

# **K.S. Rangasamy College of Technology**

**(Autonomous Institution)**



## **Curriculum & Syllabus of M. Tech. Biotechnology**

**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.**

**K.S.Rangasamy College of Technology, Tiruchengode – 637 215**

Regulation	R 2014	
Department		Department of Biotechnology
Programme Code & Name		BT : M.Tech Biotechnology
Curriculum for the Programme under Autonomous Scheme		

Semester I					
Course Name		Hours/Week			Credit
		L	T	P	
<b>THEORY</b>					
40 PBT101	Mathematics for Biotechnologists	3	1	0	4
40 PBT102	Advanced Genetic Engineering	3	0	0	3
40 PBT103	Biochemical Engineering	3	1	0	4
40 PBT104	Quality Control in Biotechnology	3	0	0	3
40 PBT105	Advanced Chemical Engineering	3	1	0	4
40 PBT106	Industrial Biopharmaceutical Technology	3	1	0	4
<b>PRACTICAL</b>					
40 PBT1P1	Advanced Genetic Engineering Laboratory	0	0	3	2
40 PBT1P2	Biochemical Engineering Laboratory	0	0	3	2
<b>Total</b>		18	4	6	26

Semester II					
Course Name		Hours / Week			Credit
		L	T	P	
<b>THEORY</b>					
40 PBT201	Bioseparation Technology	3	1	0	4
40 PBT202	Computational Biology	3	1	0	4
40 PBT203	Human Physiology and Anatomy	3	1	0	4
40 PBT204	Stem Cell Research and Applications	3	0	0	3
40 PBTE1*	Elective I	3	0	0	3
40 PBTE2*	Elective II	3	0	0	3
<b>PRACTICAL</b>					
40 PBT2P1	Bioseparation Technology Laboratory	0	0	3	2
40 PBT2P2	Computational Biology Laboratory	0	0	3	2
<b>Total</b>		18	03	6	25

Semester III					
<b>THEORY</b>					
40 PBT301	Clinical Research and Data Management	3	1	0	4
40 PBT302	IPR and Biosafety	3	1	0	4
40 PBTE3*	Elective III	3	0	0	3
<b>PRACTICAL</b>					
40 PBT3P1	Project Work - Phase I	0	0	12	5
<b>Total</b>		9	02	12	16

Semester IV					
40 PBT4P1	Project Work Phase II	0	0	40	15
<b>Total</b>		0	0	40	15

**K.S.Rangasamy College of Technology, Tiruchengode – 637 215**

Regulation		R 2014						
Department		Department of Biotechnology						
Programme Code & Name		PBT : M.Tech., Biotechnology						
Curriculum for the Programme under Autonomous Scheme								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P		C	CA	ES
Elective I								
40 PBTE 11	Environmental Biotechnology	3	0	0	3	50	50	100
40 PBTE 12	Biotechnology in Textile	3	0	0	3	50	50	100
40 PBTE 13	Analytical Instruments and Trouble Shooting	3	0	0	3	50	50	100
40 PBTE 14	Molecular Pathogenesis	3	0	0	3	50	50	100
40 PBTE 15	Medical Imaging	3	0	0	3	50	50	100
Electives II								
40 PBTE 21	Bioelectronics	3	0	0	3	50	50	100
40 PBTE 22	Tissue Engineering	3	0	0	3	50	50	100
40 PBTE 23	Biosensors and Transducers	3	0	0	3	50	50	100
40 PBTE 24	Research Methodology - Engineering And Management Studies	3	0	0	3	50	50	100
40 PBT E25	Bioreactor Design	3	0	0	3	50	50	100
Electives III								
40 PBT E31	Bioprocess Modeling and Simulation	3	0	0	3	50	50	100
40 PBT E32	Metabolic Engineering	3	0	0	3	50	50	100
40 PBT E33	Nanobiotechnology	3	0	0	3	50	50	100
40 PBT E34	Biobusiness	3	0	0	3	50	50	100
40 PBT E35	Environmental Bioremediation Technology	3	0	0	3	50	50	100
One Credit Course*								
40 PBT SE1	Molecular Diagnosis and Regenerative Medicine	1	0	1	1	50	50	100
40 PBT SE2	Clinical Research Management	1	0	1	1	50	50	100
40 PBT SE3	Medical Coding	1	0	1	1	50	50	100
40 PBT SE4	Foreign Language (French / German/ Japanese)	1	0	1	1	50	50	100
40 PBT SE5	BIOPERL	1	0	1	1	50	50	100
40 PBT SE6	Self Development	1	0	1	1	50	50	100
40 PBT SE7	Corporate Essentials for Biotechnologists	1	0	1	1	50	50	100

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 101 - MATHEMATICS FOR BIOTECHNOLOGISTS								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	1	0	60	4	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To develop the skills of the students in the fields of operations research, numerical methods, statistics and its wide applications.</li> <li>To widen the knowledge about the basics of operations research, numerical methods, statistics to PG Biotechnology students. At the end of the course, the students would have the fundamental knowledge of these areas as well.</li> </ul>							
<b>LINEAR PROGRAMMING AND TRANSPORTATION</b>								
<p>Linear Programming Problems Graphical method – Simplex method – Big-M method – Problems Assignment &amp; Transportation Problems. Assignment problem – Unbalanced assignment problem – Transportation method – North-west corner rule – Least cost method – Vogel’s approximation method – MODI method – Problems .</p>								
<b>SOLUTION OF EQUATION AND EIGEN VALUE PROBLEM</b>								
<p>Newton’s method – Regula-Falsi method – Iteration method – Gauss elimination method – Gauss-Jordan method – Gauss-seidal method – Eigen values and eigen vectors using power method – Problems.</p>								
<b>NUMERICAL INTEGRATION</b>								
<p>Trapezoidal, Simpson’s <math>\frac{1}{3}</math> and <math>\frac{3}{8}</math> rules – Romberg’s method – Gaussian two point and three quadrature formula – Double integration using Trapezoidal and Simpson’s rules – Problems.</p>								
<b>TESTING OF HYPOTHESIS</b>								
<p>Correlation and Regression, Correlation – Coefficient of correlation – Rank Correlation – Regression – Regression Equations, Testing of hypothesis Test of significance of small samples – Students ‘t’ test – Single mean – Difference of means – F-test – Chi-square test – Goodness of fit – Independence of attributes.</p>								
<b>DESIGN OF EXPERIMENTS</b>								
<p>Analysis of variance – Definition – Assumptions in Analysis of Variance – One way classification – Completely randomized design – Two way classification – Randomized Block Design – Latin Square Design – Problems</p>								
<b>Reference(s):</b>								
1	Sundaresan V, Ganapathy Subramanian K S, and Ganesan K, “Operations Research”, A.R. Publications, Chennai, Third Edition, 2005.							
2	Kandasamy P, Thilakavathy K, and Gunavathy R, "Numerical Methods", S Chand & Company Ltd, New Delhi, 2005.							
3	Gupta S C, and Kapur J N, "Fundamentals of Mathematical Statistics", Ninth Edition, S.Chand & Company, New Delhi, 1996.							
4	Grewal B S, “Higher Engineering Mathematics”, Thirty Eighth Edition, Khanna Publishers, New Delhi, 2004.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 102 - ADVANCED GENETIC ENGINEERING								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit C	Maximum Marks		
	L	T	P			CA	ES	Total
I	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>• To understand the molecular tools applied in the field of genetic engineering.</li> <li>• To impart concept of gene cloning methods, nucleic acid sequencing and gene silencing.</li> <li>• To learn advanced methods in gene cloning, gene therapy and gene knockouts.</li> </ul>							
<b>OVERVIEW OF GENETIC ENGINEERING</b>								
<p>Vectors-Artificial chromosome vectors (YAC and BAC), Viral vectors (Lambda, M13 and SV-40), Expression vectors and Shuttle vectors; Restriction Enzymes; DNA ligase; Linkers; Adaptors; Labeling of DNA- Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques-Northern, Southern and Colony hybridization, Fluorescence in situ hybridization, Chromatin Immunoprecipitation; DNaseI footprinting.</p>								
<b>GENE CLONING METHODS</b>								
<p>Construction of libraries-cDNA and genomic DNA; cloning of PCR products; Expression cloning; Jumping and hopping libraries; Southwestern and Far-western cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display.</p>								
<b>NUCLEIC ACID SEQUENCING AND GENE SILENCING</b>								
<p>Sequencing methods- Enzymatic DNA sequencing, Chemical sequencing of DNA, Automated DNA Sequencing, RNA sequencing; Introduction to siRNA; siRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing.</p>								
<b>PCR AND ITS APPLICATIONS</b>								
<p>Primer design; Fidelity of thermostable enzymes; DNA polymerases- different types; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR,; PCR in gene recombination; Deletion; addition; Overlap extension; PCR in molecular diagnostics- Viral and bacterial detection; PCR based mutagenesis, Mutation detection- SSCP, DGGE, RFLP, Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test).</p>								
<b>GENE KNOCKOUTS AND GENETHERAPY</b>								
<p>Creation of knockout mice; Disease model; Somatic and germ-line therapy- <i>in vivo</i> and <i>ex-vivo</i>; Suicide gene therapy; Gene replacement; Gene targeting.</p>								
<b>Text book(s):</b>								
1	Primrose S B, Twyman, R M, and Old, R W, "Principles of gene manipulation", 6 <sup>th</sup> edition, Blackwell Sciences Ltd, 2002.							
2	Brown T A,"Gene Cloning-An Introduction", VNR (U.K) Co. Ltd, England, 2006.							
<b>Reference(s):</b>								
1	Watson J D, "Molecular Biology of Gene", 5 <sup>th</sup> Edition, Pearson Education, New Delhi, 2004.							
2	Glick B, and Pasternak, J.J. "Molecular Biotechnology and applications of recombinant DNA", ASM Press, Washington DC, 2001.							
3	Benjamin Lewin, "Gene IX", Oxford University Press, Cambridge, U.K. 2011.							
4	J Sambrook and D W, Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 103 - BIOCHEMICAL ENGINEERING								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	1	0	60	4	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To understand the enzymw kinetics and its role on substrates.</li> <li>To impart concept of immobilized biocatalysts and its role in mass transfer resistance.</li> <li>To learn advanced methods in design of bioreactor design and analysis.</li> </ul>							
<b>ENZYME CATALYSIS IN BIOCHEMICAL REACTION</b>								
Introduction to enzyme catalysis, Specificity of Enzyme catalysis, Kinetics of single substrate reactions, Graphical representation of kinetic data, Principles of catalysis: Approximations of reactants, Covalent catalysis, General acid-base catalysis and other mechanisms in catalysis. Energetics of substrate binding, Enzyme inhibition, Pre-Steady state kinetics, Enzyme kinetics at limiting conditions, Kinetics of multi-substrate reactions.								
<b>IMMOBILIZED BIOCATALYSTS</b>								
Introduction to immobilization, Rationale and application, Methods of immobilization, Kinetics of immobilized enzymes: Effects of electro potential of microenvironment, external mass transfer, intraparticle diffusion with uncharged support, simultaneous external and internal mass transfer resistance and partitioning effects. Intraparticle diffusion and immobilized enzyme stability.								
<b>MICROBIAL GROWTH</b>								
Introduction, Stoichiometry and energetics of growth: elemental balance, metabolic coupling-ATP and NAD <sup>+</sup> , yield coefficients. Unstructured models of microbial growth: Phases of batch growth, unstructured growth models, Monod and other constitutive models of growth. Multiple substrate models and models of inhibitions, Specific nutrient uptakes.								
<b>BIOREACTOR DESIGN AND ANALYSIS</b>								
Batch reactors-death of cells in batch culture, Continuous stirred tank bioreactors-Ideal chemostat, product formation, substrate inhibition and multiple steady state, enzyme catalysis in CSTR, chemostats in series, graphical design procedures. Plug flow and packed bed bioreactors, imperfect mixing-wall growth, Fed batch reactors.								
<b>TRANSPORT PROCESSES IN BIOCHEMICAL REACTIONS</b>								
Introduction, Rheology of fermentation broths-rheology models, measurement of rheological parameters, examples of microbial broth rheology. Gas-Liquid mass transfer- Diffusion and solubility of gases in biological media, mass balances for two phases bioreactors. Bubble column-bubble generation at an orifice, mass transfer coefficient ( $k_L a$ ), gas holdup, interfacial area, $k_L a$ and liquid circulation pattern.								
<b>Text book(s):</b>								
1	Harvey W Blanch, Douglus S.Clark, "Biochemical Engineering", Marcel Dekker, Inc, New Yark, 2007.							
2	Inamdar S T A, "Biochemical Engineering: Principles and Concepts", Second Edition, Prentice Hall of India, New Delhi, 2010.							
3								
<b>Reference(s):</b>								
1	Shuler M L, and Kargi, F."Bioprocess Engineering Basic Concepts", Prentice Hall of India, New Delhi, 2003.							
2	Rao D G, "Introduction to Biochemical Engineering", Second Edition, Tata McGraw Hill, New Delhi, 2010.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 104 - QUALITY CONTROL IN BIOTECHNOLOGY								
M.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
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>• To learn the accreditation process for academic institution and industries.</li> <li>• To study basic principles in GLP, Quality Assurance and Good laboratory Practice.</li> <li>• To understand the basic process of IPR issues and its guidelines.</li> </ul>							
<b>ACCREDITATION IN ACADEMICS AND INDUSTRIES</b>								
Definition of ISO - Types of ISO, Quality plan, Quality manual - Quality control, International standards, Accreditation Bodies, NAAC, NBA, ABET, Washington Accord etc. – Applications - Documentation of results – Audits (Internal and external) - Audit reports.								
<b>GLP, QA AND GMP</b>								
Good Laboratory Practice (GLP) - Definition of GLP- Practicing GLP - Guidelines to GLP- Documentation of Laboratory work - Preparation of SOPs - Calibration records - Validation of methods - Transfer of methods - Documentation of results – Audits - Audit reports, Quality Assurance (QA) -What is QA- Requirements for implementing QA - QA concepts in ASU drug - Support work & documentation - Audit requirements Personnel Responsibility in QA. Good Manufacturing Practice (GMP) - Definition of GMP - Requirements of GMP implantation - Documentation of GMP practices - Regulatory certification of GMP - GMP in ASU Drugs - GMP in production of ASU drugs - Harmonization of SOP of manufacture - Audit for GMP compliances.								
<b>NABL</b>								
National Accreditation Board for Testing and Calibrating Laboratories (NABL) - Quality control – Applications - Documentation of results – Audits (Internal and external) - Audit reports - Calibration of equipment, glassware items and chemicals - Preparation of solvents and buffer solutions - Calibration records – Laboratory testing and accreditation –								
<b>IPR ISSUES OF NEW DRUGS</b>								
IPR issues of new Drugs - Origin of WTO- WTO & Its implications ( for drugs) - IPR issues in ASU drugs -Patenting and IPR- Patenting & Registration of New Drugs - Patent acts with emphasis on Indian patent Act - US & European patent regulations - Requirements of Patent filing - Patent protection and Patent servicing - Requirements for registering a new drug - Issues in registering new ASU drugs - Indian Drugs and Cosmetics Act - ICMR guideline - Registration requirements for a new drug - Guidelines regarding Bioanalytical studies - Introduction to foreign guidelines.								
<b>APPLICATION IN BIOTECHNOLOGY INDUSTRIES</b>								
General considerations in quality of bioproducts (enzymes/vaccines/insecticides/r-DNA product etc.) such as molecular identity – potency - purity and stability – toxicity - immunogenicity and consistency - Physical and biological containment - facilities for experiments dealing with recombinant cells and viruses - General scientific considerations for assessing possible risks of viral/bacterial insecticides - recombinant organisms in large scale production. Pros and cons of Genetically Modified Organisms.								
<b>Text book(s):</b>								
1	Total Quality Environmental Management: An ISO 14000 Approach. Vasanthakumar N. Bhat, Quorum Books, 1998.							
2	ISO9000 for Better Business: Using ISO 9000 As a Foundation for Total Quality management Jack E. Small, Lanchester Press Inc, 1996.							
<b>Reference(s):</b>								
1	Bioprocess Monitoring and Control (Hanser Series in Biotechnology) Marie-Noelle Pons, John Wiley & Sons Inc 1993.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 105 - ADVANCED CHEMICAL ENGINEERING								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	1	0	60	4	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To enhance the knowledge in mass and energy conservation, losses of thermodynamics and principles of fluid mechanics</li> <li>To impart concept on Mass transfer operations and Chemical reaction engineering.</li> <li>To understand the mechanical operations of various equipments and its role.</li> </ul>							
<b>PROCESS CALCULATIONS</b>								
Law of conservation of mass, Classification of material balance, solving material balance problems without chemical reactions, Energy balance: procedure, sensible heat and heat capacities. Relationship between $C_p$ and $C_v$ , Empirical equations for heat capacities.								
<b>HEAT TRANSFER OPERATION</b>								
Modes of heat transfer operation: conduction - Fourier's law, 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: shell and tube and double pipe heat exchangers, flow arrangements in heat exchangers, energy balance and LMTD.								
<b>MASS TRANSFER OPERATION</b>								
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; Simple distillation, Continuous rectification - binary systems, Mc Cabe Thiele analysis and calculations.								
<b>CHEMICAL REACTION ENGINEERING</b>								
Rate of reaction, Molecularity and Order of the reaction, Interpretation of batch reactor data: Constant volume reactor, Analysis of total pressure data, Differential method of analysis, half life method, Integral method of analysis: Irreversible zero, first, second, $n^{\text{th}}$ order, parallel, Series and reversible reactions and calculations.								
<b>MECHANICAL OPERATIONS</b>								
Theory involved in crushing and grinding, Construction and working of jaw and roll Crushers, Hammer and ball mills, problem based on above operations, Size separation of solids, screens, differential and cumulative analysis, study of equipments: Jig, forth flotation, magnetic and electrostatic separator.								
<b>Text book(s):</b>								
1	Gavhane K A, "Unit Operations-II", 23 <sup>rd</sup> Edition, Nirali Prakasan Publication., 2009.							
2	Gavhane K A., "Chemical Reaction Engineering - I", 13 <sup>th</sup> Edition, Nirali Prakasan Publication., 2011.							
3	Stanbury F P, Whitaker, A. and Hall, S.G. "Principles of Fermentation Technology", Aditya Books, Pvt, Ltd., 1997.							
<b>Reference(s):</b>								
1	Binay K Dutta, "Heat transfer Principles and Applications", Prentice Hall India, New Delhi, 2006.							
2	Geankoplis C J, "Transport Processes and Unit Operations", Prentice Hall India, New Delhi, 2002.							



K.S.Rangasamy College of Technology - Autonomous								
40 PBT 106 - INDUSTRIAL BIOPHARMACEUTICAL TECHNOLOGY								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	1	0	60	4	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To understand the composition and technology of biopharmaceutical drug Production, and development and use of the gene therapy.</li> <li>To enhance the theoretical knowledge and understanding of therapeutically effects as well as of undesired side effects of biopharmaceuticals.</li> <li>To recognize the role of quality assurance in biopharmaceuticals.</li> </ul>							
<b>INTRODUCTION TO PHARMACOLOGY</b>								
<p>Drug- definition, Classification, physiochemical properties, Pharmaceutical substance of plant, animal and microbial origin, Routes of administration of drug. Bioavailability studies..Bioequivalence and its determination-study design for the assessment of bioequivalence- factors influencing bioavailability and bioequivalence-Software used in biopharmaceuticals.</p>								
<b>BIOPHARMACEUTICAL MECHANISM OF ACTION</b>								
<p>Basic concepts of pharmacokinetics: Absorption- Mechanism and path ways of drug absorption-absorption rate constant-absorption half life Distribution- Physiological influence of drug distribution- protein binding of drug- and clinical significance of drug protein binding. Biotransformation of drug-Non synthetic and synthetic reaction Elimination-Concept of clearance- Organ clearance- hepatic clearance, gut wall clearance and renal clearance.</p>								
<b>NOVEL DRUG DELIVERY SYSTEMS</b>								
<p>Fundamentals of controlled drug delivery systems -Design, fabrication, evaluation and applications of controlled release systems- Implantable therapeutic systems-Bioadhesive drug delivery systems-Proteins and peptide drug delivery-Liposomes, microspheres, nanoparticles and polymeric micelles -Drug targeting: Concepts and drug carrier systems-Approaches to active drug targeting-Targeting to particular organs.</p>								
<b>BIOPHARMACEUTICALS MANUFACTURING</b>								
<p>Manufacturing of parenteral products--design and layout of manufacturing facility-clean rooms-sterile water production-general principles of cleaning-decontamination-sanitation.packaging instructions-validation-Granulation-wet and dry granulation, Tablet machines and presses. Coating of pharmaceutical dosage forms-coating process-flim coating,modified release flim coating-coating procedure and equipment. Quality control and practice.</p>								
<b>BIOPHARMACEUTICALS QUALITY ASSUARANCE</b>								
<p>The role of FDA (food and drug administration process)-role of centre for biological evaluation and research (CBER)-role of center for drug evaluation and research (CDER)-their role in biopharmaceutical production process-MHRA ACT (medicinal and health related authority-UK act)-Global harmonization of regulatory affairs-European medicine evaluation agency (EMA)-Indian pharmacopeia (IP)-United states pharmacopeia (USP).</p>								
<b>Text book(s):</b>								
1	Remington, "The Science and Practice of Pharmacy". Lippincott Williams and Wilkins, 20 <sup>th</sup> edition, 2001.							
2	Gary Walsh, "Biopharmaceuticals", John Wiley & Sons Ltd, UK, Second Edition, 2003.							
<b>Reference(s):</b>								
1	Tripathi K D, "Essentials of Medical Pharmacology", Jaypee Brothers Medical Publishers (P) Ltd. 6 <sup>th</sup> Edition, John Wiley, New Delhi, 2000.							
2	Lionel D, Edwards, Andrew, J F, Antony W F, and Peter, D S, "Principles and Practice of Pharmaceutical Medicine", Second Edition, John Wiely, London, UK, 2007.							



K.S.Rangasamy College of Technology - Autonomous								
40 PBT 1P2 - BIOCHEMICAL ENGINEERING LABORATORY								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	0	0	3	30	2	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To gained knowledge in Biochemical Engineering by giving practical knowledge in laboratory level.</li> <li>To enhance the knowledge on Purification sedimentation and separation of biomolecules.</li> <li>To impart concept on product recovery from complex material.</li> </ul>							
S.No.	Name of Experiments							
	<ol style="list-style-type: none"> <li>Determination of activation energy for enzymatic reaction</li> <li>Evaluation of parameters in Monod model for growth of microorganisms</li> <li>Evaluation of enzyme Kinetic parameters by Michaelis Menten Model</li> <li>Media optimization by Plackette Burman design</li> <li>Determination of mass transfer calculations in bioreactors</li> <li>Determination of substrate inhibition kinetics</li> <li>Evolution of Kinetics on fed batch biochemical reactions</li> <li>Effect of substrate concentration on biomass yield</li> <li>Heat transfer determination in fermenter</li> <li>Design of bubble column and packed bed column</li> <li>Solvent extraction techniques for product recovery</li> </ol>							
1	Inamdar S TA, "Biochemical Engineering Principles and Concepts", 2 <sup>nd</sup> Edition, PHI learning Pvt.Ltd, New Delhi, 2009.							
2	Pauline M Doran, Bioprocess Engineering Principles, Academic Press, London, USA, 1995.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 201 - BIOSEPARATION TECHNOLOGY								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	1	0	60	4	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To enhance the knowledge on Downstream processing technology and its applications.</li> <li>To learnt about methods to purify and characterize various types of bioproducts in large scale level.</li> <li>To impart concept on product recovery from complex material.</li> </ul>							
<p><b>INTRODUCTION TO BIOSEPARATION</b>            Overview of downstream process technology, bioproduct purification, downstream process economics, cost cutting strategies in downstream processing industry, process design criteria for bioproducts, characteristics of biological mixtures, physico chemical basis of bioseparation.</p> <p><b>RHEOLOGY AND PRIMARY SEPARATION TECHNIQUES</b>            Non-newtonian fluids, viscosity measurement, rheological properties of fermentation broth, turbulence, Cell disruption: mechanical and non-mechanical methods; filtration-types of filtration equipments, basic theory of filtration, problems related to filtration; centrifugation-ranges of centrifuges, problems related to centrifugation.</p> <p><b>PRODUCT SEPARATION AND PURIFICATION</b>            Liquid-liquid extraction: Principle, methods, aqueous polymer two phase extraction, supercritical fluid extraction; adsorption: principle, types of adsorption process; precipitation: structure of typical globular protein, protein precipitation methods, industrial scale precipitation; membrane based separation processes: types of membrane, modules, types of membrane processing, causes, consequences and control techniques, design and configuration of membrane separation equipments and application, problems related to adsorption, extraction, precipitation and membrane separation.</p> <p><b>PRODUCT PURIFICATION AND IDENTIFICATION</b>            Chromatography: general chromatography theory, resolution, scaling up, large scale chromatography, types of chromatography-ion exchange, affinity, reverse phase, hydrophobic interaction chromatography, applications; characterization of the product- electrophoresis, analysis of product purity, high performance liquid chromatography, gas chromatography, methods for measuring protein concentration, gel filtration chromatography, problems related to chromatography.</p> <p><b>PRODUCT RESOLUTION AND CASE STUDIES</b>            Crystallization, problems related to crystallization, freeze drying, finished good formulation and packaging; purification of <math>\beta</math> amylase, cephalosporin, aspartic acid, recombinant streptokinase, monoclonal antibodies, tissue plasminogen activator, Taq polymerase, insulin.</p>								
<b>Text book(s):</b>								
1	Prasad N K, "Downstream Process Technology-A New Horizon in Biotechnology", Prentice Hall of India, New Delhi, 2012.							
2	Pauline M Doran "Bioprocess Engineering Principles", Academic Press, London, USA, 2012.							
<b>Reference(s):</b>								
1	Belter P A, Cussler E L, and Wei Shou Hu, Bioseparation – Downstream Processing for Biotechnology", Wiley India Pvt. Ltd., 2011.							
2	B Sivasankar, "Bioseparations: Principles and Techniques", Phi Learning Pvt. Ltd., 2009.							
3	Ajay Kumar, Abishek Awasthi "Bioseparation Engineering: Comprehensive DSP Volumen" I.K International Publishing House Pvt. Ltd., New Delhi, 2009.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 202 - COMPUTATIONAL BIOLOGY								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	1	0	60	4	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To develop skills in inter disciplinary of the applications of computers in biotechnology</li> <li>To learn about the biological databases, computer programming in PERL and Machine learning techniques.</li> <li>To enhance the knowledge on BioPERL and its applications in Bioinformatics.</li> </ul>							
<p><b>INTRODUCTION TO COMPUTATIONAL BIOLOGY</b>  Introduction to computational biology and bioinformatics, Applications of bioinformatics, Computer and its components, Hardware basics: Processor, motherboard slots/cards, bus parallel and serial ports, various storage devices, Network – Protocols (OSI, TCP/IP and FTP models) media and topology (Tree, star, bus and ring).</p> <p><b>DATABASES AND SEARCHING ALGORITHMS</b>  Biological databases – Introduction and Functions, Dot matrix analysis, Dynamic Programming – Needleman – Wunsch algorithm and Smith – Waterman algorithm, Scoring Matrices – PAM, BLOSUM and GONNET, Heuristic methods of database searching- FASTA and BLAST family of programs.</p> <p><b>PHYLOGENETIC ANALYSIS</b>  Multiple Sequence Alignment – SP method, CLUSTALW and Iterative methods, SAGA, Motifs and their applications, Phylogenetic Analysis- Molecular clock Theory, Jukes – Cantor and Kimura’s model, Distance methods – UPGMA, Fitch-Margolish and Neighbourhood joining, Character based methods – Maximum parsimony and Maximum Likelihood , Bootstrapping Technique.</p> <p><b>MACHINE LEARNING TECHNIQUES</b>  Functional, Structural and comparative genomics, Hidden Markov Models, Neural Nets, Decision trees and their application in computational biology, Eukaryotic and prokaryotic gene finding, shotgun DNA assembly, Protein secondary structure prediction.</p> <p><b>INTRODUCTION TO PERL AND APPLICATIONS OF BIOINFORMATICS</b>  Introduction to PERL variables, Data types, arrays and hashes, File handling, Types and functions of various Microarray such as DNA microarrays, Oligonucleotide microarray, cDNA microarray, Introduction and applications of System Biology.</p>								
<b>Text book(s):</b>								
1	Bryan Bergeron, “Bioinformatics Computing”, Prentice Hall of India Pvt. Ltd., New Delhi, 2006.							
2	Baldi P, and Brunak S, “Bioinformatics: The Machine Learning Approach”, 2 <sup>nd</sup> Edition, MIT Press, 2001.							
<b>Reference(s):</b>								
1	Gusfield Dan, “Algorithms on strings Trees and sequences”, 1 <sup>st</sup> Edition, Cambridge University Press, UK, 2005.							
2	Baxevanis A D. and Oullette B F F, “A Practical Guide to the Analysis of Genes and Proteins”, 2 <sup>nd</sup> edition, John Wiley, Singapore, 2002.							
3	Mopunt D W, “Bioinformatics: Sequence and Genome Analysis”, Cold Spring Harbor Laboratory Press, USA, 2001.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 203 - HUMAN PHYSIOLOGY AND ANATOMY								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	1	0	60	4	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To make the student gain knowledge on ICD and its role in regulate the medical insurance.</li> <li>To understand the systems in Human anatomy and its functions in the developmental process.</li> <li>To impart the knowledge on applications of computer in health care its higher end applications in medicine.</li> </ul>							
<p><b>MEDICAL TERMINOLOGY</b> 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.</p> <p><b>INTERNATIONAL CLASSIFICATION OF DISEASES</b> 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.</p> <p><b>CURRENT PROCEDURAL TERMINOLOGY</b> In Introduction to CPT, Evaluation and Management, Anesthesia, Surgery (6 chapters), Radiology, Pathology and Laboratory, Medicine, Modifiers and Volume III Hospital Procedures</p> <p><b>MEDICAL INSURANCE AND REIMBURSEMENT</b> HIPAA, Medicare, Prospective Payment Systems, Revenue Codes, Reimbursement Methodologies, Data Management and Quality, Data Privacy and Security and Code Editors.</p> <p><b>COMPUTER APPLICATIONS IN HEALTH CARE</b> Applications of computer in health care- Encoder Pro Expert, 3M Flash codes, Radiology coding, Emergency coding and Hospital coding.</p>								
<b>Text book(s):</b>								
1	Chaurasia B D, Human Anatomy: Regional and Applied, Vol. I&II, CBS Publishers, New delhi.2013.							
<b>Reference(s):</b>								
1	Rizzo D, Fundamentals of Anatomy & Physiology. (3rd ed.). 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 text, Saunders Publications,Uk, 2002							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 204 - STEM CELL RESEARCH AND APPLICATIONS								
M.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
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>• To make the student gain knowledge in stem cell basics, growing of somatic and embryonic stem cells.</li> <li>• To understand the pattern of cell growth in laboratory condition.</li> <li>• To recognize and label the applications of stem cells in medicine.</li> </ul>							
<p><b>FUNDAMENTALS OF STEM CELL BIOLOGY</b>  Introduction to stem cells, Embryogenesis-Developmental stages, Definition of stem cell, Historical perspectives – origin of life, Chronology of major events in the history of stem cell research, Goals of stem cell research, Identifying stem cells, Stem cell potentials, Unique properties of stem cells, Plasticity, stem cell marker</p> <p><b>TYPES OF STEM CELLS</b>  Germ Line Stem Cell: Introduction to Germ cell development <i>in vivo</i>, Male Germ Cells, Embryonic Germ Cells, Gametes derived from embryonic stem cells, Are artificial gametes functional, Benefits of Embryonic Stem Cells- derived gametes and Embryonic Stem Cells: Current hESCs Culture Systems, Isolation, Propagation and Characterization of Human Embryonic Stem Cells, Spontaneous Differentiation of hESCs and Adult stem Cell: Phenotypic and functional properties of Adult stem cells, Implications of Adult stem cell dysfunctions in disease development, Adult stem cell differentiation-transdifferentiation. Adult stem cell types and their therapeutic applications.</p> <p><b>STEM CELL CULTURE</b>  Culturing of stem cells, isolation of stem cells from blastocysts, Mouse embryonic stem cells, Stem cell preparation from various species, Characterization and identification of stem cells, Organization and good aseptic technique in the human embryonic stem cell laboratory, Derivation of human embryonic stem cells in standard and chemically defined conditions, Blastocyst preparation, Cryopreservation</p> <p><b>APPLICATIONS OF STEM CELLS</b>  Common applications of stem cells, Applications of human embryonic stem cells in drug discovery, Stem cells as a therapy for diabetes, Parkinson &amp; Alzheimer's disease, Neurological, heart disease, spinal cord injuries, burns, Role of stem cells in human Genetics, Germ cells and artificial gametes production, animal models, Cancer stem cells: the enemy within cancers, Spinal cord regeneration, Gene therapy, stem cell based drug discovery, drug screening and toxicology.</p> <p><b>STEM CELL BASED TISSUE ENGINEERING</b>  Basic principles and components of tissue engineering, Cell types and sources, metabolic requirements of cells, Connective tissues, Reconstruction of epithelial or endothelial surface, bioreactor design on tissue engineering, Microcarrier based system, tissue engineering of liver and other important organs. Recent advances in Tissue engineering, Therapeutic applications.</p>								
<b>Text book(s):</b>								
1	Deb K D, and Totey S M, "Stem cells basics and applications" Tata Mc Graw Hill Education Pvt. Ltd. New Delhi, 2009.							
2	John R W, Master, "Animal cell culture - A practical approach" Oxford University Press, New Delhi, 2004.							
<b>Reference(s):</b>								
1	Kursad D, and Turksen D, "Embryonic Stem cell" Humana Press, London, UK, 2002.							
2	Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research, Academic Press, California, USA, 2002.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 2P1 - BIOSEPARATION TECHNOLOGY LABORATORY								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	0	0	3	27	2	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To enhance the knowledge on techniques in Downstream processing technology and its applications.</li> <li>To learnt about methods to purify and characterize various types of bioproducts.</li> <li>To impart concept on product recovery from complex material, storage and its purification.</li> </ul>							
<ol style="list-style-type: none"> <li>Cell disruption by sonication and enzymatic method</li> <li>Flocculant screening</li> <li>Purification of proteins by aqueous two phase extraction</li> <li>Precipitation of proteins by ammonium sulphate.</li> <li>Column chromatography (Gel filtration, ion exchange)</li> <li>Purification of proteins by dialysis</li> <li>Quantification of biological samples by HPLC</li> <li>Analysis of biomolecules by gas chromatography method</li> <li>Freeze drying of biological samples by lyophilization</li> </ol>								
<b>Reference(s):</b>								
1	Ponmurugan P,Nithya Ramasubramanian, Fredimoses M, "Experimental Procedures in Bioprocess Technology and Downstream Processing", Anjanaa Book House Publishers, Chennai, 2012.							
2	Roger G, Harrison," Bioseparations Science and Engineering" , Oxford University Press, 2003							
3	Jenkins RO, "Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series", Butterworth-Heinemann, USA, 1992.							



K.S.Rangasamy College of Technology - Autonomous								
40 PBT 2P2 - COMPUTATIONAL BIOLOGY LABORATORY								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	0	0	3	30	2	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To gained knowledge in Computational biology by giving practical knowledge in laboratory level.</li> <li>To impart knowledge on the usage of bioinformatics softwares towards Biological applications.</li> <li>To enhance the knowledge on BioPERL and its applications.</li> </ul>							
<ol style="list-style-type: none"> <li>Primary Databases, Derived Databases, Sequence formats, Molecular file formats and Structure Databases – PDB, SCOP and CATH.</li> <li>Sequence Analysis tools including function for Pairwise, MSA and Phylogenetic tree construction.</li> <li>Heuristic Database Searching Methods – FASTA and BLAST.</li> <li>Protein Secondary Structure Prediction – Modeller 9v11 using single, multiple templates.</li> <li>Identifying the active site of the target molecule and calculate the relative binding energy with lead molecules using ArgusLab 4.0.</li> <li>Gene Prediction using GENSCAN and RNA structure prediction using IPknot.</li> <li>Primer Designing tools – Primer3 4.0.</li> <li>Protein Simulation using GROMACS 5.0.</li> <li>Perform a PERL script to Retrieve a sequence file and search for a given pattern.</li> <li>Microarray data import from GEO and Affymetrix and expression analysis and normalization using MATLAB</li> </ol>								
1	Andreas D, Baxevanis B F, Francis Ouellette, "Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins", John Wiley & Sons, Volume 43, Second Edition, 2002.							
2	Krawetz Stephen A, Womble, David D , "Introduction to Bioinformatics - A Theoretical And Practical Approach", Humana Press, 2003.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 301 - CLINICAL RESEARCH AND DATA MANAGEMENT								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	1	0	60	4	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To enhance the knowledge on Clinical research and its applications.</li> <li>To impart the knowledge on data management and pharmacovigilance.</li> <li>To understand the methods in CTM and its scenario in India.</li> </ul>							
<p><b>INTRODUCTION TO CLINICAL RESEARCH</b> Introduction to Drug Discovery and drug Development - Basic pharmacology and clinical research: Basic conceptual knowledge about receptors, drugs, preclinical studies, pharmacodynamic, pharmacokinetic (ADME), drug interactions - Introduction to pharmacoeconomics.</p> <p><b>ETHICAL GUIDELINES</b> Ethical Guidelines for Biomedical Research on Human – Historical guidelines in Clinical Research: Nuremberg code, Declaration of Helsinki, Belmont report - International Conference on Harmonization (ICH): Brief history of ICH, Structure of ICH, ICH Harmonization Process - Guidelines for Good Clinical Practice: Guidelines of ICH, Indian GCP (CDCSO guidelines)</p> <p><b>CLINICAL TRIALS AND DATA MANAGEMENT</b> Preclinical studies: Animal toxicology, Animal pharmacology - Clinical trial – types of clinical trials – phases of clinical trial - protocol approval – Informed consent – SOP – investigator brochure - responsibility of sponsor – investigator – ethics committee – structure &amp; contents of clinical report.– trial subjects recruitment.</p> <p><b>DATA MANAGEMENT AND PHARMACOVIGILANCE</b> Clinical Data Management - Principles of CDM, Data Entry, Queries &amp; Data Clarification, Softwares in CDM - Principles of Pharmacovigilance : ADR; Assessment; Medication errors, Signal detection; Risk assessments.</p> <p><b>CLINICAL TRIAL MANAGEMENT</b> KPO(Knowledge process outsourcing) of Contract research - Contract Research Organization (CRO) Site management organizations (SMO) - Clinical Trials in India –The National Perspective - Pharmaceutical Industry – Global and Indian Perspective - Clinical Trial market - Careers in Clinical Research - clinical research education and training in India</p>								
<b>Text book(s):</b>								
1	ICMR, "Ethical guidelines for biological research on human subjects", Indian council of Medical Research Press, New Delhi, 2000.							
2	Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G. 12 <sup>th</sup> Edition, 2012.							
<b>Reference(s):</b>								
1	Schedule Y., The Drug and Cosmetic Rule. "Requirements and guidelines for permission to import and/or manufacture of new drugs for sale or to undertake clinical trials". Government of India, New Delhi, 1945.							
2	Machin, D. and Fayers, P., "Randomized clinical trails – Design, Practice and Reporting", Wiley Black well, Singapore, 2010.							
3	Knut Schoeder, "The 10 minutes Clinical Assessment", Wiley Black well, Singapore, 2010.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 302 - IPR AND BIOSAFETY								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	1	0	60	4	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To impart the knowledge on intellectual property rights and its application in Biotechnology.</li> <li>To gain knowledge on patent filing process.</li> <li>To impart the knowledge on biological safety measures and GMOs.</li> </ul>							
<b>INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS</b>								
Types of IPR: Patents, Trademarks, Trade secrets, Copyright and Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMO's IPR in R&D; IPRs relevance to Biotechnology, Case Studies.								
<b>AGREEMENTS AND TREATIES</b>								
History of GATT and TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 and recent amendments.								
<b>BASICS OF PATENTS AND CONCEPT OF PRIOR ARTS</b>								
Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees, Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO,EPO), PATENT Scope (WIPO), IPO, etc.								
<b>PATENT FILING PROCEDURES</b>								
National, International Patents and PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes, Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies.								
<b>BIOSAFETY</b>								
Introduction; Historical background; Introduction to Biological safety cabinets; Primary containment for Biohazards; Biosafety levels; Biosafety levels of specific microorganisms; Recommended Biosafety levels for infectious agents and infected animals; 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; Overview of National Regulations and relevant International Agreements including Cartagena protocol.								
<b>Text book(s):</b>								
1	BAREACT, Indian Patent Act, 1970. Acts and Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi, 2007.							
2	Kankanala, C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., New Delhi, 2007.							
<b>Reference(s):</b>								
1	The law and strategy of Biotechnological patents by Sibley. Butterworth publications, USA. 2011.							
2	Subbaram, N.R., "Handbook of Indian Patent Law and Practice ", S. Viswanathan Printers and Publishers Pvt. Ltd., New Delhi, 1998.							
3	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 PBT 3P1 - PROJECT WORK - PHASE I								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	0	0	12	45	2	100	0	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>• To make the student understand the practical problem solving process in the industry.</li> <li>• To collect review of literature from various national and international journals in the field of Biotechnology.</li> </ul>							
<ul style="list-style-type: none"> <li>• Three reviews have to be conducted by the committee of minimum of three members one of which should be guide</li> <li>• Research problem should be selected</li> <li>• Students have to collect about 20 research papers related to their work</li> <li>• Report has to be prepared by the students as per the format</li> <li>• Preliminary Implementation can be done if possible.</li> <li>• Internal evaluation has to be done for 100 marks</li> </ul>								

K.S.Rangasamy College of Technology - Autonomous								
40 PBT 4P1 - PROJECT WORK – PHASE II								
M.Tech. Biotechnology								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	0	0	40	45	10	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>• To make the student understand the practical problem solving process in the Biotechnology industry.</li> <li>• To impart the students to write R&amp;D projects in Biotechnology fields to various funding agencies.</li> </ul>							
<ul style="list-style-type: none"> <li>• Three reviews have to be conducted by the committee of minimum of three members and one among them should be the guide</li> <li>• Each review has to be evaluated for 100 marks</li> <li>• Attendance is compulsory for all reviews. If a student fails to attend review for some valid reasons, one or more chances may be given.</li> <li>• The student should publish the paper preferably in the journals/conferences.</li> <li>• Final review will be conducted by the committees that consist of minimum of three members one among them should be the guide (if possible include one external expert examiner within the college).</li> <li>• The report should be submitted by the students around at the end of May.</li> </ul>								

K.S.Rangasamy College of Technology - Autonomous								
40PBTE11- ENVIRONMENTAL BIOTECHNOLOGY								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To develop skills of the students in the area of Environmental Biotechnology and pollution.</li> <li>To impart the knowledge on environmental bioremediation and conservation of natural resources.</li> </ul>							
<b>ENVIRONMENTAL POLLUTION</b>								
Sources of Pollution, Air Pollution, Acid rain, Effect of Air pollution, Control measures of air pollution, Water Pollution, waste water treatment, Control measures of water pollution, Physio-chemical properties of waste water such as BOD, COD, Dissolved oxygen and micro and macro elements.								
<b>SOIL FORMATION</b>								
Ecosystem, Adaptation of flora and fauna, Formation of soil, Physical and chemical process of soil formation, Pedogenesis, Factors affecting soil formation, Soil characteristics, Active factors for soil formation, Soil classification, Soil complex and its properties, Soil organic matter, Humus formation and importance of humic acid.								
<b>SOIL MICROBIOLOGY</b>								
Microbial flora of Soil, Microbial Growth kinetics, Ecological adaptations of Microorganisms, Soil enzymes (Phosphatase, Cellulase, Urease and Dehydrogenase) and their role in nature, Soil microbial population and their importance. Bioleaching								
<b>BIODEGRADATION OF CHEMICALS</b>								
Introduction to pesticides, fungicides and weedicides, Effects of pesticides, fungicides and weedicides on the environment such as soil, water and air, Degradation of pesticides, fungicides and weedicides, Simple aromatics-Chlorinated Polyaromatic Petroleum Products, Surfactants, Biodegradation of pesticides, fungicides and weedicides using microorganisms.								
<b>BIOREMEDIATION OF CHEMICALS</b>								
Bioremediation of oil spilled and salt affected Soils by using microorganisms and Plants, Role of Biological indicators in Bioremediation, Solid Waste management, Dairy, Pulp, Dye, Leather and Pharmaceutical waste management, Biofertilizers for poor soil management, Biocontrol agents in pest and plant disease control.								
<b>Text book(s):</b>								
1	Stainer R Y, Ingraham J L, Wheelis ML, and Painter R R, "General Microbiology", Mc Millan Publications, New Delhi, 1989.							
2	Foster C F, and John Ware D A, "Environmental Biotechnology", Ellis Hon wood Ltd., Singapore, 1987.							
<b>Reference(s):</b>								
1	Subba Rao N S, "Soil Microbiology", Oxford & IBH Publishers Pvt. Ltd, New Delhi, 2004.							
2	Karnely D, Charbarty, K. and Omen G S, "Biotechnology and Biodegradation, Advances in Applied Biotechnology", Series I, Vol. 2, Golf Publishers Co, London, 1989.							

K.S.Rangasamy College of Technology - Autonomous								
40PBTE12 - BIOTECHNOLOGY IN TEXTILE								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To develop skills of the students in the area of applied Biotechnology with reference to textile technology.</li> <li>To incorporate the applications of both the domain for the higher applications in medicine, environment and industrial applications.</li> </ul>							
<p><b>POLYMERIC MATERIALS</b> Introduction – Origin, classification, formation of polymers – chain growth and step growth polymerization, copolymerization. Thermoplastics and thermosets. Micro structures in polymers – polymer length, molecular weight, amorphous and crystalline, thermal transitions in plastics. Physical basis of polymer processing – Liquids and viscosity, viscosity and polymer processing, shear stress in polymer system, non-newtonian flow, melt flow index.</p> <p><b>DESIGN AND ENGINEERING OF NOVEL ENZYMES FOR TEXTILE APPLICATIONS</b> Basic principles of recombinant (DNA) molecular cloning, Production of enzymes: Amylase, Cellulase and Pectinase. Searching for efficient production systems, Enzyme engineering, Design and engineering of novel enzymes for textile applications, Advantages and limitations.</p> <p><b>QUALITATIVE AND QUANTITATIVE ANALYSIS OF TEXTILE ANCILLARIES</b> Identification of textile polymers – confirmation of different groups in the textile polymers – cellulose, protein, amide, ester – methods of analysis, Fastness characters of different dyes – Investigation of dyes. Analysis of textile polymers in blends – chemicals for different polymers, methods – Density gradient method, solvent method, X-ray method.</p> <p><b>BIOTECHNOLOGY FOR MEDICAL TEXTILES</b> The application of polymer materials in medicine; Textiles in filtration, Filter fabric construction- Woven, needle felt &amp; knitted filter fabric. Waterproof breathable fabrics- Densely woven fabric, membranes, coatings, Membranes- Micro porous membrane, Hydrophilic membrane, Coatings-Microporous coating, Hydrophilic coatings, Performance of waterproof breathable fabrics. Medical textiles, Fibres used, Classification of medical textiles, Nonimplantable materials, wound dressings, bandages and plasters.</p> <p><b>ENVIRONMENTAL MANAGEMENT</b> Waste water characteristics. Waste water treatment objectives, methods and implementation considerations. Recycling of effluents. Identification and reduction of pollution sources in textile wet processing. Pollution control in man-made fibre industry. Analysis of textile processing effluents – colour, odor, pH, total solids, suspended solids, total dissolved solids, BOD, COD, total alkalinity, chloride, sulphates, calcium and chromium. Tolerance limits for effluents. Bio-degradability of textile chemicals and auxiliaries.</p>								
<b>Text book(s):</b>								
1	Gupta V B, and Kothari K K, "Man-Made Fibres Production, Processing, structure, properties and applications ", vol. I and II, Department of Textile Technology, IIT, New Delhi, 1988.							
2	Vaidya A A, "Production of Synthetic Fibres ", Prentice Hall of India Pvt. Ltd., New Delhi, 1988.							
<b>Reference(s):</b>								
1	Mark H F, Atlas S M, and D Certia E, "Man-Made Fibres-Science and Technology ", Vol.I to III, Interscience Publishers, New York, 1987.							

K.S.Rangasamy College of Technology - Autonomous								
40PBTE13- Analytical Instruments and Trouble Shooting								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To develop skills of the students in the area of Instrumentation techniques, handling of various instruments and to rectify the problems which are occur during the practice.</li> <li>To enhance the knowledge on instrumentation various instruments and its applications.</li> </ul>							
<p><b>GENERAL TECHNIQUES</b>  Definitions, preparations, derivation of Henderson-Hasselbalch equation and its application. Electrodes for pH and O<sup>2</sup> measurement. Microscopy: Light, Phase contrast, fluorescence, TEM, SEM, Atomic force, scanning and tunneling. Centrifugation-differential, density gradient and ultracentrifugation-basic principles and applications.</p> <p><b>TLC AND ELECTROPHORESIS</b>  Theory of Chromatographic separation and TLC - Principles of chromatographic separation - Introduction to chromatographic separation techniques - Principles and Practice of TLC - Uses of TLC - Some recommended solvents systems - Detection of compounds on TLC plates HPTLC - Principles and Instrumentation - HPTLC vs TLC - Densitometry and quantitation in HPTLC - HPTLC in fingerprinting and QC – Troubleshooting - Applications of Determination of molecular weight using gel filtration chromatography. Electrophoresis –Types, native SDS-PAGE and 2D PAGE.</p> <p><b>HPLC AND SPECTROSCOPIC TECHNIQUES</b>  HPLC - Principles and Instrumentation The chromatographic process - The chromatogram Separation mode - Column care - System parameters - Reverse-phase HPLC - Introduction to various HPLC techniques a. Ion-pair HPLC b. Ion-exchange HPLC c. Normal-phase HPLC d. Affinity Chromatography e. Gel permeation Chromatography - Applications of HPLC -Column switching in HPLC, Gradient reverse-phase HPLC, Column conditionsm, Computerised optimisation of HPLC HPLC detectors a. Introduction b. Principles of detection c. Universal and Specific Detectors d. Detector response e. Sensitivity considerations f. Selectivity g. Manual and Electronic Data processing. H. Troubleshooting. Theory, instrumentation and biological applications of UV-Vis, IR, CD/ORD, Fluorescence, NMR, ESR, Mossebaeur, ICP emission and Mass Spectroscopy.</p> <p><b>CELL AND MOLECULAR BIOLOGY TECHNIQUES</b>  Polymerase Chain Reaction (PCR) Applications - Principles of Thermal Cycler - DNA Amplification using PCR technology - cDNA production &amp; its use - Gene libraries &amp; their uses - Production of oligotides. Blotting techniques-Southern, Northern and Western blotting. Different types of sequencing, Microarray, MALDI and TOF.</p> <p><b>IMMUNOTECHNIQUES AND RADIOACTIVE TECHNIQUES</b>  Immunodiagnosics-ELISA, sandwich ELISA, Immuno enzyme ssays(IEA),Immunofluorescence (IFA)-theory, equipment and applications. Sources of Radiation, Radioisotopes-basics and applications in biology. Autoradiography, Geiger–Muller counter, Scintillation counting, Radiotracers, Radioimmunoassay (RIA).</p>								
<b>Text book(s):</b>								
1	Willard HH, and Merit, L L, "Instrumental Methods of Analysis", Prentice Hall of India, New Delhi, 1999.							
2	Wilson K and Walker J, Practical Biochemistry, Cambridge University Press, USA, 1988.							
<b>Reference(s):</b>								
1	Ewing G W, "Instrumental Methods of Chemical Analysis", Mc Graw Hill, New Delhi, 1995.							
2	Robert D. Braun, "Introduction to Instrumental Analysis", Phrama Book Syndicate, Adithiya Art Printers, Hyderabad, 1987.							
3	Upadhya K, Upadhya, A and Nath N, "Biophysical Chemistry", Himalaya Publishing House, New Delhi, 2007.							



K.S.Rangasamy College of Technology - Autonomous								
40PBTE14 - MOLECULAR PATHOGENESIS								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	3	0	0	30	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To learnt about Host Parasite interactions, host defense mechanisms and molecular mechanisms involved in Pathogenesis of diseases caused by <i>E. coli</i> and <i>Vibrio cholerae</i>.</li> <li>To understand the modern approaches to control pathogens.</li> </ul>							
<p><b>OVERVIEW OF MOLECULAR PATHOGENESIS</b>  Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry.</p> <p><b>HOST-DEFENSE MECHANISM AGAINST PATHOGENS</b>  Attributes &amp; components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.</p> <p><b>MOLECULAR PATHOGENESIS</b>  Virulence, virulence factors, virulence-associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, <i>Vibrio Cholerae</i>: Cholera toxin, co-regulated pili, filamentous phage, survival <i>E.coli</i> pathogens: Enterotoxigenic <i>E. coli</i>, labile &amp; stable toxins, Entero- pathogenic <i>E.coli</i>, cytoskeletal changes, intimate attachment.</p> <p><b>EXPERIMENTAL STUDIES</b>  Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria &amp; tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction &amp; host responses</p> <p><b>MODERN APPROACHES TO CONTROL PATHOGENS</b>  Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno &amp; DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines.</p>								
<b>Text book(s):</b>								
1	Iglewski B H, and Clark VL, "Molecular basis of Bacterial Pathogenesis", Academic Press, California, USA, 1990.							
2	Peter Williams, Julian Ketley and George Salmond, "Methods in Microbiology: Bacterial Pathogenesis, Vol. 27", Academic Press, California, USA, 1998.							
<b>Reference(s):</b>								
1	Recent reviews in Infect. Immun., Mol. Microbiol, Biochem. J., EMBO etc. 2005.							
2	Nester, Anderson, Roberts, Pearsall, Nester, "Microbiology: A Human Perspective", McGraw-Hill, 3 <sup>rd</sup> Edition, 2001.							
3	Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, California, USA, 2001.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBTE 15- MEDICAL IMAGING								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To understand the fundamentals of speech and signal processing, predictive coding techniques, speech recognition, speech codec standards and applications.</li> <li>To enhance knowledge on speech signal analysis.</li> </ul>							
<p><b>NATURE AND CLASSIFICATION OF SPEECH SIGNALS</b>  Nature of speech signal – Speech production mechanism. Classification of speech sounds. Digital modeling of speech signals. Significance of short -time analysis.</p> <p><b>LINEAR PREDICTION OF SPEECH SIGNALS</b>  Linear predictive coding of speech – linear prediction problem in time domain, normal equations, Relationship of linear prediction to autocorrelation and spectral domains.</p> <p><b>SPEECH PROCESSING IN TIME AND FREQUENCY DOMAIN</b>  Time domain and frequency domain methods for speech processing - methods for extracting the time –domain parameters. Zero crossings. Auto correlation function. Pitch estimation. Short - time Fourier analysis. Filter bank analysis. Formant extraction and pitch extraction. Analysis -synthesis systems.</p> <p><b>ANALYSIS OF SPEECH SIGNALS</b>  Homomorphic speech analysis – Cepstral analysis, formant and pitch estimation. Applications to speech recognition and speaker identification. Basic pattern recognition methods, codebooks and HMM's</p> <p><b>STANDARDS OF SPEECH SIGNALS</b>  Speech codec standards and applications - Standards for low bit rate vocoders; Vocoder attributes. Encoders and decoders of G723.1, G726, G727, G728, G729 standard vocoders. Basics of voice over IP. Voice quality measures in IP networks</p>								
<b>Text book(s):</b>								
1	Quatieri, T.F. 'Discrete – time Speech Signal Processing: principles and practice', pearson education, 2008.							
2	Rabiner L.R. and R.W.Schafer, 'Digital processing of speech signals', Prentice Hall,2009.							
<b>Reference(s):</b>								
1	Hanza, L. 'Voice Compression and Communications', Wiley/IEEE, 2001.							
2	Hersent, 'IP Telephony Packet Based Multimedia Communication Systems', Pearson, 2002.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT E21- BIOELECTRONICS								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To understand the methods of recording various biopotentials and the measurement of various parameters.</li> <li>To learn the various diagnostic and therapeutic equipments, Telemetry and Telemedicine.</li> </ul>							
<p><b>ELECTRO - PHYSIOLOGY AND BIOPOTENTIAL RECORDING</b>  The origin of Biopotentials; biopotential electrodes; biological amplifiers; ECG, EEG,EMG, PCG, EOG – lead systems and recording methods, typical waveforms and signal characteristics.</p> <p><b>BIO -CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENTS</b>  pH, pO<sub>2</sub>, pCO<sub>2</sub>, pHCO<sub>3</sub>, Electrophoresis, colorimeter, photometer, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood cell counters, differential count.</p> <p><b>ASSIST DEVICES</b>  Cardiac pacemakers, DC Defibrillators, Dialyser, Heart -Lung machine, Hearing aids</p> <p><b>PHYSICAL MEDICINE AND BIO -TELEMETRY</b>  Diathermies – Short - wave, ultrasonic and microwave type and their applications, medical stimulator, Telemetry principles, frequency selection, Bio -telemetry, radio pill and tele - stimulation, electrical safety.</p> <p><b>RECENT TRENDS IN MEDICAL INSTRUMENTATION</b>  Thermograph, endoscopy unit, Laser in medicine, Surgical diathermy, cryogenic application, introduction to telemedicine.</p>								
<b>Text book(s):</b>								
1	John G.Webster, 'Medical Instrumentation Application and Design', John Wiley and Sons, 4 th Edition, 2010							
2	Lesile Cromwell, 'Biomedical instrumentation and measurement', Prentice Hall, 2007.							
<b>Reference(s):</b>								
1	Khandpur, R.S. 'Handbook of Biomedical Instrumentation', McGraw -Hill, 2 <sup>nd</sup> Edition, 2003							
2	Joseph.J, Carr and John M.Brown, 'Introduction to Biomedical Equipment Technology', Pearson Education, 4thEdition, 2008.							

K.S.Rangasamy College of Technology - Autonomous								
40PBTE22- TISSUE ENGINEERING								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To impart knowledge on Tissue Engineering especially human beings.</li> <li>To impart knowledge in Tissue Engineering and stem cell basics, growth conditions and its application in medicine.</li> </ul>							
<p><b>INTRODUCTION TO TISSUE ENGINEERING</b> Basic definition; current scope of development; use in therapeutics and <i>in vitro</i> testing</p> <p><b>STRUCTURE AND ORGANIZATION OF TISSUES:</b> Epithelial, connective; vascularity, lymph. Basic developmental biology</p> <p><b>TRANSPORT PROPERTIES OF TISSUES</b> Introduction to mass transfer, Diffusion of simple metabolites, Diffusion &amp; reaction of proteins</p> <p><b>GENERAL ASPECTS OF CELLS IN CULTURE</b> Transport limits on 3D cultures, Cell-Matrix &amp; Cell-Cell Interactions, cell migration and control of cell migration, Differential cell adhesion &amp; tissue organization, Hormone &amp; Growth Factor Signaling, Growth factor delivery in tissue engineering, Scaffolds &amp; tissue engineering - Basic properties, Basic transplantation immunology, Quantitative analysis of receptor-ligand binding, Applications of growth factors: EGF/angiogenesis</p> <p><b>STEM CELLS</b> Introduction, Hematopoiesis, Stem cells &amp; bone , ES cells, Cell surface markers, FACS analysis, Basic wound healing, Introduction to liver pathophysiology, Cell transplantation for liver tissue engineering. <i>In vitro</i> organogenesis, Physiological models</p>								
<b>Text book(s):</b>								
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.							
<b>Reference(s):</b>								
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								
40PBTE23- BIOSENSORS AND TRANSDUCERS								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To impart the knowledge on Biosensors and transducers in various fields in Biotechnology.</li> <li>To enhance the knowledge on designing various biosensors.</li> </ul>							
<p><b>ADSORPTION AND DIFFUSION</b>  Basics of adsorption, Diffusion of gases in liquid and solid foods. Moisture transfer in foods, Diffusion in porous foods, Inter-phase moisture transport. Diffusion of aroma components Applications of diffusion and migration in food packaging, Flowcytometry, Immunotechniques – ELISA.</p> <p><b>STRUCTURAL ELUCIDATION AND ANALYSIS</b>  Principles and applications of the following: Microscope – Fluorescence, Confocal, Phasecontrast, Electron (Scanning and Transmission) –Radio isotopic techniques-X ray diffraction, RIA, scintillation counter, GM counter, Autoradiography. NMR, CD, IR, DSC. Spectrophotometry – Principle and application of Spectrophotometer, Atomic absorption spectrophotometer – Spectrofluorimetry,</p> <p><b>PURIFICATION TECHNIQUES</b>  Product purification - Chromatography – principles of chromatographic separations – gel filtration, reversed phase, hydrophobic interaction, ion-exchange, IMAC and bio-affinity chromatography, design and selection of chromatographic matrices; modes of operation; design of large scale chromatographic separation processes; electrophoresis separation processes and alternative procedures</p> <p><b>ENRICHMENT OPERATIONS</b>  Membrane based separations micro and ultra filtration theory, design and configuration of membrane separation equipment, applications, precipitation methods (with salts, organic solvents, and polymers, extractive separations, aqueous two-phase extraction, supercritical extraction) <i>in situ</i> product removal, integrated bioprocess.</p> <p><b>MEMBRANE FILTRATION</b>  Definitions; Reverse Osmosis (RO), Nano filtration (NF), Ultra filtration (UF) and Micro filtration (MF), Molecular weight cut off in each case. Membranes and their characteristics, Cross flow filtration; Configuration of membranes, membrane materials, Pumps and other membrane equipment. Applications in food industry, relative advantages and limitations.</p>								
<b>Text book(s):</b>								
1	Schneider G M, Stahl E, and Wilke G, "Extraction with Supercritical Gases", Verlag Chemie Publishing, Basel, 2006.							
2	Rakesh Singh and Rizwi S H, "Bioseparation Process in Foods", Marcel Dekker Inc. Hong Kong, 2005.							
<b>Reference(s):</b>								
1	Brennen K, "Food Engineering Operations", Vol 1 and 2, Elsevier Publishing, The Netherlands, 2003.							
2	Jimmy L, Humphry K, and Keller G E, "Separation Process Technology", McGraw Hill, New Delhi, 2003.							
3	Grandison A S, and Lewis M J, "Separation processes in the Food and Biotechnology industries (Principles and applications)", Woodhead publishing Ltd. Cambridge UK, 2009.							

K.S.Rangasamy College of Technology - Autonomous								
40PBTE24- RESEARCH METHODOLOGY - ENGINEERING AND MANAGEMENT STUDIES								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To understand the methods of sampling, scales and measurements applied in research.</li> <li>To enhance knowledge on analysis of report and its compilation.</li> </ul>							
<p><b>RESEARCH METHODOLOGY</b>  Research methodology – definition, mathematical tools for analysis, Types of research, exploratory research, conclusive research, modeling research, algorithmic research, Research process- steps. Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design. Secondary data- internal sources of data, external sources of data.</p> <p><b>SCALES AND MEASUREMENTS</b>  Scales – measurement, Types of scale – Thurstone’s Case V scale model, Osgood’s Semantic Differential scale, Likert scale, Q- sort scale. Sampling methods- Probability sampling methods – simple random sampling with replacement, simple random sampling without replacement, stratified sampling, cluster sampling. Non-probability sampling method – convenience sampling, judgment sampling, quota sampling.</p> <p><b>HYPOTHESES TESTING</b>  Hypotheses testing – Testing of hypotheses concerning means (one mean and difference between two means -one tailed and two tailed tests), Concerning variance – one tailed Chi-square test.</p> <p><b>SAMPLE TESTS</b>  Nonparametric tests- One sample tests – one sample sign test, Kolmogorov-Smirnov test, run test for randomness, Two sample tests – Two sample sign test, Mann-Whitney U test, K-sample test – Kruskal Wallis test (H-Test)</p> <p><b>ANALYSIS AND REPORT</b>  Introduction to Discriminant analysis, Factor analysis, cluster analysis, multidimensional scaling, conjoint analysis. Report writing- Types of report, guidelines to review report, typing instructions, oral presentation</p>								
<b>Text book(s):</b>								
<b>Reference(s):</b>								
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								
40PBTE25- BIOREACTOR DESIGN								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To gain knowledge in designing bioreactor and its analysis.</li> <li>To impart knowledge on mass and heat transfer energy conservation in different type of bioreactors, reactor control and materials balance to understand operational concepts.</li> </ul>							
<b>INTRODUCTION TO BIOPROCESS</b>								
Type of fermentation, Measurement of microbial growth: Total cell number, Viable cell number, Cell dry weight, Absorbance, Packed cell volume, Viscosity, ATP, Heat evaluation, Specific growth rate, Product formation rate, Productivity, Chemostat theory, Dilution rate, Fed- batch culture.								
<b>MIXING AND MASS TRANSFER</b>								
Mass transfer: oxygen transfer, $K_La$ measurement: Steady state, Dynamic methods, Correlation of $K_La$ for stirred tanks and Airlift reactors, Gas hold up, Liquid mixing, Characterization of agitation, Power consumption, Rheological properties: Newtonian and Non - Newtonian fluids, Laminar and turbulent shear, Shear in ALR.								
<b>DESIGN AND SCALE UP</b>								
Types of bioreactor: Stirred tank bioreactor, Airlift bioreactor, Heat transfer, Scale up of STB and ALR, ALR design: Construction, Hydrodynamics, Three phase flow, Mixing, Oxygen transfer: Isobaric and Non- isobaric method.								
<b>STRATEGIES FOR FERMENTATION CONTROL</b>								
The control loop, Analogue, Digital, PID, Time-proportioned control, Physical control: Temperature, Airflow, Pressure, Agitation, pH, Dissolved oxygen, Fermented content, Feeding, Vent gas analysis, DDC, Estimation of biomass, Fault diagnosis.								
<b>PLANT AND ANIMAL CELL BIOREACTORS</b>								
Plant cells: Bioreactors, Requirements, Design, Operations, Characterization of cell suspensions, Alternative culture for plant cells. Animal cells: Operation and design: Attached growth, Suspended growth, and Immobilized cell systems.								
<b>Text book(s):</b>								
1	Scragg A H, "Bioreactors in Biotechnology", Ellis Horwood Limited, England, 1991.							
2	Shuler M L, and Kargi F, "Bioprocess Engineering Basic Concepts", Prentice Hall of India, New Delhi, 003.							
<b>Reference(s):</b>								
1	Bailey J, and Ollis David F, "Fundamentals of Biochemical Engineering" Tata Mc Graw Hill, New Delhi, 1996.							
2	Stanbury F P, Whitaker A and Hall S G, "Principles of Fermentation Technology", Aditya Books, Pvt, Ltd., New Delhi, 1997.							

K.S.Rangasamy College of Technology - Autonomous								
40PBTE31- BIOPROCESS MODELING AND SIMULATION								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To impart knowledge on Bioprocess modeling and simulation with special reference to application in industries.</li> <li>To enhance knowledge on reaction kinetics with reference to simulation methods.</li> </ul>							
<b>OVERVIEW OF FERMENTATION PROCESSES</b>								
<p>Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.</p>								
<b>METABOLIC STOICHIOMETRY AND ENERGETICS</b>								
<p>Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth</p>								
<b>REACTION KINETICS IN BIOPROCESS</b>								
<p>Reaction kinetics for biological systems- M.M kinetics, enzyme deactivation kinetics; heterogenous reactions in bioprocessing- concentration gradients and reaction rates in solid catalysts, internal mass transfer in heterogenous reactions; Thiele modules - solid – liquid mass transfer correlations, minimizing mass transfer effects.</p>								
<b>MODELING AND SIMULATION OF BIOPROCESSES</b>								
<p>Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.</p>								
<b>SIMULATION METHODS</b>								
<p>Simulation: Introduction, Iterative convergence methods like interval halving, Newton-Raphson and explicit convergence methods. Numerical integration of ordinary differential equation and explicit numerical integration algorithm.</p>								
<b>Text book(s):</b>								
1	Shuler, M.L. and Kargi, F., "Bioprocess Engineering - Basic concepts", Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.							
2	Peter F. Stanbury, Stephen J. Hall and A. Whitaker, "Principles of Fermentation Technology", Second Edition, Butterworth – Heinemann, An Imprint of Elsevier Publications, The Netherlands, 2005.							
<b>Reference(s):</b>								
1	Van den Akker, H.E.A., "Bioprocess technology: modeling and transport phenomena", Biotol series, 6 <sup>th</sup> Edition, An Imprint of Elsevier Publications, The Netherlands, 2005.							
2	William, L. Luyben, "Process modeling, Simulation and control for Chemical Engineering", McGraw Hill Publications, New Delhi, 2003.							
3	Bailey, J. and Ollis David, F., "Fundamentals of Biochemical Engineering" Tata Mc Graw Hill, New Delhi, 1996.							
4	Pauline M.Doran, "Bioprocess Engineering Principles", Third Reprint, Academic Press, California 2010. Publications.							



K.S.Rangasamy College of Technology - Autonomous								
40PBTE32- METABOLIC ENGINEERING								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To understand the biosynthesis of primary and secondary metabolites, bioconversion process.</li> <li>To understand the industrial applications of enzymes and value added products.</li> </ul>							
<p><b>INTRODUCTION</b>  Induction-Jacob monod model, catabolite regulation, glucose effect, camp deficiency, feed back regulation, regulation in branched pathways, differential regulation by isoenzymes, concerted feed back regulation, cumulative feed back regulation, amino acid regulation of RNA synthesis, energy charge, regulation, amino acid regulation of RNA synthesis, energy charge, regulation, permeability control passive diffusion, active transport group transportation.</p> <p><b>SYNTHESIS OF PRIMARY METABOLITES</b>  Alteration of feed back regulation, limiting accumulation of end products, feedback, resistant mutants, alteration of permeability, metabolites.</p> <p><b>BIOSYNTHESIS OF SECONDARY METABOLITES</b>  Precursor effects, propphase, idiophase relationship, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism, producers of secondary etabolites</p> <p><b>BIOCONVERSIONS</b>  Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances</p> <p><b>REGULATION OF ENZYME PRODUCTION</b>  Strain selection, improving fermentation, recognizing growth cycle peak, induction, feed back repression, catabolite repression, mutants resistant to repression, gene dosage.</p>								
<b>Text book(s):</b>								
1	Wang D I C, Cooney C L, Demain A L, Dunnill P, Humphery A E, Lilly M D, "Fermentation And Enzyme Technology", John Wiley and Sons., Singapore, 1980.							
2	Stanbury F P, Whitaker, A. and Hall S G, "Principles of Fermentation Technology", Aditya Books, Pvt, Ltd., New Delhi, 1997.							
<b>Reference(s):</b>								
1	Zubay G, "Biochemistry ", Macmillan Publishers, New Delhi, 1989.							
2	William L, Luyben, "Process modeling, Simulation and control for Chemical Engineering", McGraw Hill Publications, New Delhi, 2003.							

K.S.Rangasamy College of Technology - Autonomous								
40PBTE33- NANOBIO TECHNOLOGY								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To impart the basic knowledge in Nanobiotechnology and its applications.</li> <li>To enhance knowledge on extensive knowledge in nano structures, nano oncology and nano technology devices.</li> </ul>							
<b>INTRODUCTION TO NANOTECHNOLOGY AND NANOPARTICLES</b>								
<p>Introduction to Nanotechnology, Need of quantum mechanics, Nanobiology concepts- definition, Biological Nanoobjects- Topology of DNA-protein-lipid assembly-Biological networks, Nanoparticles- types and properties - fullerenes- carbon nano tubes-quantum dots- nano core- nano shells- nano composites,</p>								
<b>SYNTHESIS OF NANOMATERIALS</b>								
<p>Nanomaterials-Preparation-Top down and bottom up approach- Physical methods-Ball milling- Plasma arcing – Laser ablation method, Chemical method - Sol-gels-Chemical vapour deposition- Electrodeposition, Biological methods.. Biological Methods of Synthesis: Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Mechanism of formation; Viruses as components for the formation of nanostructured materials; Synthesis process and application, Role of plants in nanoparticle synthesis</p>								
<b>MOLECULAR NANOTECHNOLOGY</b>								
<p>Atoms by inference, Electron microscopes – Scanning electron microscope- Modern transmission electron microscope, Scanning Probe microscopy – atomic force microscope – scanning tunneling microscope, nano manipulator, FTIR, XRD and Dip pen nanolithography, Nano tweezers.</p>								
<b>NANOBIOMETRICS</b>								
<p>Introduction, Lipid as nanobricks and mortar- lipid structure- Self assembled monolayers- Self-organising supramolecular structures, Bacterial S-layer proteins,Nanoscale motors- Biological computing based on bacteriorhodopsin- ion channels as sensors, DNA: using DNA to build nano-cubs and hinges- DNA as smart glue- DNA as nanowires - DNA computers,</p>								
<b>APPLICATION OF NANOBIO TECHNOLOGY</b>								
<p>Application of Nano Biotechnology in medicine - Biocompatible inorganic devices- implant coatings, stents, seeds, Drug delivery- cancer treatment, Bioconjugated silica nanoparticles for bioanalytical applications- Dye doped – Biofunctionalization of silica nanoparticles- Cellular labeling/detection, DNA analysis, small molecules-protein interactions-microarray and genome chips- nano biosensors and nano biochips.</p>								
<b>Text book(s):</b>								
1	Mick Wilson, Kamali Kannangara, Geoff Smith and Michelle Simmons, Nanotechnology Basic science and emerging technologies, Overseas Press India Private Limited, New Delhi, India, 2005.							
2	Niemeyer C. M. and Mirkin C. A., 2004 Nanobiotechnology – Concepts, applications and perspectives. Wiley VCH Publishers, New Delhi, India, 2004.							
<b>Reference(s):</b>								
1	Rosenthal, S.J. and Wright, D.W., “Nanobiotechnology Protocols in Methods in Molecular Biology Series”, Humana Press, USA, 2007.							
2	Ralph, S. Greco, Fritz B. Prinz and Lane, R., “Nanoscale Technology in biological systems”, Smithm CRC Press, California, USA, 2005.							
3	Handbook of Nanostructured Biomaterials and their Applications in Nanobiotechnology – Hari Singh Nalwa O.V.Salata. Journal of nanoBiotechnology 2004.							

K.S.Rangasamy College of Technology - Autonomous								
40PBTE34- BIOBUSINESS								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To make the students to understand about the Biotechnology techniques, marketing of bioproducts and drugs.</li> <li>To create the mindset in start of Biotech companies for various domains.</li> <li>To Learn about bioethics issues in developing and marketing biotech products to the public.</li> </ul>							
<b>OVERVIEW OF BIOTECHNOLOGY INDUSTRIES</b>								
Scope - Biotechnology Industries in India and Abroad - Fundamentals of Biotechnology for biobusiness - Trends and key issues in Biotechnology and devices industries - Technology basis in industry segment, emerging technologies and technical convergences issues.								
<b>NEW VENTURE CREATION – ENTREPRENEURSHIP</b>								
Plant tissue culture lab construction – Equipment, glassware and chemical requirements - techniques in culturing of plants. Export of tissue cultured plants to abroad – Vermitechnology – Mushroom cultivation - single cell protein - Biofertilizer technology - production - Commercialization of R&D- Fermentation technology: Bakery, Dairy products.								
<b>PRODUCT DEVELOPMENT</b>								
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.								
<b>INTELLECTUAL PROPERTY, BIOETHICS AND LEGAL ISSUES</b>								
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.								
<b>BIOBUSINESS PLANS</b>								
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.								
<b>Text book(s):</b>								
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.							
<b>Reference(s):</b>								
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								
40PBTE35- ENVIRONMENTAL BIOREMEDIATION TECHNOLOGY								
M.Tech. Biotechnology								
Elective	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To enhance the knowledge in the field of biodegradation technology.</li> <li>To impart skills to overcome the problems arising in the field of biodegradation technology.</li> </ul>							
<b>BIOREMEDIATION TECHNOLOGY</b>								
Introduction to Bioremediation, Types of Bioremediation, Bioremediation of surface soil and sludges, Bioremediation of subsurface material, In situ technologies, Ex-situ technologies, Phytoremediation, Bioaugmentation of naturally occurring microbial activities; Environmental modification - use of co-substrates, oxygen supplementation (Composting and aerobic bioreactors, in situ aeration).								
<b>MICROORGANISMS FOR BIOREMEDIATION</b>								
General microbial strategies for initiating attack on xenobiotics - Biodegradation strategies for key classes of compounds - Factors affecting biodegradation; Biodegradation kinetics; Biodegradation Engineering and Modelling; Biocatalysis Enzymes and major reactions and its kinetics.								
<b>MOLECULAR APPROACH FOR BIOREMEDIATION</b>								
Restriction endonucleases, techniques of restriction mapping-vectors-plasmid PBR 322 and Lambda phage, cosmid - construction of chimeric DNA, ligases, gene closing-Southern, northern and western blotting, dot and slot blots-construction of Genomic and cDNA libraries-PCR (polymerase chain reaction) and gene cloning - use of genetically altered microorganisms for field biodegradation of hazardous materials.								
<b>BIODEGRADATION FOR HAZARDOUS WASTES</b>								
Introduction - Hazardous wastes-biodegradation of Hazardous wastes - biological detoxification of cyanide - market for hazardous waste management-biotechnology applications to hazardous waste management - Source and Management Safety.								
<b>ENVIRONMENTAL NANOTECHNOLOGY</b>								
Environmental Nanotechnology Research - Nanotechnology for Bioremediation of Heavy metals - New Bioremediation Technologies to Remove Heavy Metals and Radionuclides using Fe (III), Sulfate and Sulfur Reducing Bacteria - Bioremediation of Petroleum Sludge using Bacterial Consortium and Biosurfactant - Biofilms in Porous Media: Mathematical Modeling and Numerical Simulations - Biosensor Technology for monitoring pollutants								
<b>Text book(s):</b>								
1	S.N.Jogdand. S. N., Environmental biotechnology, Himalaya Publishing House, New Delhi, India, 1995							
<b>Reference(s):</b>								
1	Baker, K.H.and Herson, D.S., Bioremediation McGraw Hill, New York, USA, 1994.							
2	Gupta, P.K. Biotechnology, Rastogi Publications, New Delhi, India, 1997.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT SE1- MOLECULAR DIAGNOSIS AND REGENERATIVE MEDICINE								
M.Tech. Biotechnology								
Value Added Course	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
	1	0	1	20	1	50	50	100
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To learn the knowledge of molecular diagnostics, stem cell research and biomaterial with respect to biomedical applications.</li> <li>To recognize and label the techniques in regenerative medicine.</li> </ul>							
<b>MOLECULAR DIAGNOSTICS</b>								
Fundamentals of Molecular diagnostics, diagnosis of bacterial, viral and fungal infection. Identifying human disease genes.								
<b>GENETICS IN CHROMOSOMAL DISORDER</b>								
Chromosomal diseases: various chromosomal aberrations, Repetition of basic genetic mechanisms in connection with these disorders. Cancer genetics- oncogenes, tumour suppressor genes.								
<b>BIOMATERIAL</b>								
Structure-Property Relationships of biomaterials, Biocompatibility of implants and devices- Host Response to Biomaterials, Biofunctionality-Material Response to Biological Environment, Scaffold Design and their applications in tissue engineering and regenerative medicine								
<b>REGENERATIVE MEDICINE</b>								
Embryonic Stem Cell Technology, Adult Stem Cell Technology, Advanced Stem Cell Laboratory Techniques and Clinical Applications, Tissue engineering								
<b>TECHNIQUES IN MOLECULAR DIAGNOSTICS AND REGENERATIVE MEDICINE</b>								
Reverse transcriptase PCR, Genetic screening of drug response, Synthesis of biomaterial, Isolation and culture of mesenchymal stem cell from Bone marrow.								
<b>Text book(s):</b>								
1	David E. Bruns, Edward R. Ashwood, Carl A. Burtis. (2007). Fundamentals of Molecular Diagnostics Saunders Group. UK.							
2	Stein M., (2011) Human Stem Cell Technology and Biology: A Research Guide and Laboratory Manual. First Edn. Wiley-Blackwell, New York, USA.							
<b>Reference(s):</b>								
1	A.J.F. Griffiths, J.H. Miller, D.T. Suzuki, R.C. Lewontin and W.M. Gelbart, W.H. Freeman, (2000) An Introduction to Genetic Analysis, Wiley-Blackwell, New York, USA.							
2	J.Mao, G. Vunjak-Novakovic et al (Ed): (2008) Translational Approaches in Tissue Engineering & Regenerative Medicine, Artech House, INC Publications. UK.							

The Course is offered by Virtis Bio Labs, Salem, Tamil Nadu. Students can select the value added course from third semester onwards.

K.S.Rangasamy College of Technology - Autonomous								
40 PBT SE2- CLINICAL RESEARCH MANAGEMENT								
M.Tech. Biotechnology								
Value Added Course	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
		1	0		1	20	1	50
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To enhance the knowledge of clinical trial phases and design, planning, implementation, data analysis.</li> <li>To impart the regulatory and procedural guidelines and ethical considerations in CTM.</li> </ul>							
<b>CLINICAL PHARMACOLOGY AND DRUG DISCOVERY PROCESS</b>								
Introduction to clinical research, basic terminologies in CR, pharmacokinetic and pharmacodynamic study, types of dosage forms, drug discovery process- preclinical studies-in vivo-in vitro-in silico studies								
<b>CILNICAL PHASES OF DRUG DEVELOPMENT</b>								
Phase 0 studies: Micro dosing studies, Phase 1- Human pharmacology study, Phase 2- Therapeutic exploratory trial, Phase 3- Therapeutic confirmatory trial, Phase 4- PMS, BA/BE studies								
<b>DRUG REGULATIONS AND GUIDELINES</b>								
History of clinical research- ICH GCP guidelines- Principles of ICH- Sponsor responsibilities- IRB/IEC: composition, powers and review procedures, roles and responsibilities in clinical research- Informed consent process: importance, elements, special consideration								
<b>CLINICAL RESEARCH MANAGEMENT</b>								
Role of CRO and SMO- Audit and Inspection in CR- Protocol designing- CRF designing- SOP designing								
<b>ETHICS IN CLINICAL RESEARCH</b>								
Background of ethics in CR, a historical overview, codes related to ethics- Highlights of Nuremberg code- Importance of Declaration of Helsinki, Belmont report								
<b>Text book(s):</b>								
1	ICMR, (2000) "Ethical guidelines for biological research on human subjects", Indian council of Medical Research Press, New Delhi,.							
2	Schedule Y., (1945) The Drug and Cosmetic Rule. "Requirements and guidelines for permission to import and/ or manufacture of new drugs for sale or to undertake clinical trials". Government of India, New Delhi,.							
3	Code of federal regulations and ICH Guidelines GCP Reference guide, 2006.							

The Course is offered by M/S. Point Perfect Transcription Services India Private Limited, Coimbatore, Tamil Nadu. Students can select the value added course from third semester onwards

K.S.Rangasamy College of Technology - Autonomous								
40 PBT SE3- MEDICAL CODING								
M.Tech. Biotechnology								
Value Added Course	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
		1	0	1	20	1	50	50
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To enhance the knowledge of Anatomy and Physiology of Human being.</li> <li>To impart the knowledge on Medical Coding, Billing Cycle, RCM, Coding Compliance and HIPAA Laws.</li> </ul>							
<b>HUMAN ANATOMY &amp; PHYSIOLOGY PART I</b>								
Cardio Vascular System, Blood & Its Components ,Integumentary System, Endocrine System, Urology, Male Reproductive System.---- Location, Shape, Size, Structure, Physiology, Pathology, Diagnostic Test, Terminologies								
<b>HUMAN ANATOMY &amp; PHYSIOLOGY PART II</b>								
Female Reproductive Systems, Nervous System, Gastro Intestinal System, Pulmonology, Special Sciences, Orthopedics, Lymphatic System---Location, Shape, Size, Structure, Physiology, Pathology, Diagnostic Test, Terminologies								
<b>CURRENT PROCEDURE TERMINOLOGY CODING (CPT)</b>								
CPT Codes, CPT Description, Medical Record Format,Speciality Listings and its Format, Usage of CPT Manuals, Software usage, Examples of CPT Speciality Code Practice								
<b>INTERNATIONAL CLASSIFICATION OF DISEASE CODING(ICD)</b>								
ICD Codes, ICD 9 CM – ICD 10 Transition, Diagnosis Interpretation, Usage of ICD Manuals, Index Listings, Tabular Listings, Software usage, Examples of Dx Code Practice.								
<b>MODIFIERS, E&amp;M CODING, MEDICAL BILLING CYCLE&amp;OVERVIEW</b>								
Modifiers Listing, Usage and Indexing, E& M codes, classification, Application of E&M, Tabulation, Listings, Software usage, Examples of E&M Code Practice								
<b>Text book(s):</b>								
1	CPT AMA Professional Edition, London, UK, 2013.							
2	ICD 9CM Physicians Vol I and Vol II Contexo A division of Access Intelligence, London, UK, 2013.							
3	Guyton Physiology, Robinson's Pathology, Cunningham's Anatomy, Davidson Text of Medicine, David Ellen Chabner language of medicine, Medical Terminology. CRC Press, California, UK, 2013.							

The Course is offered by M/S. Point professional infotech Private Limited, Coimbatore, Tamil Nadu.

Students can select the value added course from third semester onwards.

K.S.Rangasamy College of Technology - Autonomous								
40 PBT SE5- BIOPERL								
M.Tech. Biotechnology								
Value Added Course	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
		1	0	1	20	1	50	50
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To enhance students' knowledge on BioPERL and its applications.</li> <li>To impart the knowledge on data structures and algorithms for biology.</li> </ul>							
<p><b>Introduction to BIOPERL</b>  Accessing and installing Perl and BioPerl, Running Perl programs  Editors, Finding help Using modules, like BioPerl</p> <p><b>The Art of Programming</b>  The Programming process, Algorithms. Sequences and Strings- Variables: Array and Files</p> <p><b>Motifs and Loops</b>  Flow control, String operators and Writing files. Subroutines : Scoping, Arguments, Command line arguments,  Passing data to subroutines, Modules and Libraries and Debugging</p> <p><b>Data Structures and Algorithms for Biology</b>  Hashes: Translating DNA into Proteins, Working with the FASTA Format and Reading frames</p> <p><b>Regular Expressions</b>  Restriction Maps: Restriction Enzyme Data. Working with GenBank data, Analyzing DNA, Working with BLAST  output, BioPerl Modules.</p>								
<b>Text book(s):</b>								
1	James Tisdall, Beginning Perl for Bioinformatics, An Introduction to Perl for Biologists, O'Reilly Media, UK, 2001.							
2	Tom Christiansen, brian d foy, Larry Wall, Jon Orwant, Programming Perl, 4 <sup>th</sup> Edition Unmatched power for text processing and scripting, O'Reilly Media, UK, 2012.							



K.S.Rangasamy College of Technology - Autonomous								
40 PBT SE6- SELF DEVELOPMENT								
M.Tech. Biotechnology								
Value Added Course	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
		1	0	1	20	1	50	50
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To enhance students' knowledge on personality development towards building a positive social image and fulfilling social responsibility.</li> <li>To recognize the social and behavioral responsibility in the society.</li> </ul>							
<p><b>WRITTEN COMMUNICATION</b> Usage of noun, pronoun, adjective (Comparative Forms), Verb, Adjectives, Adverb, Tenses, Articles and Preposition - Change of Voice - Change of Speech - Synonyms &amp; Antonyms - One Word Substitution. Analogies - Sentence Formation -Sentence Completion - Sentence Correction - idioms &amp; Phrases - Jumbled Sentences, Letter Drafting (Formal Letters) – Reading Comprehension.</p> <p><b>ORAL COMMUNICATION</b> Self Introduction - Situational Dialogues / Role Play (Telephonic Skills) – Oral Presentations – Prepared -'Just A Minute' Sessions (JAM) Describing Objects / Situations / People, Information Transfer - Picture Talk – News Paper and Book Review.</p> <p><b>Personality Development</b> Definition and basics of personality, analyzing strength and weakness (SW), Corporate theories on personality development , increasing vocabulary, Body language, Listening, Communication barriers, Overcoming these Barriers.</p> <p><b>TECHNIQUES IN PERSONALITY DEVELOPMENT I</b> Building self- esteem and self confidence, working on attitudes, Introduction to leadership, leadership stages, Group dynamics, Team building, Interpersonal relationships, analysis of Ego states, Transaction stroks and life positions, Stress management. Time management, concept, Importance and need, steps towards better time management.</p> <p><b>TECHNIQUES IN PERSONALITY DEVELOPMENT II</b> Projecting a positive social image, Definition and importance of social image, looking great and attractive, Public speaking, Voice modulation, Social graces and proper E-mail and telephone etiqutte, Table manners, Personal interview sessions.</p>								
<b>Text book(s):</b>								
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	Objective Instant Arithmetic by M.B. Lal & GoswamiUpkar Publications, 2012.							
3	Abhijit Guha, "Quantitative Aptitude", TMH, 3 <sup>rd</sup> edition, 2013.							

K.S.Rangasamy College of Technology - Autonomous								
40 PBT SE7- Corporate Essentials for Biotechnologists								
M.Tech. Biotechnology								
Value Added Course	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
		1	0		1	20	1	50
<b>Objective(s)</b>	<ul style="list-style-type: none"> <li>To empower the knowledge on various equipments used in the pharma industries and opportunities for life science graduates.</li> <li>To impart the knowledge in supply chain industry, corporate etiquette, communication and technical skills.</li> </ul>							
<p><b>CORPORATE CULTURE/ETIQUETTE AND SUPPLY CHAIN MANAGEMENT</b>  Entering the world of work for the first time can be greater challenge and one has to equip himself/herself to get in to grips with its new realities. This module gives an orientation to the written and unwritten etiquette of the corporate world and helps the participants' with the transition from the campus to the corporate world. This module will give an overview of Supply Chain Management and its 3 levels of activities - Strategic, Tactical and Operational.</p> <p><b>COMMUNICATION AND TECHNICAL SKILLS</b></p> <p>Microsoft Excel is an essential end-user computing tool that can help perform a wide range of tasks. From making some of the mundane tasks more bearable through automation, to everyday functional tasks, MS Excel has been dominating the spreadsheet product industry with a share of more than 90 percent. Most companies and businesses demand that their staff learn Excel so that they can stay competitive.</p> <p><b>GLASSWARE and PLASTICWARE - Application</b>  Laboratory plastic ware and glassware items are the most important accessories in the Biotech Industry. This session gives the participants an orientation to the most common of these items, their uses and standard operating procedures to be followed while handling such products. This session introduces the participants to the world of scientific instruments and tools that are used to collect data, take measurements and record observations.</p> <p><b>SAFETY and CLEANROOM, LIFE SCIENCE and CLINICAL</b></p> <p>Safety and clean rooms operate in a controlled environment and enforce certain protocols. This session helps understand the requirements and prohibitions of such areas and learn and apply proper discipline. Life sciences and clinical study endeavors product discovery, development, and manufacturing of state of the art solutions for enhanced living. Participants will be given an orientation on the various aspects of this field.</p> <p><b>REGULATIONS</b>  Understanding and addressing relevant process safety standards, codes, regulations, and laws over the life of a process is key for any Biotech organization. Resources in this section describe processes for maintaining adherence to applicable standards, codes, regulations, and laws (standards), the attributes of a standards system, and the steps an organization might take to implement the standards element.</p>								
<b>Text book(s):</b>								
1	Mitra K. Barun, 'Effective Technical Communication – A Guide for Scientists and Engineers', Oxford University Press, New Delhi, 2006.							
2	James R.Evans & William M.Lidsay, "The Management and Control of Quality", (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).							

The Course is offered by VWR Lab Products Pvt Ltd., Coimbatore. Students can select the value added course from fourth semester onwards