular Modelling. • To apply the modelling skills to understand the analog and structure based drug design concepts for synthesizing new potent drugs
Course Outcomes	**At the end of the course, the students will be able to** 1. annotate the various biological data from different biological database and basic Linux commands 2. determine the similarity between the sequences using BLAST and FASTA 3. analyze the arrangement of sequences like Genome, DNA, RNA or protein and to probe the regions of similarity and identity among them 4. analyze the evolutionary relationships among the organisms through phylogentic tools 5. infer and configure the structural conformations of proteins 6. elucidate the 3D structure of the target protein from its amino acid sequence 7. draw and configure the two dimensional structure of the small molecules 8. perform Molecular dynamic on the target protein using GROMACS. 9. probe the interaction of the proteins with ligands and predict the orientation of the molecule bound with each other. 10. read, analyze and visualize genomic, proteomic and microarray data using MATLAB®

List of experiments

1. Basic Linux commands , Retrieval of biological sequences: Protein and DNA from database and 3-D structure of proteins - viewing and analysis
2. Data Base Searching Tools – BLAST and FASTA
3. Sequence Alignment
    a. Pairwise alignment – Global and Local
    b. Multiple Sequence Alignment – ClustalX
    c. Whole Genome Alignment
4. Phylogenetic Analysis – Phy lip.
5. Structure Visualization Tool
6. Homology Modelling – Modeller 9v7
7. 2D Structure Drawing Tools and Lead Optimization Studies
8. Molecular Dynamics Simulation of target protein using GROMACS
9. Molecular Docking - Arguslab
10. MATLAB® - Bioinformatics Tool box.

Text book(s):

1. Bioinformatics: A practical guide to the analysis of genes & proteins, Edited by Baxevanis & Outlette, 3rd edition, John Wiley & Sons, inc. publication, 2004.
2. Molecular Modelling for Beginners, Alan Hinchliffe, 2nd Edition, John Wiley & Sons, inc. publication 2008.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	**Biotechnology**		**Programme Code & Name**			**B. Tech Biotechnology**		
Semester VI								
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**ES**	**Total**
40 TP 0P4	**Career Competency Development IV**	**0**	**0**	**2**	**0**	**100**	**00**	**100**
Objective(s)	To enhance employability skills and to develop career competency							

Unit – 1	**Written and Oral Communication – Part 2**	**Hrs**
Self Introduction – GD - Personal Interview Skills **Practices** on Reading Comprehension Level 2 – Paragraph Writing - News paper and Book Review Writing - Skimming and Scanning – Interpretation of Pictorial Representations - Sentence Completion - Sentence Correction - Jumbled Sentences - Synonyms & Antonyms - Using the Same Word as Different Parts of Speech - Editing **Materials:** Instructor Manual, Word power Made Easy Book, News Papers		4
Unit – 2	**Verbal & Logical Reasoning – Part 2**	**8**
Analogies – Blood Relations – Seating Arrangements – Syllogism - Statements and Conclusions, Cause and Effect – Deriving Conclusions from Passages – Series Completion (Numbers, Alphabets & Figures) – Analytical Reasoning – Classification – Critical Reasoning **Practices**: Analogies – Blood Relations - Statement & Conclusions **Materials:** Instructor Manual, Verbal Reasoning by R.S.Aggarwal		
Unit – 3	**Quantitative Aptitude - Part – 5**	**6**
Geometry - Straight Line – Triangles – Quadrilaterals – Circles – Co-ordinate Geometry – Cube – Cone – Sphere. **Materials:** Instructor Manual, Aptitude book		
Unit – 4	**Data Interpretation and Analysis**	**6**
Data Interpretation based on Text – Data Interpretation based on Graphs and Tables. Graphs can be Column Graphs, Bar Graphs, Line Charts, Pie Chart, Graphs representing Area, Venn Diagram & Flow Charts. **Materials:** Instructor Manual, Aptitude Book		
Unit – 5	**Technical & Programming Skills – Part 2**	**6**
Core Subject – 4,5,6 **Practices :** Questions from Gate Material **Materials:** Text Book, Gate Material		
	Total	**30**

Evaluation Criteria

S.No.	Particular	Test Portion	Marks
1	Evaluation 1 Written Test	15 Questions each from Unit 1, 2, 3, 4 & 5 (External Evaluation)	60
2	Evaluation 2 - Oral Communication	GD and HR Interview (External Evaluation by English, MBA Dept.)	20
3	Evaluation 3 – Technical Interview	Internal Evaluation by the Dept. – 3 Core Subjects	20
		Total	100

Reference Books

1. Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.
2. Abhijit Guha, “Quantitative Aptitude”, TMH, 3rd edition
3. Objective Instant Arithmetic by M.B. Lal & GoswamiUpkar Publications.
4. Word Power Made Easy by Norman Lewis W.R. GOYAL Publications

Note:

- Instructor can cover the syllabus by Class room activities and Assignments (5 Assignments/week)
- Instructor Manual has Class work questions, Assignment questions and Rough Work pages
- Each Assignment has 20 questions from Unit 1,2,3,4,5 and 5 questions from Unit 1 (Oral Communication) & Unit 5(Programs)
- Evaluation has to be conducted as like Lab Examination.

K.S.Rangasamy College of Technology - Autonomous

40 HS 003 - Total Quality Management

Common to All Branches

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	2	0	0	45	2	50	50	100

Objective(s)	• To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management, statistical approach for quality control, ISO and QS certification process and its need for the industries.
Course Outcomes	**At the end of the course, the student will be able to** 1. recognize the basic concepts of total quality management. 2. list the role of senior management. 3. identify the customer satisfaction, retention and employee involvement. 4. locate the continuous process improvement techniques. 5. list the seven tools of quality and new seven management tools. 6. demonstrate concept of six sigma. 7. implement the concept of quality function deployment. 8. assess the total productive maintenance, failure mode and effective analyses. 9. demonstrate the need for ISO 9000 and other quality system. 10. categorize the quality auditing.

Introduction

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Quality Council, Quality Statements, Deming Philosophy, Barriers to TQM Implementation.

TQM Principles

Customer satisfaction, Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement, Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership, Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures-Basic Concepts, Strategy.

Statistical Process Control (SPC)

The tools of quality, Statistical Fundamentals, Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma.

TQM Tools

Benchmarking, Reasons to Benchmark, Benchmarking Process, Quality Circle, Quality Function Deployment (QFD). House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), Concept, Improvement Needs, FMEA–Stages, Types.

Quality Systems

Need for ISO 9000 Quality Systems, ISO 9001:2008 ISO 14000 Quality Systems, Elements Concepts, Implementation, Documentation, Quality Auditing, Requirements and Benefits, Non Conformance report, Case Studies on Educational System.

Text book(s):

1	Dale H.Besterfiled, *et al.,* "Total Quality Management", Pearson Education Asia, 1999. (Indian reprint 2002).

Reference(s):

1	James R.Evans & William M.Lidsay, "The Management and Control of Quality", (5th Edition), South-Western (Thomson Learning), 2002.
2	Feigenbaum.A.V. "Total Quality Management", McGraw Hill, 1991.
3	Jayakumar.V, Total Quality Management", Lakshmi Publications, 2006.
4	Suburaj, Ramasamy "Total Quality Management", Tata McGraw Hill, 2005.

K.S.Rangasamy College of Technology - Autonomous

40 BT 701 - Biopharmaceutical Technology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	1	0	60	4	50	50	100

Objective(s)

- To understand the basics concepts of pharmacology
- To know about the drug manufacturing process and kinetics
- To learn about the biopharmaceutical quality assurance

Course Outcomes

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

1. describe the classification of drugs and origin of pharmaceutical substance from different sources.
2. analyze the clinical trials and different routes of drug administration.
3. pronounce the manufacturing facilities of drugs and granulation process.
4. illustrate the coating process and quality control in drug manufacturing process.
5. explicate the concepts of adsorption and distribution of drugs.
6. explain the biotransformation process and bioavailability of drugs.
7. designate the classification of pharmaceutical dosage forms.
8. define the use of semi- solid dosage form and inhalants.
9. determine the role of quality assurance in biological evaluation of the drug.
10. describe the regulatory affairs and their role in biopharmaceutical quality assurance.

Introduction to Pharmacology

Drug: definition - classification - physiochemical properties - pharmaceutical substances of plant origin - pharmaceuticals of animal origin - pharmaceutical substances of microbial origin - routes of administration of drug - patenting in biotechnology.

The drug manufacturing process

The manufacturing facility - Cleaning, decontamination and sanitation (CDS), documentation, specifications, records - compression and granulation of tablets - coating of pharmaceutical dosage forms - film coating, modified release film coating - coating procedure and equipment - quality control and practice.

Pharmacokinetics and Biotransformation

Basic concepts of pharmacokinetics: absorption - mechanism of drug absorption - distribution - biotransformation of drug - non synthetic and synthetic reaction elimination, organ clearance - hepatic clearance, renal clearance, bioavailability and bioequivalence.

Pharmaceutical dosage forms

Definition of dosage forms, classification of dosage forms - solid unit dosages - tablets, capsules, pills, troches, cachets, liquids - solutions, lotions, suspension, elixirs, emulsions, liniments semi-solid - ointments, creams, gels - inhalations and inhalants - extracts - tinctures and fluid extracts.

Biopharmaceuticals quality assurance

Role of Food and drug administration (FDA), Centre for biological evaluation and research (CBER), Center for drug evaluation and research - global harmonization of regulatory affairs - European medicine evaluation agency (EMEA) - Indian pharmacopeia (IP) - United states pharmacopeia (USP).

Text book(s):

1. Remington, "The Science and Practice of Pharmacy", 22th edition, Lippincott Williams & Wilkins, 2012.
2. Gary Walsh, "Biopharmaceuticals", 2nd edition, John Wiley & Sons Ltd, UK, 2003.

Reference(s):

1. Tripathi, K.D. "Essentials of Medical Pharmacology", 6th edition, Jaypee Brothers Medical Publishers (P) Ltd., John Wiley, New Delhi, 2000.
2. Goodman and Gilman's, "The Pharmacological Basis of Therapeutics", 11th edition, McGraw-Hill Medical Publishing Division, New York, 2006.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 702 - Nanobiotechnology								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100

Objective(s)	• To develop the fundamental understanding of basic concepts of nano particles and its uses. • To widen the knowledge about the production and applications of Nanoparticles in health, environment, pollution and food industry.
Course Outcomes	**At the end of the course, the students will be able to** 1. know the basic concepts in nano biotechnology and the systems used in nano electronics and microelectronics. 2. synthesize different types of nano particles such as carbon nano tubes, quantum dots. 3. classify the methods for nano scale materials (Top down and Bottom up methods) including ball milling, laser ablation, plasma arcing and chemical vapour deposition. 4. characterizenano materials using FTIR, XRD and Scanning Probe Microscopy. 5. illustrate the mechanism of lipids as nano bricks and nano mortars and its self organizing supra molecular structure. 6. explain the role of S Layer proteins, Ion channels, DNA based artificial nanostructure and DNA computers in nanotechnology. 7. describe the application of transducing elements in bionanotechnology. 8. understand the mechanism of drug delivery using different types of nano materials. 9. understand the mechanism of action of nanoparticles against infectious diseases. 10. utilize and apply nanotechnology for environmental remediation, waste water treatment and food industry.

Introduction to Nanobiotechnology and Synthesis

Introduction - types and properties of nanoparticles, Carbon nanotubes, Quantum dots, fullerenes, Nanopores, Nanoshells, Nanocomposites; synthesis of nanoscale materials - top down and bottom up approaches, physical method: ball milling - plasma arcing - laser ablation method, chemical method: sol gels – chemical vapour deposition, green synthesis of nanoparticles, nanoparticle synthesis by fungi, bacteria and actinomycetes.

Characterization of Nanomaterials

Types of characterization, optical probe - CLSM, SNOM, 2PFM, DLS, electron probe - SEM, TEM, HRTEM, AES, STEM, scanning probe - AFM, CFM, MFM, STM, APM, spectroscopy probe - UPS, UVVS, AAS, LSPR, ion-particle probe - XRD, EDX, NMR, thermodynamic - TGA, DSC, BET.

Nanomolecules in biosystems

Introduction - lipids as nano bricks and mortar - lipid structure - self organizing supra molecular structures, proteins - S Layer proteins, nanoscale motors - based on bacteriorhodopsin - ion channels as sensors, DNA - DNA based artificial nanostructures - DNA as nanowires - DNA computers.

Nano biotechnological detection systems

Types of transducing element and its applications in bio-nanotechnology – electrochemical transducer, optical transducer, nano biosensor, quantum dots, gold nanoparticels, DNA detection, small scale systems of drug delivery - Pills, stent, gels and magnets.

Application of Nanobiotechnology

Application of nanobiotechnology in treatment of infectious diseases: viral, fungal, chronic diseases, Nanotechnology for cancer diagnosis and treatment: targeted delivery of anticancer drugs - gold nanoparticles, functionalized gold nanoparticles for protein delivery. Nanobiotechnology in environmental remediation, wastewater treatment, food industry - detection of pathogens, preservation and packaging.

Text book(s):

1	Mick Wilson, Kamali Kannangara, Geoff Smith and Michelle Simmon sons, “Nanotechnology Basic science and emerging technologies”, Overseas Press India Private Limited, New Delhi, India, 2005.
2	Niemeyer C. M. and Mirkin C. A., “Nanobiotechnology - Concepts, applications and perspectives” Wiley VCH Publishers, New Delhi, India, 2004.

Reference(s):

1	Ralph S. Greco, Fritz B. Prinz and Lane R., “Nanoscale Technology in biological systems”, Smithm CRC Press, California, USA, 2005.
2	Chad A Mirkin and Christof M. Niemeyer (Eds), “Nanobiotechnology - II more concepts and applications”, Wiley VCH, 2007.

K.S.Rangasamy College of Technology - Autonomous

40 BT 705 - Downstream Processing

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	1	0	60	4	50	50	100

Objective(s)

- To learn the various unit operations and their applications in downstream processing of bioproduct.
- To acquire knowledge in recovery, purification and formulation of bioproducts of commercial interest.
- To emphasis the separation techniques for products produced through fermentation technology.

Course Outcomes

At the end of the course the student would be able to learn

1. describe the characteristics of biomolecules and cost cutting strategies associated with downstream processing.
2. derive the cell disruption kinetics of various cell disruption methods and pretreatment.
3. design industrial filters and understand the principle of compressibility and resistances.
4. know design of tubular, disc bowl and basket centrifuges for biomolecule separation and scale up.
5. apply adsorption, aqueous two phase extraction and precipitation for the separation of biomolecules.
6. describe the operational requirements of membrane separation processes in bioproduct purification.
7. demonstrate the basic principles and terminologies of chromatographic techniques.
8. characterize novel chromatographic techniques and their applications in bioseparation.
9. illustrate the operational requirements of industrial crystallizersand kinetics of crystal growth
10. understand the principle of freeze dryer and their applications.

Introduction to downstream and intracellular product release

Introduction to downstream processing - characteristics of biomolecules - economics of downstream processing - cost cutting strategy - physico chemical basis of bioseparation - location of products and product release kinetics - cell disruption methods: mechanical, chemical and enzymatic process; pretreatment and stabilization of bioproducts.

Primary separation and isolation

Principle of batch filtration - pretreatment of fermentation broth, design of industrial filters: plate and frame filter press, leaf filter, continuous filtration: rotary drum filter - calculation in batch and continuous filtration - centrifugation: principle, design and types of industrial centrifuges - scale up of centrifugation - problems to find settling velocity, angular velocity, sigma factor and number of discs in centrifugation.

Product recovery and concentration

Adsorption: isotherms, adsorption in batch, CSTR and fixed bed - problems in adsorption isotherms and break point time in fixed bed adsorption - principle of cloud point, aqueous two phase and supercritical fluid extraction - membrane separation processes: microfiltration, ultrafiltration, reverse osmosis and dialysis, precipitation of proteins by different methods.

Product purification

Chromatography: principle and practice, ion exchange, size exclusion, bioaffinity, hydrophobic interaction, reverse phase, pseudo affinity chromatography, high performance liquid chromatography, flash chromatography and gas chromatographic techniques.

Final product purification and polishing

Crystallization: nucleation, crystal growth, crystal size distribution, kinetics of crystallization, population density, industrial crystallizers, recrystallization; drying - drying terminologies, drying curve, industrial dryers, freeze drying principles and applications - problems related to relative humidity and population density.

Text book(s) :

1. Belter P. A., Cussler E.L. and Wei-Houhu, “Bioseparations - Downstream Processing For Biotechnology”, Wiley Interscience Pub., New Delhi, 1988.
2. Sivasankar B., “Bioseparations - Principles and Techniques”, Prentice Hall of India Private Limited, New Delhi, 2006.

Reference(s) :

1. Nooralabettu Krishna Prasad, “Downstream Process Technology - A New Horizon In Biotechnology”, PHI Learning Private Limited, New Delhi, 2012.
2. Roger.G, Harrison, Paul Todd, Scott R.Rudge and Demetri P.Petrides, “Bioseperation Science and Engineering” Oxford University Press, Newyork , 2003.

K.S.Rangasamy College of Technology - Autonomous

40 BT 7P1 - Biological Data Analysis Laboratory

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	0	0	3	45	2	50	50	100

Objective(s)	• To determine the correct statistical technique for many biological experiments, and able to apply each technique and interpret the results. • To recognize experimental designs for appropriate statistical test and evaluate the results.
Course Outcomes	**At the end of the course, the students will be able to** 1. organize data and visualize the data in different views. 2. perform one sample T-test and Paired sample T-test for the given bio data. 3. execute test of hypothesis using F-test and Chi-square test for the provided biological data and able to interpret the results. 4. implement Analysis of Variance using One way ANOVA, Two way ANOVA principle for the given data. 5. do regression analysis for SLR using SPSS. 6. organize regression analysis for SLR using SPSS or XLSTAT. 7. establish factor and discriminant analysis for the provided data. 8. complete the Principle Component Analysis of Multivariate Methods for the bio data. 9. cluster the data using K-means algorithm and analyze the results. 10. apply RSM for the data using MATLAB® tool box.

List of experiments

1. Introduction to Biostatistics - Organizing data, Descriptive Measures, Statistical Visualization.
2. Testing of Hypothesis - One sample T-test, Paired sample T-test.
3. Testing of Hypothesis - F-test, Chi-square test.
4. Analysis of Variance - One way ANOVA, Two way ANOVA.
5. Regression Analysis - Single Linear Regression.
6. Multiple Linear Regression
7. Factor and discriminant Analysis
8. Multivariate Methods - Principle Component Analysis
9. Cluster Analysis - K-Means
10. MATLAB® - Response Surface Methodology

Text book(s):

1	Michael Whitlock and Dolph Schluter, “The Analysis of Biological Data”, 1st edition, Roberts and Company Publishers, 2008.

K.S.Rangasamy College of Technology - Autonomous								
40 BT 7P2 - Downstream Processing Laboratory								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	0	0	3	45	2	50	50	100

Objective(s)	• To gain knowledge on various purification stages of downstream processing to obtain a finished bioproduct.
Course Outcomes	**At the end of the course, the students will be able to** 1. demonstrate the disruption of cells by ultrasonication method and estimate the amount of protein released. 2. recover the product by cross current leaching technique. 3. perform centrifugation to study the effect of density gradient for separation of molecules. 4. execute and verify the biosorption studies. 5. perform the extraction of the biomolecules from the given sample using aqueous two phase system. 6. examine precipitation of proteins using acetone, ammonium sulphate and isoelectric methods. 7. determine the amount of protein recovered by differential partitioning using aqueous two phase extraction 8. analyze separation of the biomolecules by chromatographic techniques. 9. carryout crystallization studies to understand the finishing operations. 10. demonstrate the operating procedure of freeze dryer.

List of experiments

1. Studies on cell disruption and cell separation by different methods.
2. Solid-Liquid separation by centrifugation
3. Biosorption studies - Verification of Freundlich Isotherm
4. Product recovery by Cross current leaching
5. Aqueous two phase extraction of biomolecules
6. Enzyme purification by isoelectric precipitation and acetone
7. Studies on ammonium sulphate precipitation
8. Studies on product purification by chromatographic techniques
9. Product purification by crystallization
10. Product polishing by freeze drying

Text book(s):

1	Roger.G . Harrison, Paul Todd, Scott R. Rudge and Demetri P.Petrides,“Bioseperation Science and Engineering”, Oxford University Press, New York, 2003.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	**Biotechnology**		**Programme Code & Name**		**B.Tech. Biotechnology**			
Semester VII								
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**ES**	**Total**
40 TP 0P5	**Career Competency Development V**	**0**	**0**	**2**	**0**	**100**	**00**	**100**
Objective(s)	To enhance employability skills and to develop career competency							

Unit – 1	**Written and Oral Communication**	**Hrs**
Self Introduction – GD – HR Interview Skills – Corporate Profile Review **Practices** on Company Based Questions and Competitive Exams **Materials:** Instructor Manual		6
Unit – 2	**Verbal & Logical Reasoning**	6
Practices on Company Based Questions and Competitive Exams **Materials:** Instructor Manual		
Unit – 3	**Quantitative Aptitude**	6
Practices on Company Based Questions and Competitive Exams **Materials:** Instructor Manual		
Unit – 4	**Data Interpretation and Analysis**	6
Practices on Company Based Questions and Competitive Exams **Materials:** Instructor Manual		
Unit – 5	**Programming & Technical Skills – Part 3**	6
C Language - Control Structures – Data Types – Arrays – Operators -Functions- Structures – Pointers-Files **Practices :** Programs and Find Output and Errors **Materials:** Instructor Manual , Exploring C by Yashwant Kanetkar		
	Total	**30**

Evaluation Criteria

S.No.	Particular	Test Portion	Marks
1	Evaluation 1 Written Test	15 Questions each from Unit 1, 2,3, 4 & 5 (External Evaluation)	60
2	Evaluation 2 - Oral Communication	GD and HR Interview (External Evaluation by English, MBA Dept.)	20
3	Evaluation 3 – Technical Interview	Internal Evaluation by the Dept. – 3 Core Subjects	20
		Total	**100**

Reference Books

1. Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.
2. Abhijit Guha, “Quantitative Aptitude”, TMH, 3rd edition
3. Objective Instant Arithmetic by M.B. Lal & GoswamiUpkar Publications.
4. Word Power Made Easy by Norman Lewis W.R. GOYAL PUBlications

Note:

- Instructor can cover the syllabus by Class room activities and Assignments(5 Assignments/week)
- Instructor Manual has Class work questions, Assignment questions and Rough work pages
- Each Assignment has 20 questions for Unit 1,2,3,4 & 5 and Unit 5 and 5 questions from Unit 5(Algorithms) & Unit 1(Oral Communication)
- Evaluation has to be conducted as like Lab Examination.

K.S.Rangasamy College of Technology - Autonomous								
40 HS 002 - Engineering Economics and Financial Accounting								
Common to All Branches								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	2	0	0	45	2	50	50	100

Objective(s)	• The main objective of this course is to make the Engineering student to know about the basic of economics, how to organize a business, financial aspects related to business,
Course Outcomes	**At the end of the course, the student will be able to** 1. apply suitable demand forecasting techniques. 2. appraise the prevailing market structure. 3. describe forms of business in an organization. 4. distinguish between proprietorship and partnership. 5. explain the various kinds of banking. 6. illustrate the balance sheet with a suitable example. 7. differentiate between fixed cost and variable cost. 8. interpret technical feasibility and economic feasibility. 9. apply break even analysis in engineering projects. 10. summarize the managerial uses of break even analysis.

Basic Economics

Definition of economics – nature and scope of economics – basic concepts of economics – factors of production – demand analysis – definition of demand – Law of demand – Exception to law of demand – Factors affecting demand – elasticity of demand – demand forecasting – definition of supply – factors affecting supply – elasticity of supply – market structure – perfect competition – imperfect competition - monopoly – duopoly – oligopoly and bilateral monopoly .

Organization and Business Financing

Forms of business – proprietorship – partnership - joint stock company - cooperative organization - state Enterprise - mixed economy - Money and banking – kinds of banking - commercial banks - central banking functions - control of credit - monetary policy - credit instrument – Types of financing - Short term borrowing - Long term borrowing - Internal generation of funds - External commercial borrowings - Assistance from government budgeting support and international finance corporations.

Financial Accounting and Capital Budgeting

The balance Sheet and related concepts – The profit and loss statement and related concepts – Financial ratio analysis – Cash flow analysis – fund flow analysis – Capital budgeting– Average rate of return – Payback period – Net present value and internal rate of return.

Cost Analysis

Types of costing – traditional costing approach - activity based costing - Fixed Cost – variable cost – marginal cost – cost output relationship in the short run and in long run – pricing practice – full cost pricing – marginal cost pricing – going rate pricing – bid pricing – pricing for a rate of return – appraising project profitability - cost benefit analysis – feasibility reports – appraisal process – technical feasibility - economic feasibility – financial feasibility.

Break Even Analysis

Basic assumptions – break even chart – managerial uses of break even analysis - applications of break even analysis in engineering projects.

Textbook(s):

1.	Khan MY and Jain PK., “Financial Management” McGraw - Hill Publishing Co., Ltd., New York, 2000.
2.	Varshney RL and Maheshwary KL. “Managerial Economics” S Chand and Co., New Delhi, 2001.

Reference(s):

1.	Barthwal R.R., “Industrial Economics - An Introductory” Text Book, New Age Publications, New Delhi, 2001.
2.	Samuelson P.A., “Economics - An Introductory Analysis”, McGraw - Hill & Co., New York, 2000.
3.	S.K.Bhattacharyya, John Deardon and Y.M.Koppikar, “Accounting for Management Text and Cases”, Vikas Publishing House Pvt Ltd., New Delhi – 110002, 1984.
4.	V.L.Mote, Samuel and G.S.Gupta, “Managerial Economics – Concepts and Cases”, Tata Mcgraw Hill Publishing Company Ltd., New Delhi – 110002, 1981.

K.S.Rangasamy College of Technology - Autonomous

40 BT E11 - Environmental Biotechnology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	50	50	100

Objective(s)

- To familiarize the learners with the impacts of pollution, Biodegradation and Bioremediation.
- To enlighten the learners about waste management.
- To enable students to learn the basic concepts of interactions of radiation with environment.

Course Outcomes

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

1. describe the types and sources of air and water pollution and to determine the measures to be undergone to control pollution.
2. identify the mechanism of acid rain and the effect of dissolved oxygen, dissolved carbon-di-oxide.
3. understand the physical and chemical process of soil formation and the factors affecting it.
4. describe the size and performance of individual components of the ecosystem like soil organic matter, soil chemical constituents and humus formation.
5. outline the various types of soil microbes and their growth and ecological adaptability.
6. discuss the importance of soil microbes and their enzyme activity such as phosphatase, cellulase, urease and dehydrogenase.
7. explain the consequence of pesticides and its degradation pathways
8. illustrate the action, effect of fungicides and weedicides such as DDT, simple aromatics, chlorinated polyaromatic petroleum products and surfactants.
9. appraise the use of microbes and plants in bioremediation of oil spilled and salt affected soils along with the usage of biofertilizers for poor soil management.
10. summarize the role of biological indicators and solid waste management of dairy, pulp leather and pharmaceutical effluents

Environmental Pollution

Types and sources of air, water and soil pollution, monitoring of air and water pollution, noise pollution, impact of pollution on human health, environment and assets;water and air pollution control technologies.

Bioremediation technologies

Remediation technologies - Bioventing-biosparging and bioslurping - Phytoremediation - Bioabsorption and Bioleaching of heavy metals: Cadmium, Lead, Mercury, Metal binding targets and organisms, Bioabsorption, Metal microbial interaction, Biomethylation of elements (Methylation of mercury and arsenic), Commercial biosorbants, bioleaching, metal precipitation, advantages and disadvantages of bioleaching.

Solid Waste Management

Solid waste management: Introduction, management of municipal, agricultural, industrial, mining, hazardous (biomedical) waste, waste treatment methods (Incineration, pyrolysis) and Solid waste management methods (composting, wormiculture and methane production) landfill. Hazardous waste treatment. Biofuels.

Biodegradation

Remediation of degraded ecosystems, degradation of xenobiotics in environment, decay behaviour& degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides and heavy metals degradative pathways.

Interactions of nuclear radiation

Ionizing and Non-Ionizing Radiation -Types/sources of ionizing radiation (e.g., X-, gamma rays; Radon, cesium, strontium),Measurement of ionizing radiation,Health effects of ionizing radiation (burns, mutations, cancers) ,sources of environmental exposure to ionizing and non ionizing radiation,Environmental hazards of disposal of ionizing wastes.Non-ionizing radiation and its impact on health (UV light, electromagnetic radiation, cell-phone RFradiation).

Text book(s):

1	Baird, C. and Cann, M.Environmental Chemistry. W.H. Freeman and Company 2008.
2	Botkin, Daniel B. and Keller, Edward A. Environmental Science: Earth as a Living Planet. 6th ed. John Wiley & Sons, USA. 2007

Reference(s):

1	Environmental Biotechnology. Concepts and Applications. Edited by H.-J. Jördening and J. Winter
2	Friis, Robert H. Essentials of Environmental Health. Jones and Bartlett, Inc., Sudbury, MA.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E12 - Biodiversity								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	50	50	100

Objective(s)	• To learn the fundamentals and concepts of biodiversity and its patterns. • To understand the importance of species, genetic and ecosystem biodiversity. • To provide a better knowledge about the biodiversity conservation and management through remote sensing.
Course Outcomes	**At the end of the course, the students will be able to** 1. understand the fundamental concept and history of biodiversity science. 2. illustrate the composition and scales of biodiversity. 3. analyze the various aspects of metapopulation and spatial ecology of species diversity. 4. identify the host-parasite, predator-prey and plant herbivore interactions and the components of community ecology. 5. evaluate the importance of genetic variation and methods for measuring genetic diversity. 6. summarize the different levels of population exploitation of genetic diversity. 7. outline the structure and functioning of the ecosystem diversity. 8. bring out the species interaction and ecosystem processes and the concept of restoration ecology. 9. explore the role of biotechnology in biodiversity conservation and the molecular approaches to assess biodiversity 10. know the application of Remote Sensing, GIS and GPS in biodiversity conservation and management.

Fundamentals of Biodiversity

Biodiversity: concept and definition - scope and constraints of biodiversity science - history of the earth and biodiversity patterns through geological times - composition and scales of biodiversity: genetic, species, ecosystem, landscape/pattern, agro, bicultural and urban biodiversity.

Species Diversity

Density independent versus density dependent growth - metapopulation and spatial ecology - assumptions and evidence for the existence of metapopulations in nature - interspecific interactions: host-parasite, predator-prey and plant herbivore interaction - community ecology - structure and function of communities.

Genetic Biodiversity

Importance of genetic variation within individuals, within and between populations - measuring genetic diversity by the Hardy-Weinberg law - evolutionary forces for genetic variation by genetic drift and natural selection - different levels of population exploitation of genetic diversity.

Ecosystem Diversity

Ecosystem: structure and functioning - ecosystem diversity and landscapes - tropic dynamics and temporal dynamics - human induced ecosystem change - urban ecosystem species effects on ecosystem processes - species interaction and ecosystem processes - landscape heterogeneity - restoration ecology.

Biodiversity conservation

Role of biotechnology in biodiversity conservation - in-situ and ex-situ conservation - molecular approaches to assess biodiversity: DNA fingerprinting, Single Nucleotide Polymorphism - Application of Remote Sensing, Geographic Information System (GIS) and Global Positioning Systems (GPS) in biodiversity conservation and management.

Text book(s):

1	Smith R. L. and Smith T. M., “Elements of Ecology”, Benjamin-Cummings Publishing Company, 2014.
2	Van Dyke F., “Conservation Biology Foundations, Concepts, Applications”, 2nd edition, Springer, 2008.

Reference(s):

1	Hamilton M., “Population Genetics”, Wiley-Blackwell Publications, USA, 2009.
2	Jensen, John R., “Remote Sensing of the Environment: An Earth Resource Perspective”, 2nd edition, Dorling Kindersley, 2009.

K.S.Rangasamy College of Technology - Autonomous

40 BT E13 - Environmental Hazards and Management

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	50	50	100

Objective(s)

- To understand the concepts of environmental hazards, disasters and stress.
- To impart technologies used in disaster management and role of organizations and media.
- To provide the different aspects to create awareness about the disaster management.

Course Outcomes

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

1. understand the concepts of environmental hazards, disasters and stress.
2. analyze the different approaches that are related to human ecology.
3. categorize the types of environmental hazards and disasters.
4. outline the various exogenous and endogenous hazards.
5. describe the concept of disaster management and its strategies.
6. demonstrate the disaster management framework and the role of various organizations and media.
7. identify the technologies that can be employed in the disaster risk reduction.
8. review the contribution of remote sensing in the disaster management.
9. analyze the methods implicated in creating awareness towards disaster management.
10. report the diverse development planning system and financial arrangements for the effective disaster management.

Environmental Hazards

Concepts of environmental hazards, environmental disasters and environmental stress - hazard approaches in relation with human ecology - landscape, ecosystem and perception approach - human ecology and its application in the geographical researches.

Types of Environmental Hazards and Disasters

Natural and man induced hazards and disasters - planetary and extra planetary hazards - exogenous hazards: cyclones, lightning, hailstorms, flood, soil erosion - endogenous hazards: volcanic eruption, earthquakes, landslides - environmental impacts of hazards and disasters.

Disaster Management

Disaster management - effect to migrate natural disaster at national and global levels - international strategy for disaster reduction - concept of disaster management - national disaster management framework - financial arrangements - role of government and media in disaster management - central, state, district and local administration - disaster response - police and other organizations.

Technology in Disaster risk reduction

Application of various technologies - Data bases, RDBMS, Management Information systems and decision support system - geographic information systems, Intranets and extranets - video teleconferencing and Remote sensing technology - contribution of remote sensing and GIS in the disaster management.

Awareness towards Disaster management

Disaster risk reduction by education - disaster information network - risk management through public awareness - implication of development planning - emergency response - case study on Tsunami, cyclone Thane and Sikkim earthquake.

Text book(s):

1	Pardeep Sahni, Madhavi Malalgoda and Ariyabandu, “Disaster risk reduction in South Asia”, First Edition, PHI, 2003.
2	R.B.Singh (Ed), Disaster Management, Rawat Publication, New Delhi, 2000.

Reference(s):

1	M.C.Gupta, “Manuals on Natural Disaster Management in India”, National Centre for Disaster Management, IIPA, New Delhi, 2001.
2	U.K.Chakrabarty, Industrial Disaster Management and Emergency Response, Asian Books Pvt. Ltd., New Delhi, 2007.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E14 - Agricultural Engineering								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	50	50	100

Objective(s)	• To Lean the basic concepts in the current practices of Agronomy. • To discuss the importance of agricultural structures and irrigation methods. • To understand the post harvest procedures for the improvement of marketing strategy.
Course Outcomes	**At the end of the course, the students will be able to** 1. determine the principles of agronomy for managing the environmental impact of agriculture. 2. illustrate the different types of tillage for agricultural preparation of soil. 3. describe on the various propagation techniques used in horticulture. 4. illustrate the concept and importance of basic horticulture methods. 5. characterize the building permit requirements for livestock operations. 6. outline the design and construction of fences and structures for plant environment. 7. determine the various methods of artificial application of water to the land or soil which is used to assist in the growing of agricultural crops. 8. examine the design and construction of canals to moderate depression created to channel water. 9. clarify the concept of designing, operation and testing of various machines used in post harvesting. 10. study the storage technologies for better postharvest practice.

Principles of agronomy

Definition of agriculture and agronomy – Factors affecting crop growth – climate and weather parameters – Soil fertility and productivity–tillage and tilth - objective and principles –different kinds of tillage.

Basic Horticulture

Horticulture -Definition–scope and importance –Propagation –definition –propagation methods –seed propagation-vegetative propagation -cutting, layering, grafting and budding methods –specialized plant parts for propagation –micro propagation.

Agricultural Structures

Site selection, design and construction of farmstead - farm house, cattle shed, dairy bam, poultry shed, hog housing, machinery and implement shed, storage structures for food grains, feed and forage. Design and consturction of fences and farm roads. Structures for plant environment - green houses, poly houses and shade houses.

Irrigation and Drainage

Sources of water for irrigation. Techniques of measuring soil moisture - laboratory and in situ, Soil-water plant relationships. Methods of irrigation - surface, sprinkler and drip, fertigation. Irrigation efficiencies and their estimation. Design and construction of canals, field channels, underground pipelines, head-gates, diversion boxes and structures for road crossing.

Post Harvest and Storage Engineering

Threshing machines- design, principles, operations, maintenance and testing, winnovers, cleaners and graders & separators, Design principles, operation, maintenance and testing.

Storage bins –detection and control of fungal and microbial insects and pests growth in the stored produce, storage technologies-control atmosphere storage, modified atmosphere storage, cover and plinth storage, hypobaric storage. Retail storage packaging.

Text book(s):

1	Sankaran, S. and V.T Subbaiah Mudaliar, “Principles of Agronomy". The Bangalore printing and pub co. Bangalaore, 1993
2	Michael and Ojha. Principles of Agricultural Engineering. Jain brothers, New Delhi, 2005.
3	Jagdishwar Sahay. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi, 2006.

Reference(s):

1	George Acquaah, Horticulture-principles and practices. Prentice-Half of India Pvt. Ltd., New Delhi, 2002.
2	Michael, A.M., Irrigation -Theory and Practice, Vikas publishing house, New Delhi, 1990.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E15 - Organic Farming								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VI	3	0	0	45	3	50	50	100

Objective(s)	• To impart the principles and importance of organic farmimg. • To learn the production technology of organic compost and to practice the its design criteria. • To provide the better understanding about organic standard certificates and learn the future perspectives of organic farmimg.
Course Outcomes	**At the end of the course, the students will be able to** 1. understand the principles and impact of Green Revolution on organic farmimg. 2. identify the various types of farming and the challenges for organic agriculture. 3. comprehend the various components of soil fertility and the techniques to manage the soil fertility. 4. categorize the different types of organic manures. 5. illustrate the production of organic compost and the method of its spreading. 6. appraise the design criteria and the kinetics for composting and its practical method. 7. know the history and development of organic standards and certification 8. assess the conformity processes and to interpret the key challenges for the future of organic regulation. 9. outline the economic management in organic agriculture 10. analyze the performance of organic fertilizer in rice, sugarcane, sorghum and banana.

Overview of Organic farming

Origin and principles for organic farming - Indian Agriculture before the Green Revolution - The Green Revolution - Impact of Green Revolution on the environment - types of farming: pure organic, integrated and mixed farming system - need and challenges for organic agriculture.

Soil Fertility and Manures

Components of soil fertility - physical, chemical and biological - managing soil fertility in organic farming systems - organic manures: farmyard, compost sheep and goat, poultry, oil-cakes, sewage, sludge and sullage manure.

Production of Organic compost

Composting - importance of composting - method of spreading compost - microbes involved in composting - design criteria - rate and time of application - kinetics of composting - type and amount of compost - practical method of making compost.

Organic standards and certification

History and development of organic standards and certification - organic standards setting processes - conformity assessment processes (international verification processes) - key challenges for the future of organic regulation.

Perspectives of Organic Farming

Economic management in organic agriculture - Understanding the market for organic food - Social responsibility in organic agriculture: learning, collaboration and regulation - Organic fertilizer: Supplementary nutrient source for rice, sugarcane, sorghum and banana.

Text book(s):

1	Kristensen, P., Taji, A. and Reganold, J., “Organic Agriculture: A Global Perspective”, CSIRO Press, Victoria, Australia, 2006.
2	Lampkin Nicolas, “Organic Farming”, The University of Wisconsin - Madison. Farming Press, 1990.

Reference(s):

1	Joshi, M., Setty, T.K.P. and Prabhakarasetty, “Sustainability through Organic farming”, 1st edition, Kalyani Publishers, Ludhiana, India, 2006.
2	Bavec, F. and Bavec, M., “Organic Production and Use of Alternative Crops”, CRC Press, Boca Raton, FL, 2007.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E21 - Biotechnology for Healthcare								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100
Objective(s)	• To understand the application of biotechnology to human health and disease treatment. • To expertise the modern health care and impact of biotechnology on human societies.							
Course Outcomes	**At the end of the course, the students will be able to** 1. know about health care concepts and its benefits. 2. describe the types of diseases and modes of transmission 3. know the diverse application of proteins as biotechnology products for health care. 4. describe the types and synthesis of oligosaccharides for treatment of diseases 5. describe the importance of chemotherapeutic agents in treatment of bacterial, fungal, protozoan and viral diseases. 6. infer the theory and causes of endocrine disorders and drugs approved for endocrinology 7. delineate the importance of cardiac agents and side effects. 8. study the myocardial agents and its causes 9. determine the types of anticancer drugs and its therapeutic effect. 10.know the radioprotective agents and its uses							

Basics of health care and control of diseases

Health care - definition, types, different kinds of diseases- infectious, communicable, non-communicable and degenerative, modes of transmission of diseases- contact-air -water – vectors, personal hygiene- essentials, safe disposal of Bio Medical Waste (BMW) Management, control of vectors and pests, Immunization-awareness, precautions, booster doses in children's and adults.

Therapeutic aspects of biomacromolecules and Drug targeting

Diverse uses of proteins, peptides, antimicrobial peptides, enzymes - oncolytic, oligosaccharides - polysaccharide bacterial product, glycoprotein, anticoagulant-heparin.

Chemotherapeutic agents and Endocrine drugs

Antimicrobial drugs-general considerations-classification-Mechanism of action-side effects, antibacterial agents- sulphonamides, clotrimazole, qunolones, Beta-lactum antibiotics, aminoglycosides, antifungal drugs-polyene-griseofulvin, antiviral agents, endocrine disorders - types and causes - drugs and hormones approved for endocrinology.

Cardiovascular Drugs

Cardiac glycosides-mechanism of action, side effects, classes of anti arrhythmic drugs, anti anginal drugs, myocardial infarction agents, antihypertensive drugs, anticoagulants.

Anti cancer drug and Radiological agents

Anticancer drugs - overview and types - chemotherapy - cytotoxic drugs - targeted drugs - hormonal drugs. Therapeutic effect of anticancer agents, Radiosensitizers and Radioprotective agents.

Text book(s):

1	Cristine M. Bladon, ""Pharmaceutical Chemistry", John Wiley & Sons. Ltd. 2002.
2	Ananthanarayan, R and Panicker, C. K.J., "Text book of Microbiology", 9th Edition, Orient Longman, New Delhi, 2013.
3	Burger S., "Medicinal Chemistry and Drug Discovery", 5th edition, Manfred E. Wolff. A Wiley & Sons. Inc., 2000.

Reference(s):

1	Carmen Avendaño and J. Carlos Menéndez, "Medicinal Chemistry of Anticancer Drugs", Elsevier, 2008.

K.S.Rangasamy College of Technology - Autonomous

40 BT E22 - Clinical Immunology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100

Objective(s)

- To provide a comprehensive understanding of basics of clinical immunology
- To provide in depth knowledge in cellular and molecular mechanisms of immunopathology.
- To learn the clinical immunology procedures, various techniques like developing diagnostic tests,characterization of lymphocytes, purification of antigens and antibody engineering etc.

Course Outcomes

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

1. understand the methods of collection of various clinical samples.
2. determine the presence of diverse pathogens present in the samples.
3. identify different methods of tissue preparation and identification of antigen.
4. study of various cell types in inflammatory sites.
5. know the different techniques and methodology for diagnosis of disease.
6. outline the classification and identification of lymphocyte population.
7. elucidate molecular methods for identification of antigen.
8. various applications of molecular immunology.
9. identify suitable molecular diagnostic method for identification of diseases.
10. know the recent methods available for treating human diseases.

Basics of Clinical Immunology

Introduction to clinical immunology, selection, collection and transport of specimens - blood, urine, sputum, CSF, pus and faeces - transport media and storage - safety and specimen preparation - microscopic examination of specimen -staining and motility - examination of body fluids, cell counts, ascitic fluid, pleural fluid, synovial fluid, pericardial fluid, urinary calculi.

Immunopathology

Introduction to histopathology - preparation and storage of tissues, fixatives - mode of action, indications, preparation, decalcification - processing of tissues for routine paraffin sections and other methods of embedding, identification and characterization of cells and antigens from inflammatory site and infected tissues - isolation of lymphocyte populations.

Immunodiagnosis

Immunological basis of antigen and antibody interactions - precipitation (VDRL), agglutination (blood grouping, WIDAL) and immuno electrophoresis, synthesis and purification of antigens using affinity chromatography - immuno cytochemistry- immuno fluorescence and immuno electron microscopy - Western blot analysis - principle and applications of ELISA and Radioimmuno Assay (RIA).

Molecular Immunology and diagnosis

Trends in immunology of infectious diseases and tumours - recombinant DNA technology for the study of the immune system - anti-idiotypic antibodies and catalytic antibodies - immuno therapy with genetically engineered antibodies - applications of nucleic acid hybridization and PCR in molecular diagnosis.

Therapeutic applications

Role of DNA micro array and protein chips, biotherapy, probiotics, phage therapy - virotherapy with lytic viruses - si RNA therapeutics and photodynamic therapy - laboratory automation in clinical practices.

Text book(s):

1. Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry W. Schroeder, Jr., Anthony J. Frew, and Cornelia Weyand M., “Clinical Immunology - Principles and Practice”, 4th edition, Elsevier Ltd., 2013.
2. Abbas K. A., Litchman A. H. and Pober J. S., “Cellular and Molecular Immunology”, 4th edition, W. B. Saunders Co., Pennsylvania, USA, 2005.
3. Talwar G.P. and Gupta S.K A, “Hand book of practical and clinical immunology”, Vol. I & II, CSB Publications, New Delhi, 1992.

Reference(s):

1. Tizard R.I., “Immunology”, 4th edition, Chennai Microprint Pvt. Ltd., Chennai, 2004.
2. Roitt I., Brostoff J. and David M. “Immunology”, 6th edition, Mosby publishers Ltd., New York, 2001.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E23 - Stem Cell Technology								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100

Objective(s)	• To develop the skills in the area of stem cell research and its applications. • To widen the knowledge about the isolation • To develop the culturing procedure and applications of stem cells to treat diseases.
Course Outcomes	**At the end of the course, the students will be able to** 1. summarize the process of embryogenesis in humans and differentiation of stem cells. 2. discuss the various types, sources, characterization and plasticity of stem cells. 3. identify the aseptic conditions for growing embryonic stem cells in laboratory and the advantages of stem cell usage. 4. comprehend the need and use of stem cell banks and registries and regulations in European and non European countries 5 outline the steps involved in isolation and preparation of neural cells culture. 6. sequence the steps involved in culturing and sub culturing neurospheres and its differentiation into neurons, mesenchymal stem cells and bone marrow. 7. assess the novel stem cell based treatments, animal cloning and transgenic animals. 8. summarize how stem cells based drug discovery and toxicological studies are made. 9. illustrate the applications of hematopoietic stem cells from cord blood. 10. summarize the applications of stem cells in Parkinson's disease, Huntington's disease and Alzheimer's disease.

Introduction to Stem Cells

Introduction to stem cells, embryogenesis, differentiation of stem cells, origin and characterization of human stem cells and its applications - plasticity of human somatic stem cells - sources of stem cells: cord blood and bone marrow - scientific and technical obstacles of novel human stem cell based therapy - stem cell marker.

Human Embryonic Stem Cell research

Sources for human embryonic stem cells (hESC) - growing of hESC in laboratory - animal stem cells - current advantages and limitations of hESC and human somatic cells - properties of embryonic stem cells - developments regarding establishment of human stem cell banks and registries - regulations in European member and Non European countries regarding hESC research.

Isolation and identification of Stem Cells

Neural diseases - preparation of complete neuroculture, culturing and subculturing human neurospheres - differentiation of human neurospheres and neurons, astrocytes and oligodendrocytes - immuno-labeling procedure - mesenchymal stem cells - retinal stem cells - bone marrow.

Stem Cell therapy

Novel stem cell based gene therapy genetically engineered stem cells - stem cells and animal cloning - transgenic animals and stem cells - stem cell therapy vs cell protection - stem cell in cellular assays for screening - stem cell based drug discovery and toxicological studies - hematopoietic stem cell transplantation.

Applications of Stem Cells

Clinical applications of hematopoietic stem cells from cord blood, treatment of neural diseases such as Parkinson's disease, Huntington's disease and Alzheimer's disease - treatment of cardiac arrest - repair of damaged organs such as the liver and pancreas - application of stem cells in bone regeneration.

Text book(s):

1	Thomas C.G. Bosch. "Stem Cells, from Hydra to Man", Springer India Pvt. Ltd., New Delhi, 2009.
2	Jane E. Bottenstein. "Neural Stem Cells, Development and Transplantation", Springer India Pvt. Ltd. New Delhi, 2010.

Reference(s):

1	Kevin D. Bunting. "Hematopoietic Stem Cell Protocols", Humana Press, Springer India Pvt. Ltd., New Delhi, 2009.
2	Deb K.D and Totey S.M., "Stem cells basics and applications", Tata Mc Graw Hill Education Pvt. Ltd., New Delhi, 2009.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E24 - Tissue Engineering								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100

Objective(s)	• To develop the skills of the students in the area of tissue engineering. • To widen the knowledge about the culturing of tissues. • To develop the skills related to molecular interactions in tissue engineering
Course Outcomes	**At the end of the course, the students will be able to** 1. illustrate the basic concepts of tissue engineering such as its origin, triad and a cellular prosthesis. 2. outline the various types of stem cells and its basic principles. 3. interpret the concept of vascularisation and organization of cells into higher ordered structures. 4. learn the concept of ECM interaction, composition and delivery with reference to receptors for extracellular matrix molecules. 5. characterize the concept of mass transfer and diffusion of simple metabolites. 6. learn the basics of molecular and cell transport through tissues. 7. outline the recent advancement such as 3D cultures in tissue engineering and use of scaffolds. 8. illustrate the applications of growth factors such as VEGF and the process of angiogenesis. 9. discuss the application of tissue engineering for renal function replacement. 10. summarize the clinical implementation of bone regeneration by mesenchymal stem cells.

Introduction to Tissue Engineering

History and scope of tissue engineering - definition - scientific challenges, general scientific issues - tissue engineering in perspectives - origin, triad, a cellular prosthesis - stem cells: basic principles, cell culture techniques in tissue engineering.

Structure and Organization of Tissues

Vascularisation of *in vitro* and *in vivo* - organization of cells into higher ordered structures - EMT and MET transformation - composition and delivery of ECM - receptors for extracellular matrix molecules.

Transport properties of Tissues

Mass transfer in tissue, diffusion of simple metabolites, diffusion and reaction of proteins-carrier protein and channel-molecular and cell transport through tissues, cell-cell interaction and cell-matrix interaction - transport limits in 3D culture.

General aspects of Cells in Culture

Cell migration and control of cell migration - differential cell adhesion and tissue organization - growth factor delivery in tissue engineering - scaffolds and tissue engineering - synthesis properties and fabrication - transplantation immunology - applications of growth factors: VEGF/angiogenesis.

Application of Tissue Engineering

Liver organization and development, designing of bioreactors for liver tissue engineering, hepatic liver support system - tissue engineering approach to renal function replacement - bone regeneration by mesenchymal stem cells - skin tissue engineering and its replacement.

Text book(s):

1	Samuel E., Lynch L.L. and Be Roberts J. Geng, “Tissue Engineering”, Wiley Black well, Singapore, 2010.
2	Bernard Prish, “Tissue-Engineering - Design, Practice and Reporting”, Woodhead Publishing Ltd. Cambridge UK, 2009.

Reference(s):

1	Lanza L. and Langer P., “Principle and Applications of Tissue Engineering”, Wiley Black well, Singapore, 2010.
2	Atala O.P. and Lanza L. “Methods of Tissue Engineering”, Woodhead Publishing Ltd, Cambridge UK, 2009.

K.S.Rangasamy College of Technology - Autonomous								
40 EC E25 - Medical Imaging								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100

Objective(s)	• To know the overview of radiation and its application in imaging. • To study the depth of nuclear medicine and imaging applications in therapy. • To learn the basic concepts of signal and image processing, its types and frequency analysis.
Course Outcomes	**At the end of the course, the students will be able to** 1. deliver the fundamental concepts of electromagnetic radiation and its properties. 2. describe the physical principles of contrast agents used in radiology and articulate in general terms how they improve subject contrast. 3. explores the working of Mammography, CT, MRI and ultrasound imaging. 4. establishes understanding of the principle behind nuclear medicine (PET and SPECT), ultrasound and optical imaging. 5. exploration of medical imaging devices and new medical imaging systems 6. details the principles and benefits of Quality assurance for diagnostic imaging equipment 7. knowledge on image sampling, enhancement, restoration, segmentation and representation 8. aids in troubleshooting during acquisition of image and its processing. 9. describes the imaging processing methods in medicine and basic concepts in medical imaging. 10. acquires knowledge on digital imaging concepts and its acquisition.

Electromagnetic radiation in imaging

Basic concepts of Electromagnetic Radiation - electromagnetic waves - relationship between frequency and wavelength - electromagnetic spectrum - sources of electromagnetic radiation - Wave-particle duality - photons, energy of photons - production of X-Rays - interactions between X-Rays and matter of relevance to medical imaging - radiation quantities and units - dosimetry parameters - contrast agents - radiation protection measures.

Medical imaging devices in the current scenario

Mammography - computed tomography (CT) - magnetic resonance imaging (MRI) - ultrasound imaging - nuclear medicine - positron emission tomography (PET) and single photon emission computer tomography (SPECT) - cardiovascular angiograms detections - advantages and disadvantages of medical imaging.

Imaging equipment and its quality

Imaging systems - pulse-echo imaging - real-time systems, Doppler systems, imaging system and equipment quality - electrical safety in imaging equipment and issues - quality control in medical imaging equipments.

Image acquisition and enhancement techniques

Elements of visual perception - image sampling, Image reconstruction and display - filtered back projection - Voxels and pixels - CT-numbers - window width and level, subtraction, averaging, filtering and smoothing - transducers and the ultrasonic field - pulse sequences - production of the image, image quality and Artefacts in imaging.

Image processing

Image processing-feature extraction and analysis. edge detection - thresholding - region based segmentation - boundary representation - chair codes - polygonal approximation - boundary segments - boundary descriptors - radiographic and fluoroscopic image acquisition.

Text book(s):

1	Rafael C Gonzalez, Richard E. Woods, “Digital image processing”, 3rd edition, Prentice Hall, 2008.
2	Paul Suetens, “Fundamentals of medical imaging” Cambridge University Press, 2002.

Reference(s):

1	Wang L.V. and Hi Wu, “Biomedical Optics: Principles and Imaging”, Wiley, 2007.
2	Andrew Webb, “Introduction to Biomedical Imaging”, John Wiley & Sons, Inc, 2003.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E31 - Biostatistics								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100

Objective(s)	• To acquire skills in the concepts of Statistics. • To acquire skills in handling situations involving the process of making scientific judgments in the face of uncertainty and variation. • To provide an understanding of the statistical methods by which real life problems are analyzed. • To construct an appropriate model using time series approach.
Course Outcomes	**At the end of the course, the students will be able to** 1. acquire the knowledge about different types of data. 2. acquire the knowledge to draw the different types of diagrams for the given statistical data. 3. understand the concepts of basic measures of central tendency. 4. understand the concepts of basic measures of dispersion. 5. apply sign, Mann – Whitney and Kruskal – Wallis H tests for testing the hypothesis about parent population. 6. find the sampling and probability distributions of given number of runs. 7. know the components of time series and methods to measure the trend. 8. apply suitable methods for measuring seasonal variations in time series. 9. acquire the knowledge to find he different types of correlations. 10. acquire the knowledge of Parameter estimation.

Descriptive Statistics

Data - Classification of data - Primary data and Secondary data - Questionnaire - Frequency Distribution – Histogram – Frequency Polygon – Ogive Curve – Pie Diagram.

Statistics

Measures of Central Tendency – Mean, Median, Mode – Measures of Dispersion – Quartile deviation, Mean deviation, Standard deviation – Coefficient of Variation.

Nonparametric Tests

Introduction – The sign test - The Mann – Whitney U test – The Kruskal – Wallis H test - The H test corrected for ties – The runs test for Randomness.

Time Series

Components of a time series – Method of least square – Fit a Straight line, Parabola, Exponential curve – Method of seasonal variations – Ratio to trend method – Ratio to moving average method – Link relative method.

Estimation Theory

Multiple and Partial Correlations - Parameter estimation - Method of maximum likelihood estimates - Method of moments.

Text book(s):

1	Gupta S.C and Kapoor V.K., “Fundamentals of Mathematical Statistics”, 11th edition, S Chand & Company Ltd, New Delhi, 2007.
2	Arora P.N and Arora S, “Statistics for Management”, S. Chand & company Ltd, New Delhi, 2007.

Reference(s):

1	Veerarajan T., “Probability, Statistics and Random Process”, 3rd edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2011.
2	Murray R Spiegel, John Schiller and Alu Srinivasan R, “Probability and Statistics”,2nd edition, Schaums Outline series, McGraw – Hill, New Delhi, 2000.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E32 - Research Design and Analysis								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100
Objective(s)	• To understand the methods of sampling, scales and measurements applied in research. • To design the research work using literature review and methodology. • To enhance the knowledge on analysis of report and its compilation.							
Course Outcomes	**At the end of the course the student would be able to learn** 1. apply the research methodology and research process theoretical knowledge in research design. 2. evaluate the primary and secondary data to compile for the research. 3. analyze the measurement of the collected samples. 4. validate the research design and conclusion. 5. construct the research design with control techniques in experimental research. 6. illustrate the Quasi experimental design and single case research design. 7. identify the research problem from the survey research. 8. apply the qualitative and mixed research methods. 9. analyze the experimental data and interpret the research findings. 10. conclude the research hypothesis with scientific report writing and presentations.							

Research Methodology

Definition, types - exploratory, conclusive, modeling and algorithmic research - research process: steps - data collection methods: primary data - observation method, personal interview, telephonic interview, mail survey, questionnaire design and secondary data - internal and external sources.

Measuring, sampling and validity

Measurement - scales of measurement, psychometric properties of good measurement - sampling: random, and nonrandom, random selection and random assignment, research validity - statistical conclusion, construct, internal and external validity.

Methods of research

Steps in survey research, qualitative research: characteristics, research validity - descriptive, interpretive, theoretical, internal and external validity, methods - phenomenology, ethnography, case study research and grounded theory; mixed methods research.

Experimental methods

Control techniques in experimental research - randomization, matching, counter balancing, control of participant and experimenter effects, experimental research design, quasi experimental designs - time-series and regression discontinuity, single-case designs and its methodological considerations.

Analysis, interpretation and report

Introduction to discriminate analysis, factor analysis, cluster analysis, multidimensional scaling, conjoint analysis - report writing: types of report, guidelines to review report, typing instructions, poster and oral presentation.

Text book (s) :

1	Larry B. Christensen, R. Burke Johnson and Lisa A. Turner, “Research Methods, Design and Analysis”, 12th edition, Pearson Education, Inc., New Jersey, 2014.

Reference(s) :

1	Kothari C R, “Research Methodology - Methods and techniques”, New Age Publications, New Delhi, 2009.
2	Panneerselvam R, “Research Methodology”, Prentice-Hall of India, New Delhi, 2004.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E33 - Metabolic Engineering								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100

Objective(s)	• To make the student understand metabolism and feedback regulation and synthesis of metabolites • To explore the bioconversion reactions and their applications • To apply the knowledge of bioinformatics in metabolic engineering
Course Outcomes	**At the end of the course, the students will be able to** 1. understand the basic concepts of metabolism along with different models for cell reaction. 2. know the concepts of feedback regulation, importance, scope and future of metabolic engineering. 3. comprehend the alterations and mutations along with amino acid synthesis regulation. 4. identify the regulation of secondary metabolite pathways and catabolite regulation. 5. analyze the bioconversion reactions and know the regulation of enzyme synthesis. 6. explore mixed or sequential bioconversions and applications of bioconversions. 7. develop an optimized strain for efficient enzyme production in fermentation. 8. improve fermentation and modify metabolic pathways for improved yield. 9. develop a model of metabolic pathways and analyze metabolic fluxes. 10. create algorithms for metabolic pathway synthesis and structure the metabolic networks.

Components of Metabolic engineering

Basic concepts of metabolic engineering - overview of cellular metabolism - different models for cellular reactions - Jacob Monod model - catabolite, camp deficiency - feedback regulation - regulation in branched pathways, concerted and cumulative feedback regulation – scope and future of metabolic engineering.

Synthesis of primary metabolites and secondary metabolites

Alteration of feedback regulation - limiting accumulation of end products - resistant mutants - alteration of permeability - amino acid synthesis pathways and its regulation at enzyme and whole cell level - regulation of secondary metabolite pathways - precursor effects - prophophase, idiophase relationships, catabolite regulation by passing control of secondary metabolism.

Bioconversions

Advantages of bioconversions - specificity - yields - factors important to bioconversions - regulation of enzyme synthesis - mutation - permeability - co-metabolism - avoidance of product inhibition - mixed or sequential bioconversions - conversion of insoluble substances - applications of bioconversions.

Regulation of enzyme production

Strain selection and its genetic improvement - gene dosage - metabolic pathway manipulations to improve the fermentation - optimization and control of the metabolic activities - improving fermentation - modification of the existing or the introduction of entirely new metabolic pathways.

Role of computer modeling in metabolic engineering

Experimental determination method of flux distribution - metabolic flux analysis and its applications - metabolic engineering with bioinformatics - metabolic pathway modeling - analysis of metabolic control and the structure metabolic networks - metabolic pathway synthesis algorithms - modeling of individual metabolic pathway with computer network.

Text book(s):

1	Cortassa S., Aon M.A., Iglesias A.A, Aon J.C. and Lloyd D., “An introduction to metabolic and cellular engineering”, 2nd edition, World Scientific, 2011.

Reference(s):

1	John Villadsen, Jens Nielsen and Gunnar Lidénn (Eds), “Bioreaction Engineering Principles”, 3rd edition, Springer New York, 2011.
2	George Stephanopoulos, Aristos A. Aristidou and Jens Nielsen, “Metabolic Engineering: Principles and Methodologies”, Academic Press, 1998.

K.S.Rangasamy College of Technology - Autonomous

40 BT E35 - Bioreactor Design

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100

Objective(s)

- To understand the basic concepts of bioreactor analysis and design of bioreactors.
- To study about the hydrodynamics and mass transfer in bioreactors.
- To make the students to undertake research / project work in bioreactor design.

Course Outcomes

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

1. understand the types of bioreactors such as aerobic, anaerobic, stirred tank and bubble column reactors.
2. design and construction of airlift loop, fixed bed, fluidized and immobilized enzyme reactors.
3. design and analytic dynamics of biochemical reactors ,membrane and hollow fiber reactors
4. develop the stability analysis of microbial reactors with and without recycle.
5. develop bioreactor geometry, calculation and measurement of mass transfer coefficient.
6. derive kinetic models and their effect in correlation of mechanical design.
7. demonstrate the importance of hydrodynamic regime ,mixing power dissipation and gas holdup in bioreactors.
8. outline the importance of isometric turbulence model, rheology of culture broth and develop models for bioreactor operation.
9. develop design consideration and process strategies for plant and animal bioreactors.
10. develop design consideration and process strategies for Frosch and centrifugal field reactors.

Types of Bioreactors

General types of bioreactors: aerobic and anaerobic - conventional stirred tank and bubble columns - airlift loop, fixed bed, fluidized bed, immobilized whole cell and immobilized enzyme bioreactors.

Bioreactor analysis and design

Analysis of bioreactor dynamics - design solutions of biochemical reactors: airlift and rotary bioreactors - membrane reactors for enzymatic processes - hollow-fiber bioreactors - process stability of microbial reactors - analysis of mixed microbial population - microbial reactors with and without cell recycle.

Design of bioreactors

Bioreactor geometry, constants and variables, dependence of parameters - process calculations, overall mass transfer coefficient, power per volume concept, kinetic models and their effects in correlation development - mechanical aspects of reactor design.

Hydrodynamics and mass transfer in bioreactors

Hydrodynamic regime, mixing and backmixing, transitional zones - power dissipation and gas holdup in bioreactors - mass transfer coefficient - significance and determination - isometric turbulence model in bioreactors - rheology of culture broths, modes and models for bioreactor operation.

Novel bioreactors

Photo-bioreactors - mammalian and plant cell bioreactors - inverse fluid flow units - microbial and mammalian cell hollow fiber - Frosch reactor - centrifugal field reactors.

Text book(s):

1	Stanbury F P, Whitaker A and Hall S G, “Principles of Fermentation Technology”, Aditya Books, Pvt, Ltd., New Delhi, 2013.
2	Bailey J.A and Ollis D.F., “Fundamentals of Biochemical Engineering”, McGraw Hill - New York, 1986.

Reference(s):

1	Karl Schrrugal, “Bioreaction Engineering”, John Wiley, UK, 1983.
2	Atkinson B and Mavitona F., “Biochemical Engineering - An Biotechnology Handbook, McGraw Hill, UK, 1991.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E36 - Bioprocess Modeling and Simulation								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VII	3	0	0	45	3	50	50	100

Objective(s)	• To understand the basics of modeling principles for the implementation in the biochemical systems. • To impart the knowledge of mathematical models and the numerical models for the modelling of a bioreactor. • To provide the better understanding about the modeling approaches and the application of MATLAB and SIMULINK.
Course Outcomes	**At the end of the course, the students will be able to** 1. know the basic modeling principles and classification of modeling techniques. 2. understand the energy equations, equilibrium states and chemical kinetics. 3. design the reactor modeling of batch, CSTR, bubble column and airlift reactor. 4. intend the modeling of the continuous and batch distillation system. 5 solve the linear and non-linear algebraic equations related problems. 6. elucidate the problems related to the numerical integration. 7. illustrate the growth kinetic models and compartment models. 8. outline the thermal death kinetics models and stochastic model for thermal sterilization. 9. sketch the fundamentals of MATLAB and the data analysis. 10. apply MATLAB and SIMULINK in the bioprocess systems and simulation of CSTR in series and batch reactor.

Basic modeling principles

Basic modeling principles - types of models - uses of mathematical modeling - classification of modeling techniques - fundamental laws - energy equations - continuity equation - equations of motion - transport equations - equations of state - equilibrium states and chemical kinetics - examples.

Mathematical Models

Reactor modeling: batch reactor - continuous stirred tank reactors with cooling and heating jacket or coil - fed batch reactor - steam jacketed vessel - bubble column system - airlift reactor - boiling of single component liquid: open and closed vessel - continuous boiling system - batch distillation.

Numerical Methods

Solution of linear algebraic equations by Gauss elimination, Gauss siedel iterative method - solution of non-algebraic equations by Bisection method, Newton Raphson Method - Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Euler's method and Runga Kutta method.

Modeling approaches

Growth kinetic models - structured and unstructured systems - compartment models - deterministic and stochastic approaches for modeling structured systems - thermal death kinetics models - stochastic model for thermal sterilization of medium.

Application of MATLAB and SIMULINK

Basics - data analysis - curve fittings - input and output in MATLAB - application in bioprocess systems: solving problems using MATLAB and SIMULINK for dynamic systems by numerical integration and Euler methods - simulation of CSTR in series and batch reactor.

Text book(s):

1	M. K. Jain, S. R. K. Iyengar, and R. K. Jain, "Numerical Methods", 6th Edition, New Age International Publishers, New Delhi, 2012
2	B. Wayne Bequette, "Process Dynamics: Modeling, Analysis and Simulation", Prentice-Hall, 1998.

Reference(s):

1	Said S.E.H. Elnashaie and Parag Garhyan, "Conservation Equations and Modeling of Chemical and Biochemical Processes", Marcel Dekker, 2003.
2	Shuler, M.L. and Kargi, F., "Bioprocess Engineering - Basic concepts", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E42 - Marine Biotechnology								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	50	50	100

Objective(s)	• To provide the knowledge about the diversity of marine microbes and the aquatic animals • To impart the biomedical importance of marine organisms. • To understand the environmental impacts of the aquatic biotechnology.
Course Outcomes	**At the end of the course, the students will be able to** 1. explain the different habitats of marine biodiversity and its nutrient requirements. 2. illustrate the interaction between marine microbes and adaptability to extreme environments. 3. describe the aquaculture related artificial insemination and eye stalk ablation and transgenic fish technology. 4. explain the development of fish diets, disease management and vaccine development. 5. describe the use of bioactive compounds of the marine natural products obtained from different marine organisms. 6. understand the exploitation of new antibiotics and drugs from marine organisms. 7. identify the marine sources that produces the polymers and biomaterials like agar, agarose, alginates, chitin, chitosan and heparin. 8. explain the nature of antifouling compounds and biopotential uses of halophilic bacteria. 9. interpret the control of oil spills and the bioremediation using microbes. 10. describe the engineering of marine natural products its environmental risks and benefits.

Introduction to Marine Biodiversity

Marine microbial diversity: symbiotic, free-living, biofilm, proximity to ocean surface or sediments: Euphotic, Mesopelagic, Bathopelagic, Benthos - concentration of nutrients and growth substrates: Oligotrophic, Mesotrophic, Eutrophic, algal blooms - hydrothermal vents: vent biodiversity - applications of extremozymes.

Marine aquaculture

Shellfish and crustacean culture: shrimps, edible mussels, pearl oyster, crabs, fish aquaculture: artificial insemination, eye stalk ablation - transgenic fish technology, transgenic fishes with growth hormone (GH) and antifreeze genes, development of healthy fish diets, probiotics bacteria and their importance in aquaculture, vaccines for aquaculture.

Biomedical importance of marine organisms

Marine pharmacology: pharmaceutical and bioactive natural products - microalgae as a source of bioactive molecules - new antibiotics and medicines from marine organisms - unculturable bacteria, occurrence, characteristics and exploitation.

Biomaterials and Bioprocessing

Polymers and biomaterials: properties and production of agarose - agar - alginates - carrageenans - chitin - chitosan - carotene - heparin - marine flavourants - environmentally friendly antifouling compounds, biopotential uses of halophilic organisms.

Environmental impacts of Aquatic biotechnology

Control of oil spills and bioremediation - Genetically Engineered Marine Organisms - seaweeds for removal of heavy metal pollutants - introduction of coral bleaching - biosphere reserve - Gulf of mannar, impact of invasive organisms, environmental and economic risks and benefits.

Text book(s):

1	Bright Singh I.S, Somnath Pai S., Rosamma Philip and Mohan Das A., "Aquaculture Medicine", 1st edition, Paico Printing Press, India, 2003.
2	Advances in Biochemical Engineering/Biotechnology- Marine Biotechnology I &II ; Y. LeGal, R. Ulber, Springer Verlag Berlin Heidelberg, 2005.

Reference(s):

1	Attaway, D. H., Zaborsky, O. R. (Ed.), "Marine Biotechnology: Volume I, Pharmaceuticals and Bioactive Natural Products", New York, USA, 1993.
2	Y.K. Lee and S. Salminen, "Handbook of probiotics and prebiotics", 2nd edition, Wiley, A John Wiley and sonsinc publication, 2009.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E43 - Biofuel Technology								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	50	50	100

Objective(s)	• To impart the fundamentals and concepts of biofuels and its usage. • To learn the technology and advancements in the production of biodiesel, bioethanol and biohydrogen. • To provide the better understanding about the design and recent trends of microbial fuel cells.
Course Outcomes	**At the end of the course, the students will be able to** 1. understand the fundamentals of biofuels and the alternate energies. 2. identify the various types of feedstocks and biomass that are used in the biofuel production. 3. comprehend the sources and the production process of biodiesel. 4. assess the quality control, environmental and economic aspects of biodiesel. 5 illustrate the sources, pretreatment and manufacturing process of bioethanol. 6. appraise the purification methods, regulations associated with bioethanol and its recent advancements. 7. know the sources, enzymes and various technologies that are implemented in biohydrogen production. 8. design the reactors and the detection and quantification of biohydrogen. **9.** outline the biochemical basis and fuel cell design of Microbial Fuel Cells**.** 10. analyze the performance of MFC and its effectiveness in the wastewater treatment.

Overview of biofuels

Biofuels: energy use and efficiency - biofuel production - I and II generation biofuels - alternative energies - biochemical pathways review for organoheterotrophic, lithotrophic and phototrophic metabolism - biofuel feedstocks: starch, sugar, lignocellulosic, agro and industrial byproducts - biomass production for fuel - yeast and algal cultures - biomass conversion to heat and power.

Production technology of Biodiesel and Bioethanol

Biodiesel: algae, edible and non edible oils as sources - production technologies: conventional and lipase mediated process - quality control aspects - ASTM (D-6751) and Indian standards (IS15607) - environmental and economic aspects of B100 and B20. Bioethanol: sugar, starch, lignocellulosic substrates and byproducts of biodiesel industry as sources - production process - purification - uses of bioethanol - advances in bioethanol production.

Biogas Production

Biogas: cow dung, agricultural and municipal waste as substrate - types of digesters and their suitability - aerobic and anaerobic bioconversion processes - factors affecting the biogas generation process - gas storage systems - application of biogas in domestic, industry and vehicles - advantages and disadvantages.

Biohydrogen Production

Biohydrogen: Carbon sources and culture parameters - enzymes involved in the production process - production technologies: biophotolysis, photofermentation and batch fermentation - reactors design - factors affecting the production process - detection and quantification - advances in biohydrogen production technology.

Microbial Fuel Cells

Biochemical basis - fuel cell design: anode & cathode compartment - microbial cultures - redox mediators - exchange membrane - power density - MFC performance methods: substrate and biomass measurements - basic power calculations - wastewater treatment effectiveness - advances in MFC.

Text book(s):

1	Jonathan R.M, “Biofuels - Methods and Protocols (Methods in Molecular Biology Series)”, Humana Press, New York, 2009.
2	Caye M. Drapcho, N.P. Nhuan and T. H. Walker, “Biofuels Engineering Process Technology”, Mc Graw Hill Publishers, New York, 2008.

Reference(s):

1	Lisbeth Olsson (Ed.), “Biofuels (Advances in Biochemical Engineering/Biotechnology Series)”, Springer-Verlag Publishers, Berlin, 2007.
2	Glazer and Nikaido, “Microbial Biotechnology - Fundamentals of Applied Microbiology”, 2nd edition, Cambridge University Press, 2007.

K.S.Rangasamy College of Technology - Autonomous

40 BT E44 - Textile Biotechnology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	50	50	100

Objective(s)

- To familiarize the learners with the knowledge of enzymes for processing fibres.
- To enlighten the learners about medical textiles and agricultural textiles.
- To enable students to learn the basic concepts of management of textile effluents with environment.

Course Outcomes

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

1. recognize the scope of biotechnology in textiles, preparation of fiber and fabric.
2. analyze the applications of biotechnology in textiles and wool processing.
3. relate the types of enzymes used in textile industries.
4. identify their effectiveness against various strains.
5. review the antimicrobial fibres, disposable products and the operating room garments.
6. explain the use of textiles in burns, splinting and dressings.
7. discuss the requirement and properties of textiles used in crop covers.
8. describe the properties of textiles used in food packaging, bags and luggage.
9. explain the basic concepts of effluent treatment processes.
10. discuss the advances in effluent treatment, and the norms for effluent discharge.

Scope of Biotechnology in Textiles

Scopes and applications of biotechnology in textiles - fiber and fabric preparation - application of oxidoreductase in the fabric preparation - the method of wool processing and its applications.

Enzymes in Textiles

Types of enzymes and their effectiveness against various strains - proteases, lipases, amylases and cellulases - role of laccase, pectinase, peroxidase and glucose oxidase in the field of textile technology.

Medical Textiles

Super absorbant fibres - antimicrobial fibres - disposable products - operating room garments - infection control and barrier materials - bandaging and pressure garments - breathable nonwoven hygienic products - wound care materials - use of textiles in burns - splinting - skin substitutes and grafts - dressings - wound care dressings - sutures - vascular prosthesis - gelatin impregnated graft.

Textiles in Agriculture

Requirement and properties of textiles used in crop covers, bird netting, shade fabrics, soil mats, sacks and silos - textiles in packaging - requirement and properties of textiles used in food packaging, bags and luggage.

Effluent Treatment

Introduction - flow chart of effluent treatment processes - primary, secondary and tertiary treatments - evaporation and reverse osmosis - colour removal in waste water - recovery and reuse of water - advances in effluent treatment - introduction to concept of eco-friendly textile - norms for effluent discharge.

Text book(s):

1. Cavaco Paulo A. and Gubitz G., “Textile processing with enzymes”, Woodhead Publishing Ltd, Cambridge, UK, 2003.
2. Anand S.C., Kennedy J.F. Miraftab M. and Rajendran S., “Medical Textiles and Biomaterials for Health care”, Wood head Publishing Ltd, 2006.

Reference(s):

1. Brydson J.A., “Flow properties of polymer melts”, Life books, London, 1978.
2. Peter J Hausr, “Advances in Treating Textile Effluent”, InTech Publisher, Croatia, 2011.

K.S.Rangasamy College of Technology - Autonomous

40 BT E45 - Human Biomechanics

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	50	50	100

Objective(s)

- To understand the concept of biomechanics, motion behaviour of organs and its kinetics.
- To design and develop the model of bone, muscle, various joints and connective fluids.
- To develop and analyse the application and implant manufacturing process in biomechanics

Course Outcomes

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

1. analyze the principles of mechanics and behavior in our body parts.
2. understand the concepts of motion with kinetics and anthropometry.
3. explore the conception of bones and its mechanical properties.
4. empathize the different kinetic models in bones including osteoporosis.
5 design and analyze the architecture and mechanics involved in the skeletal muscle.
6. construct the theory and models involved in the muscular function.
7. recognize the skeletal joints and its types involved in bone.
8. comprehend the various biomechanical analysis and its application in blood flow.
9. know the concept of different application in modeling and various body system.
10. identify the respiratory cycle and implant manufacturing process.

Introduction to Biomechanics

Principles of mechanics - Newton's laws - mechanical behavior of bodies in contact, work, power and energy relationship - relationships between linear and angular motion - kinetics and kinematic concepts for human motion, characterizing elastic anisotropy - anthropometry.

Bones and Cartilages

Structure of bones - composition and properties of bones and relationship to structure - blood circulation in bone - elastic properties of bones - mechanical properties of bone, Maxwell & Kelvin-Voight models - modeling and remodeling of bones - Wolfe's law of bone remodeling - composite models for bone - bone response to stress - Osteoporosis

Mechanics of Skeletal Muscles

Skeletal muscle: Structure, muscle fibers, types: connective and non-connective tissues, and its architecture, muscle mechanics - motor units - sliding element theory - function -contraction - Hill"s three element model - factors affecting muscular force generation - muscular strength, power and endurance.

Biomechanics of Joints and Biofluids

skeletal joints - forces and stresses in human joints - analysis of rigid bodies in equilibrium, types of joint - biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle - application of loads - Couette flow - Hagen-poiseuille equation in blood flow. .

Applications of Biomechanics

Modeling: cartilage, tendon, ligament and muscle**,** cardiovascular system - artificial heart valves - biological and mechanical valves development - testing of valves - respiratory cycle - lung ventilation model, design of orthopedic implant manufacturing process of implants - fixation of implants.

Text book(s):

1. Hall S. J., "Basic biomechanics", 6th edition, Boston: McGraw Hill, 2012.
2. Bruce M. Koeppen and Bruce A. Stanton, Berne & Levy "Physiology", 6th updated edition, Mosby, 2009.

Reference(s):

1. Ozkaya N and Nordin M, "Fundamentals of Biomechanics - Equilibrium, Motion and Deformation", 3rd edition, Springer-Verlag, 2012.
2. Hamilton N., Weimar W. and Luttgens K., "Kinesiology: Scientific Basis of Human Motion", 12th edition, Boston: McGraw Hill, 2012.

K.S.Rangasamy College of Technology - Autonomous

40 BT E47 - Bioresource Technology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	50	50	100

Objective(s)

- To make the students explore the biodiversity and characterize the wastes generated through their management
- To motivate them to effectively design a bioreactor and scale-up the bio-processes
- To understand the impact on environment and to frame bioremedial procedures

Course Outcomes

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

1. characterize the different types of bioresources and wastes.
2. explore the roles of bioprospecting, ecotourism and biodiversity policies.
3. understand the various bioenergy generation processes.
4. design a bioreactor for efficient bio-energy production and scaling-up procedures.
5. analyze the cell growth and the kinetics of product formation and enzymatic conversions.
6. explore the information on microbial fuel cell, biocatalysis, biopolymers and biosurfactants.
7. optimize yield and recycle and minimize the waste generation.
8. management of regional and environmental impacts, remote sensing and GIS.
9. know the concepts of activated sludge, digestion, biodegradation and biofiltration.
10. construct the bioremedial procedures, bioleaching, effluent management and membranes.

Introduction to Bioresources

Bioresources and its types - availability of different organic wastes - characteristics of solid and liquid wastes - consumptive use: logging, fishing, quarrying and Non-consumptive use: bioprospecting, ecotourism, research - biodiversity policies: importance of natural resources economic development policies, environmental and natural resources policies.

Bioenergy

Different bioenergy generation processes: biomethanation, biohydrogen, bioethanol, biodiesel - bioreactor design for bio-energy - comparative analysis on different bioenergy generation processes - scaling up problems - economic analysis of the process.

Microbial resources

Cell growth and product formation kinetics, enzymatic conversion and treatment of cellulose and lignocelluloses - algal cultivation and harvesting for Microbial Fuel Cells - biocatalysis - biopolymers - biosurfactants.

Natural resource management and conservation

Sustainable yield management - reduction and minimization of waste - recycling of solid, liquid and gaseous wastes - integrated development planning and integrated coastal zone management - environmental impact assessments - protected area systems - community based natural resource - Remote sensing and GIS

Bioresource utilisation

Activated sludge - aerobic and anaerobic digestion - biodegradation of toxic compounds - biofiltration - biological nutrients removal - bioremediation – biosorption and bioleaching of heavy metals - constructed wetlands for industrial effluents - membrane technology.

Text book(s):

1	Ashok Pandey, “Concise Encyclopedia of Bioresource Technology”, CRC Press, 2009.
2	Goodbody, I. and Thomas-Hope, E. “Natural Resource Management for Sustainable Development of the Caribbean”, Canoe Press, University of the West Indies, Mona, 2002.

Reference(s):

1	Cunningham W. and Saigo B., “Environmental Science, A Global Concern”, McGraw Hill, New York, 2001.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E53 - Human Physiology and Anatomy								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	50	50	100

Objective(s)	• To make the student gain knowledge on ICD and its role in regulate the medical insurance • To understand the systems in Human anatomy and its functions in the developmental process. • To impart the knowledge on applications of computer in health care its higher end applications in medicine.
Course Outcomes	**At the end of the course, the students will be able to** 1. understand the fundamental medical terminology. 2. discuss the nervous system, circulatory system and respiratory system. 3. identify the ICD and the complications of pregnancy and abortions 4. describe the signs, symptoms, injuries, poisoning and complications of various diseases. 5. understand the concept of CPT and the process of anesthesia at the time of surgery. 6. comprehend the importance of radiology, pathology and volume III Hospital procedures. 7. explore the vital role of HIPAA and medicare. 8. categorize the data management, data privacy and security in the medical insurance. 9. explore the applications of computer in health care. 10. outline the radiology coding, emergency coding and hospital coding.

Medical terminology

Introduction to International Classifications of Diseases-9-CM, infections and parasitic diseases - neoplasm, endocrine, nutritional, metabolic diseases - blood and blood forming organs - mental disorders - nervous system and sense organs - circulatory system and respiratory system.

International Classification Of Diseases

Digestive system - genitourinary system - complications of pregnancy and abortions - skin and subcutaneous - musculoskeletal and connective tissue - congenital anomalies - perinatal period conditions - signs and symptoms, injuries, poisoning and complications.

Current Procedural Terminology

Introduction to CPT - evaluation and management - anesthesia - surgery (6 chapters) - radiology - pathology and laboratory - medicine, modifiers and Volume III Hospital procedures.

Medical Insurance and reimbursement

HIPAA – medicare - prospective payment systems - revenue codes - reimbursement methodologies - data management and quality - data privacy, security and code editors.

Computer applications in Health care

Applications of computer in health care - encoder Pro Expert - 3M Flash codes - radiology coding, emergency coding and hospital coding

Text book(s):

1. Chaurasia B D, “Human Anatomy: Regional and Applied”, Vol. I &II, CBS Publishers, New Delhi, 2013.

Reference(s):

1. Rizzo D, “Fundamentals of Anatomy & Physiology”, 3rd edition, Clifton Park, NY: Thomson Delmar. ISBN: 1-1110-3869-4, 2010.
2. Linda L, French and Marilyn Takahashi Fordney, “Medical Insurance Billing and Coding An Essentials Work tex”t, Saunders Publications, UK, 2002.

K.S.Rangasamy College of Technology - Autonomous								
40 BT E54 - Genomics and Proteomics								
B.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	50	50	100

Objective(s)	• To know the overview of Genome and genetic analysis. • To learn the implication of genome sequencing by learning the techniques. • To have wide knowledge on tools and applications of functional genomics and proteomics.
Course Outcomes	**At the end of the course, the students will be able to** 1. acquire knowledge on genome sequence and structure through genetic mapping and analysis. 2. determine the position of genes on a chromosome using molecular markers such as STS, SST, hybrid mapping and its expression. 3. determine the precise order of nucleotides by chemical and automated sequencing method. 4. describe the method of predicting of mutations and gene functions. 5. analyze the information of gene expression through SAGE and SADE. 6. determine the similarity among protein sequences and mine data from different database. 7. utilize the functional genomics in disease diagnosis and pharmaceutical aspects. 8. identify the expressed proteins and probe the interaction among proteins and ligands. 9. illustrate and analyze the proteins with reference to 2D electrophoresis and IEF. 10. characterize the individual molecules based on their mass by mass spectrophotometry and MALDI-TOF and protein mass fingerprinting.

Structural Genomics

Overview of genome - genome sequence acquisition and analysis - genetic elements that control gene expression: constitutive and inducible gene expression - genetic analysis: linkage mapping and analysis - high resolution chromosome maps - physical mapping: hybrid mapping strategies, sequence specific tags (SST), sequence-tagged sites (STS) and ISH.

DNA Sequencing

Variations in sequencing methods - ladder, fluorescent, shotgun, transposon-mediated, automated sequencing - finding genes and mutations, genome wide measurement of gene expression, parallel signature sequencing, implications of DNA and genomes sequencing.

Functional Genomics and its application

Comparative genomics of mitochondrial genome and eukaryotes, orthologs and paralogs, serial analysis of gene expression (SAGE), SAGE adaptation for downsized extracts (SADE), GEO dataset analysis - role of genomics in polygenic disorders, functional genomic analysis using forward and reverse genetics - pharmacogenomics.

Proteomics

Overview of analytical proteomics, analytical protein and peptide separations, protein digestion techniques, SALSA: An Algorithm for Mining Specific Features of Tandem MS Data - applications of proteomics - mining proteomes - protein expression profiling - identifying protein-protein interactions and protein complexes - protein modifications and mapping protein - new directions in proteomics.

Tools for Proteomics and its application

2D and SDS gel pattern analysis - MASCOT analysis - SELDI protein chip technology - mass spectrophotometry - MALDI-TOF - mass analyzers - peptide mass fingerprinting - protein arrays and metabolic labeling - application in medical proteomics - pharmaceuticals and GMO plants.

Text book(s):

1	Sandor S., "Genomics and Proteomics: Functional and Computational Aspects", 1st edition,Springer, 2013.
2	Primrose S.B and Twyman R., "Principles of Genome Analysis and Genomics", Blackwell Publishers, 3rd edition, 2007.

Reference(s):

1	Cantor C.R, "Genomics", John Wiley, UK, 1999.
2	Daniel C. Liebler and John R. Yates, "Introduction to Proteomics", Humana press, New Jersey, 2002.

K.S.Rangasamy College of Technology - Autonomous

40 BT E55 - System Biology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	50	50	100

Objective(s)	• To understand the biological structure as well as network architecture of the system. • To know the qualitative and quantitative dynamics of the system supported by predicted modeling • To identify the control points in the system and design methodologies for the system.
Course Outcomes	**At the end of the course, the students will be able to** 1. know the overview of the gene regulations and gene expression in eukaryotic systems. 2. understand the genetic switches and molecular, system paradigm. 3. identify the kinetics, identical and independent binding sites. 4. classify the interacting and non-interacting binding sites. 5. distinguish the genetic switches and amplifiers for gene expression. 6. apprehend the consequences of noise in biochemical systems. 7. define the principle of quorum sensing and Drosophila development. 8. analyze the development precision for Drosophila embryo. 9. recite the basic concepts in gene expression networks 10. relate the aspects of multi-stability in gene networks.

Fundamentals of Systems Biology

Overview of gene control - working of genetic switches - introductory systems biology the biochemical paradigm, genetic paradigm and the systems paradigm.

Protein-ligand Interactions

Equilibrium binding and co-operativity - Michaelis-Menten Kinetics - identical and independent binding sites - Identical and interacting binding sites, non interacting binding sites.

Gene Expression

Genetic switch in Lambda phage - Noise-based switches and amplifiers for gene expression - synthetic genetic switches - *E.coli* chemotaxis - biological oscillators - genetic oscillators - the origin and consequences of noise in biochemical systems.

Developmental Systems Biology

Building an organism starting from a single cell **-** quorum sensing - programmed population control by cell-cell communication and regulated killing - Drosophila development - establishment of the developmental precision and proportions in the early Drosophila embryo.

Gene expression networks

Gene regulation at a single cell level - transcription networks - basic concepts - coherent Feed Forward Loop (FFL) and delay gate - the incoherent FFL - temporal order, signaling networks and neuron circuits - aspects of multi-stability in the gene networks.

Text book(s):

1	Uri Alon, “An Introduction to Systems Biology: Design Principles of Biological Circuits”, 2nd edition, CRC Press, 2006.
2	Edda Klipp, Wolfram Liebermeister, Christoph Wierling and Axel Kowald, “Systems Biology: A Textbook”, 2nd Edition, Wiley-Blackwell, 2016.

Reference(s):

1	Kitano *et al.,* “Systems Biology: A Brief Overview, Science”, Vol.295, pp.1662-1664, 2002.
2	John Ross et al., “Complex Systems: From Chemistry to Systems Biology”, PNAS, Vol.106, pp.6433-6434, 2009.

K.S.Rangasamy College of Technology - Autonomous

40 BT E57 - Entrepreneurship in Biotechnology

B.Tech. Biotechnology

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	3	0	0	45	3	50	50	100

Objective(s)

- To make the students to understand about the Biotechnology techniques, marketing of bioproducts and drugs.
- To create the mindset in start of Biotech companies. Learn about bioethics issues in developing and marketing biotech products to the public.

Course Outcomes

At the end of the course students can able to

1. know various areas of biotechnology industries in india and abroad and the fundamentals issues related to biobusiness.
2. classify the scope of biotechnology industries based on industry segment, emerging technology and technical convergence issues.
3. develop new venture procedures for promoting entrepreneurship in biotechnology.
4. describe production and commercialization of fermented, dairy and bakery products.
5. design and development of alcohol, enzyme, organic acids and antibiotics and their research project management.
6. apply biotechnology knowledge for transition from R&D to business units and Industry Institute interaction.
7. describe different types of intellectual property rights, bioethics and legal issues.
8. distinguish different types of transgenic bioproducts production, branding concerns and licensing procedures.
9. illustrate the business planning and financial strategies for bio-based industries and its regulatory concerns.
10. discuss the case studies types of various biotechnology industries and strategic planning.

Overview of Biotechnology Industries

Scope - Biotechnology Industries in India and Abroad - Fundamentals of Biotechnology for biobusiness - Trends and keg issues in Biotechnology and devices industries - Technology basis in industry segment, emerging technologies and technical convergences issues.

New Venture Creation - Entrepreneurship

Plant tissue culture lab construction – Equipment, glassware and chemical requirements - techniques in culturing of plants. Export of tissue cultured plants to aboard – Vermitechnology – Mushroom cultivation - single cell protein - Biofertilizer technology - production - Commercialization of R&D- Fermentation technology: Bakery, Dairy products.

Product Development

Beer, wine and ethanol production using different sources– Enzyme: production, purification and characterization - Organic acids (Citric, lactic) production - Antibiotic production - Biogas technology - Azolla cultivation - Product development and project management, transition from R&D to business units. Institute–industry interaction and partnership/ alliances.

Intellectual Property, Bioethics and Legal Issues

Intellectual property rights in Biotech, Patent laws - Bioethics and current legal issues - Marketing and public perceptions in product development – Genetically modified products and organisms (Transgenic products) - Technology licensing and branding concerns.

Biobusiness Plans

Healthcare, the Biomedical Sciences, agriculture and Agrobiotechnology. Transfer and business planning -Bank loan and finance strategy – Budget plan – licensing and Branding Concerns and Opportunities, Policy and regulatory Concerns and Opportunities Financial assistance for R&D projects and entrepreneurship. Corporate partners marketing – Model project: Case studies of different industries and their strategic planning.

Text book(s):

1	Richard Oliver. “The coming Biotech age: The business of Biomaterials”, McGraw Hill Publications, New York, USA, 2000.
2	Karthikeyan, S. and Arthur Ruf . “Biobusiness”. MJP Publications. Chennai, India. 2009.

Reference(s):

1	Ruth Ellen Bulger. “The ethical dimensions of the Biological sciences: Cambridge University Press”. New York. 1993.
2	Gurinder Shahi. “BioBusiness in Asia: How countries Can Capitalize on the Life Science Revolution” Pearson Prentice Hall, 2004.
3	Cynthia Robbins., “The business of Biotechnology”, UK, HarperCollins, 2001.

K.S.Rangasamy College of Technology - Autonomous								
40 HS 001 - Professional Ethics								
Common to All Branches								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
VIII	2	0	0	45	2	50	50	100
Objectives	• To create an awareness on Ethics and Human Values and instill Moral and Social Values in students							
Course Outcomes	**At the end of the course, the students will be able to** 1. know the concept of ethics and engineering as a profession. 2. learn the core qualities of professional practitioners. 3. realize engineering as experimentation. 4. study the role of codes and industrial standards as per law. 5. understand the need of safety in testing and designing. 6. know about risk benefit analysis and reducing risk. 7. understand the importance of collegiality, conflict of interest, and professional rights. 8. know the employee rights and IPR. 9. understand the ethics in MNC's, Computers and Social Medias. 10. know the values of engineers as managers and engineers responsibilities in weapons development.							

Introduction

Morals, values and ethics – Integrity – Respect for others, Honesty – Commitment – Character– Core qualities of professional practitioners –Theories of right action – Types of inquiry – Kohlberg's stages of moral development – Carol Gilligan theory – Moral dilemmas – Moral autonomy.

Engineering as Social Experimentation

Engineering as Experimentation – Engineers as Responsible Experiments – Codes of Ethics – A Balanced Outlook on Law – The Challenger Case Study and Volks Wagon's Case Study.

Engineers Responsibility for Safety and Risk

Safety and Risk – Assessment of Safety and Risk – Risk Benefit analysis and reducing Risk – The Three Mile Island Disaster Case Study and Chennai Moulivakkam Building Accident case study.

Responsibilities and Rights

Collegiality and Loyalty – Respect for Authority – Conflict of Interest – Collective Bargaining – Confidentiality - Occupational Crime – Professional Rights – Employee Rights – Customers Rights - Intellectual Property Rights (IPR) – Discrimination – Nestle Maggi Case Study.

Global Issues

Multinational corporations(MNC) – Environmental Ethics – Computer ethics – Social Media Ethics – Engineers as Managers, Expert Witnesses and Advisors – Moral leadership - Weapons development – The Bhopal Gas Tragedy Case Study.

Text book(s):

1. Govindarajan M, Natarajan S, Senthil Kumar V.S, "Engineering Ethics", Prentice Hall of India (P) Ltd, New Delhi, 10th Reprint, 2009.

Reference(s):

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw -Hill Publishing Company Limited, New Delhi, 2007.
2. Govindan K.R., and Sendhil Kumar S., "Professional Ethics and Human Values", Anuradha Publications, Chennai, 2011.

K.S.Rangasamy College of Technology - Autonomous

40 BT SE10 - Computational Genomics

B.Tech. Biotechnology

	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
	1	0	1	20	1	50	50	100

Objective(s)

- To understand the fundamentals of the human genome organization.
- To impart the tools and methods that are used in the Genomics research.
- To provide the fundamental aspects of genomic medicine and applications related to cancer treatment using Next generation ddiagnostic biomarkers.

Course Outcomes

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

1. outline the basis of human genome organization and its regulatory functions.
2. understand the applications of the gene signatures in human biology and its wide spread usage in the medicine.
3. categorize the various components of the human genome databases.
4. demonstrate the types of tracks in the genome browser.
5. summarize the various methods of computational genomics.
6. analyze the gene expression data and its pathway.
7. investigate the pharmacology of drugs for the drug designing and drug development process.
8. compile the fate of the drug metabolism and its genetic variations.
9. interpret the next generation diagnostic biomarkers for cancer with the existing tools.
10. practice the new Genomic Medicine concepts in cancer therapeutics.

Functional Genomics

Overview of Human Genome organization - distribution of genes, Regulatory regions - Applications of gene signatures in human biology and translational medicine.

Genomic Databases and Resources

Components of human Genome databases - expansion and customization of genome annotations - EnsEMBL Genome Browser - UCSC Genome Browser - types of tracks in genome browser.

Tools and methods in Genomics Research

Overview of Computational Genomics methods - Genome analysis tools, Geneset enrichment analysis, Pathway focused analysis of gene expression data.

Pharmacogenomics

Pharmacokinetics and pharmacodynamics - Molecular pharmacology of drugs, Drug design and development strategies - Chemogenomics and Reverse chemogenomics - Genetic variations and drug metabolism.

Personalized Medicine

Next generation Diagnostic Biomarkers for Cancer, Therapeutics based on Transcriptomics and Genomics, Genomic Medicine concepts in cancer therapeutics.

Text book(s):

1	Daniel L. Hartl and Elizabeth W. Jones, Genetics: Analysis of genes and genome, 5th Edition, Jones and Bartlett Publishers, 2005.
2	Christoph W. Sensen, Essential of genomics and bioinformatics, John Wiley & Sons ltd., 2005.

Reference(s):

1	Alain Bernot, Genome Transcriptome and Proteome Analysis, Wiley, 2005.
2	Maria Anisimova, Evolutionary Genomics: Statistical and Computational Methods, Humana Press, 2012.
3	Charles R. Cantor and Cassandra L. Smith, Genomics: The Science and Technology Behind the Human Genome Project, John Wiley & Sons, 2004.